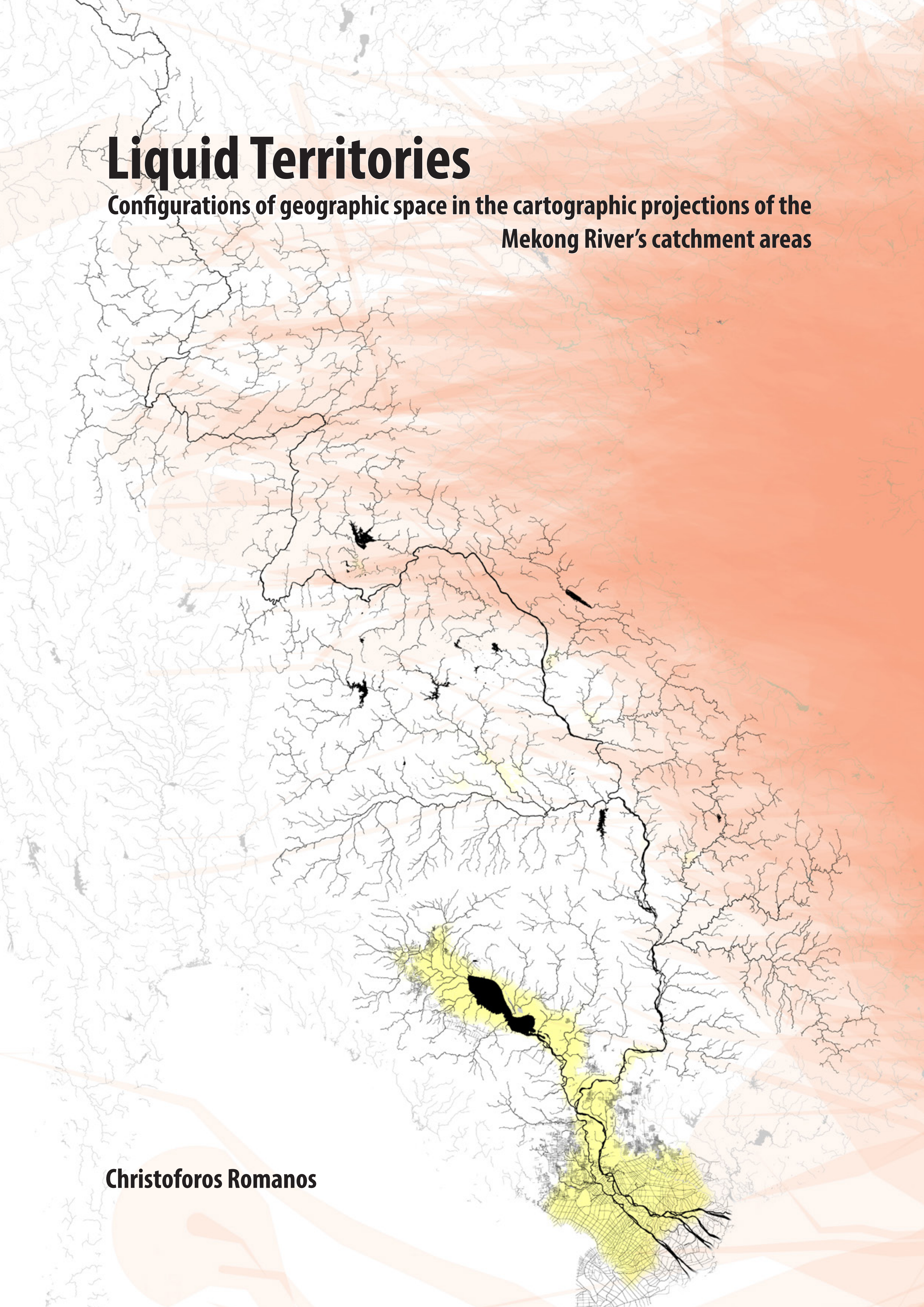
Liquid Territories

Configurations of geographic space in the cartographic projections of the Mekong River's catchment areas



Christoforos Romanos

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DISSERTATION

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by

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Propositions

1 Projections of the Mekong's basin illustrate the domestication of the river.

2 The delineation of the Mekong's basin specifies an area for political as well as technical operations.

3 By evoking the delta's hydrology, state planning prescribes the spatial parameters for redistributing people and activities within the Mekong Delta.

4 Mapping the Mekong's floodplain aligns the temporary extent of inundation with a permanent state of impending danger.

5 The floodplain's delineation articulates the response to a perceived imbalance in the natural, political and social equilibrium.

6 Catchments project the power to shape geography.

7 If rivers, mountains and soils have the capacity to affect where and how human activities unfold, catchment areas become capable of affecting human activity only when they are projected on the surface of a map.

8 The delineation of catchments transforms the possibilities inherent in mapping water into the illusory certainty of a specific territory.

9 Region describes. Territory prescribes.

10 Geography is designed.

Summary

The countless waterways which collectively form the Mekong River are the main source of water for millions of people speaking different languages. Diverted in dams, reservoirs and irrigation canals, the river supports extensive agricultural economies across parts of Thailand, Laos, Cambodia and Vietnam and generates power for dispersed households and remote settlements. Such control of the Mekong's water resources is underpinned by the idea that the river occupies a geographic space that extends beyond the limits of its perennial waterways. Fundamental to the estimation of precipitation and water volume, the denotation of hydrological catchment areas indicates the cumulative geographic extent encompassed by a specific behaviour of surface water. The basis for planning water infrastructure, allusions to the spatial dimensions of the Mekong's surface flows have also prescribed the regulation of land and the transformation of the terrain as well as conceptually differentiating or unifying parts of mainland Southeast Asia to articulate distinct geographic entities.

Spanning vast magnitudes of space that are beyond an average individual's immediate experience or a single state's jurisdiction, knowledge of the catchment is extracted from the information collected and presented on maps. Maps of the river's catchments however are not always the result of recording the flows of water, nor the domain of a single discourse. With diverging intentions, the Mekong's catchments have been repeatedly drawn by geographers, engineers and cartographers since before the start of European colonization. Distinct and sometimes conflicting cartographic projections of the basin, delta and floodplain have structured geopolitical strategy, the exercise of military power and regional planning. As a result, the spatial articulation of surface water flows is reflected in the configuration of national boundaries and the arrangement of settlements. To understand why and how the Mekong's catchments have become the geographic reference for human activities, the research examines the maps and discourses structuring the areal delineation of the basin, the delta and the floodplain. Drawing on critical cartography, the thesis investigates the maps' propositions to ask what territories are displayed, maintained and produced with reference to the river's catchments.

Focused on maps from different periods, the research examines the discourses of hydrology, geography, cartography as well as military science, colonial politics and regional planning to suggest answers. Taking into account the condition of cartographic as well as scientific knowledge when each map was drawn, the investigation is divided into three sections each focused on one of Mekong River's natural catchments. Concentrating on the way the basin, delta and floodplain are referenced to map, delineate and plan geographic space, the dissertation begins by explaining the conceptualisation of the *area of water* and its ideological representation in the cartography of the *frontières naturelles*. The research then identifies how mapping the Mekong's basin has supported the projection of

geopolitical claims and has been used to define an autonomous area of operations. The thesis continues to examine the correlation of the geographic delta with defensive infrastructure and the subsequent emergence of the Mekong Delta in the patterns of settlements. Finally, the research illustrates how the marginal *atopia* equated with a section of the floodplain has been 'redeemed' by infrastructure and converted into a plain of rice. Analysing these discourses, the research shows that cartographic descriptions of catchment areas are also tools to prescribe human activities, rationalised by references to the natural flows of water.

Samenvatting

De ontelbare waterwegen die samen de Mekong Rivier vormen zijn de belangrijkste bron voor water van miljoenen mensen die allerlei talen spreken. Omgeleid door stuwdammen, reservoirs en irrigatiekanalen, voorziet de rivier de uitgebreide landbouweconomieën in delen van Thailand, Laos, Cambodja en Vietnam van water en verspreide huishoudens en afgelegen nederzettingen van stroom. Dergelijke controle over de watervoorraden van de Mekong wordt onderbouwd door het idee dat de rivier een geografische ruimte inneemt die verder reikt dan de grenzen gevormd door de waterwegen zelf. Fundamenteel voor het inschatten van neerslag en watervolume, geeft het aanduiden van hydrologische stroomgebieden de cumulatieve geografische omvang weer die wordt omvat door een specifiek gedrag van oppervlaktewater. Als basis voor het plannen van waterinfrastructuur, zinspeelt de ruimtelijke dimensie van de oppervlaktestromen van de Mekong ook op de regulering van land en de transformatie van het terrein, evenals het conceptueel differentiëren of verenigen van delen van het vasteland van Zuidoost-Azië om als dusdanig verschillende geografische entiteiten te articuleren.

Gezien de uitgestrekte hoeveelheden ruimte die de onmiddellijke ervaring van een gemiddeld individu of de jurisdictie van een enkele staat te boven gaan, wordt kennis van het stroomgebied ontleend aan de informatie verzameld en gepresenteerd op kaarten. Kaarten van de stroomgebieden van de rivier zijn echter niet altijd het resultaat van het vastleggen van de waterstromen, noch het domein van een enkel discours. Met uiteenlopende bedoelingen zijn de stroomgebieden van de Mekong vóór en sinds het begin van de Europese kolonisatie herhaaldelijk getekend door geografen, ingenieurs en cartografen. Onderscheidbare en soms tegenstrijdige cartografische projecties van het stroomgebied, de delta en de uiterwaarden hebben geopolitieke strategie, de uitoefening van militaire macht en regionale planning gestructureerd. De ruimtelijke articulatie van oppervlaktewaterstromen weerspiegeld zich hierdoor dan ook in de configuratie van landsgrenzen en de inrichting van nederzettingen. Om te begrijpen waarom en hoe de stroomgebieden van de Mekong de geografische referentie zijn geworden voor menselijke activiteiten, worden in het onderzoek de kaarten en discoursen die de gebiedsafbakening van het stroomgebied, de delta en de uiterwaarden structureren onderzocht. Het proefschrift onderzoekt, gebruikmakend van kritische cartografie, de beweringen door de kaarten naar voorgeschoven en vraagt zich af welke territoria worden weergegeven, behouden en geproduceerd met verwijzing naar de stroomgebieden van de rivier.

Zich richtend op kaarten uit verschillende periodes, worden het discours van hydrologie, geografie, cartografie evenals militaire wetenschap, koloniale politiek en regionale planning onderzocht om antwoorden te suggereren. Rekening houdend met de staat van zowel de cartografische als de wetenschappelijke

kennis op het moment van tekenen van elke kaart, is het onderzoek onderverdeeld in drie secties, elk gericht op een van de natuurlijke stroomgebieden van de Mekong-rivier. Concentrerend op de manier waarop naar het stroomgebied, de delta en de uiterwaarden wordt verwezen om de geografische ruimte in kaart te brengen, af te bakenen en te plannen, begint het proefschrift met het uitleggen van de conceptualisering van het watergebied en de ideologische weergave ervan in de cartografie van de *frontières naturelles*. Het onderzoek identificeert vervolgens hoe het in kaart brengen van het Mekong-stroomgebied de projectie van geopolitieke claims heeft ondersteund en is gebruikt om een autonoom operatiegebied te definiëren. Het proefschrift gaat verder met het onderzoeken van de correlatie van de geografische delta met defensieve infrastructuur en de daaropvolgende opkomst van de Mekongdelta als nederzettingen-patroon. Tot slot illustreert het onderzoek hoe de *atopia* aan de rand, een deel van de uiterwaarden, werd 'verlost' door middel van infrastructuur en werd omgezet in een vlakte van rijst. Door het analyseren van deze discoursen, laat het onderzoek zien dat cartografische beschrijvingen van stroomgebieden ook instrumenten zijn om menselijke activiteiten te dicteren, gerationaliseerd door verwijzingen naar de natuurlijke stromen van water.

Preface

Based on an incomplete proposal for the planning of the Mekong Delta, this research project was conceived in 2018. Maps, remote imagery and spatial data, coupled with social statistics and official masterplans, presented this 40,000 km^2 region according to the location of roads, settlement patterns, administrative units or the imaginary colours representing land uses. The Delta's particular association with the river also meant that the same geographic space could be described with hydrological diagrams, the plans of canals and the principles of water management. Combined through the architect's eye, water, infrastructure and thousands of kilometres of canal-side settlements defined a delta of many parts that would nonetheless be collectively planned.

Less than a year after beginning work on the thesis, the start of the coronavirus lockdown cancelled many plans. Without the possibility of conducting fieldwork, the clarity of the view constructed from mapped information became even more urgent. Awareness that my perspective was remote (and would remain so for the duration of the lockdown), provided the incentive to reframe the initial investigation about water infrastructure through the technical tools that construct this view. Consequently, the research is an attempt to understand what is made known by visualising the flows of water on maps, but also what is made when the cartographer - like the architect – projects an image of the world on the surface of a map.

Contents

Introduction

Just as in the laboratory we create formulaic understandings of the processes of the physical world so too, in the map, nature is reduced to a graphic formula.

Deconstructing the map, John B Harley, 1989

In 2016, the World Bank announced its support to the Government of Vietnam for a project situated on 40,000 km^2 surrounding the Mekong River's outflows into the East Sea (South China Sea). The home of more than 17 million people living among countless waterways, the Mekong Delta presented as the focus of project emerged at the confluence of multiple problems related to water. Global changes in weather patterns portended disruption to the regular supply of river water that has allowed farmers to plan harvests and a rice-producing economy to flourish. Far upstream, and under different geopolitical jurisdictions, water diversions for hydropower production and irrigation were linked to downstream fluctuations in the quality of the river's water and the sediment deposits vital to cultivation and biodiversity. Along with the significant impacts to the hydrological regime resulting from intensive agriculture, the problems underpinning the project described this as "one of the most vulnerable deltas to the impacts of climate change".[1] In a context where canals, dikes and irrigated areas are critical to where people locate their homes, how they socialise and what crops are grown, the project's focus on modifying the infrastructure controlling the river's seasonal flows was intended to mitigate the adverse impact of these imminent threats.

Nonetheless on maps, the *delta* threatened by climate change and the Mekong Delta planned with the World Bank's support to deal with its impacts encompass different extents. This is not only because the project excludes the densely inhabited administrative provinces of Vietnam's Mekong Delta situated on the periphery of Ho Chi Minh City and the city of Can Tho [**Fig 0.1**].[2] First referred to with the geographic term *delta* less than two hundred years ago, the area defined by the hydrogeological process of sediment accumulation is crossed by the waterways that act as references to the border between Vietnam and Cambodia. Dividing and apportioning control of the delta formed by the diachronic action of water, the mapped borderline does not merely indicate the limits of geopolitical power. Given a material presence by its alignment with a canal and rivers, the

1 World Bank (2016), *International Development Association project appraisal document on a proposed credit in the amount of sdr 218.8 million (us$310 million equivalent) to the Socialist Republic of Vietnam for a Mekong Delta integrated climate resilience and sustainable livelihoods project (English).* Washington, DC: World Bank Group. p.7.

2 The project covers 9 of the 13 administrative provinces in Vietnam's Mekong Delta region. Of the four administrative units excluded, Long An and Tien Giang, are closest to Ho Chi Minh City, while Can Tho City and Hau Giang were previously part of Can Tho Province. Cumulatively, the 2019 population of the four units accounts for nearly a third (5,420,920) of the Mekong Delta's (17,273,630) population. Vietnam General Statistics Office (2020), *Completed Results of the 2019 Viet Nam Population and Housing Census (Tổng điều tra dân số và nhà ở năm 2019).* Hanoi: Statistical Publishing House.

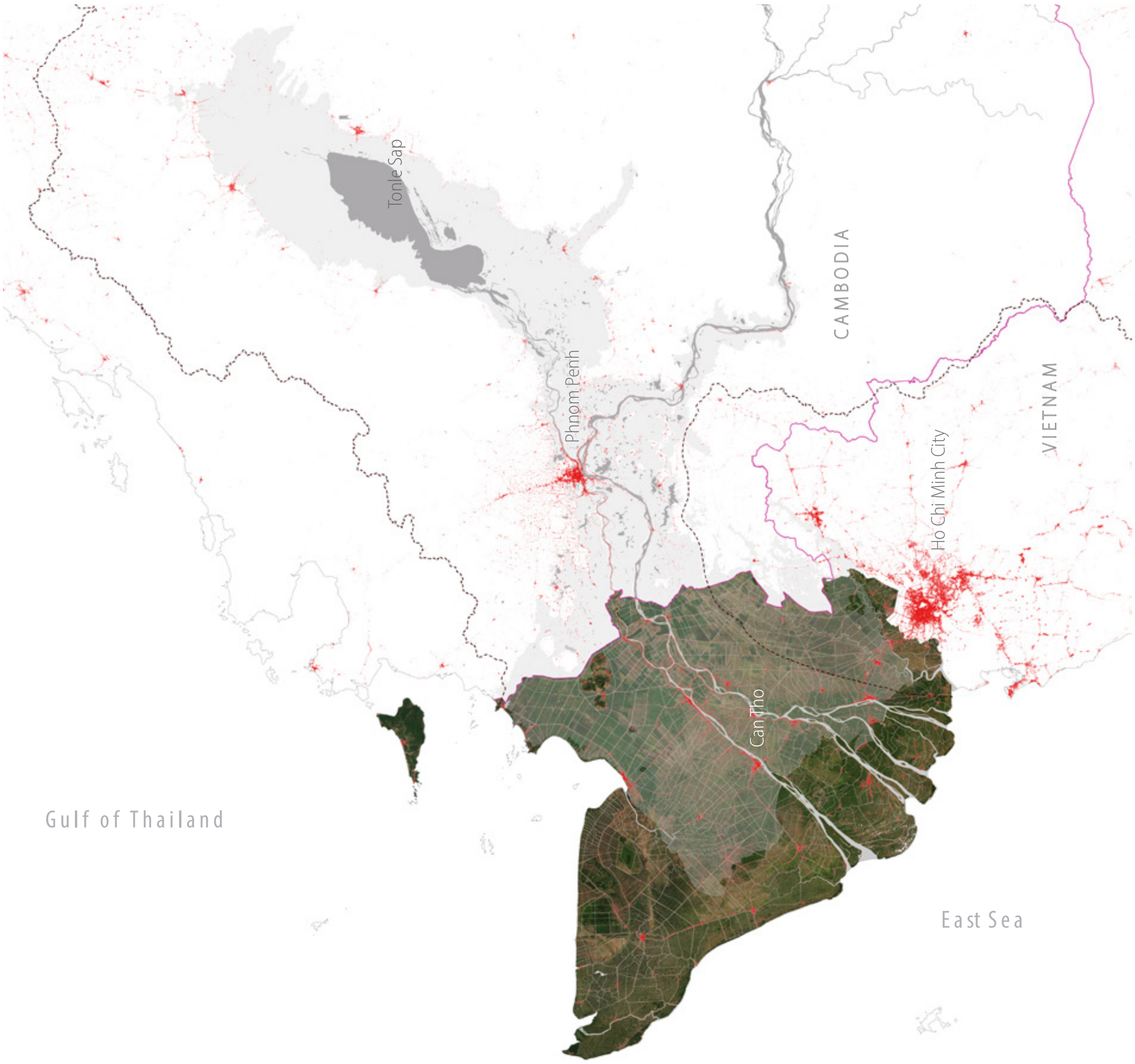


Fig 0.1 Vietnam's Mekong Delta region The map shows the administrative extent of Vietnam's Mekong Delta (satellite image), the extent of the flood (grey shade), settlement clusters (red shade), national boundaries (pink line) and the Mekong River's basin (dotted line). The sediments deposited by the Mekong extend north of Phnom Penh. The Mekong Delta is bounded by the international border with Cambodia to the north, Ho Chi Minh City to the east and extends into the sea in all other directions. Phu Quoc, an island in the Gulf of Thailand, is also included in the administrative Delta. Author (2021). *Spatial data sources:* Rivers in South and East Asia from HydroSHEDS (FAO, 2009); World Water Bodies (ESRI, 2011); Maximum flood extents (MRC, 2011); Urban footprint (DLR, 2014)); Lower Mekong Basin (MRC, 2011); Country Boundaries (MRC, 2011).

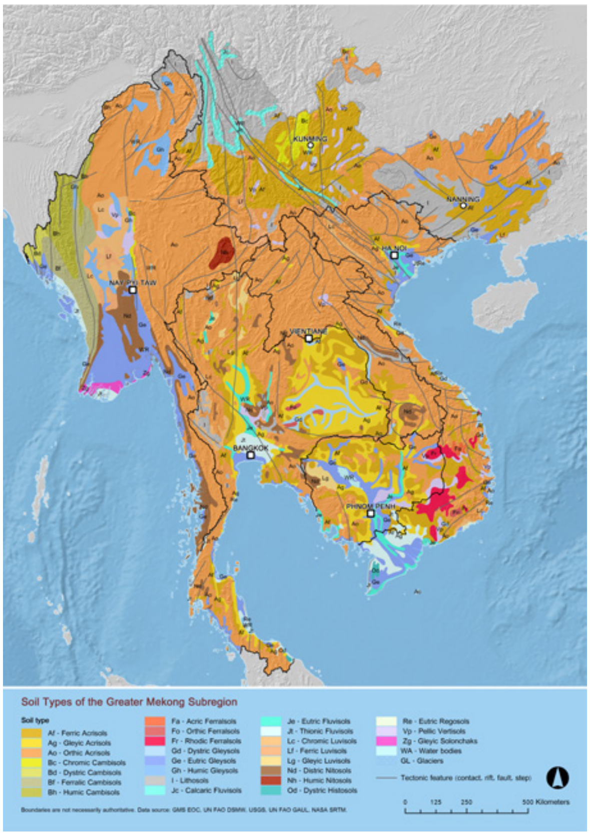
cartographic boundary is coterminous with the physical limit of a distinct network of water infrastructure that defines the terrain of the Mekong's delta. Designed to drain floodwater, to irrigate fields or to transport people, the canals and dikes constituting the network have significantly differentiated the flows of surface water and the condition of the ground in Vietnam from those across the border. If on the one hand maps allow a specific delta to be discerned from the ground condition of adjoining terrains, on the other, cartographic boundaries create the conditions for the Delta to be distinguished from the *delta.*

The agency of cartography in the process of describing and controlling the Mekong's flows is not confined to the river's lowlands. Upstream, significant sections of the national boundaries of riparian countries align with the linear watersheds of river basins or with the *thalweg* of the river's mainstream. Widely accepted as a single and continuous system of aquatic flows, management of the river's water resources between Laos, Thailand, Cambodia and Vietnam is coordinated with reference to the Lower Mekong Basin. A geographic area determined by the cartography of both the river and the political boundaries formed in relation to the river, the Lower Mekong Basin is underpinned by the assumption that the river's surface flows encompass a hydrological *catchment*. Unlike the distance between two embankments that defines the liquid area covered by a distinct waterway, catchment areas such as drainage basins, inundated plains or coastal deltas can extend far beyond the perennial flows of the river. A concept of particular significance for hydrology, the idea of the catchment allows a group of waterways to be considered collectively along with the seasonally wet (or dry) terrain *between* waterways. As a result, the catchment area can encompass thousands of square kilometres, even if the terrestrial ground covered by waterways is only a small fraction of that extent. Specifying a catchment not only helps explain the way surface water behaves - from a raindrop falling on a distant mountain to the inundation experienced thousands of kilometres downstream. Although in one sense only a background detail in the process of designing water infrastructure, mapped representations of catchments quantify the surface area used to estimate how much water any new infrastructure project will need to divert, and where, within that area, canals, reservoirs and dams will be located and given dimensions. If knowledge of a natural catchment's hydrology is decisive for regulating the wetness of the ground in many parts of the world, knowledge of the Mekong's has served as more than a generic explanation of the way water flows. The extent of terrain articulated by the catchment's area has been accepted as critical for the management of land as well as water resources, and has been contested as the geopolitical limit of colonial and later, national jurisdictions. Classified as geographic units, references to the Mekong's catchments have defined what constitutes the 'context' that affects planning decisions, and, as in the case of the Mekong Delta, the 'site' where those decisions are implemented.

Typically regarded as a scientific process that results in "a correct relational model of the terrain" which faithfully represents natural phenomena,[3] the delineation of the catchment area does not necessarily produce pictorial images of objectively perceived truths. Even if today visualisations of the terrain are constructed from spatial data generated through remote sensing rather than the topographic surveys of the past, datasets as well as the maps prepared by processing those datasets rarely depict exactly the same terrain or catchment [**Fig 0.2**].[4] Prepared for a different purpose, through a different disciplinary lens, or using different methods to distinguish the value of the terrain, maps on which the Mekong's river basin or delta appear are the result of the cartographer's power to select which and how information is depicted within a set of prescribed rules. Between geographers identifying the limits of a naturally-determined region or engineers conceptualising the control of water resources, the knowledge derived from viewing the catchment area in relation to the content of

3 John B. Harley (1989), *Deconstructing the Map*. Cartographica, v. 26, n. 2, p.3.

4 For example, there are (at least) three versions of the Mekong River's basin given by different datasets, two of those published by the Mekong River Commission and discussed in Chapter 10. This is due to the different methods used for delineation, as well as the datasets (Digital Elevation Models) used for determining watersheds. Represented on maps, the distance between the watersheds of different versions can be several kilometres across.



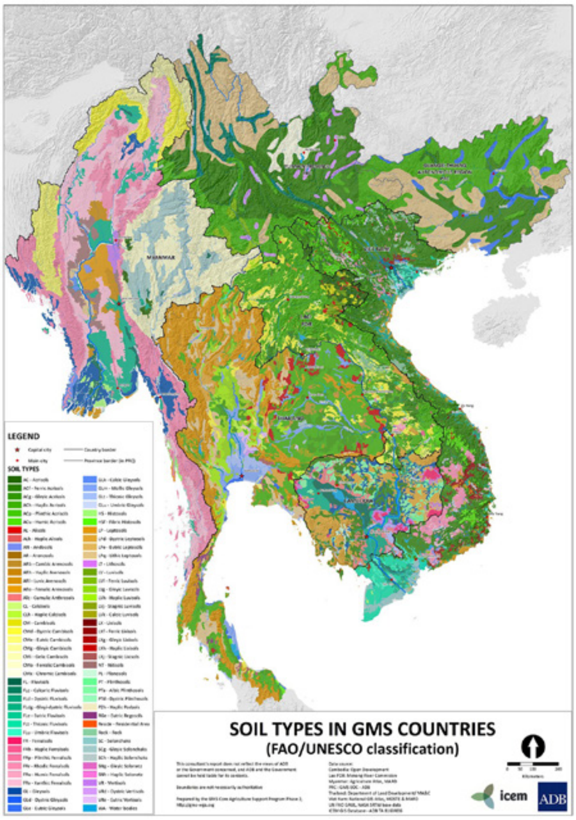


Fig 0.2 Soil maps of Southeast Asia Even within the narrow scope of showing soil types within the same extent of geographic space, recent maps prepared using different methods of soil classification, information sources and representation techniques result in different understandings of the ground conditions in any one area.
GMS Information Portal (2012), *Soil types of the Greater Mekong Subregion*; ICEM/ ADB (2011-2020), *Soil types in GMS countries.*

the map is, at least partially, determined by the maps' authors. Considering that what is being *planned* with reference to the delta, or *managed* by appealing to the extent of the drainage basin is not limited to water but can also affect the entire geographic space the catchment encompasses, the ideas which make it possible for catchments to first *specify* an area and then to suggest that area is a relevant *context* for decision-making, need to be understood.

If this still alludes to the same natural phenomenon given cartographic form in planning maps, hydrological diagrams or military charts, these different perspectives do not all refer to the same geography. Where hydrologists and engineers imagine their work taking place in the cartographic space of the river's catchment, the state's water managers imagine theirs also taking place within a district or a province. Thus, while the former informs the planning and design of water infrastructure, the latter organizes farmers into groups with collective responsibility in keeping canals dredged and water gates operational. The distinction between these two areal forms is not simply the spatial difference between the catchment's natural *whole* and the province's manmade *part*. Representations of waterways showing strategic conduits on a military chart, or water resources on a topographic map, arguably influence what is considered the 'entirety' of geographic space included in each network of flows. In other words, while the information displayed may still be acknowledged as 'accurate', and even if these distinctions are simply versions of the same observable conditions, there is still scope for the map to shape the relevance of that information to those using it.

The lenses through which the Mekong's basin, delta or floodplain are produced on a map converge when considering the impact of the catchment's pictorial delineation. Examining the cartography of natural phenomena in extensive detail, Denis Wood and John Fels have pointed out that even maps which authoritatively present "incontrovertible characteristics" of the terrain, are themselves underpinned by assumptions that create and convey "authority about, and ultimately over" an extent of geographic space.[5] Maps of the Mekong therefore not only depict the river's diachronic, physical transformation. They also express notions about geographic space and the way that space is controlled that may underpin the significance of their representation today. Problematised as a scarce resource situated within the terrain or contested under different jurisdictions, does not address the way conceptualisations of discrete hydrological areas affect how the river's water and its catchments' geographic space is exploited. If the changes effected by the depiction of catchment areas can be distinguished from the maps in which they appear, would this indicate that maps referring to the delta or the river basin are also technical documents that prescribe the way human activities transform geographic space? In other words, rather than simply a projection of a particular hydrological relationship, is the presence of a catchment's area on the map the cause that triggers a specific course of action? The thesis investigates the geographic relationships instigated by the Mekong's basin, delta and floodplain to understand how maps make catchment areas 'visible', and what notions are represented by their areal extent.

Understudied in the context of Southeast Asia, the agency of maps - and in particular the depiction of rivers and catchments - to induce as well as reflect the physical transformation to the environment becomes more critical through the prism of adaptation to climate change. Considering that spatial design strategies need to be coordinated across vast extents of geographic space to have a cumulative effect, are the basin, the delta and floodplain still adequate responses to answer which extents of geographic space are best suited to design mitigation strategies or to plan the adaptation of millions of people to anticipated conditions? Especially as changing weather patterns unevenly affect the Mekong River's geography and anthropogenic modifications realign surface water flows to make existing configurations of catchment areas increasingly irrelevant. To interrogate the adoption of the Mekong's catchments for organizing spatial decisions, defining the areal extent of interventions and dimensioning those interventions with reference to the context specified by the catchment, the perspective of the spatial designer that shapes the condition of the ground through the medium of the map, can offer new insights to what would otherwise be questions of hydrology and cartography. Rarely discussed as consequential to the impending water crisis, the research confronts the idea that planning deltas, managing river basins or reclaiming floodplains are collectively human interventions within or in relation to a *natural* geographic unit defined by the river's surface flows. Examined through the viewpoint of design, what maps of catchments *do* and what they *represent* become equally important. In this sense, the dissertation does not so much challenge the idea that catchments are geographic units, but rather questions what terrestrial geography is being articulated by referencing the area which describes the constantly fluctuating flows of water. The thesis problematises issues of water in terms of space, to

5 Denis Wood & John Fels (2008), *The Natures of Maps: Cartographic Constructions of the Natural World*, Cartographica , v. 43, n.3, p.190.

speculate on the territories produced by the amorphous, liquid contents of the Mekong River when these are specified as catchments.

Research goals and questions

The research engages with one of the basic forms of knowledge about the Mekong River. The reference for quantifying water and for framing the impact of rivers on social groups, what are perceived to be 'natural' catchments such as drainage basins, coastal deltas and inundated floodplains are essentially hydrological concepts that describe the behaviour of a group of waterways in relation to geographic space. As such, they are rarely questioned beyond their capacity to act as the setting for human activities or as the geographic reference for the study and control of rivers. To problematise catchments, the thesis engages with the discourses that make these universally-applicable hydrological concepts 'visible' on maps. The way water forms rivers, the way rivers are conceived as catchments and how catchments are presented on maps, forms a line of inquiry to approach the specificity of the Mekong. Water in the context of mainland Southeast Asia, the areal conceptualisation of the Mekong River and the maps on which catchments are shown, are part of distinct discourses that engage with the historical, climatic, political, social and geographic qualities of the Mekong River. The research is oriented through these varied discourses by concentrating on the depiction of water as river as catchment area on maps. Maps are therefore the subject of analysis and the lens from which to examine the conditions under which a specific geographic extent is discerned from the collective flows of water.

The river's geographic space

Water as a natural resource that can be exploited and controlled, or as a cultural notion related to identity and place, are ideas that occupy extensive bibliographies. Yet although many studies acknowledge the importance of water in human activities as well as the ground conditions it creates, Leonard Andaya observes that rivers in the context of Southeast Asia are often accepted as single - if mutable - waterbodies among the social sciences and humanities.[7] These approaches leave aside that the perception of the river as a continuous *body* of surface flows extending from distant mountain valleys is also a notion that is socially constructed. Articulated on a map, the Mekong River for example is presented flowing more than 4,000 km from the Tibetan Plateau to the East Sea, even though less than a fifth of the river's total water volume is sourced from China.[8] The role of maps in constructing the river's body is demonstrated by Dilip da Cunha. Examining the cartographic construction of the Ganges, he has argued that the delineation of embankments in successive mapping efforts "invented" the river by "separating water from land".[9] Referencing the methods and techniques of cartography, Da Cunha shows that the pictorial determination of the ground's perennial *wetness* not only affected how the river's water was controlled, but also accorded the Ganges' flows with dimensions that could primarily be appreciated on maps. Da Cunha's insights into the Ganges's current condition suggest that

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6 In fact hydrological as well as geological and geographic concepts have contributed to identify river basins and deltas. For the purpose of brevity and clarity, *hydrogeology* will be replaced by *hydrology* in the thesis.

7 Leonard Andaya (2018), *Water in the Study of Southeast Asia.* Kemanusiaan, v. 25, Supp. 1. p. 24.

8 The Mekong River Commission indicates that 16% of the river's water drains from China. Mekong River Commission (2004), *State of the basin report, 2003*. Vientiane: MRC.

9 Dilip da Cunha (2019), *The Invention of Rivers: Alexander's Eye and Ganga's Descent*. Penn studies in landscape architecture. University of Pennsylvania Press.

recurring depictions of the river on maps have created the perception of a riverine whole. Considering that, as Andaya points out, “traditional” perceptions of waterways reflect a group of people’s engagement with the specificity of local hydrological conditions, unifying these multiple perspectives into the river’s mapped 'body' can also be understood as a construction with social, technical or political motives. Viewing the Mekong River’s 'entirety' as socially constructed through the lens of its cartographic representation underpins the research approach towards maps of the river’s catchments.

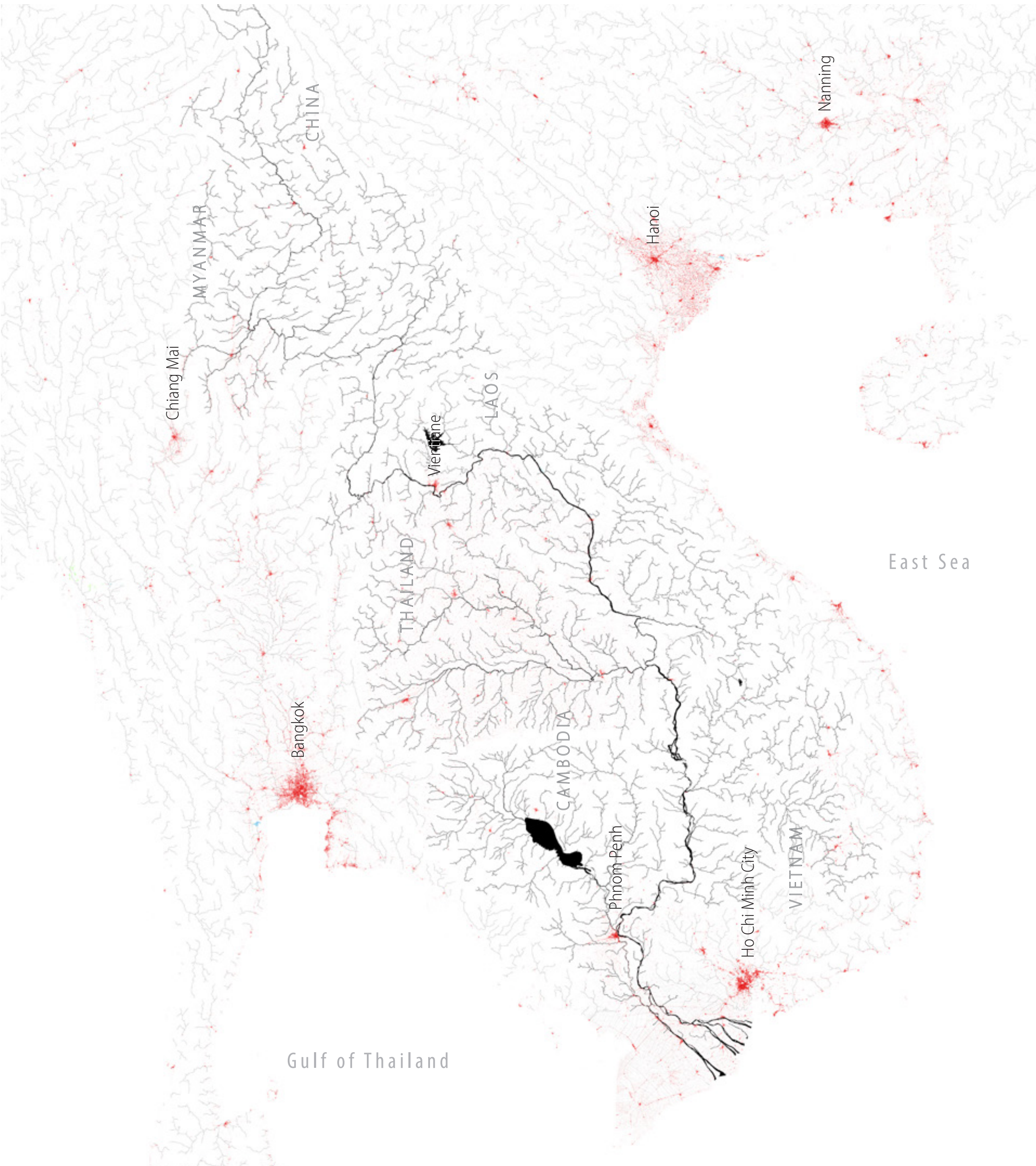

Fig 0.3 Distinguishing the Mekong River’s drainage basin Understood from the perspective of hydrology, the Mekong River’s basin consists of a group of rivers that merge into a central (main) flow carried downstream to the sea. The Mekong courses past six countires and its basin continues northwards (beyond the edge of the map) to the Tibetan Plateau. Author (2021). *Spatial data sources:* Rivers in South and East Asia from HydroSHEDS (FAO, 2009); Urban footprint (DLR, 2014).

In conceiving the Mekong as a 'body' composed of multiple surface flows, the areal specificity of the river's catchments becomes important. Equated with the extent of geographic space on which all surface water drains towards a single waterway, the river's basin is constructed on different principles than the delta that refers to the landform created by the river's sediment deposits or the floodplain which defines the land subject to inundation. As distinct flows of the same river, the basin could be perceived as the *whole* from which the delta is extracted, and the floodplain as the *part* from which the delta is composed. Even if the construction of the Mekong's catchments is conditional on recording specific ground conditions, the unit of geographic space that emerges on maps is not only discussed in terms of scientific hydrology. Although not specific to the Mekong, water expert François Molle's study of the concept of river basins has outlined the hydrological, institutional and political discourses that have accompanied the conceptualisation of the catchment area. Separating the period between 1930-1970 from previous and subsequent eras, Molle's investigation notes that spreading faith in the achievements of modernism and the technological exploitation of rivers made the concept critical to the formulation of regional planning and water management practices across the globe.[10] In this respect, Thu Dieu Nguyen and David Ekbladh discuss in detail the involvement of American and international engineers as well as the United Nations in the post-war planning of water infrastructure within the Mekong River's basin.[11] Yet, although they underpin these historical studies, neither the river nor the basin are part of the problematisation. Instead, the river and basin maintain their status as resources that different actors seek to exploit, and the geographic setting for Cold War events. Maps play a far more important role for David Biggs' discussion of the Mekong Delta's environmental history. Concentrating on human modifications of the terrain, Biggs outlines the sequence of projects and plans that have contributed to the current configuration of waterways, showing that quite often, plans for water infrastructure were based on maps prepared during previous political administrations.[12] However, Biggs' reference to the *Mekong Delta* even before French colonization introduced the term to Southeast Asia's geography, makes it difficult to discern what, apart from the national and administrative boundaries that he acknowledges divide the 'natural' delta, constitute the entirety of the geographic space he is discussing. To examine how accreted sediments become a delta that becomes the Delta, or how mountain ridge-lines become the Mekong's river basin that becomes the Lower Mekong Basin, the research needs to focus on the cartographic practices that bring these concepts into existence by making them visible.

The very human production of the relationship between rivers and geographic space is articulated by researchers from the field of political ecology. Questioning how society, the technology controlling water and the physical terrain intersect in governance and state institutions, Rutgerd Boelens, Erik Swyngedouw and others have argued that a "spatially bound" network consisting of "humans, water flows, ecological relations, hydraulic infrastructure, financial means, legal-

10 François Molle (2006), *River-basin planning and management: The social life of a concept.* Geoforum n. 40, p. 489.

11 See Thu Dieu Nguyen (1999), *The Mekong River and the Struggle for Indochina.* Westport, CT: Greenwood Publishing Group and David Ekbladh (2002), *"Mr. TVA". Grass-root development, David Lilienthal, and the rise and fall of the Tennessee Valley Authority as a symbol for U.S. overseas development, 1933–1973.* Diplomatic History, v. 26, n. 3.

12 David Biggs (2010), *Quagmire: Nation Building and Nature in the Mekong Delta*. Seattle: University of Washington Press.

administrative arrangements and cultural institutions" materialise in *hydrosocial territories.*[13] These territories are organized through plans, a specific course of action projected at different spatial scales, scales which are themselves contingent on administrative, cultural, jurisdictional and hydrological relationships. As such, the hydrosocial construction of territories is not only material but also imaginary, alluding to a set of interrelated practices that, together with mapping, constitute a *governable* geographic space. Catchment areas such as drainage basins, deltas and floodplains could therefore be considered as scales constructed for the purposes of governance, regulation and control. While the role of maps in this construction is not explicitly addressed, the overlapping discourses which pinpoint one particular spatial scale as most relevant for executing a specific operation, resonate with the idea that catchment areas are not only the outlines of a hydrological relationship. To therefore understand why they are drawn, requires the research to examine ideas from a range of disciplines that establish the context of the map from social, economic and political perspectives as well as those of the sciences of cartography and hydrology.

Mapping the river's space

The most challenging aspect of what this research proposes to investigate is the relationship between the map and the world to which the map refers. The research assumes that maps are not only cartographic representations of an externally perceived reality but also a medium that underpins a particular notion of reality in relation to geographic space. The reality depicted on a map *represents* an experience of the world, while the reality *created* by a map involves knowledge drawn from appreciation of that depiction.[14] By claiming to directly reference the geography they represent, Denis Cosgrove argues that maps actively produce how different social groups understand that terrain to be composed.[15] The significance of a river or a mountain on a map is therefore not only in describing the condition of the ground. It also indicates what a social group considers most important in the terrain, suggesting that what is worthy of depiction also reflects the relationship of that social group with the terrain. For the practices which are regulated according to the geographic space shown on maps, the reality that maps construct is not just that of a specific "geographical imagination". Reality can take material form through the design of infrastructure or the planning of regions, practices which rely on the spatial relationships depicted on maps to make decisions. From this perspective, landscape architect James Corner has argued that maps "do not *represent geographies* or ideas; rather they *effect* their actualization."[16] The research examines the transition between the pictorial representation of the condition of the ground, and the way maps are used to differentiate or to unite geographic space, with or without the intention to effectuate a particular course of action.

The study of cartographic representations is approached from the perspective of the maps' *construction*. Construction in this sense indicates the preparation of

13 Rutgerd Boelens, Jaime Hoogesteger, Erik Swyngedouw, Jeroen Vos & Philippus Wester (2016), *Hydrosocial territories: a political ecology perspective.* Water International, n. 41. v. 1, p. 2. .

14 Pablo Fernández & Manfred Buchroithner (2014), *Paradigms in Cartography: An Epistemological Review of the 20th and 21st Centuries*. Berlin: Springer, p. 3.

15 Denis Cosgrove (2008), *Images and imagination in 20th-century environmentalism: from the Sierras to the Poles.* Environment and Planning A, v.40, p. 1864.

16 James Corner (1999), *The Agency of Mapping: Speculation, Critique and Invention.* In Denis Cosgrove (ed.), *Mappings.* London : Reaktion Books, p. 225.

the two-dimensional representation. This is contingent on particular methods of collecting information such as aerial photography or surveys, as well as the cartographic conventions and rules that can represent a slope with contour lines, or the river as situated between the outline of embankments. Construction however also refers to the scientific, strategic or political notions which have informed how that representation is visually constituted by the cartographer and therefore what 'reality' the map shows. Multiple disciplinary practices converge for the cartography of hydrological catchments - from surveyors collecting information about the topography, to cartographers giving the information a pictorial definition on a map, to hydrologists distinguishing the catchment area from the depicted terrain, before eventually presenting that area as the context of hydrological studies, regional planning or water control. Based on the science of cartography on the one hand, and the Natural or Earth Sciences on the other,[17] the question of the map's 'objectivity' is less important than the set of common rules, accepted by the scientific community, that allow hydrological principles to inform the delineation of the drainage basin, coastal deltas or flooded plains on a map prepared by a different cartographer. From the perspective that such scientific endeavours are also socially as well as technically conditional, the philosopher of science Thomas Kuhn has argued that the 'truth' of scientific knowledge is relative, suggesting that the examination of maps needs to be conducted in relation to the discourses which underpin a specific depiction rather than as accurate representation of an overarching scientifically-constructed reality.[18] Even if digital technology has dramatically changed the way maps are prepared in the last 20 years, not only have the concepts that define catchments been developed through successive hydrological, geological or geographic theories and observations, but the representation of the Mekong River has changed as cartographic science has adopted different methods of collecting measurements and rules for structuring the depiction. As such, and especially for maps sourced from different periods, the study of catchments needs to account for the evolution of disciplinary-dependent scientific theories that relate to map-making and the geography of the earth.

The map's scientific attributes align in one important way. Part of the calculation which allows the volume of water to be estimated, the surface extent of a catchment is determined by the information provided on the map. The delineation of the catchment area which defines the extent of this particular hydrological relationship may not always be presented on maps as a linear boundary. In its allusion to the specificity of geographic space however, an outer limit is implied. The point where two basins are differentiated from each other or where an extent of land ceases to be a delta or a floodplain, the outer edge of the catchment's area is the result of multiple observable phenomena such as the location of soils, mountains and waterways. Examining the ontological status of geographic boundaries, Anthony Galton has argued that boundaries which "exist by virtue of the distribution of matter in space and time but are not themselves made of matter" are epiphenomenal rather than material.[19] In this sense, while the soils,

17 The epistemic field which today groups together hydrology and geology, *Earth* (or Geo) *Sciences* focus on studies of the earth's atmosphere, hydrosphere, and geosphere and replace the former category of Natural Science.

18 Thomas Kuhn (1970), *The Structure of Scientific Revolutions (2nd ed.)* Chicago, IL: Chicago University Press.

19 *"In all these cases the boundary is real but lacks physical substance; it is located in space but does not occupy space. It arises as a by-product of particular distributions of matter or energy (including human behaviour) over space and time."* Antony Galton (2003), *On the Ontological Status of Geographical Boundaries.* In M. Duckham *et al.* (eds.), *Foundations of Geographic Information Science.* London: Taylor & Francis, p. 155.

rivers and mountains are observable phenomena with specific material qualities, the area outlined as a catchment can be thought of as an *epiphenomenon* that exists as an outcome of multiple geophysical processes. Reversed, the implication that catchments are delineated through a combination of observable phenomena, suggests that maps which display the basin for example are not necessarily all constructed with reference to the same set of ground conditions cumulatively categorized as 'nature'. Examining maps that purport to describe a common 'nature', researchers Wood and Fels have suggested that depending on the way information about the terrain is brought together within the cartographic frame, maps can propose different 'natures'. Either through omission of certain features, or deliberate emphasis on others through graphical means, the ideas which a map can communicate about the system of interrelationships collectively referenced as 'nature' are critical to what a catchment's limit is intended to represent. As important as delineation is to the existence of the catchment, the actions and notions which determine where to place the conceptual limit require careful observation to understand what 'nature' the catchment constructs on the map.

If the boundary of the basin is not itself real, the defined spaces it can invoke and the way knowledge of those spaces is used to make decisions, indicate that it is not just important to examine what maps show, but ultimately also what maps do. Even if unintentional, in the discourses of critical cartography, maps are discussed in terms of their capacity to project authority. JB Harley has argued that the projection of power on maps is subject to the *external power* of social, political and cultural conditions and the *internal power* of cartographic processes.[20] Through *internal power*, the technical production of maps appears to appropriate the terrain by cataloguing, displaying and, through recurrent depiction, standardising and normalising available geographic knowledge. In the case of the Mekong, repeated representations of the basin, the floodplain or the river's delta on different maps confirm the presence of catchments in specific locations, and contribute to making them an unequivocal reference for parts of the terrain. The catchments drawn through the subtleties of *internal power* are therefore not necessarily the result of mapping the terrain and delineating the catchment, but rather what Corner describes as *tracings*, an almost mechanical action carried out on the map that reveals nothing new. While Harley's *internal power* permeates all maps, the cultural production of maps is projected through *external power*. The subdivisions of national and administrative boundaries that articulate the state's authority to apply specific rules and regulations within an extent of geographic space is the most explicit form of *external power*.

Considering the role national governments play in the collection of the information used to prepare maps, the cartographic perspective in general is also quite often that of the state or has been calibrated in relation to a state-centric view. In what is referred to as *methodological territorialism*, certain practices are directly informed by the measurable extent of units of geographic space.[21] These include statistics, demographics and economics where geographic units serve as the basis for censuses, social analyses or economic forecasts. Such

20 Harley (1989), p. 11.

21 Brenner and Schmid define *methodological territorialism* as social processes bounded and self-enclosed within clearly delineated, mutually exclusive zones. Neil Brenner & Christian Schmidt (2014), *The 'Urban Age' in Question*, International Journal of Urban and Regional Research, v.38, n. 3, p. 744. See also Orum, A.M. & Elden, S. (2019),*Territory/Territoriality*. In A.M. Orum (ed.) (2022), *The Wiley Blackwell Encyclopedia of Urban and Regional Studies.*

units reflect the state's need to govern rather than any consistently observable differences that warrant geographic distinction. As Brenner and Schmidt have argued, the conclusions drawn from the geographic units of information affect policy by presenting information as homogeneously distributed within the unit's extent.[22] The units that measure demography, record land uses or even subdivide the flows of water are therefore a way of recording phenomena but also a way of knowing the world, calibrated against the state-centric view through which information is created. This is especially important when references are made to geographic spaces whose magnitude exceeds what can easily be experienced first-hand. Knowledge of a vast terrain such as the Mekong basin, not as a piecemeal collection of experiences but as an entirety encompassing all those experiences, is only communicated on maps. Given the magnitude of geographic space, the information needed to construct such a map is inevitably collected from different sources. Mapping therefore includes the process of collecting information from measured surveys, other maps, remote imagining, aerial photography and field inspections, which are combined into a singular depiction. Understanding how information is obtained and interpreted to produce a map is critical to understand what technical, social and political relationships underpin the representation of water flows and the terrain.

Beyond the boundaries of countries, administrative units or property however, the intentional or unintentional projection of authority on the map can be communicated to the viewer in different ways. Apart from the graphical composition of the map, the representation of material differentiations observable in the terrain through lines and colours, the cartographer's selection of which features to display but also the notions which describe a waterway as a barrier rather than a conduit or a particular soil type as unproductive, converge to assign broad or specific values to parts of the mapped terrain. When the interpretation of these values allows a specific area to emerge into significance or another to fade, the discourses of critical cartography have discussed the relationship between power and maps in terms of the display, maintenance or production of *territory*.[23] Where boundaries explicitly indicate the state's power in relation to a geographic area, the cartographic configuration of the terrain that makes certain features 'visible' can evoke a different territory on the same map. If multiple territories can be discerned on the same map, the spatial qualities of catchment areas that allow the river basin, floodplain or the delta to appear as *territories* are important. Plans for entire regions such as those prepared for the Mekong Delta, but also water management within the extent of the Lower Mekong Basin, suggest that catchment areas are not merely descriptive of a ground condition. As the geographic space referenced for the control of water, the catchment's limits resonate with other forms of organization. Identifying common factors in the long-term success of irrigation institutions, economist Elinor Ostrom has pointed out that delineating the limits of responsibility and access is the "foundation for organizing collective action" with regards to water.[24] Although the institutions Ostrom references are far smaller than the magnitude of an entire catchment, the

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22 From their perspective, the territorial method of collecting data and presenting information has reinforced notional distinctions between urban and rural environments, presenting land as either one or the other where in many cases such distinctions are problematic. *ibid*, p. 774.

23 See for example, Fernández & Buchroithner (2014), but also Harley (1989) and Wood & Fels (2008).

24 Ostrom lists eight design principles most of which are related to the institution's structure. The first indicates that the *"boundaries of the service area and the individuals or households with rights to use water from an irrigation* (...)

principle of defining a specific space to reduce the uncertainty of *what* is being controlled is equally as important as ascertaining *for whom* water is controlled. Considered in terms of the importance of water to daily activities, agriculture as well as electricity production, Molle and other researchers have pointed out that the control of water either directly through infrastructure or through governance is also a means to exert power over people and to regulate geographic space.[25] Selecting what terrain to map, delineating parts of that terrain and organizing the differentiated terrain therefore constitute operations that can potentially evoke discrete territories. Identifying what the mapped area describes, the principles of the delineation and the way the cartographic information is instrumentalised is therefore critical to understand how the catchment area affects human activities.

Intended contribution

The research is reflective of the current moment where the intersection of issues regarding climatic change, human activity and the exploitation of water have resulted in a renewed emphasis on the value of 'natural' geographic units to act as the setting for spatial decision-making. The intention is not to question the veracity of claims from scientific hydrology that see particular catchment areas as distinct parts of the river's geography. Rather, the research seeks to clarify why those claims are so important in the context of the Mekong River, and what those claims produce. The examination of the relationships through which the Mekong Delta, the Lower Mekong Basin and the Plain of Reeds are intertwined is not intended to define what these geographic units are, but rather what makes them into discernible 'units'.

The multiple lenses which cartography brings to fundamental questions about our knowledge of the world and the ways that knowledge shapes the world, make the critical examination of maps in this particular context a valuable tool to address general issues of urbanization, resource distribution and planning. More specifically, the dissertation seeks to contribute to broader questions about the processes of settlement in Southeast Asia by changing the focus from the city-centric perspective of 'mega-urban regions' to the formation of the rice-growing 'hinterland' as a region. In this way it addresses Stephen Cairns' critique of the logic that all settlement conditions are "urban in intent or destiny", using catchment areas to view the processes of urbanization from a different spatial perspective. The thesis also explores how catchment areas can be instrumental to these processes when these are adopted as planning units, a situation that may resonate with conditions in other parts of Southeast Asia, where densely populated rice-growing regions are dependent on the regular supply of water. From different perspectives, the discourses of *planetary urbanization* and *hydrosocial territories* identify *scale* and *territory* as instrumental to the processes through which resources such as water are exploited in the service of discrete settlement-types such as cities.[26] The research contributes to these discussions, giving emphasis to the production of territories through the evocation of the catchment area and revealing how that territory is instrumentalized to achieve particular objectives. What territory 'contains', if not what it signifies, become

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24 (...) *system are clearly defined.*" Elinor Ostrom (1993), *Design Principles in Long-Enduring Irrigation Institutions.* Water Resources Research, v. 29, n. 7, p. 1908.

25 François Molle,, Peter Mollinga & Philippus Wester (2009), *Hydraulic Bureaucracies and the Hydraulic Mission: Flows of Water, Flows of Power.* Water Alternatives, v. 2, n. 3, pp. 328-329.

26 See Neil Brenner (2019), *New Urban Spaces: Urban Theory and the Scale Question.* New York: Oxford University Press.

increasingly important for the design disciplines that are collectively responsible for the planning of regions. In this regard, territory is often used to indicate an extent of the earth's surface while rarely specifying the contingencies which differentiate that extent from other terrains, or which make other spatial terms such as *region* or *place* unnecessary. Through the lens of one set of geographic units that also become the units for planning, the research questions the *design of territory* to bring new insights into what this concept may imply for the way the 'site' of planning is conceived.

The thesis emerges from, and provides insights into, the specific geographic units which it addresses. Covering in detail particular moments in cartographic history, the research examines certain historical facts about the Mekong Delta, elaborating on parts of the research already conducted by historians. Thus while not itself a historical account, the thesis provides new perspectives on the settlement of the Vietnamese section of the delta by discussing maps that have not been analysed before. Because maps show a general condition of the terrain including settlements, infrastructure as well as the river's flows, appreciation of these maps and the context in which they were drawn, may provide other researchers, aware of current conditions in the Mekong Delta, with a new viewpoint to define the specificity of the landscape. Since the Mekong Delta and the Lower Mekong Basin are included as examples in discourses of global water and regional planning, the findings of the thesis are considered immediately relevant to the viewpoints which propagate the idea that a delta or a basin are the most appropriate or relevant geographic magnitudes on which to project a plan – a specific course of action. In this sense, the thesis engages with recent critical appraisals of the planning practices which adopt catchment areas to signify the spatial limits of water management or design interventions. These include the use of the river basin's extent for regional resource management as well as the delta planning approach developed in the Netherlands which has directly influenced planning of the Mekong Delta.

Research questions

This research takes as its starting point the contention that the projection of catchment areas on maps, displays, maintains and produces territory. Mapping, delineating and planning with reference to catchment areas allude to three overlapping operations that may evoke different territories. For the purpose of the thesis, *mapping* refers to the process of collecting information about the condition of the terrain from surveys, other maps or other sources; *delineating* refers to the intentional differentiation of one particular part of the terrain and; *planning* refers to the instrumentalization of mapping and delineation to organize land, water and people's activities. As such the research is guided by the following overarching question:

- *What territories are displayed, maintained or produced by mapping, delineating and planning the Mekong River's catchment areas?*

Three additional questions were formulated to support and answer the main research question. Accordingly the sub-questions inquire into the cartographic practices that are hypothesised to display, maintain or produce territories:

- *What relationships are being mapped by collecting and displaying information about the Mekong's catchment areas?*
- *What does the delineation of the Mekong's catchment areas differentiate?*
- *What is being planned and controlled by mapping and delineating the river's catchments?*

Research design

To reiterate, the research focuses on the proposition of maps that represent the Mekong River's catchment areas. Propositions take the form of arguments that create connections between "conditions, states, processes, and behaviours."[27] The research is designed to understand how these connections are created or supported by the map, and how the map constructs knowledge and meaning rather than merely present information. The approach to understanding propositions is therefore hermeneutic, involving a justifiable interpretation of the map's visual construction. Accordingly, the research method engages with three issues: how a map is *read*, which maps are selected for study and in what order are those maps analysed.

Reading maps

As described, maps of catchment areas are part of discourses that engage with rivers, water resources and geographic space from different perspectives. Consequently, the discourses that underpin a map's construction of knowledge are not limited to textual or oral interactions. For the purpose of the thesis, the *cartographic frame* – the physical limit of a specific map on paper or on screen – acts as an organizing principle for the discourses that are involved in the analysis of each map. Within the frame, the cartographer selects "some aspects of a perceived reality" and makes them more salient, noticeable and meaningful so as to define a particular problem, promote an interpretation or justify a recommendation.[28] The cartographic frame which defines what is included within the map, therefore distinguishes which discourses are relevant to the map's proposition.

The discourses relevant for interpreting maps of rivers are grouped into *technical* and *cultural*. The technical component includes the cartographic processes that are related to surveying, recording, projecting and visualising the terrain on which the catchment area appears. Because catchment areas are also products of scientific observations, the technical aspects of the map's preparation include the hydrological, geological and geographic theories which support the existence of river basins, coastal deltas and inundated floodplains, and specify the conditions of their delineation. *Technical* discourses therefore embrace Harley's *internal power* and authors Wood and Fels' conception of the *perimap* that involves the "production surrounding a map".[29] The *cultural* component corresponds with Harley's *external power* and the *epimap* that for Wood and Fels includes the discourses shaping the map's appreciation and the use of the information that it communicates. These include political and military-strategic considerations, regional planning, resource exploitation and agricultural production and are "not materially appended" to the map, but exist in the public discourses that relate to the geographic space the map represents.[30] Since these discourses are historically and contextually contingent, the *cultural* arguments which form the map's proposition are examined relative to the period and place in which the map was created. This requires the research to draw on knowledge that is not explicitly about maps, but rather forms the social context of their production.

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27 Wood & Fels (2008), p. 190.

28 Robert M. Entman (1993), *Framing: Toward Clarification of a Fractured Paradigm*. Journal of Communication, v. 43, n. 4, p. 52.

29 Wood & Fels (2008), pp. 192-193.

30 *ibid.*

The technical and cultural discourses intersect. Delineation can be a product of cultural as well as technical considerations. When the area that is outlined denotes the 'site' of a plan or a fortified frontier, the map's capacity to project social and political ideas onto particular features of the ground can directly – or indirectly - affect human activities. Moreover, the technical component is also relative to the period in which it was produced since what constitutes scientific "truth", or what is considered the standards of *right* depiction has evolved along with cultural discourses. Maps for this thesis are therefore read through multiple lenses to establish their specificity within the sequence of recurring depictions of the subject, and to understand the various conditions that underpin a particular map's proposition.

Selection of maps

The research investigates the different ways the area of rivers is conceptualised and how the cartographic construction of that area has informed the different dimensions or scales of water control in Southeast Asia. The thesis proposes to study the questions posed by the mapping of catchment areas by focus on three geographic units, each associated with the Mekong River's natural flows. The Mekong's *basin*, the *delta* and *floodplain* reference specific sections of mainland Southeast Asia. These catchment areas have been the repeated focus of cartographic efforts relating to the river's flows. They range in magnitude from 900,000 km^2 for the Mekong's basin, to around 50,000 km^2 for the floodplain, and all three extend across two or more national jurisdictions. Introduced to the region's geographic nomenclature during European colonization, the basin, delta and floodplain are also notions which have informed successive attempts at regional planning as well as the control of the Mekong's water in the last seventy years. The Mekong's drainage basin, the delta and the floodplain therefore serve as three viewpoints to focus the study and the selection of material for analysis.

The basic principle that underpins the selection of maps is the depiction of water or rivers. Broadly, these include representations of the geographic space which is or later becomes recognized as one of the three catchment areas. Since the theories which make a basin or delta distinguishable from adjoining terrains are based in European scientific thought and cartographic practices, the majority of selected maps are drawn from the Western tradition that has been incorporated into the way maps are produced in Southeast Asia today. These include maps of the Mekong's catchment areas from different periods of French colonization that were published in Paris or in Hanoi by the *Service géographique de l'Indochine*, maps published by the United Nations or the governments of Southeast Asia's post-colonial regimes, maps presented in consultant reports for governments and multilateral organizations, and maps disseminated by the post-unification Vietnamese government or published on the internet. Because maps can only be definitively grouped into types in relation to the discourses which underpin their creation, the range of maps used as references for this study is broad and includes planning, military, geographic and hydrological maps.

The geographic focus of maps is on what is today considered the Lower Mekong Basin. This grounds the research within an area that is associated with the historical domains of the kingdoms of Siam and Vietnam, but deliberately excludes notions of the river associated with China.[31] To examine the effect of maps of

31 Dams along the Lancang (the Chinese name for the Mekong) and Chinese-funded infrastructure in downstream countries play an increasingly important role in determining the river's flows. However, the perception of the river basin from a Chinese perspective is not within the scope of the thesis.

catchment areas, local cartographic as well as cosmographic notions of the terrain are introduced into the research material. Examples from Vietnamese, Burmese as well as Thai cartographic traditions are necessary to understand how maps were used prior or during European colonisation to control and determine human activities and to construct a mental image of geographic space. The unevenness or lack of a cartographic record from non-Western sources however does not permit a full picture of pre-colonial mapping practices to emerge. What maps have survived are more glimpses into local discourses about geographic space rather than conclusive evidence of the configuration of mountains and rivers. Thus rather than claiming that maps represent the world-view of the people that made them, they will be examined as locally-constructed perspectives of particular areas at a particular time.

Customized maps prepared using spatial data and visualised in GIS software are also included in the research. Spatial data layers are sourced from the data repository of the Mekong River Commission, German and Japanese space agencies, the United Nations Satellite Centre (UNOSAT), ESRI and the Database of Global Administrative Areas among others. These layers were available either free or with a set fee through the internet. The maps constructed with this spatial data are used to illustrate a current condition, to visualise a past condition or to analyse a particular map.

Sequence of analysis

The selected maps and identified discourses are grouped and discussed according to the mapping of the Mekong's drainage basin, the delta and the floodplain. The sequence of the analysis follows the same order, with the basin discussed first, followed by the delta, and finally the floodplain. Partly this sequence acknowledges the scalar convention whereby understanding the larger magnitude of the basin provides a context in which to examine the more limited extent of the delta, and consequently the delta forms the geographic context to discuss the more limited extent of the floodplain. Rather than assuming the floodplain is part of the delta, or that the basin is the geographic whole which encompasses the delta and the floodplain, each unit is examined according to the discourses dictating its own pictorial delineation. For each of the three catchment areas, maps and discourses are grouped thematically, observing the chronological sequence of different maps' construction. These themes encompass subjects such as military defence, colonial or Cold War geopolitics, infrastructure and regional planning. Starting with the colonial and pre-colonial cartography of the basin, delta and floodplain, the discourses identified as relevant to discuss maps of each catchment overlap chronologically. Because of the overlap, references to the other units within separate analyses are treated carefully to avoid assuming these refer to exactly the same geographic space. For example, the delta referred to from the perspective of the basin, may not be the same delta referred to when considering the floodplain.

Terminology

Special attention is given in the thesis to make distinctions between terms that are sometimes considered synonymous. In the thesis a *plan* – a specific course of action - is projected onto a *map*. A planar, two-dimensional projection of a specific course of action is therefore a map and not a plan *per se*. One of the anticipated outcomes of producing maps of geography and projecting plans on those maps, direct evocations of *territory* are deliberately avoided in discussions of maps to allow different manifestations of territories to emerge from the analysis. In this sense, *region*, *place* as well as *land* and *terrain* are not equivalent to *territory* and are not used as such.

The thesis distinguishes the potentially non-geographic concepts of *space* or *area*, with the space or area referring to an extent of the terrestrial surface. A *geographic space* therefore refers to the tangible, material qualities of a specific portion of the earth's surface, while a *geographic area* is the conceptual, planar extent of a geographic space that is formed on maps. Hydrological concepts and capitalised toponyms that refer to those concepts are also distinguished. The Mekong Delta is not immediately equivalent with the Mekong's delta, neither is the Lower Mekong Basin the same as the Mekong River's basin. The term *catchment* here is distinguished from the uses of the same term in transport or retail studies where it can denote a walkable distance from a transit stop or a customer service area.

Thesis outline

The research is grouped into 10 chapters. With the exception of the first, three chapters are dedicated to the analyses of maps for each of the basin, the delta and floodplain, resetting the chronological timeline as each catchment area is introduced. Each of the chapters discussing the basin, delta and floodplain begins with a map. Prepared using the same cartographic conventions and spatial data, the nine maps summarise geographic knowledge about the current condition of the Mekong River's catchment areas. Together, the maps provide a consistent point of reference throughout the thesis to appreciate the various cartographic endeavours being discussed.

Chapter one presents the concept of the river's catchment area and its cartography from the perspective of early European hydrologists and geographers. Focusing on the work of Pierre Perrault, the notions of a *natural equilibrium* and the hydrological *principle of continuity* describe how the river's water becomes quantifiable when conceptualised in terms of a specific geographic space. Explained through the work of Philippe Buache, the chapter illustrates how Perrault's theory of the river basin was interpreted on maps. A global natural subdivision recalling the ideological precepts of France's *frontières naturelles*, as well as the epistemic *working object* of the science of Geography, the chapter outlines the contradictions which underlie the mapping of the catchment's area, preparing the reader for the encounter of European cartographers with the reality of the Mekong River.

	Basin	Delta	Floodplain
1 **The area of water** • An areal equilibrium • Nature's frontiers • The catchment's cartography	2 **A plan for water** • The geography of authority • A natural *commons* • Mapping the Mekong's valley • Mountain and water	5 **A map of water** • Curating cartographic knowledge • Cosmographic flows • Engineering an *imperial* geography	8 **A section in water** • Pathologies of an empty map • The archaeology of limits
	3 **Uniting geographic space** • The geology of water • The TVA's catchment • Planning *unity*	6 **Shaping the delta** • The extent of inhabitation • Hinged terrains • Seeding settlement	9 **Articulating inundation** • Challenging flatness • Haven from threat
	4 **The river's nations** • From drainage area to development unit • The basin as project • Producing geography	7 **The metropolis' hinterland** • The area of agglomeration • The hinterland's metropolis • Planning the Mekong's delta	10 **The region's immergence** • Isolating wetness • The geography of irrigation

Chapters two to four examine the Mekong's basin. **Chapter Two** introduces the notion of the *valley* and the first European depictions of a continuous body of water called the Mekong River. In the first part of the chapter, attention is given to the cartographic equation of the river valley with the extent of the Siamese king's authority. Alternative meanings of the valley as a *natural commons* and the river basin as *hydraulic staircase* are explained in the works of French geographer Élisée Reclus and the engineer Thomé de Gamond. These provide counterpoints to consider Francis Garnier's detailed maps of the Mekong River. In a context dominated by semi-autonomous polities and the overlapping jurisdictions of powerful kings, Garnier's surveys diverged from the standards of hydrography to show not only the river's waters but also the hypothetical limits of the distant watershed. The political dimensions of mapping the Mekong River's valley and the disputed delineation of Southeast Asia's colonial boundaries is illustrated in John McCarthy's maps of Siam and contrasted with Vietnamese map-makers depictions of the emperor's domain as *mountains and water*. The significance of the valley and its cartographic dimensions for the state's control of resources is examined in **Chapter Three.** Underpinned by the widely-held assumption that the post-world war planning of water infrastructure along the Mekong River was based on principles developed by the Tennessee Valley Authority (TVA), the chapter shifts focus to the maps of American geologists and planners. Investigating the importance of mapping the *arid region's* drainage basins for John Powell, the chapter highlights the theories that made basins a "unit of country" and the setting for the autonomous regulation of water resources. In the maps of the TVA's geographers and the writings of the organization's director David Lilienthal, Powell's theories were reformulated into a technical alternative to political problems. Lilienthal's conception of a "unity of nature and mankind" in the form of the basin and the TVA's deliberate integration of diverse problems into multi-purpose project-solutions, provide the basis to consider the planning of the Mekong's basin in the next chapter. Referencing geographer Gilbert White's maps of the earth's amorphous drainage areas that he distinguished from planned river basins, **Chapter Four** examines how the catchment area became the spatial unit for the United Nations' *integrated river basin development*. Applied to the contested extents of the Mekong River, the need to separate the technical from the political project, gave rise to the conditions for the Lower Mekong Basin to appear on maps. The chapter shows how, along with new cartographic surveys, the Mekong Committee's plans for a hydraulic 'cascade' of mainstream hydropower dams defined a particular geographic space, and examines the unfulfilled promise of coordinating infrastructure design on the principles of the catchment's area.

Chapters five to seven deal with the Mekong's delta. What appeared as an irrigated sub-region on the Mekong Committee's maps, the delta was perceived as part of the domain of the Vietnamese and Cambodian kings prior to colonization. With a delta's areal conception constituting a cartographic 'object' *par excellence*, **Chapter Five** examines the emergence of the Mekong delta on maps from three directions. The first, approaches the delta's appearance in the pages of European atlases and geographic accounts of Southeast Asia, and identifies the hydrological and geological observations of the Rhône River's coastal lowlands that correlate the idea of the delta with the process of sediment accumulation. The second, presents how the Mekong's lowlands were viewed in the itinerary maps drawn in the Vietnamese empire's capital, and the cosmographic cartography built into the design of the Cambodian capital at Angkor. The third part of chapter five uses military maps to show the delta constructed by the defensive network of citadels and waterways that structured Vietnam's imperial geography, and that subsequently created the conditions for the boundary that defines the Mekong Delta to be drawn. Within the geographic space delineated by national boundaries, **Chapter Six** investigates Vidal de la Blache's influence on conceptualising the geography of the delta. The construction of canals by the French colony's engineers and the formation of regional settlements that encompassed groups of manmade waterways serves as a context to discuss geographer Pierre Gourou's map of the villages of Cochinchina's Delta. Analysing the map, the chapter discusses how the areal form of human settlement could describe the terrain of Vidal's *milieu*, allowing Gourou to draw conclusions about the Delta's density and pinpoint "underpopulated" areas. As the conflict between North and South Vietnam worsened, the "underpopulated" delta became the site for strategic *hinge cities,* in the post-colonial state's attempts to exert military power over an 'invisible' enemy. Examined through plans for canal-based townships, *agrovilles* and *strategic hamlets*, chapter six outlines how plans for settlement created a notional "human wall" along the frontier that collectively defined the state's control of the *rural* Delta. Counterposing the agricultural Delta with the metropolitan area of *urban* Ho Chi Minh City, **Chapter Seven** focuses on the planned delta. From the metropolis' rice-growing hinterland to the vulnerable region planned by Dutch water experts, the chapter examines the Delta that appears in maps which present the transformation of current conditions according to a specific course of action. Looking at the delta defined by planning discourses, the chapter shows how the 'urban' has defined the "hydrological zones" drawn by Dutch planners and that formed the basis for the World Bank's current project.

Where the boundaries of the basin and the delta meet, the section of the floodplain known today as the Plain of Reeds is the focus of chapters eight to ten. Resetting the timeline to the colonial period once again, **Chapter Eight** analyses maps of the Plain that presented the location of inundation as a *territory of risk*. The threat of disease from stagnant water, of violence from insurgents and of lost harvests due to the action of the water, converged with the observable seasonal overflow of the Mekong River to describe an uninhabitable *atopia* beyond the jurisdiction of the colonial state. Plans to 'correct' these conditions are presented in **Chapter Nine**. Drawing on maps from the PhD thesis of military officer Victor Delahaye, the first part of the chapter shows how the planning of canals to drain floodwater was underpinned by his own contour map that accorded to the Plain of Reeds the dimensions of a catchment area. Switching focus to forty years later, the second part of the chapter references maps prepared by the US Army's Engineer Agency of Resources Inventories (EARI) to plan polders in the Plain of Reeds. Explaining the importance of 'diked' settlement enclosures in the context of the Mekong's delta, the chapter examines the EARI's drawings of the Plain's catchment area and its strategic subdivision with infrastructure that aimed to drain the flood as well as control farmers' access to water for military and political objectives. Although never implemented, parts of these plans are echoed in the network of canals constructed by Vietnam's governments after 1980 to transform the Plain of Reeds into a Plain of Rice. In **Chapter Ten**, the planning of this network and its impacts are discussed with maps of hydrological models used to quantify the water diversions resulting from dikes and spatial data from the Mekong River Commission. The chapter reflects on the adoption of the irrigation units used to plan the canals to also indicate catchment areas, and the region's disappearance within the contradictory propositions declared by maps.

CHAPTER 1 The area of water

According to ideas purely theoretic, we should be tempted to admit, that rivers, having once issued from Alpine vallies, at the tops of which they take birth, must rapidly leave the mountains on a plane more or less inclined, the greatest declivity of which would be perpendicular to the axis of the chain, or the principal line of ridges. Such a supposition, however, would be contrary to what we observe in the most majestic rivers of India and China.

Personal narrative of travel to the equinoctial regions of the New Continent, Alexander von Humboldt, 1822

Delimited by the lines representing embankments, the depiction of rivers on maps appears to suggest a linear body of water flowing over the terrestrial surface. Although the fixed cartographic extents of natural waterways essentially reduces their hydrological significance to the visible route of surface water, the spatial relationship between water and land is not restricted to the width and length of the river's perennial flows. Expressed as a *catchment area*, the measurable extent of geographic space contributing to the collection and drainage of a river's flows can extend far from the mainstream. Encompassing the sometimes dry terrestrial surfaces of distant mountains, inundated plains and sedimented lowlands, geographic references to a river's hydrological catchment are underpinned by specific ideas about the behaviour of surface water. Apart from describing an observable natural phenomenon, knowledge of the catchment's areal magnitude is necessary for the quantification of water volume in any part of a river system as well as for defining the geographic impact of inundation. But while critical to the practices of water control, the hydrological relationships denoted by natural catchments are often too vast in magnitude to be perceived in their entirety solely through the ground-level experience of a single individual. Articulating the catchment's boundary on maps has therefore been a preoccupation for both hydrologists and cartographers that have needed to distinguish the limits of these hydrological relationships from drawings of mountains, rivers and sediment deposits. If this would imply that the catchment's mapped outline is simply representative of a natural phenomenon, the process of translating that phenomenon into the pictorial language of cartography has not been confined to the knowledge derived from scientific hydrology. Arguments that equated the geographic space of rivers with the political ideology of natural frontiers or with the hypothetical geographic subdivision of the entire globe, appeared almost simultaneously with the catchment's theoretical inception in Enlightenment France. The basis for subsequent mappings of the Mekong River and its hydrological basin, the ability to *see* the catchment on a map, became increasingly important for European cartographers visualising the unexplored hinterlands of distant continents and for geographers searching for the epistemic *working object* of their discipline. Beginning with the emergence of the catchment area as a scientific concept, this chapter investigates the hydrological, geographic and political notions which allowed parts of the terrestrial surface to be differentiated from each other based on a river's flows. Examining the maps prepared by European geographers prior to the colonization of Southeast Asia, the chapter asks what phenomenon was being mapped with reference to the catchment: the behaviour of surface water, the apparent relationship between rivers and land or the spatial unit of political geography?

An areal equilibrium

In contrast to the linear waterbody depicted on maps, to arrive at the conclusion that a river has, in some sense, a geographic space 'belonging' to it, the river itself needs to be perceived as having areal properties. For the late 17th century pioneers of scientific hydrology such as Edme Mariotte and Pierre Perrault, the extent where water collects as a result of rainfall or flooding, was instrumentalised in the form of a space called the *catchment* to aid in the estimation of the total volume of rainfall.[1] Both Mariotte and Perrault structured their hydrological treatises around their response to the question if rain could - by itself - account for all the water in rivers. Brother of the architect Claude Perrault who designed the Paris Observatory, Pierre's significant contribution to the study of water *On the Origin of Streams*, constructed the concept of what later came to be known as the hydrological cycle. By closely studying the origins of the River Seine he imagined the catchment as a natural reservoir which collected all the rain that was to be distributed among Seine's tributaries.[2] He estimated the basin's area through observations of "the sides of its course" which extended outwards from the river to nearby slopes.[3] Refined to exclude streams and water courses that drained in other directions, the extent was used to quantify the rainwater collected in the catchment. From this he concluded:

> *All this water thus accumulated* [...] *from its source to the place of designation, and which must serve also to supply all the losses, such as the feeding of trees, grasses, evaporation, useless flows into the River...*[4]

The "losses" which Perrault attributed to "useless flows", and computed to around five times the volume flowing down the Seine, served as the proof to confirm that rain could indeed supply all the water for the river. In order to estimate this loss however, Perrault required knowledge of an anticipated total from which to calculate the deficit in the catchment. This total was found using a unique concept that serves as a fundamental theorem of hydrology. The *principle of continuity* in the science of water expressed a fundamental law of mass conservation, holding that the amount of water entering a distinct system of hydraulic flows would be equal to the amount of water exiting the system. The principle was elegantly summarised by Da Vinci using the metaphor of the tree:

> *All the branches of a tree at every stage of its height when put together are equal in thickness to the trunk* [below them]*. All the branches of a*

1 The term *catchment* is used here to indicate the general relationship between a river and surrounding land which becomes specific within the geographic limits of the river's basin.

2 Investigating the origin of rivers was a popular topic of research among scholars from the Renaissance onwards. The question of origin could be considered as an investigation into the river's catchment, before this concept acquired a scientific dimension.

3 To estimate the basin's area Perrault observes that the "*course of the nascent river*" is around around three leagues long "*...et les costez de son cours s'estendent a droit et a la gauche environ deux lieues de chaque costé.*" La Rocque translates this into English as "*...the slopes of its* [the river's] *bed extend to the right and left about two leagues on each side*" which would erroneously equate the catchment with the (river) bed. *Les costez* (from *costé*) is better imagined as the sides or slopes extending from the river. Pierre Perrault (1674), *De l'origine des fontaines*. Paris: Impri. Pierre le Petit, p. 210. See also Asit Biswas (1970), *History of Hydrology*. Amsterdam & London: North-Holland Publishing Company, p. 210.

4 *"Toute cètte eau ainsi ramassée en la quantité· que nous venons de dire, est ce qui doit servir à faire couler cette Rivière pendant une année, depuis la source jusques au lieu que nous avons designé, & qui doit servir aussi à suppléer à tout ce qu'il peut y avoir de dechets, comme aliments d'arbres, plantes, herbes, évaporations, écoulemens inutiles dans la Rivière qui ne sont que la grossir pour un temps & pendant qu'il pleut..."* Perrault (1674), p. 258.

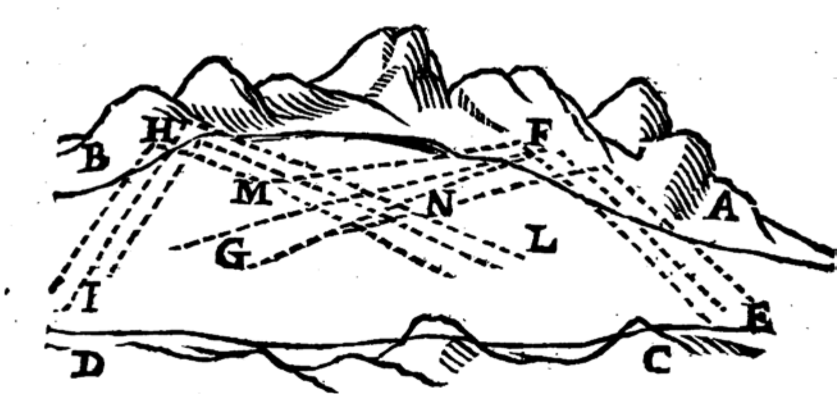

Fig 1.1 Analysis of wind directions Mariotte's interest was focused on the kinetic qualities of water and other fluids. Discussing the direction of winds and precipitation, the diagram is used to visualise the generic geographic relationships of these phenomena, presenting a calculable areal plane embedded within a valley.
Edme Mariotte (1686), *Traite du Mouvement des Eaux et des Autres Corps Fluides*, p. 62.

> *water* [course], *at every stage of its course, if they are of equal rapidity, are equal to the body of the main stream.*[5]

This simple concept, provided the study of water with a basis to consider the water volume measurable inside the catchment as an absolute total from which all other flows emerged. Enclosing a distinct hydrological continuity which included the rivers, their surrounding 'sides' as well as precipitation and evaporation, the catchment presented a geography unified through a 'hydrocentric' lens. By imagining that the quantity of a river's flow at any one point could be approximated as the sum of the water in all upstream waterways, the catchment made distant - sometimes unnavigable - rivers immediately dependent on each other. In this sense, the *principle of continuity* provided the reasoning to splice together geographic spaces, hundreds of kilometres apart, that were outside the immediate experience (and jurisdiction) of a single average individual.[6] The significance of this concept however is not only that it helped anchor hydrology to an extended geographic dimension. The suggestion that a fixed total of water was distributed among river branches of varying lengths, breadths and navigable conditions presented the *part* as proportional to the *whole*. With individual rivers each sharing a determinable portion of the total amount, a distinct hierarchy was formed based on the volume of water collected within the limits of the catchment. In this new register, rivers with larger catchments (and water volumes) were privileged over sometimes historically significant rivers with smaller catchments, which in turn become labelled as tributaries in relation to the main flow.

The catchment's reference to the geographic properties of a river and its surrounding sloped ground as well as its conceptual dependence on an autonomous hydrological continuity suggest that the term functioned in two ways. As a proxy for a particular geographic space, the edge of the catchment could be imagined as signifying the limit of a specific area on a map. What distinguished this area from all others that could be drawn on a map, was the idea that all the water within the catchment's limit drained into one main river. The geographic

5 Leonardo DaVinci quoted in Christopher Duffy (2017), *The terrestrial hydrologic cycle: an historical sense of balance*. WIREs Water, v. 4, e1216, p.12.

6 The general acceptance of this principle among hydrologists is credited by Asit Biswas to Bendetto Castelli one of many notable Italians that dominated the field of hydrology. Biswas (1970), p. 202.

space comprising the catchment was visualised according to the geometry of a bowl or basin, the sloping edges collecting and directing water that ultimately discharged into the sea. As an area delineating the action of water however, the catchment was also an abstraction of geographic space, a mathematical plane utilised to calculate volume, flow or evaporation.[7] This distinction is important because while the catchment always indicated an enumerated relationship with water, its delineation did not necessarily reflect the configuration of geographic space. The divergence was not only due to the dearth of reliable topographic information on 17th century maps which could not be used for detailed calculations. The principle of continuity allowed the individual catchment to be conceptualised as a distinct collection of water-related phenomena without the need to reference the specifics of its riverine topography. Yet if the principle of continuity signified how specific waterways could be constituted as a group, differentiating one particular catchment from other similar groups required not only a way to consider what was included, but also what the collection of waterways entailed when considered together. Switching his level of engagement from the river to the more general category of water, Perrault explained that:

> *…the waters which remain* [in the catchment] *being able to supply the continual evaporations, the sources* [of rivers] *which are produced from them flow in a continual and almost always equal course, because there is sufficient matter to maintain them in this state.*[8]

That the catchment delineated an area where unpredictable, yet measurable, atmospheric phenomena such as precipitation and evaporation would nonetheless maintain a constant flow, suggests that for Perrault, the geographic basin was something more than an assemblage of separate parts. The state of internal stability suggested by Perrault's hydrological reasoning is discussed by Christopher Duffy in relation to the broader scientific concept of the *natural balance*. Building on Joel Kaye's analysis of the notion of balance in western literature, Duffy argues that early scientific hydrologists such as Perrault saw the internally self-regulating actions of water which maintained the principle of continuity as a reflection of a perceived state of equilibrium within nature.[9] This particular concept of balance, becomes clearer when considering the area delineated by the catchment from the perspective of the hydrological cycle. As the plane upon which rain becomes stream, stream becomes river and river becomes sea, the basin was considered to encapsulate the entire range of processes related to water as a general phenomenon, as well as more particularly the journey of a single raindrop to the sea. The faith that together these processes, however turbulent, would always result in the inflow being equal to the outflow, reinforced the view of internal completeness and autonomy in relation to the catchment. Moreover, it assigned to the cumulative whole an idealised condition of balance that would have been impossible to assign to any of the individual parts.

As Duffy claims, the sense of an observable state of equilibrium in the interaction between natural phenomena developed into laws of conservation from which

7 It is not known if early hydrologists informed their thinking with maps. Mariotte, for example estimated the drainage area of the Seine as 60 by 50 leagues, a square which had as much to do with the basin's conceptualisation as a calculable plane, as with the topography encompassed by a group of waterways. Biswas (1970), p. 217.

8 Perrault writes: "*les eaux qui y demeurent pouvant fournir aux évaporations continuelles, les sources qui en sont produites coulent d'un cours continuel & presque toûjours égal , à cause qu'il y à de la matiere suffisante pour les entretenir en cet estat…*" Perrault (1674), pp. 251-252.

9 Duffy (2017), pp. 14-17.

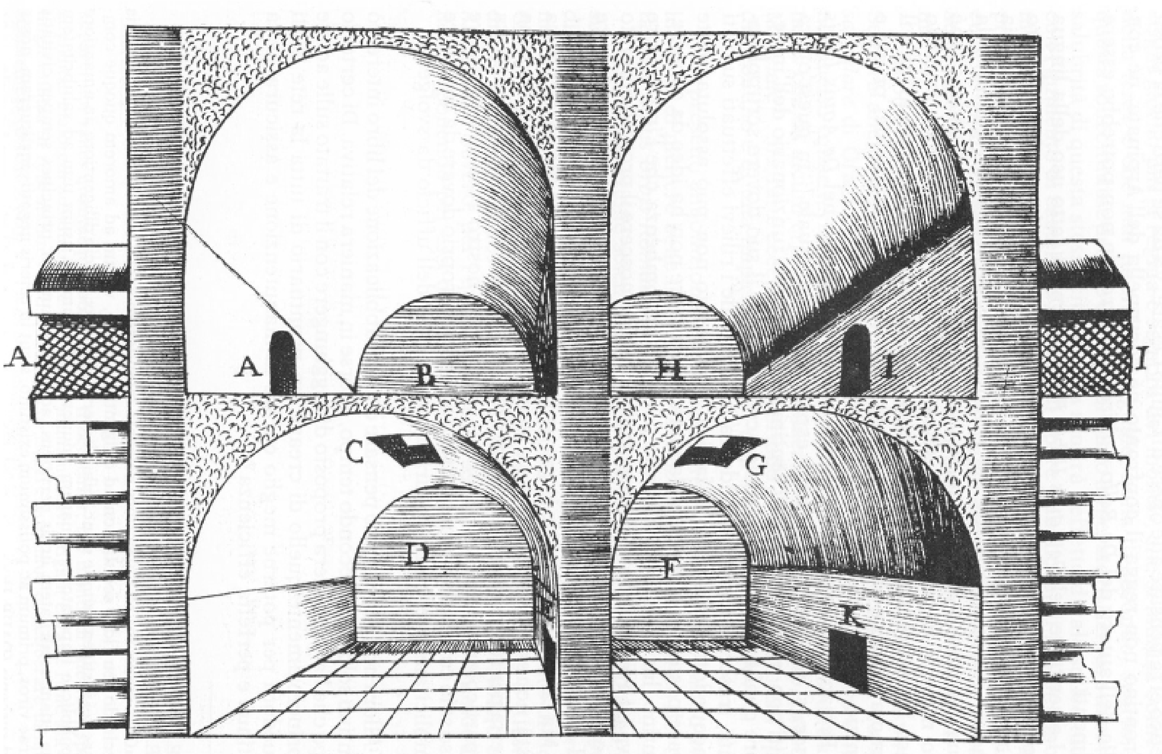

Fig 1.2 Cross section of Roman aqueduct Prepared by the antiquarian Fabretti, the drawing gives an impression of the Roman water system, as the author recorded it in the late 17th century. His use of the sectional perspective is not coincidental since the aim of the illustration is to explain the technical flows of water through the system (from A to B, C to D etc). Raffaele Fabretti (1680), *De aquis et aquaeductibus veteris Romae: Dissertationes tres*. Typis Ioannis Baptistae Bussoti, p.125.

the mathematical formulations for force, mass, energy as well as water are derived. However, as far as water is concerned this only appears inevitable in hindsight. James Dooge, a historian of hydrology, has attempted to determine a genealogy for the science of water from the multiple practices, treatises and computations of water. Comparing the critical role played by the principle of continuity in hydrology with Newton's laws of motion in astronomy, he notes how the influential treatises by Vitruvius and the Roman water commissioner Frontinus display no understanding of the principle.[10] The hydrological study by the architect Giovanni Fontana da Meli of the River Tiber in Rome, illustrates how these ancient manuscripts still influenced hydrological practices even as late as 1598. As Asit Biswas explains, Fontana's study meticulously recorded the width and depth of all the streams flowing into the Tiber in an attempt to estimate their cross-sectional area.[11] According to the mathematical precedent established by Frontinus, this sectional area was considered exactly equal to the amount of water discharged through the waterway, enabling Fontana to estimate the overall water quantity affecting Rome during a recent flood. For Roman-era engineers, the cross-section had been critical concept to dimension infrastructure such as aqueducts, that were needed to transport water across great distances. But the conceptualisation of the action of water purely through the sectional area had limits that went beyond the flaws in the mathematical formulation itself. The technical focus on replicating the natural flow of rivers implied by

10 James Dooge (1988), *Hydrology in perspective*. Hydrological Sciences Journal, v 33, n 1, p. 64.
11 Biswas (1970), p. 202.

the concentration on the section, limited the need for water control practices to understand water-related phenomena that took place beyond the boundaries of the section. And even though Vitruvius was well aware of the *quadratus locus* (square area) especially with regard to agricultural fields, that particular spatial understanding remained unconnected with water.[12] The planar conceptualisation of water was therefore inaccessible to pre-17th century architects and engineers until the introduction of the principle of continuity gave water an explicit geographic dimension.

Perrault's measurement of water through the planar catchment, did not eliminate or replace the need to consider water in terms of a cross section. But between its use as an approximation of a geographic space in equilibrium, and a computable extent underpinned by the internally self-regulating action of water, the catchment could be seen to embody aspects of what Max Jammer distinguishes as the primordial values of the concept of area (henceforth *Area*). In an argument constructed as a precursor to the theories of space in physics, Jammer distinguishes between the *square unit* denoting an area's extent and the *areal unit* denoting an area's activity. Using metrology as his framework of comparison, Jammer notes that within the evolution of mathematics in pre-modern cultures, the units used to enumerate an extent of geographic space were also, at the same time, the units for other forms of quantification. In this sense, the same value that indicated the square area of an agricultural field could also represent the weight of the crop produced on that field, or the number of seeds needed for its cultivation.[13] By equating the value of an area's extent with the value of a specific activity enacted within the limits of that area, Jammer hypothesises that in its conceptualization, Area was intimately anthropocentric. Over many generations of refinement, the calibration of units of extent in relation to units of activity allowed geographic space to be approached from the perspective of the human labour involved in its domestication or cultivation.

The association between *area* and human activity suggested by Jammer was more clearly articulated in the way hydrological theory, and the catchment in particular could be used to cross between the confines of the experimental laboratory and the water-logged field. For engineers tasked with draining wetlands or irrigating agricultural plots, knowledge of the catchment provided a new perspective. Quantifying the impact of annual inundation in terms of a specific unit of liquid volume did not only describe the physical condition of a landscape 'invaded' by

12 Throughout the 10 Books, Vitruvius makes reference to the Roman concept of *locus* in the sense of a place or particular site. His reference to the square area is limited to one passage in Book IX where he discusses Plato's theorems "*If there is a square area* [quadratus locus], *or field with equal sides, and it is necessary to double it, there will be required some number which cannot be found by multiplication; this is determined by a perfect geometrical figure*." Vitruvius (1934), *On Architecture, Volume II: Books 6-10*, translated by Frank Granger. Loeb Classical Library 280, Cambridge, MA: Harvard University Press, p. 199.

13 Jammer's metrological analysis focuses on the units utilised by Mesopotamian state bureaucrats more than 3000 years ago. He points out that *še* (𒊺) the basic unit of area was also the basic unit for grain and hypothesises how area could simultaneously function as a *square unit* measuring an extent and an *areal unit*, quantifying an activity. Similar overlaps between extent and activity as measures of area can be seen in Mesoamerica in the early years of Spanish colonization where residents in today's Mexico recorded the precise outer limits of agricultural plots, enumerating their extent in terms of glyphs indicating corn or other crops. This contrasts with Spanish governors' concurrent use of the *fanega* – a traditional unit of space in Spain, calibrated against a container of barley. Max Jammer (1954), *Concepts of space, the history of theories of space in physics*. Cambridge MA: Harvard University Press, p. 7. See also Harvey and Williams (1980), *Aztec Arithmetic: Positional Notation and Area Calculation.* Science, v. 210, pp. 499 – 510.

water. The magnitude of a calculated volume of water also structured the technical requirements for the canals that needed to be excavated, or the height of the dikes that needed to constructed. In other words, the planar catchment allowed the area of water to be imagined in terms of human activity. Traditional practices of floodplain drainage or water supply infrastructure, refined over generations, could now be adjusted according to the metric of an extended geographic relationship. As Dooge notes, the study of water through the medium of classic mathematics was essentially deterministic. The symmetry encoded in the principle of continuity, presented hydrologists and water engineers with the opportunity to rationalise, and therefore eliminate the uncertainty posed by seemingly random natural phenomena. Control of water, and by extension control of the land affected by water, became a possibility within the boundaries of the catchment.

Nature's frontiers

Perrault and Mariotte theorised the existence of the river basin in a period when cartography had only recently been elevated into a scientific pursuit. On the European continent, the centre of cartographic knowledge and where new astronomical surveying techniques were systematically adopted was Paris. Yet at the beginning of the Sun King’s reign (1643-1715), maps of France - typically constructed at the level of provincial administration - rarely followed any common standards in their representation of natural or man-made features. Without a consistent scale or reference across the surface of the map, the use of cartography to communicate the measure of geographic space was limited, if not impossible. Moreover, the perspectives which informed the disposition of natural features on individual provincial maps were built on oral traditions and local histories presenting the location of rivers and mountains duplicating or sometimes determining the distinction between separate domains.[14] These maps were so different from each other in their representation of the terrain, that they prevented the royal cartographer and first director of the Paris Observatory Jean-Dominique Cassini from combining them into a unified map of the kingdom. But these incommensurable perspectives of the same terrain were not only a problem of graphical representation.[15] They also involved the use of maps to present different interpretations of the role of nature in shaping France and more broadly human affairs.

The discourse around France’s *frontières naturelles* (natural frontiers) reflected the changing concerns of politicians, military strategists as well as scientists in the *Ancien Regime* with regard to the nature’s role in the manmade organization of geographic space. Peter Sahlins explains that politicians supporting a theory of natural frontiers such as Cardinal Richelieu, considered the location of mountains and rivers as an indicator of France’s innate size.[16] The differentiation of France’s

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14 Peter Sahlins (1990), *Natural Frontiers Revisited: France's Boundaries since the Seventeenth Century*. The American Historical Review, v. 95, n. 5, p. 1428.

15 According to Turnbull, Cassini would respond to the localised perspective of French maps by launching the first complete survey of France according to a triangulated system of reference points. The project of surveying France would stretch across four generations of the Cassini family that remained involved in the role of cartographer until completed. David Turnbull (1996), *Cartography and Science in Early Modern Europe: Mapping the Construction of Knowledge Spaces*. Imago Mundi, v. 48, p. 16.

16 According to this point of view, the extents of France were dictated by the location of Ancient Gaul which placed the Pyrenees, the Rhine and the Alps at the edges of the geographic space occupied by a distinct cultural group (the Gauls).

sovereignty along these geographical features however, defied the complexity of governing these vast natural 'boundaries'. This was reflected in the negotiated legal documents that resulted from conflicts between royal courts in Europe. Signifying the end of hostilities between France and the Hapsburg dynasty, the 1648 Westphalian peace treaty legally confirmed the absolute power of sovereigns over a determined extent of land. Where it came to determining authority over the shared waterways of the Rhine however, the treaty stipulated that:

> *…for the future, the Commerce and Transportation shall be free to the Inhabitants on both sides of the Rhine, and the adjacent Provinces: Above all, the Navigation of the Rhine be free, and none of the Parties shall be permitted to hinder Boats going up, or coming down, detain, stop, or molest them…*[17]

By denying the sovereign states through which the river meandered the right to block trade or impose tolls or taxes, the treatment of the Rhine in the words of the Treaty, presented limits to the monarch's absolute power over geographic space. The 'violation' of absolute sovereignty in the case of the Rhine was due to the importance of the river as a trade route for all riparian users along its length. Considering that laden river barges were usually pulled by draught horses, the area which was being addressed by the Treaty extended beyond the perennial width of the river. The historian Terdje Tvedt argues that where it came to the river forming a boundary, the Treaty underlined the importance of cooperation between states and the "creation of authority structures that were not coterminous with geographical borders".[18] The difference between the rhetoric of the *frontières naturelles* and the autonomous organization of the area adjacent to the Rhine illustrates the practical limitations of conceptualising the boundary in terms of a natural feature. This was not because the river or mountain could not be conceptualised as an edge. Yet such a simplified linear separation of France from her neighbours could not account for the notional space of activity structured on the conventions of regional trade that surrounded the river. The conceptual chasm between the idea of a linear river boundary – as it continued to be portrayed on maps - and the reality of a 'corridor' of riverine activity, highlights the ideological character of the discourse around *frontières naturelles*. Within this framework, the river's role in determining the boundaries of political authority was essentially passive, a rhetorical (one-dimensional) instrument to further the goal of a unified French identity and political nation-building.

Positioned on maps relative to where the boundaries "ought to be" rather than necessarily reflecting the physiognomy of the landscape, mountains and rivers continued to represent the borders of French sovereignty even as cartographic practices evolved. The founding of the *Academie Royale des Sciences* (henceforth the *Academy*) in 1666 and Observatory a few years, sought to rectify an absence of standards related to cartographic projection, surveying and representation. The new astronomical and geodetic techniques introduced to cartographic practice through the Academy, rescaled the disproportionate prominence of rivers, hills or forests presented in provincial maps to fit the boundaries of a national narrative. Nonetheless, maps of France prepared by Cassini's son Jacques, continued to sketch the Alps and Pyrenees as clear, linear limits, incorporating

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17 Tvedt, McIntyre and Woldetsadik (2011), *Sovereignty, the Web of Water and the Myth of Westphalia*. In Tvedt, T., McIntyre, O. and Woldestsadik, T.K. (eds.), *A History of Water, Series 3, Volume 2, Sovereignty and International Water Law*, IB Tauris.

18 *ibid*, p. 7.

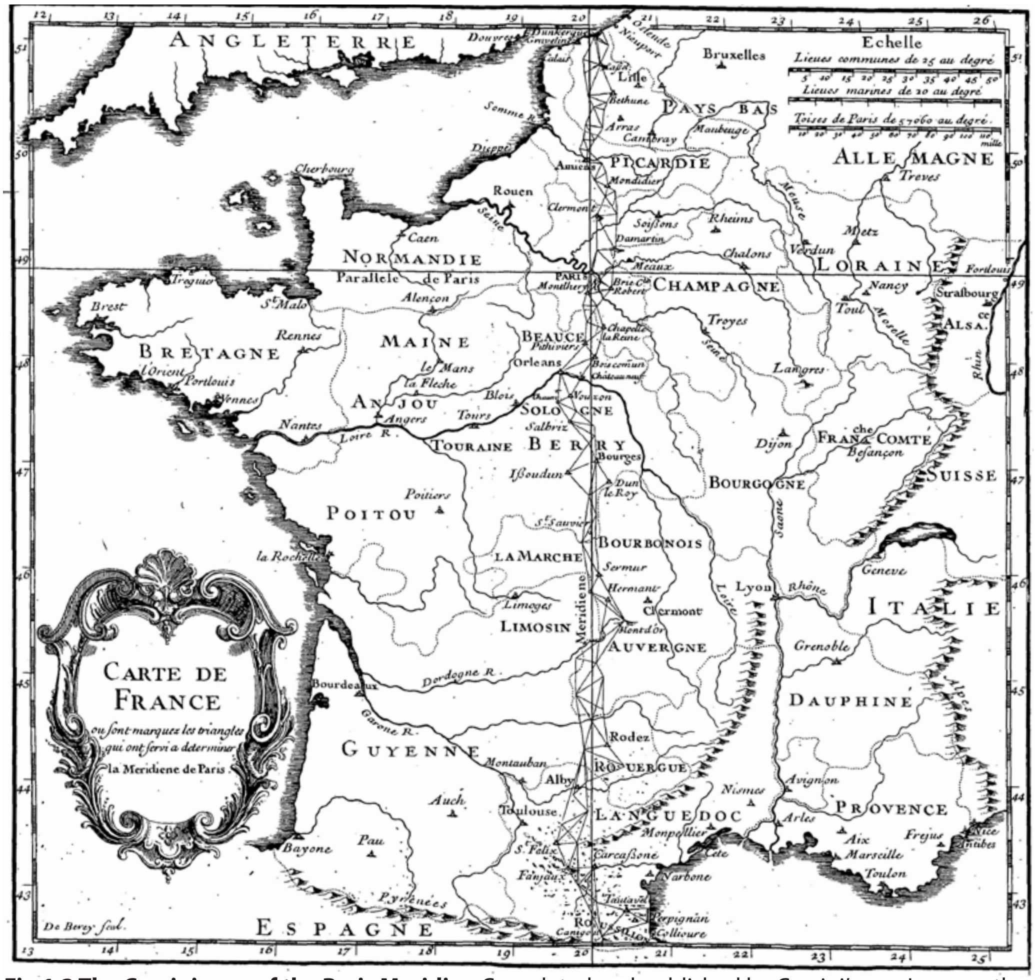

Fig 1.3 The Cassini map of the Paris Meridian Completed and published by Cassini's son Jacques, the map gives physical expression to the boundaries of France. Linear mountains (south and east) and the Rhine (north) are drawn according to the triangulated reference points following the meridien.
Jacques Cassini (1723), *Traité de la grandeur et de la figure de la terre.*

rivers and mountains into the cartographic language used to express the limits of a domain [**Fig 1.3**].[19] The Genevan political philosopher Jean-Jacques Rousseau who idealised society's relationship with nature in his writing, discussed Europe's natural boundaries through this lens:

> *The lie of the mountains, seas, and rivers, which serve as boundaries of the various nations which people it, seems to have fixed forever their number and size. We may fairly say that the political order of the Continent is in some sense the work of nature.*[20]

Rousseau's invocation of a political order as the product of nature, shifted emphasis from a question about the *frontières* to questions about the agency of nature to shape human affairs. From Rousseau's perspective, the relationship

19 The question if natural features, mountains especially, became part of the cartographic conventions to represent boundaries is not clearly answered by Peter Sahlins. Instead he provides evidence from the work of prominent French cartographers of the 17th century, Nicolas Samson and Pierre Duval. Samson's map of the French colonies in America (1656) uses mountains as a graphic device to indicate the limit of French authority. The placement of mountains where none were known to exist would suggest that for these cartographers it was the combination of a lack of knowledge about the terrain they were representing and the need to indicate the boundaries of France which on these occasions "united" with nature. See Sahlins (1990), pp. 1429-1432.

20 Rousseau quoted in Sahlins (1990), p. 1436.

between the terrain and the limits of polities was observable in the mountainous configuration of the Swiss Confederacy. In the generalised condition implied by this statement however, the role of Nature is not that of a passive receptacle of human action. For Rousseau and the other *philosophes*, the environment was active in defining the character of social relationships, and stabilising an imagined harmony with Nature. In this sense, the natural boundary reflected – more than delimited – particular cultural or linguistic specificities, characteristics that for Rousseau could be further elucidated through the study of nature and its aesthetic reception by people. The conflation of natural features with political space on maps, augmented the perception that the two were related. However, the implication that the product of the natural boundary was a political space rather than a geophysical area which is only subsequently given a political dimension, suggests there was limited scope to independently examine the nature to which these boundaries referred.

Theorizing the catchment's cartography

The story of nature related through maps was not always a representation of political narratives. Maps used to record the effects of recurring natural phenomena such as floods, made cartographic practices useful for systematic observation and for the deployment of technological means to mitigate their impact. Drawings of the 1740 Paris flood for example showed the plan of the city along with the land inundated by the river and the cellars in which water had entered. Prepared by the architect and cartographer Philippe Buache, the drawings and the report which accompanied them gave a detailed account of his observations and recommendations based on almost ten years of mapping the river Seine.[21] In addition to recording the location of flood waters, Buache's level surveys of the city's streets in relation to the river, presented the topography beneath Paris and used it to identify the sloped ground which directed water towards the Seine. The drawing named *Second Plan* however goes some way further than simply illustrating the condition of the ground [**Fig 1.4**]. A distinct linear mark that resembles a berm, indicated the limits of the flood in relation to the slope, making apparent an areal relationship that was only possible to imagine through the medium of the map.

As the first member of the Academy to hold the title of Geographer within the newly established scientific discipline, Buache's maps resonated beyond scientific circles.[22] Apart from publishing his research on the Parisian floods, Buache's scientific output included two maps prepared in 1744. These presented the Pacific Ocean and France subdivided according to mountain ranges and river basins respectively. Published eight years later, Buache's *Essai de Géographie Physique* in the prestigious *Mémoires de l'Académie Royale des Sciences*, appeared to synthesize the two maps into a rational geographic theory of the globe's geophysical structure. Accompanied by two new maps, his essay introduced the concept of the

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21 Buache's early architectural education would have made him familiar with the use of drawings to reveal technical relationships as well as to dictate construction. Following completion of his architectural studies in Rome, he apprenticed with the royal cartographer and Academician Delisle, learning to visualise nature through the official language of maps.

22 In one of the earliest geological maps authored by Buache, the scientific visualisation of the underground had political repercussions when it revealed the common substratum shared by rival kingdoms. Michael Heffernan (2014), *Geography and the Paris Academy of Sciences: politics and patronage in early 18th-century France*. Transactions of the Institute of British Geographers, v. 39, n. 1, pp. 62-75.

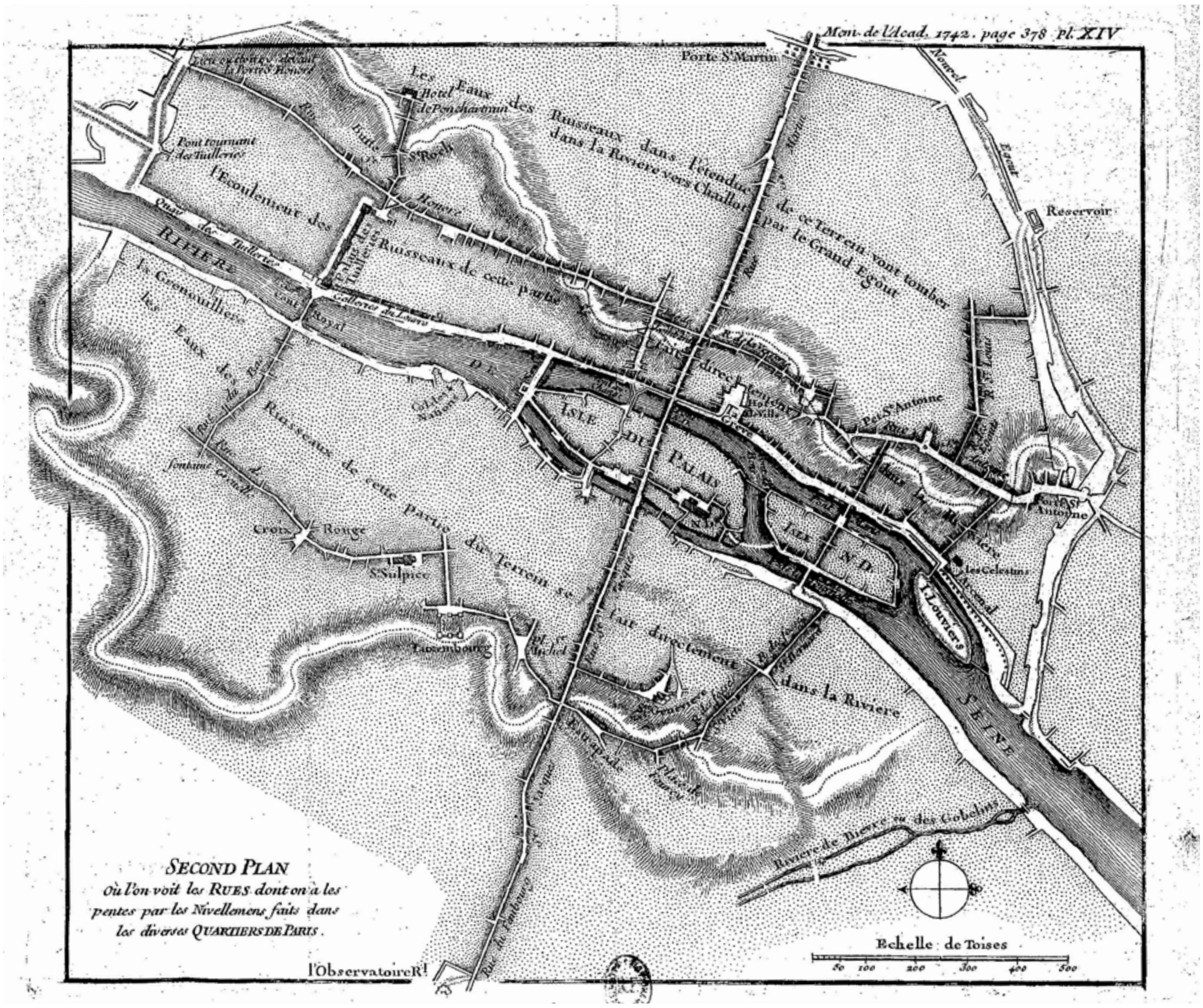

Fig 1.4 Buache's Second Plan Showing the limits of the Paris flood in relation to the city's topography, the grey shaded areas represent the ground sloped towards the river Seine. A linear limit (dotted line within thick white line shaded on either side) between the river and the city's neighbourhoods, marks the area where the flood's impacts were recorded.
Philippe Buache (1742), *Second Plan.* Mémoires de l'Académie Royale des Sciences.

river basin. With almost nothing – as Buache claimed - known about geography below the 50th parallel (of latitude) his maps gave shape to distant, unknown landmasses based on the configuration of rivers and mountains. In the manner of scientific treatises dealing with a new field of knowledge, the text distinguished three categories of rivers and their respective mountains. Rather than size, the hierarchy proposed by Buache relied on the physical disposition between these three types, with the great (*grande*) rivers and mountains forming the 'spines' and the lateral (*moyenne*) and coastal (*de côtes*) mountains the 'branches'. The structured geophysical order that emerged on the map was therefore:

> *...according to the natural division of the Earth Globe [...] with the lands inclined towards each sea, and whose waters, from rivers and streams discharge therein from the chains of mountains, which are like the crest of their basins.*[23]

23 *"Une connoissance plus détaillée pourroit être donnée en trois cartes, qui, selon la division naturelle, du Globe terrestre représenteroient à part, chacune des trois grands mers, avec les terreins inclines vers chaque mer, et dont les eaux des fleuves et rivieres s'y dechargent depuis les chaines de montagnes, qui sont comme la crete de leurs bassins."* Philippe Buache (1752), *Essai de géographie physique.* Mémoires de l'Académie royale des sciences, pp. 407-408.

The conception of the mountain crest as the highest part of an inclined surface that descended to the sea, explained the way "rivers and streams" were part of a new geographic principle called the river basin. Based on the "clues provided by rivers", Buache proceeded to deduce the location of the unknown "chains of mountains" from the location of known rivers.[24] The adherence to the basin as a geographic principle was reflected in the two new maps. On the global scale, mountain ribbons appeared on parts of the maps where mountains would have been known not to exist, such as the range bisecting the Iberian Peninsula. These even extended into the seas to form underwater basins that subdivided the ocean according to an invisible aquatic topography. On the second map focused on the English Channel, the clearly labelled names of the river basins inside France, were presented within the limits of sometimes fictional mountain ranges, such as the one dividing the Loire and Seine basins to the south of Paris [**Fig 1.5**]. However, the novel, planimetric projection of the mountains which gave the surface of the map a sense of relational measure did not distinguish between existing and imaginary topographic elevations.[25] Especially in areas close to Paris where the map's information could be easily verified, the misrepresentation of the terrain's configuration would have been difficult to reconcile with Buache's position as the head of a scientific discipline devoted to improve the accuracy of cartographic depiction.[26]

Fig 1.5 The imaginary topography of catchments Using mountains to signify the hypothetical limits of river basins in France, Buache's map presents a topography that does not distinguish between existing and "imaginary" elevations such as the fictional range dividing the catchments of the Seine and Loire rivers.
Philippe Buache (1752), *Carte Physique et Profil de la Manche.* Mémoires de l'Académie Royale des Sciences.

Buache's *Essai de Géographie* clarified that his intention was to contribute to the field of physical geography, which he distinguished from the political and cultural references of *historical geography* and the technical, theory-laden methods of *mathematical geography*.[27] In his role as Academician, the disciplinary specificity is important. It served to ground his work in the practical knowledge that "can be known simply and as all men use it more or less", and to distinguish it from the Academy's related fields of knowledge such as astronomy.[28] The allusion to a collective sphere of geographic knowledge, presented these maps as the visualisation of a common reality that could be objectively understood. Objectivity in the mid to late 18th century however was not the same epistemic value as it is today. Lorraine Daston and Peter Galison that have examined the historical evolution of objectivity, point out the difference between a later idea of a "morality of self-restraint" and an earlier notion of "truth to nature".[29] This 'nature' however is not a reference to the non-human world. Ernst Cassirer, in his study of Enlightenment thinking suggests that "natural" refers to all knowledge "as long as it springs from human reason and does not rely on other foundations for certainty".[30] This suggests a truth bounded by the comprehension of reality rather than a specific group of objects. Thus, while in the second half of the 19th century, the creation and collection of scientific images went through a process of expunging the curatorial eye of the expert, in Buache's time the role of the scientist was to interpret natural phenomena and explain them through new cognitive types and categories. Evaluating the maps in terms of their objectivity is therefore different from understanding the information they depict as an accurate representation of nature. Faithfulness or truth to nature functioned through the interpretative action of the expert and not as a value-free "view from nowhere". As Daston and Galison argue, this did not mean early scientific work was abandoned to the subjective caprices of the scientist. Rather, the standard ensuring the objectivity of the depiction was the consistency of the scientist's approach towards the primary source of investigation, namely the non-human world. From this perspective, the fictional representation of mountains which resulted from the rigorous application of the theory of basins, was evidence of the author's objectivity and in that sense, a necessary deceit for the maps to maintain their scientific value.

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24 *"...j'ai cru que pour parvenir à cette connoinance, je devois me servir des indices que fournissent les rivières." ibid*, p. 402.

25 The survey map of France published in 1744 by Cassini III, still showed mountains drawn in elevation. Buache on the other hand presents mountains as if drawn in plan, the same viewpoint as rivers and roads. In this way he "breaks" from convention by giving the entire topography a semblance of scalar consistency and by introducing a measurable quality to the extent (and location) of mountains.

26 Some scholars such as Bernard Debarbieux have claimed that Buache did not travel much, implying that his maps were a result of ignorance. On the other hand, Buache is reported to have had ample opportunity to examine existing cartographic knowledge of the areas he depicted, having spent 17 years as an official at the Dépôt de la Marine where the French Navy stored its maps. See George Kish (1976), *Early Thematic Mapping: The Work of Philippe Buache*. Imago Mundi , v. 28, pp. 129-136.

27 Buache (1752), p. 400.

28 *"La Géographie physique ou naturelle peut etre considérée simplement et telle que tous les hommes en font plus ou moins d'usage : c'est alors la connoissance de Ia situation et du sol extérieur des lieux qu'ils habitent , et de ceux qui les environnent" ibid.*

29 Lorraine Daston & Peter Galison (1992), *The Image of Objectivity.* Representations, n. 40, *Special Issue: Seeing Science*, p. 84.

30 Ernst Cassirer (1951/2006), *The Philosophy of the Enlightenment*. Princeton, NJ: Princeton University Press, p. 39

However theoretically credible, the drawings of mountains which acted as much to separate the basins from each other as to provide each river with its own areal limits, posited a possible geophysical configuration that contradicted experience. In the hypothetical world presented on the surface of the map, mountains were not only depictions of natural barriers but also the structural elements for rational geographic conjecture. Buache's use of cartographic methods for speculative purposes was not unique. Cartographers focusing on physical geography, would invariably speculate on the geography of parts of the globe even where their knowledge was non-existent, or as in the case of adherents to the ideology of the *frontières naturelles*, use maps to underpin abstract political arguments. Where Buache's maps differ however, are in their uncompromising deployment of a specific, *scientific* theory even where this appeared to contradict common knowledge. The devotion to the theory of the basin is not limited to how the maps themselves demonstrate a scientific concept related to water. Referring to his proposed framework of mountains in terms of a *système*,[31] indicates that for Buache at least, the interrelationships reflected on the maps were as important as the results they produced. Moreover, his evocation of a natural geophysical order encompassing the entire globe (see earlier quote), suggests that the value of the conceptual basin includes its ability to provide the reference for a scientifically determinable subdivision of the world. By using the basin as the model to configure this subdivision, authorship of the monumental ribbons of elevated ground crossing the map is shared between the perceived agency of nature and the agency of the cartographer to predict nature's underlying patterns.

Perhaps the most famous student of Buache's work on river basins was Alexander von Humboldt. Highly influential to the subsequent study of geography and mountains in particular, Humboldt considered the French cartographer a man of science referencing his maps in his travels through South America. His survey of the Orinoco river basin however challenged the fundamental assumptions in Buache's theory [**Fig 1.6**]. In Humboldt's personal narratives, he noted that in the

Fig 1.6 Carte du cours de Rio Meta Humboldt's maps of the Orinoco focus on the river and its tributaries. Mountains are "cut" by the map frame giving the impression of a broader geographic continuity. Unlike Buache's planetary approach, Humboldt's view of mountains is formed from the materials recorded in his drawings and first-hand observations.
Humboldt & Bonpland (1813/1831), *Voyage de MM. Alexandre de Humboldt et Aime Bonpland. Atlas Geographique et Physique, pour Accompagner la Relation Historique. Sixieme livraison*, Paris, Londres: Imprimerie de J. Smith.

low-lying landscape of the New World “small risings of counter-slopes” occurred more frequently than monumental chains of mountains.[32] His criticism, aimed towards the inaccuracy of Buache’s deductions, was particularly directed at the foundational principle of ‘containing’ the basin between two ridge-lines. This idea clashed with the experience of the Orinoco River's delta where the confluences of rivers and streams, flowing from multiple directions, intertwined to make the distinction between basins impossible and perhaps meaningless. Reflecting on these differences he remarked that:

> *...it is a false application of the principles of hydrography, when geographers attempt to determine the chains of mountains in countries of which they suppose they know the course of the rivers.*[33]

This would appear to lay the responsibility for the mistaken location of mountains on the limited knowledge of distant rivers from which the basin was deduced. But following his own fieldwork in the area, Humboldt observed that the use of theoretical ideas to construct physical maps was problematic in general. The most interesting part of this critique, was the identification of where the problem had originated. Looking closely at the assumptions governing the delineation of the basin, Humboldt clarified that these were based on the ‘enclosed’ valley, a model inspired by the European Alpine landscape that had little resemblance with the environments he was examining. In contrast to the theories of European ‘arm-chair’ geographers, Humboldt’s own cartographic work aspired towards a “truth to nature” based on close personal observation and direct experience. Mountains, which for Buache formed a geophysical division of global dimensions, were for Humboldt a specific type of landscape to be studied, and not a substitute for an edge or the limit of a natural phenomenon. Buache’s theory was therefore useful only in so far as it indicated where mountains were located and less so with regard to describing a universal principle of hydrology. But where the theory of the basin failed to resonate with the actual experience of nature, its suggestion of a primordial subdivision of the Earth was met with far greater interest, especially among the growing community of scientists calling themselves geographers.

Even before the establishment of the Academy, geographic knowledge corresponded with the information displayed on maps. The way cartographers organized the world into political divisions was also the way to study and teach geography in the universities and royal courts of 18th century Europe. The

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31 See Isabelle Laboulais (2006), *Les systèmes : Un enjeu épistémologique de la géographie des lumières*. Revue d’histoire des sciences, v. 59, pp. 97-125. Buache himself noted the articulation of a *système* on his maps.

32 Humboldt writes: "*Accustomed to consider the rivers of Europe only in that part of their course where they are contained between two lines of ridges [lignes de faites], consequently enclosed in valleys; and forgetting, that the obstacles which inflect both the tributary streams and principal recipients are less frequently chains of mountains, than small risings of counter-slopes; we find a difficulty in conceiving the simultaneous existence of these windings, these bifurcations, these communications of rivers in the New World*." Alexander von Humboldt 1814-1829 (1827), *Personal narratives of Travel to the Equinoctial Regions of the New Continent during the years 1799-1804 by A. de Humboldt and Aimé Bonpland with maps and plans*. London, Longman, translated by H.M. Williams. 2nd Edition. 7 Volumes. London: Longman, Hurst, Rees, Orme and Brown. Volume 5. p. 450. The differences between Humboldt and Buache's ideas are presented in detailed arguments by Bernard Debarbieux in *Mountains Between Corporal Experience And Pure Rationality: Buache And Von Humboldt’s Contradictory Theories*, in Denis Cosgrove & Veronica della Dora (eds.)(2008), *High Place Cultural Geographies of Mountains and Ice*, I.B.Taurus.

33 Alexander von Humboldt (1811), *Essai politique sur le royaume de la nouvelle Espagne.* Paris, F. Schoell. Quoted from Bernard Debarbieux, *The various figures of Mountains in Humboldt’s Science and Rhetoric*. Cybergeo : European Journal of Geography, Epistemology, History, Teaching, doc 618 (Online since 21 August 2012).

elevation of geography in 1730 as a new branch of science within the Academy's carefully defined categories of knowledge created the need for an epistemically structured approach to the subject.[34] Yet unlike anatomy or astronomy that could assuredly affirm the human body or the star as the unit of research, geographers had yet to establish what Daston and Galison call their *working object*. In its role as an epistemic unit, the *working object* of geography would need to distinguish the object of study from all other possible natural objects and phenomena as well as function as the area from which theories are formed and to which they are applied.[35] As the representative of the science of Geography within the Academy, Buache's public role made him at least partially responsible for the formulation of the epistemic unit. Invariably however, this required consensus of which phenomena, out of all other perceivable transformations in the physical and social environment, were considered important enough to inform the constitution of the *working object*'s area. According to Hartshorne, one of the few areas of agreement was the doubt surrounding the use of political boundaries to constitute the unit of study. The speed by which jurisdictions changed as a result of wars or alliances, and the indefinite relationship of borders with other historical, cultural or even geophysical relationships, motivated geographers to look elsewhere for their scientific frame. The limits of basins that appeared on Buache's maps were therefore more than a theory of geophysical relationships. For geographers and quite possibly Buache himself, they reflected the potential for a naturally delineated unit on which to base geographic study that would replace the ephemerality of political borders.

But although rivers themselves were intimately connected with the human settlements in their proximity, the geographic space encompassed by the basin often extended to include distant inaccessible terrains, linked to each other only by the notional flows of water depicted on maps. As such, while the basin provided a scientific theory for geospatial subdivision, as an areal unit for the study of human relationships it had limited resonance.[36] For Carl Ritter, the technical basis for the delineation of the basin was considered too simplistic to be acceptable as the common unit for the study of geography. His alternative to the basin, the *region*, was expressly based on the belief that the areal dimension of natural and social phenomena coalesced into distinguishable 'organic' unities.[37] His inclusion of rivers - as well as basins - among the instruments which delineated regions, confirmed the importance he assigned to the relationship between the social and natural environment. Nonetheless, the idea that the region's outline would form a permanent areal standard had less to do with how cultural ideas or historical facts appeared to transform in relation to a fixed geographic space, as it did with where some part of these social qualities was perceived to be spatially concentrated. If the articulation of the region specified the domain of phenomena worthy of study on the one hand, on the other it also functioned as the reference

34 The cartographer Guillaume Delisle, Buache's mentor and teacher to the king, successfully lobbied for the creation of the new Academic chair alongside astronomy, geometry, mechanics and anatomy, botany, chemistry. Created specifically with Buache in mind, the political background leading to the creation of a new institutional branch of science is covered by Heffernan (2012).

35 Daston & Galison (1992), p. 85.

36 Richard Hartshorne (1939/ 1951), *The nature of geography: a critical survey of current thought in the light of the past.* Lancaster, PA: The Association of American Geographers, p. 39. Hartshorne devotes a considerable portion of his book on natural boundaries and the conception of the *concrete whole* in the evolution of scientific geography, approaching the subject mainly from the works of German geographers.

37 *ibid*, p. 67.

from which to analyse those same phenomena. In this sense, the epistemic act of formulating the boundaries *of* the region was also a hypothesis *about* the region, an argument validated through the consistency of the narratives that structured its internal coherence. Since objectivity was relative to the persuasive arguments and credentials of the geographer, this conundrum revealed the subjective hand of geographers in shaping how the scientific *working object* was conceived.

The determination of the region had one further intellectual consequence. In separating one part of the surface of the earth from all others it raised, once more, the question of how that part was related to the whole. Was it an autonomous fragment as Buache's deterministic logic had implied or an interdependent component? As Hartshorne explains, for Ritter the earth as a whole was an "organism", with the continents and smaller regions related as organs would be to a body.[38] This organic analogy however does not help, since as Hartshorne's lengthy argument in *The Nature of Geography* illustrates, what "organism" implied for different geographers was as elusive as determining a commonly acceptable *working object.* Yet, the difference between a part deduced from an idea of the whole, and a whole inferred from an analysis of the part is important. According to Cassirer the "truth of nature" was not demonstrable through the deterministic processes of deductive or mathematical reasoning which follow almost as proofs of a preconceived structure of relationships, but could only be surmised from analysis of the part.[39] Seen from the perspective that an ultimate, objective "truth" was at stake in the scientific examinations of the Enlightenment, Buache's work was compromised by his belief in an existing global structure from which the part is derived. But while his maps' focus is on the location of mountains what is presented is nonetheless a *système* that relies on basins – the existence of mountains being so inexorably linked to the existence of rivers, that one cannot make sense on the map without the other.

Conclusion

Buache's theory of the basin had a basis in the hydrological ideas developed by Perrault and Mariotte. But where the two hydrologists deduced the quantity of water from the hypothetical catchment, Buache deduced the shape of the basin from the magnitude of the river. Geography, responsible for the study of the earth and distinguishable from mere cartography, was the science best equipped to speculate on these issues. Employing cartographic methods to communicate the geographic theory of global subdivision, suggests that the maps accompanying Buache's thesis were themselves tools or instruments of the argument, pictorial evidence of the theory's reflection of the "truth". For those inspired by this vision of reality, the accuracy of the maps' depiction of mountains was less important than the greater "truth" of a world neatly subdivided by natural forces. The epistemic arguments around partitioning the earth's surface, reinforced the idea that what accounted for the integrity of the part was its place within a greater whole.

Ultimately however, the configuration of any regional 'object' distinguished in this way, would always be contingent on the geographer's ability to convincingly

38 *ibid*, p. 256.

39 Cassirer's study of Enlightenment nature and natural science, draws out the contrasts between the Cartesian deductive thinking derived from 'first principles' and Newtonian inductive reasoning that accounted for phenomena on "the sole basis of the observable facts and general principles of natural science". Cassirer (1951/2006), p. 49.

Fig 1.7 Reference map of East Asia from Carl Ritter's *Erikunde* The map is divided into the regions that are referenced by the different chapters of Ritter's geographic descriptions of East Asia.
Heinrich Mahlmann (1844), *Register Karte zu Carl Ritters Erikunde II, Buch, theil II-VI. Ost-Asien.*

construct a narrative of internal coherence. As Peter Galison has pointed out, the way *working objects* were depicted tells us much about the scientific world, but what constitutes the standards of "right" depiction tells us more about the scientists involved.[40] Thus, if the map of the basin mirrored any "truth", it was not the agency of mountains and rivers to divide the globe into discernible units. Rather, it reflected the human need to perceive the distant, unknown and uncharted parts of the world according to what was already known. From this angle, the geography of other continents became categorised according the classificatory registers first observed and confirmed within the European scientific tradition. With very limited first-hand experience of these places,

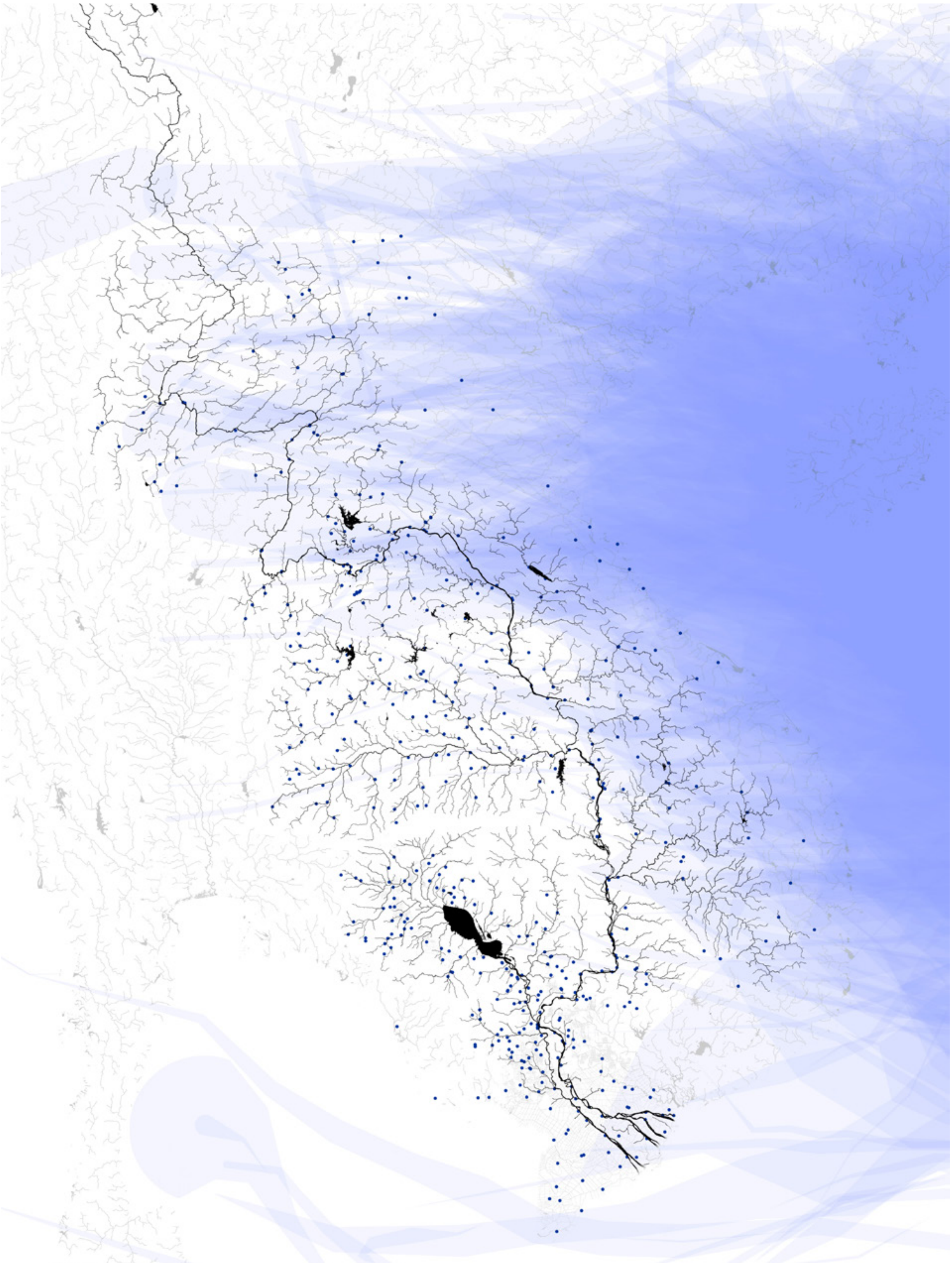
40 Peter Galison (2010), *The Objective Image, Inaugural Address for Treaty of Utrecht Chair at Utrecht University.* Universiteit Utrecht, Faculteit Geesteswetenschappen, p.30.

Africa, the Americas and Asia became knowable through the subdivision of the regional *working object*. Thus, for Ritter, the rational scientific presentation of history, society and nature became entwined with what the region included and excluded, making little-known areas such as the Mekong River, present within a global geographic discourse. Yet between the comfort of writing about places on the other side of the world to how that written knowledge was instrumentalised on the ground, the distance was surprisingly short. As European geographers explicated their understanding of Southeast Asia's rarely visited hinterlands through maps and texts, the impression they created was of a place familiar and simultaneously unknown.

PART ONE

BASIN

Following a course that descends from the Tibetan Plateau to reach the coastal lowlands of the East Sea, the mainstream of the Mekong River collects the water flowing from melting glaciers, forested mountain valleys and densely inhabited plains. The countless rivers and streams which merge to form the Mekong are the source of water for groups of people speaking multiple languages that can live thousands of kilometres away from each other. Included in the jurisdictions of separate national, social and political groups, the geographic space encompassed by these flows has been drawn on maps numerous times in different periods. The majority have focused the cartographic frame on the most densely populated sections, part of the contested historical domains of Siam, Vietnam, Cambodia and multiple semi-autonomous polities. Since the violent start of European colonisation, this space has been defined as the river's *basin*. Suggesting a single region unified by the flows of the river, maps of the hydrological catchment area have described a particular way of seeing the geography of Southeast Asia. If over time, the basin's limits have been refined according to improvements in cartography, the terms of this unification have changed, but not only according to the evolution of scientific hydrology. The development of new techniques for regulating surface water as well as the conflict over the sovereignty of the terrestrial surface encompassed by the basin, suggest different premises for cartographers to consider the catchment's extent. Discussing the depiction of the Mekong's basin on maps is therefore not only a question of representing the behaviour of water. Taking into account that maps of the Mekong River have also reflected the predominant technical, social and political narratives in the periods they were drawn, what land, domain or infrastructure is being unified by delineating the catchment's area is equally important.



Map A The map shows the flows of the Mekong River which drain *into* the mainstream (black). Blue dots represent the location of the 400+ rainfall gauges used by the Mekong River Commission to measure precipitation and to estimate the water volume flowing into the river system. The blue shade shows the paths of major tropical cyclones. The uneven distribution of gauges and their absence from the areas affected by wet season weather events suggests the lack of hydrological information for significant parts of the river basin.
Author (2022). Spatial data sources: *World water bodies (ESRI, 2014); Rivers of South and East Asia (FAO, 2014); Archive of Global Tropical Cyclone Tracks (OCHA, 2019); Rainfall data (MRC, 2005).*

CHAPTER 2 A plan for water

People mingle with people like streams with streams, rivers with rivers; sooner or later they will form a single nation, just as all the waters of the same basin end up merging into a single river.

Histoire d'un ruisseau, Élisée Reclus, 1869

If the area enclosed between two mountains and bisected by a river might have appeared as a catchment to an engineer or a hydrologist, then for many geographers the same area was more commonly identified as a *valley*.[1] Prominent in the toponymy of numerous places within continental Europe, valleys also featured in the European names of geographic areas in Africa and Asia. From narrow Alpine openings to the vast riparian lands included within historical landscapes such as the "Nile Valley", the types of geographic space denominated by the valley varied widely. Drawn by Francis Garnier, the most important map of the Mekong in the 19th century was prepared after an arduous surveying journey in the *vallée du Mekong.* A military officer that participated in the invasion and colonization of Southeast Asia on behalf of the French Empire, Garnier's maps of the river did not only focus on the hydrography of the Mekong. Imagining a river valley of great wealth, mapped projections of mountains located far beyond the mainstream suggested the geography of Southeast Asia's hinterlands was a function of sovereignty. Denoted by cartographic boundaries, the European conceptualisation of authority over geographic space contrasted with the unbounded dominion of kings depicted by Siamese and Vietnamese map-makers. Noting the sometimes subtle alterations of the geographic features represented on maps to respond to questions of authority, the chapter argues that the basin indicated on maps became equated with the areal unit of political control.

The geography of authority

European colonization of the Southeast Asia peninsula begun with the British invasion of Burma (today's Myanmar) in 1824. Situated along the trade route between British-ruled India and Qing-dynasty China, British embassies to the Burmese royal court had been regular since the late 18th century. With a long tradition in producing maps, the Burmese were interested in the new ways of cartographic representation on European maps. Conversely, in the journals of ambassador Francis Hamilton, Burmese maps were viewed as fascinating

1 Humboldt, who had noticed the Eurocentric bias of relying on the geomorphology of the valley to delineate river catchments, did not hesitate to characterise as *valleys* a wider geographic space related to rivers, reserving the term *basin* for more technical relationships between slope and water flow. The geophysical basis for considering valleys, featured prominently in Carl Ritter's influential textbook *Comparative Geography*. There, along with fissures, chasms and abysses, the *valley* described one feature of a broader category of geographic phenomena known as mountains and used as an alternative for river basins. Carl Ritter (1865), *Comparative Geography, translated for the use of schools and colleges by William L. Gage*, Philadelphia: J.B. Lippincott & Co, p. 90 and p. 105.

cultural artifacts but inaccurate portrayals of the peninsula's geography.[2] This was especially the case for maps showing Burma in relation to neighbouring kingdoms [**Fig 2.1**]. Of the Burmese maps reproduced and published by Hamilton, those depicting what lay eastwards of the Salween river showed the Mekong disproportionately shorter than waterways within Burma and far closer to Rangoon than British cartographers estimated. Yet first-hand knowledge of these far-away places would have been extraordinary for any single Burmese cartographer. The inclusion of the Mekong or the even more distant Country of the Kiokachin Shan (Cochin China) within the map, show that geographic knowledge in pre-colonial Burma was collected and compiled, probably from multiple sources.[3] In a period where geographic knowledge could reveal new trade routes, especially to the vast lands ruled from Beijing, rival European merchants competed for information about hinterland polities and terrains. Despite their divergence from the coastal observations made by sailors, from the European perspective local maps were valuable sources of knowledge. Multiple local maps, navigation charts, accounts from personal visits and the intelligence gathered through Ambassadors were therefore necessary to compile the most accurate European maps of Southeast Asia.

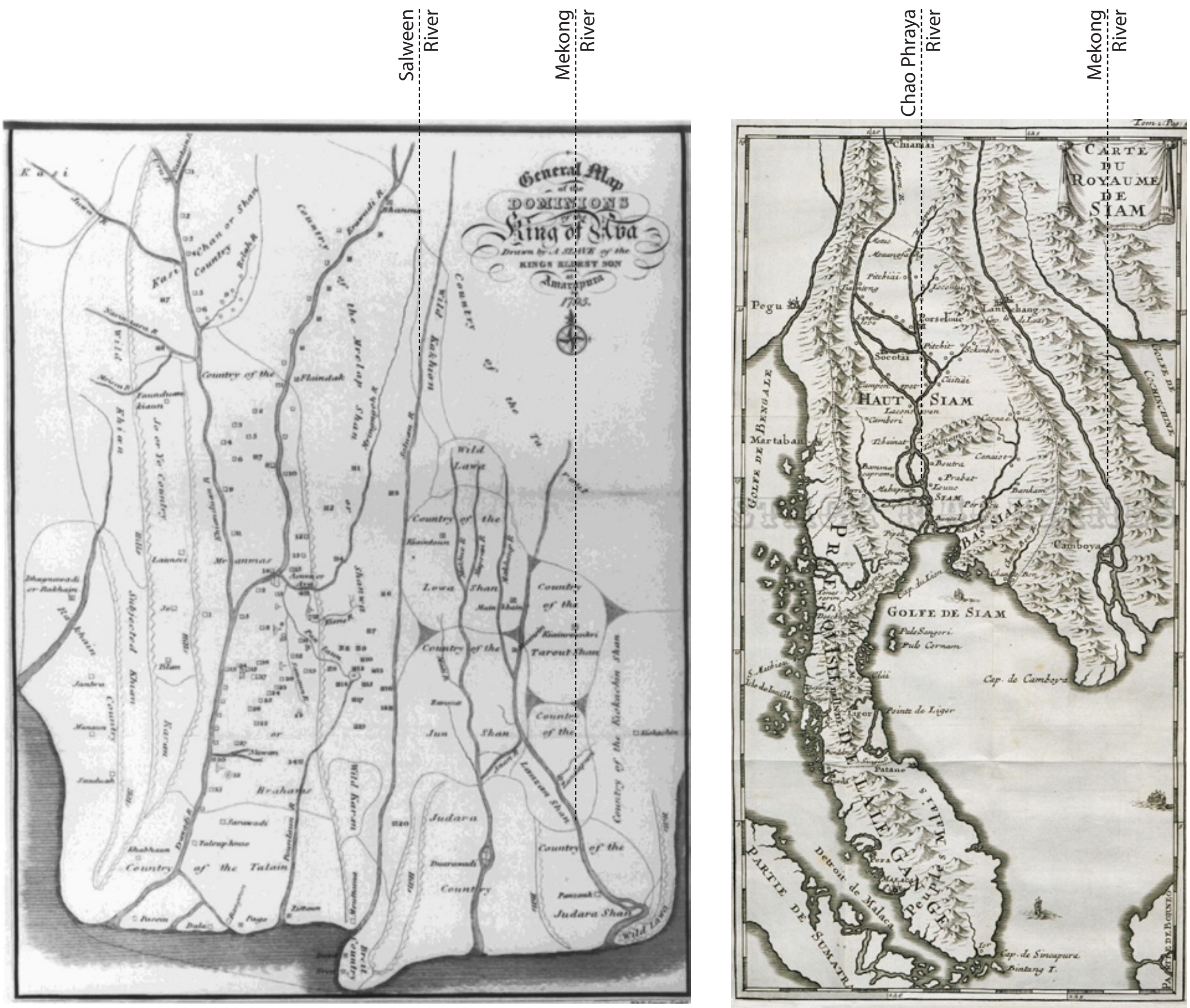


Fig 2.1 Cartographic views of Southeast Asia The Burmese map (left) shows the Mekong flowing towards the bottom right corner of the map, dwarfed by the rivers within the kingdom of Ava. To the right La Loubère's map of Siam shows the route of the Mekong aligned with the adjacent mountains ranges.
Francis Hamilton (1820), *"An Account of a Map of the Countries Subject to the King of Ava, Drawn by a Slave of the King's Eldest Son," Edinburgh Philosophical Journal, v 2, pl. X;* La Loubère (1693), p. 6.

The result of one of these syntheses from multiple sources was the map of Siam prepared by the cartographic office of John and Charles Walker on behalf of the British Ambassador John Crawfurd. Published in 1828 as an inset to Crawfurd's account of his ambassadorship, it was considered the most accurate representation of the peninsula during that period [**Fig 2.2**].[4] Relying on sources collected by Crawfurd during his ambassadorship to the kingdom, the Walkers' depiction of Southeast Asia's hinterlands was also based on Francis Hamilton's Burmese depictions as well as a much older map by the French Ambassador to Siam, Simon de La Loubère.[5] La Loubère, who had compiled and published a celebrated written account of his three-month stay in the country, claimed that:

> ...[foreign visitors] *know almost nothing of the Inland Country, because the Siamese have not made a Map of their Country, or at least know how to keep it secret.*[6]

His own map was informed by travelling up the Menam (Chao Phraya) River. By his own admission however, the accuracy of the drawing was far from satisfactory having visited only a small part of the country and seemingly without referencing any local map. According to his account, on his return to France La Loubère delivered his drawing to the royal cartographer Jean- Dominique Cassini, presumably to improve the map with supplementary notes before publication. La Loubère's text did not indicate what these notes may have been, but his impression of Siam's extent was clarified early on when he exclaimed (in the margin) "The Country of Siam is only a Valley". And although he described Siam's boundaries to the east and west as reaching ranges of mountains, how far these were located from the river was not related. Modified by Cassini according to the cartographic conventions he himself had helped establish through the Academy, the published map depicted the Southeast Asia peninsula structured by linear mountain ranges, that aligned perfectly with the dotted line denoting the limits of the kingdom.[7] On the map, Siam itself was presented almost like Buache would later design his map of river basins, with the Chao Phraya river as a central spine, whose outermost branches touched an enclosing wall of mountains to the east and west [**Fig 2.1**]. Using mountains to indicate the limits of countries where the geography was unknown, the cartographic tropes of the *frontières naturelles* gave Siam an illusory physical presence on the map that resembled the civilised, "naturally" delimited kingdoms of Europe.

With source maps already distorted either by the French or the Burmese perspective, it was left up to the cartographer to determine how these materials could construct the visual representation of inland areas that could not be visually verified by sailing along the coast. In its final iteration, Walker's map included the north-south linear mountains from La Loubère's publication, repositioned according to a new cartographic system of global coordinates and the carefully

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2 Joseph E. Schwartzberg (1995a), *Southeast Asian Geographical Maps*, in J.B. Harley and David Woodward, *The History of Cartography, v 2, book 2: Cartography in the Traditional East and Southeast Asian Societies*, Chicago: University of Chicago Press, p. 745.

3 *ibid*, p. 747.

4 Larry Sternstein (1993), T*he London Company's Envoys Plot Siam*, The Journal of the Siam Society v 81, n 2, p. 53.

5 *ibid.*

6 Simon de La Loubère (1693), *A new historical relation of the kingdom of Siam*, London: Printed by F.L. for Tho. Horne, Francis Saunders, and Tho. Bennet, p.3. See also Ronald S. Love (1994), *French Views of Siam in the 1680s.* Journal of the Siam Society, v. 82, n. 2.

Fig 2.2 John Walker's 1828 map of Siam and Cochin China Extolled for its accurate portrayal of the coastline and especially the Gulf of Siam, this was considered the most authoritative map of the Southeast Asia peninsula for decades. Originally published in John Crawfurd (1830), *Journal of an embassy from the governor-general of India to the courts of Siam and Cochin China. 2 vols*, London: H. Colburn & R. Bentley.

delineated coastal edge. Main rivers and their branches - the Chao Phraya, Mekong and Irrawaddy - appeared framed by mountain ranges all the way from their estuaries to their sources in the distant north. To this depiction of Southeast Asia's topography, Walker added further detail of neighbouring kingdoms including Cambodia and the coastal country of Cochin China. Like Siam, these kingdoms also appeared to be confined within areas separated from each other by the planimetric projections of mountain ranges framing the rivers. First translated into English six years earlier, Humboldt's warnings regarding the Eurocentric biases of the theory of the basin, were either unknown to Walker or, convinced by the reality of Cassini's mountainous frontier, simply ignored. However inadvertently, the reproduction of the conventions of *frontières naturelles* reintroduced the politics of topography into a new generation of mapping practices that had promised increased accuracy.

The view from the valley

For the French, the map's presentation of the Mekong as a navigable corridor, provided further evidence of a long-theorised link between the river's estuary and China. The lands through which the river meandered however remained beyond the first-hand experience of European cartographers. Confined to the mountainous 'bowl' bisected by the Chao Phraya, the European image of Siam did not reflect the different types of authority exercised by the Siamese crown beyond this imaginary delineation.[8] Unlike the absolute sovereignty of European states over a delineated national space, the Siamese overlordship over multiple smaller kingdoms and tiny chiefdoms was often shared with other powerful kingdoms such as Burma or Vietnam.[9] This included the kingdom of Cambodia which paid tribute to both Siam and Vietnam. The condition of multiple sovereignty, through which local chiefs paid annual tribute to two or three overlords, meant that the authority of the region's powerful kingdoms often overlapped. Any mapped boundary indicating the absolute limits of sovereignty was therefore not compatible with the actual political situation along the Mekong's riparian areas.

From the perspective of the region's inhabitants, the spatial dimension of the state's power was conceptualised on different values. A map considered the oldest non-cosmographic cartographic depiction of Siamese origin presents the strategic terrain adjacent to Mekong [**Fig 2.3**].[10] The so-called *Military map from the reign of King Ramathibodi I*, was constructed during the reign of King Rama (1782-1809) and a copy subsequently reused in 1827 to transcribe military information regarding the disposition of troops fighting the principality of Vientiane in today's Laos. Framed between the thick band of black ink representing the Mekong river to right and the pictorial bifurcations of the Chao Phraya river to the left, the Khorat Plateau on which the map focuses, is rendered with key natural features and important settlements are presented in terms of their military strength. Roads as well as river routes are labelled in terms of travel time between destinations

7 Without La Loubère's original, the extent of Cassini's modifications is impossible to discern. Considering the author's first-hand knowledge was limited to travelling along the river, the eminent director of the Observatory may have been confronted with a mostly empty map surface and scant information to make improvements.

8 Nor did it reflect the possibility that, since La Loubère's time, the borders of Siam may have changed. It's as if the permanence of mountains made the kingdom itself unchangeable in the European imagination.

9 Thongchai Winichakul (1994), *Siam Mapped: A History of the Geo-Body of a Nation*, Honolulu: University of Hawaii Press, pp. 30-31.

10 In Walker's version, the area the map refers to was inadvertently separated from the "country of Siam" by the mostly imaginary mountain range separating the flows of the Chao Phraya from those of the Mekong.

Fig 2.3 Military map of Siam from the reign of King Ramathibodi I The Mekong frames the geographic space to the right, and the branches of the Chao Phraya to the left. Ayutthaya, the old capital of Siam is located on the island at the bottom left. Vientiene, the current capital of Laos, is shown as a fortified town, north of the Mekong.
From Schwartzberg (1995), p.764.

which nonetheless does not appear to affect how the distance separating destinations is portrayed. Contemporary analysis of this map has pointed out the inconsistency in the detail of its geographic depiction. Scholars have especially focused on the proportional differences within the map's cartographic frame which becomes increasingly compressed in areas closer to the Mekong.[11] These variations in the level of detail and spatial proportion within the same map have been explained in terms of their importance to the military campaign: the highest level of detail and accuracy reserved for areas of primary strategic value.[12] As the Thai scholar Thongchai Winichakul has argued, the map's lack of religious symbolism suggests the intention to represent a "piece of the earth's surface" rather than a cosmological relationship.[13] Nonetheless, it is drawn without any reference to where or how it is situated in relation to other kingdoms or indeed

11 This is pointed out by Schwartzberg's brief analysis of this map which along with Winichakul's are both based on Victor Kennedy's 1970 examination. Schwartzberg (1995a), p. 763.

12 A lack of other maps to compare with, makes it impossible to confirm if this scalar differentiation was a deliberate representational technique within Siam's now lost cartographic tradition, or a one-off depiction that balanced between different levels of geographic knowledge.

13 Winichakul (1994), pp. 30-31.

Fig 2.4 Panels from the Traiphum (Story of three worlds) Prepared during Siam's Thonburi period (1767-1782), Schwartzberg describes these maps as belonging to the realm of sacred myth which gradually merge into the physical world as known to Thais, within the same cartographic space.
Triphum Photo Book(1999) , Krungsri Ayudhya - Krung Thonburi Edition, Volume 2, Fine Arts Department publications.

any broader concept of global geographic space. Based on his examination of this map within Thailand's historical cartographic tradition, Winichakul concludes that in the Siamese world view, local and global geography were classified under separate categories of knowledge about space, analogous with the difference between modern geography and astronomy.

But while it is difficult to conceive what this difference entailed based purely on abstract concepts such as scale, what is clear is that different spatial conceptions were reflected in parallel cartographic practices. On 'local' maps such as the portrayal of the Khorat Plateau, the knowledge presented was useful for military operations, administrative works or trade. Intimately linked with human activity, the geographic space presented on that "piece of the earth's surface" would correspond with the areas claimed by the Siamese crown. When imagining neighbouring or distant kingdoms however, Winichakul hypothesises that a different spatial conception was triggered. Based admittedly on limited evidence, he argues that maps such as the Traiphum displayed the relationship of Siam to other kingdoms according to the "orderly relations of sacred entities" rather than geographic space [**Fig 2.4**].[14] Consequently, if "sacred entities" were absent from the lands portrayed on the military map, it would preclude this area from attaining cosmological significance. But would this have meant that the Khorat Plateau - and perhaps other similar areas where sovereignty was shared - were registered only as part of a 'local' category of space? In other words, was the "realm" of the cosmological kingdom able to incorporate, pictographically at least, the changes taking place on the earthly kingdom? Considering one was the product of an elite class of rulers and the other a representation of geographic space through cultural and religious values, any correspondence between the two categories would not have been immediate. The adoption of European concepts of geography by the Siamese court in the second quarter of the 19th century therefore primarily affected what was considered 'local' space. The process of integrating European cartographic practices required the Siamese cartographer to reconcile the sacred reality of the cosmological perspective with the view that Siam was only one part of a larger global whole.

14 *ibid*, pp. 33-34.

A natural commons

The delineation of the mountainous boundaries in Walker's map may have been a product of European attempts to portray Siam's political configuration. Yet even without reliable first-hand information or maps from which to draw the vast hinterlands of Southeast Asia, the courses of the region's major rivers like the Mekong were all depicted lying almost equidistant between the mountainous boundaries. While the location of rivers on the map could have been a result of the cartographer's aesthetic decisions when confronted with a blank canvas which had to be filled, the delineation of their courses in relation to the mountains also suggests that the cartographer was depicting a specific geographic relationship. In the European context the understanding of this relationship evolved in two distinct trajectories: one based on engineering water flows and one which saw the basin as an opportunity for decentralising political power.

The engineering trajectory was underpinned by updated knowledge of the river basin's hydrology. At the end of the 18th century, the English polymath John Dalton confirmed the calculability of the *water balance* within distinct catchment areas [**Fig 2.5**]. Relying on maps to distinguish between the catchments of different river systems, Dalton's calculations accounted for the sources of a river's water from precipitation and dew, and the losses from evaporation.[15] The condition of the ground was critical to these estimations.

> *Upon looking on the surface of any country, three principal varieties of surface present themselves to view, as far as respects evaporation, namely water, ground covered with grass and other vegetables and bare soil...*[16]

With different surfaces giving distinct answers to the quantity of evaporation, such generalisations of the properties of the ground allowed Dalton to calculate the relationship between inflow and outflow in respective catchments as a ratio. Thus knowing how run-off and evaporation contributed to the Thames' hydrology allowed Dalton to estimate the water balance in other catchments.[17] The generalised properties of the area encompassed by catchments developed by Dalton became increasingly important for engineers working with water. In France, proposals for new canals that would allow laden barges to travel across the country were crystallised in the Plan Becquey that would inform the construction of new waterways for the next three decades.[18] Evoking the *principle of association* (*l'esprit d'association*), Becquey addressed the willingness of individuals to invest in water projects through entities called "companies".[19]

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15 John Dalton's significant contribution to the science of hydrology is outlined by historian John Dooge. Dalton based his calculation on Halley's century-old estimations of the Thames river's runoff but was careful in specifying the extent of geographic space that runoff was derived from. John Dooge (1974), *The Development Of Hydrological Concepts In Britain And Ireland Between 1674 And 1874*, Hydrological Sciences Journal, v. 19, n. 3, pp. 287-292.

16 Dalton (1799) quoted in Dooge (1974), p. 291.

17 According to Dooge, Dalton relied on observations and measurements of the Thames by other scientists for his calculations. His geographic subdivision of England and Wales into seven districts took into account the slopes of river systems and allowed him to calculate the surface run-offs of other districts as a proportion of the Thames' better known catchment.

18 In charge of the Bureau of Bridges and Road (*Ponts et Chaussées*), François-Louis Becquey successfully campaigned to adopt a nationwide plan to improve France's waterways. Reed Geiger (1984), *Planning the French Canals: The "Becquey Plan" of 1820-1822,* The Journal of Economic History, v. 44, n. 2, *The Tasks of Economic History,* p. 332.

19 A concept that was adopted and propagated by Saint-Simonians, the *principle of association* reflected faith in the power of industrialists to improve social conditions through technical means, looking to Great Britain for the (...)

Fig 2.5 Regional constructs To the left, Dalton's geographic subdivision of England and Wales into seven districts allowed him to calculate the *water balance* in other catchments with reference to the hydrology of the Thames. Above, a page from a French atlas depicting the Seine's basin with its notional centre located around the economic centre of Paris.
John Dalton (1799), *Experiments and observations to determine [...]*, Memoirs of the Literary and Philosophical Society of Manchester, v.5, part 1, p. 357.; Drioux & Leroy (1886), *Bassin de la Seine*, in *Atlas Universel Et Classique*; Paris: Eugene Belin & Fils.

While only theoretical, a plan to harness *association* for the organization of the relationship between waterways and human activity was compiled by Thomé de Gamond. Trained in engineering in the Netherlands, Gamond's plan had been presented in 1832 to government ministers and the state bureaucrats responsible for public works, but had lacked appeal since private companies in charge of infrastructure had not yet adequately developed in France.[20] Later considered visionary for his proposal to tunnel under the English Channel, Gamond's plan sought to capitalise on France's natural topography to restructure the irregular and fragmented waterways for multiple purposes that included household use, irrigation, navigation and generating motor force.[21] To achieve this restructuring, France's waterways would need to be modified into *hydraulic staircases* (*escalier hydraulique*) according to the inclined slope followed by surface water on its journey towards he sea.[22] But although, as he acknowledged, France was possessed of nine natural hydrographic catchments, to enable exploitation of the proposed system his plan combined existing catchments together, reducing them into five "basins" each administered separately by private or public companies

19 (...) model to privately organize capital. Although the theme of *association* was not born from Saint-Simonian religious technocracy, according to Ferraton, the concept became popular after Saint Simon's death in 1825 but started losing appeal after 1832. See Cyrille Ferraton (2007), *L'association : une réponse à la « question sociale*. In *Associations et coopératives: Une autre histoire économique*. Toulouse: Érès

20 Thomé de Gamond (1871), *Mémoire sur le régime général des eaux courantes. Plan d'ensemble pour la transformation de l'appareil hydraulique de la France*. Paris: Dunod, p.2. Gamond references *l'esprit d'association* throughout his text, lamenting that the model for financing railway infrastructure in France was not yet mature enough to undertake his plan.

21 *ibid*, p. 13.

22 *"Ce serail, en d'autres termes, la transformation du plan incliné de nos rivières en un escalier hydraulique." ibid*, p. 12.

[**Fig 2.6**].[23] Where the plan for controlling water became a plan for the region encompassed by the river basins was in how settlement and industrial production would be reorganized as a consequence of the hydraulic 'cascade'. Dams, proposed throughout the new system and equipped with mills and turbines would form the centres of new industrial facilities where up to 15 million people would be relocated. Transforming industrial production in France according to the outline of his basins, Gamond's vision not only prefigured the multi-purpose water infrastructure of the Tennessee Valley, but also gave the geographic extent of hydrological catchments the significance of an administrative region.

The idea that an administrative unit would be discerned in the shape of the river basin came partially as a reaction to the centralisation of power in Paris during the Napoleonic era.[24] Historian Ozouf-Marignier has pointed out that for French local

Fig 2.6 Gamond's plan to transform France's hydraulic network The geographic divisions into which Gamond divided France, consolidated multiple river catchments into larger basins. The *Bassin de la Gironde* for example included the Garonne and Adour rivers and the *Bassin du Rhin* parts of the Meuse, while others encompassed numerous smaller rivers flowing directly into the sea, that were never perceived as part of the same continuous network of waterways.
Gamond (1871), p. 82.

elites considering the concept for the purposes of administrative subdivision, the geographic space encompassed by river basins sometimes contradicted with the notion of rivers as the boundary between two regions.[25] As she goes on to explain, focus on the watershed as the dividing line between administrative compartments was supported by the widespread perception that small towns commanded geographic spaces that, if not coterminous with the basin, were in line with the principles that saw mountains as the edge of a distinct domain. The perception of "commanding" such a space was exemplified by the geographic distribution of social practices which, measured in relation to rivers, gave weight to the circulation of products and people via waterways.[26] The subtle change in focus from the basin's outline to the internal structure of the basin's geographic space, presented the waterbodies included within the outline as distinct collections of infrastructure enabling economic and social activity. Yet with social and economic relationships not uniformly dependent on activities confined within the two ridgelines indicating the limits of a catchment, the relationship between France's network of waterways, groups of people and the theory of the basin was not structured purely on the hydrological logic of a river's flows but also on assumptions about what unified the geographic space those flows encompassed.

The vague relationship between the river basin and human activity was given a new political clarity by Ritter's student Elisée Reclus. A noted geographer and French political activist, Reclus' 1868 book *Histoire d'un Ruisseau*, presented a geographic narrative of people and places centred around the journey of water from its sources in mountain streams to the sea. Throughout the descriptive narration that recalls the poetic language of von Humboldt, Reclus' detailed gaze focused on the multiple manifestations of flowing water and the cultural, social and technical adaptations made in response. Focused on the social interactions with the environment, the geography practiced by Reclus was nonetheless significantly different from Humboldt's. To describe the outer limit of his focus, Reclus did not rely on maps. Instead, he expressed the relationship between people, land and water embedded in the concept of the basin through a human perspective. In an early chapter he described where mountain streams were born:

> *... at first we only see a sort of labyrinth where depressions and heights alternate without order: but if we hovered like a bird or, if we were swinging in the basket of a balloon, we would see that the limits of the basin are rounded off around all the sources of the stream like an amphitheatre and that all the valleys open in the vast roundness bow down, converging towards each other and meet in a common valley.*[27]

23 "*...notre territoire comprend neuf bassins hydrographiques naturels et distincts : ceux de la Seine, de lu Loire, de la GiToncle, du Rhône, du Rhin, de l'Escaut, de la Manche, de l'Océan et de la Mediterranée. Mais nous avons pensqu'il serait grandement préférable, en vue d'une meilleure exploitation, de réduire à cinq et peutêtre même à quatre le nombre de ces bassins." ibid*, p. 75.

24 Ozouf-Marignier briefly references the 1851 proposal by Ferdinand Béchard to arrange France's administrative structure according to the outlines of river basins as well as the works of engineers Louis Jacques Goussier (1787), Joseph-Michel Dutens (1829) and Michel Chevalier (1832) that proposed plans for waterways regulated in terms of river basins.

25 Marie-Vic Ozouf-Marignier (2002), *Bassins hydrographiques et divisions administratives en France (XIXe-XXe siècle)*, Trames, n. 10, p. 64.

26 *ibid*, p. 71.

27 "*Les brusques escarpments, les promontoires avancés ne permettent pas de comprendre d'un regard l'ordonnance du paysage : on ne voit d'abord qu'une sorte de labyrinthe où dépressions et hauteurs alternent sans ordre : mais si* (...)

Himself a keen aeronaut, Reclus' use of the aerial angle brought the vast geographic space referenced by the river basin, into a new realm of human experience that had been made popular by Jules Verne's *Five Weeks in a Balloon.*[28] The characterization of the basin as a *common valley* (*vallée commune*) composed of smaller valleys, presented the theoretical area of the river in terms of a comprehensible though morphologically broad geophysical formation. Yet, where individual valleys may once have been considered as distinct geographic units circumscribing their own spatial domain, Reclus' narrative made them popular as a constituent part of a larger geography, shaped to funnel the river downstream. The limits of that even larger geography were expressed in the final chapter of the book where Reclus presented the hydrological cycle (*les cycle des eaux*). Taking the ocean as the starting point where "thousands and millions of streams" ended up, the movement of water through evaporation, rain, surface and underground flows were framed on an abstract planetary scale. From the perspective of this global lens, Reclus could imagine the basin as the place where the world's people merged into one nation just as all the waters merged into one river.[29] By linking the emergence of the nation with the notional area of the river basin rather than the boundaries of the state, Reclus' view appeared, on the surface at least, to address the older arguments around geography's *working object*. Yet the use of an idealised valley as a metaphor for an inclusive communal space, was also representative of his own anarchist political views on social justice and international solidarity.

Ferretti, who has studied Reclus' later teaching career, has argued that in his lectures, communities were presented as "entities traditionally opposed to the political framework of states and boundaries".[30] His "non-statist" approach to geographic analysis was especially directed at the examination of societies in East Asia where global imperial rivalries were reshaping France's authority far beyond the country's boundaries.[31] His astute observation of political conditions in East Asia was particularly relevant in the context of the Mekong River. Understood through European eyes, the political geography of the region was dominated by the fall and rise of great empires and prehistoric kingdoms. These were often imagined to share some of the same qualities as European kingdoms with fixed boundaries, non-overlapping sovereignty and state bureaucracies. The criteria set by the geopolitical imagination of European geographers however was arguably the opposite of Southeast Asia's reality. Most contemporary scholars of the region agree that what was perceived as an Asian "state" in the 19th century, shared few characteristics with European or even Chinese states lacking political centralization, defined borders, dynastic succession or an organized

27 (...) *l'on planait comme l'oiseau, ou si l'on se balançait dans la nacelle d'un ballon, on verrait que les limites du bassin s'arrondissent auteur de toutes les sources du ruisseau comme un amphithéâtre et que tous les vallons.; ouverts dans la vaste rondeur s'inclinent en convergeant l'un vers l'autre et se réunissent en une vallée commune."* Elisée Reclus (1882), *Histoire d'un Ruisseau*. Paris: J. Hetzel & co, pp. 49-50

28 Reclus is reported as having participated in the Siege of Paris with the famed aeronaut and aerial photographer Felix Nadar.

29 *"Les peuples se melent aux peuples comme les ruisseaux aux ruiseaux, les rivieres aux rivieres; tôt ou tard, ils ne formeront plus qu'une seule nation, de même que toutes les eaux d'un même bassin finissent par se confondre en un seul fleuve"*, Reclus (1868), pp. 316-317.

30 Federico Ferretti (2017), *Teaching Anarchist Geographies: Elisée Reclus in Brussels and "The Art of Not Being Governed"*, Annals of the American Association of Geographers, v. 108, n 1, p.3.

31 *ibid*, p. 13.

bureaucracy.[32] Especially after WW2, western historians examining Southeast Asia through the cultural influence of India, developed an alternative model for Southeast Asian polities based on the Indian concept of the *mandala*.

What has come to be known as a *mandala* or *galactic polity*, describes the overlapping power relationships between individual leaders, a "circle of power" so to speak, without geographic limits on authority or boundaries. Wolters, who coined the term in the late 1960s, related early Sanskrit inscriptions mentioning "the glorious sovereign of three kings" or "a pure circle of kings and brahmans" with the historical formation of the Khmer Empire based in Angkor.[33] For Wolters, each *mandala* polity was centred on an individual hegemon, with the polities of lesser kings forming the constituent parts while remaining nominally autonomous to switch allegiances or challenge the dominant leader. This politically unstable relationship however was perceived quite differently by foreign emissaries. Wolters hypothesised that Chinese ambassadors reporting on southern Cambodia in the early Christian era, ascribed the features of the Chinese dynastic kingdom to Southeast Asia's loose *mandala*. The "kingdom of Funan" which was reported by the Chinese in the 3rd century – and still persists in the region's historiography - attributed to the "kingdom" features the Chinese assumed it should possess in order to conform with their view of the world.[34] With the region's political history reflecting the observer's viewpoint more than the possible reality on the ground, Reclus' intuitive rejection of colonial boundaries to describe geographic relationships can be seen as an early attempt to approach the subject matter on its own terms. Understood from this perspective, the river basin to which Reclus ascribed inclusive political ideals, was less a geographic area and more a spatial container within which social relationship could be structured without reference to the prejudices of European nation-states. Yet the allusion to a natural commons shared by the peoples of different nations was not unique. From a different direction the same views were echoed in the French Empire's colonization of the Mekong's cartographic valley that appeared, on maps at least, to enclose a distinct domain of its own.

Mapping the Mekong's valley

In the three decades leading up to the invasion of Vietnam, the British trading outposts in Hong Kong, Singapore and Malaya increasingly dominated European maritime trade with Qing dynasty China. From this perspective, the Mekong River was increasingly seen by French diplomats as a strategic inland route to China that bypassed their geopolitical rivals in British Burma.[35] Hoping to replicate the success of British merchant ports, a concerted effort to establish a permanent French presence in Southeast Asia began in 1858. Meeting fierce resistance in the north, the French and Spanish navies besieged the trading port of Gia Dinh, defeating the Vietnamese garrison there and renaming the town Saigon. Maps

32 Oliver Wolters (1999). *History, Culture and Religion in Southeast Asian Perspectives. Revised edition*, Ithaca, NY: Southeast Asia Program Publications (SEAP), p. 27.

33 *ibid.*

34 *ibid*, p. 109.

35 From their missionaries established in Vietnam, the French received regular information on the region's politics and people, who on maps appeared concentrated in a narrow strip of land between the Annamite mountains and the coast of the East Sea (South China Sea). Ostensibly for the execution of these missionaries, the French had mounted three consecutive naval expeditions during the 1840s against the Empire of Vietnam. See Milton Osborne (1999), *River Road to China : The Search for the Source of the Mekong, 1866–73*, Atlantic Monthly Press.

that (erroneously) located Saigon at the Mekong's navigable estuary, also showed that further upstream the river traversed through the lands of the former Khmer Empire and the power base of Cambodia's king close to Phnom Penh. The riverine links to the inland kingdom had made the Mekong's delta a crossroads for Chinese, Khmer, Vietnamese and Malay merchants for centuries.[36] However, European knowledge of the river upstream from Phnom Penh was extremely limited. Thus, despite the promise of a lucrative commercial route to China, any concerted effort at exploration was considered a risky and therefore unattractive prospect.

The attitude towards exploration changed as the expenses of the military campaign increasingly began to make the colonial enterprise a financial liability for the French state. Lured by the potential of upstream commercial opportunities, the *Commission d'exploration du Mékong* set off in two *canonnières* from Saigon in 1866 to explore the trade route to China. In a team of seven that included four military officers, the person responsible for the preparation of the mission's map was the young naval lieutenant Francis Garnier. The colony's acting inspector of indigenous affairs at the time, Garnier had been one those urging for the exploration of the rivers flowing from Tibet, imagining an "unknown wealth" in the "valleys and the mountains that enclose them".[37] Garnier's mapping expertise had been developed during his military training at the *École navale* (French naval academy) in Brest. At the academy, Garnier had been taught hydrography, a discipline related to but different from cartography. Centred on the science and techniques of navigation, training in hydrography had been initially provided at private schools to merchant sailors and mariners. By the 18th century however royal schools of hydrography had been organized in French coastal towns and had gradually become part of the formal curriculum of naval academies.[38] With the maps published in 1844's *Le Pilote Français*, the academician Charles-François Beautemps-Beaupré, set a new standard for the depiction of marine coastal surveys, carefully detailing the bathymetry and coastal edge of France [**Fig 2.7**]. In contrast to their cartographic counterparts however, hydrographic surveys did not necessarily include topographic features situated beyond the river. Features such as mountains were therefore rarely depicted, unless these were considered essential to navigation, either as reference points or as potential hazards. Garnier's survey of the Khong waterfalls a few days upstream from Phnom Penh, was in many ways typical of this approach, focusing on the delineation of embankments and recording bottom measures to map depth [**Fig 2.7**].

Colonial hopes for a commercial gateway to Chinese markets however were soon quashed when further upstream the mission encountered new obstacles to riverine navigation. Confronted with the Mekong's extensive cataracts, attention

36 For an understanding of the ethnic diversity of riverine commerce in the pre-colonial lower delta of the Mekong see Nola Cooke & Tana Li (eds.) (2004), *Water Frontier: Commerce and the Chinese in the Lower Mekong Region, 1750-1880*. Singapore: Singapore University Press.

37 Garnier writes: *"qu'on interrogele parcours de ces fleuves gigantesques, qui descendent du plateau du Thibet en traversant l'une des parties les plus populeuses de la Chine; qu'on essaie de mesurer les richesses inconnues enfouies dans leurs vallées et les montagnes qui les enserrent."* G. Francis (1864), *La Cochinchine française en 1864*. Paris: E. Dentu, p. 32.

38 Following the French Revolution and reorganization of the Academy, hydrography was integrated into the new scientific discipline of Navigation alongside Geography and Astronomy. For an overview of the history of hydrography in France see https://fr.wikipedia.org/wiki/Histoire_de_l%27enseignement_maritime_en_France, accessed 20th May 2021. Also see Marie-Cécile Kasprzyk-Istin (2018), *De la navigation maritime à la navigation aérienne : transferts de méthodes mathématiques et de connaissances en France dans la première moitié du XXe siècle*, Université de Nantes, unpublished doctoral thesis, pp. 13-14.

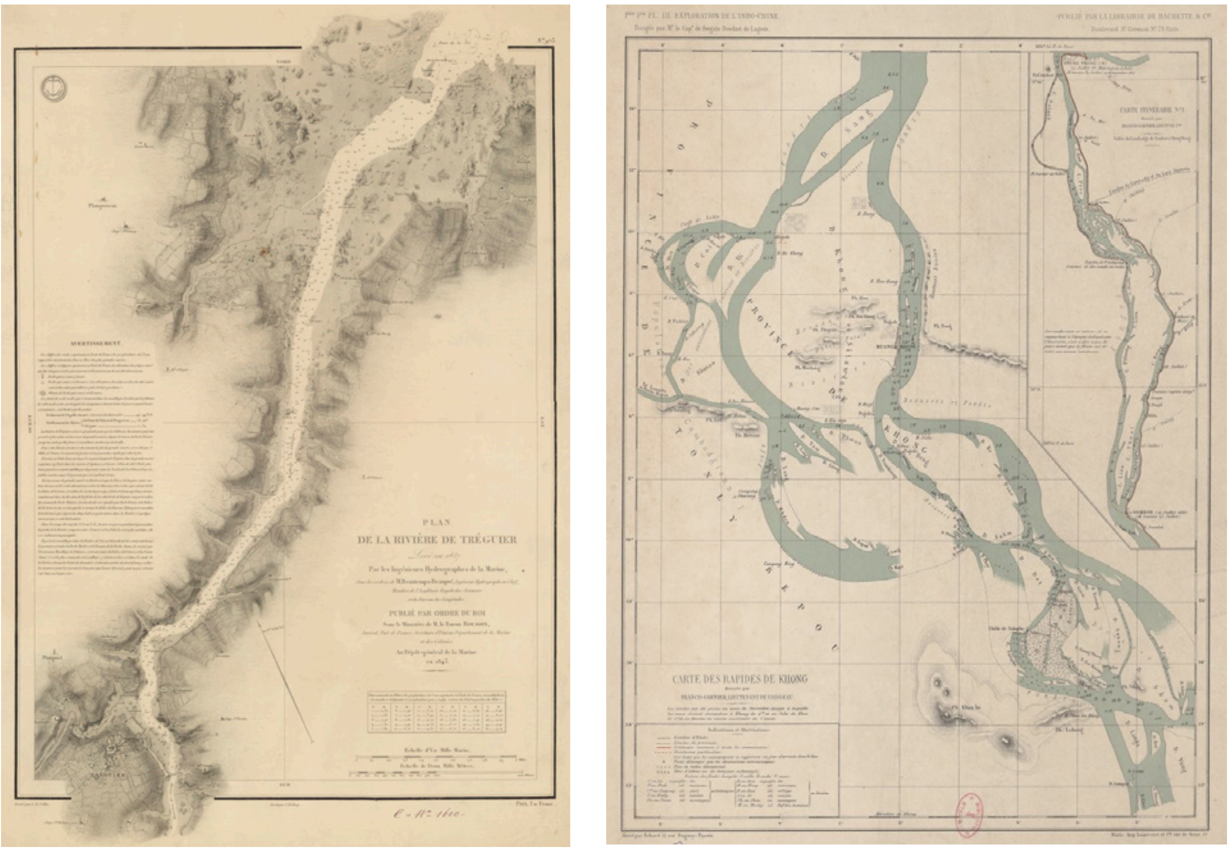

Fig 2.7 Navigational topographies Despite the difficulties faced in delineating the Khong rapids, Garnier's drawing (right) is faithful to the principles of hydrographic mapping displayed in the map by Beautemps-Beaupré (left). Note that both maps only display topographic features in the immediate vicinity of the river useful for riverine navigation.
Beautemps-Beaupré (1843), *Plan de la rivière de Tréguier : levé en 1837*; Francis Garnier, Ernest Doudart de Lagrée & Erhard Schieble (1873), *Exploration de l'Indochine. Dirigée par Mr. le Cape de frégate Doudart de Lagrée*. Paris: Impr. Lemercier.

was redirected to the mission's scientific scope, and over the next two years Garnier and his colleagues produced hundreds of charts of the Mekong's course. Garnier's widely read account of the journey, structured the spatial sequence of his narrative on the expedition's movement through smaller valleys included within the greater geographic space of the *vallée du Cambodge* or *Mékong*. However, for Garnier the valley was not simply a topographic separation between natural areas. In the first footnote to an account of the Siamese court's claims over north Cambodia, he explained that:

> *We perhaps too forget today, by theoretically dividing Indo-China between France and England, that the kingdom of Siam is, at least in part, a natural annex of the valley of the Mekong.*[39]

The conceptualisation of the valley as a determinant of sovereign authority is surprising, especially since in their journey outside the theoretical limits of Siam, the expedition's movements were controlled by passports issued by the Siamese. Based simply on Garnier's first-hand experience, the opposite relationship should have been true: that is that at least part of the Mekong's valley was an annex – natural or not - of the kingdom of Siam. His footnote however reveals that the value given by Garnier to the river valley (*vallée du fleuve*) exceeded Ritter's

39 *"On oublie peut-être trop aujourd'hui, en partageant théoriquement l'Indo-Chine entre la France et l'Angleterre, que le royaume de Siam est, au moins en partie, une anuexe naturelle de la vallée du Mékong."* Francis (1864), p. 14.

geophysical definition of term. Calibrated in relation to the state's 'natural' limits, the valley referenced by Garnier echoed the imagined reality of the 'enclosed' Siam that had appeared on Walker's earlier map. The idea of the valley also informed the construction of the maps charting the course of the Mekong as the team journeyed further upstream. Especially in the more mountainous areas of Laos, the topographic delineation of the river valley appeared equally as important as the hydrographic survey of the river itself. Of the seven maps published in the folio of 1873, the drawing showing the mountainous kingdom of Luang Prabang – a Siamese vassal state claimed also by Vietnam- was framed to suggest that the focus of attention should be shared between the river's meander and the mountains [**Fig 2.8**].[40] On the map, the exaggeratedly linear representation of the mountain chain indicated the hypothetical separation between the waters flowing in opposite directions towards the Mekong and the Chao Phraya rivers.[41] Following closely along both embankments of the Mekong, the map depicted the depth of the gorge in which the river was situated. The sides of the gorge blocked the view to the distant mountain peaks across almost the entire length of the river shown on the map, making them an unusual feature to include since they had limited value as navigational references. Given that Garnier's team did not survey the mountains, the delineation of the valley's limit in this map was most likely conjecture on the part of Garnier.

From this perspective, Garnier's cartographic representation of the distant mountains which for him - and perhaps other military men - also symbolised the limits of Siam's authority, may not have been a strictly scientific depiction of the area's geography. Rather, it could be concluded that the purpose of including the mountain "lines" in the cartographic frame was strategic. With the watershed acting as a proxy for jurisdiction, the location of mountains provided the topographic 'reality' in which to restrict Siam's political authority. While the decision of what was included in the maps may not have been Garnier's alone given his military commission, arguably these were the first surveyed drawings of inland Southeast Asia and, according to Sternstein, the most accurate update to the region's map since Walker. The subsequent recognition by the prestigious *Société de géographie* of Garnier's contributions to the science of geography, confirmed the value of his mapping efforts as objective geographic portrayals according to the scientific standards of the Academy. In this sense, any information displayed on the map's surface would have been perceived as equally 'real' irrespective of how the individual parts were surveyed. As the most updated reference for the Mekong's geography, anyone seriously interested in the region would eventually have had to turn to these maps. And there, the viewer would have been confronted with the mountainous limits which despite being labelled *supposée* (hypothetical), appeared to refine rather than dismiss the information presented in the previous map by Walker. Even if the limits of the valley had yet to be surveyed, the map presented a reality in which a wall of mountains was somewhere present. In a multi-ethnic region where the relationships between kingdoms and vassal polities were not based on fixed political boundaries, the edge of the Mekong's imagined valley indicated a possible frontier for French influence in the region.

40 Francis Garnier, Ernest Doudart de Lagrée & Erhard Schieble (1873), *Exploration de l'Indochine. Dirigée par Mr. le Cape. de frégate Doudart de Lagrée*. Paris: Hachette.

41 On the map, mountains are annotated *"Ligne supposee de partage des eaux de la vallée du cambodge et de la vallée du menam".*

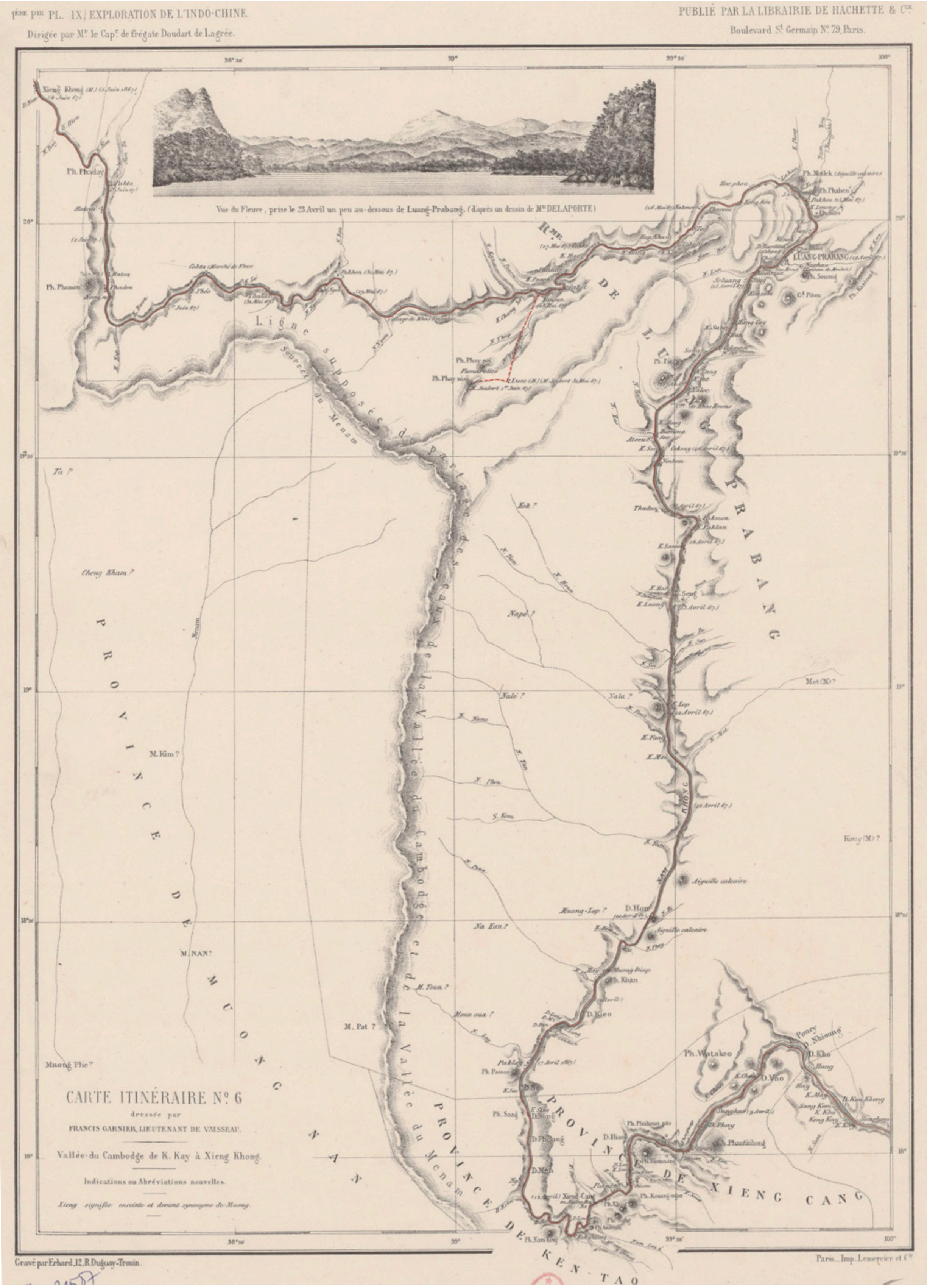

Fig 2.8 The upper reaches of the Mekong's valley The map's framing centres the eye's focus on the space between the river (right) and mountain range (left). It is the first map to note the curve of the Mekong at Luang Prabang (top right). Note the steep slopes of the canyon surrounding the Mekong which blocked view of the distant mountain range.
Garnier, de Lagrée & Schieble (1873), *Exploration de l'Indochine. Dirigée par Mr. le Cape de frégate Doudart de Lagrée*. Paris: Impr. Lemercier.

The most immediate consequence of Garnier's journey was that attention on finding a river route to China switched from the Mekong to north Vietnam. Undertaking a successful mission to the sources of the Red River, Garnier later participated in the military campaign to consolidate French colonial authority over the entire Empire of Vietnam. Under French rule, the country was split into three *pays* (regions): *Cochinchine* to the south, *Tonkin* in the north and *Annam* in the centre. In addition to Cochinchine, the French hold over the Mekong valley included the protectorate of the kingdom of Cambodia which, prior to colonization, had been under the overlordship of both Vietnam and Siam. With the inclusion of Cambodia into colonial maps, boundaries confirming the limits of Siamese authority became necessary for the French as well as Siam's king who launched efforts to map his own country.[42] But what exactly constituted the Siam that would be depicted was not a certainty for neither the king nor his officials. Advised by the British that were keeping a concerned eye on French expansion in the region, expert foreign surveyors were hired by the Siamese to train teams of cartographers in western mapping techniques. Initially, the earliest uses of western cartography were reported to have been limited to infrastructure works in Bangkok and provincial areas.[43] However, as the pressure increased to delimit boundaries with the British colonies in Burma to the north and Malaya to the south as well as with the French to the east, attention became focused on surveying the mountain boundaries and rivers which could mark the outer extents of sovereignty. Working from the framework of the British geodetic triangulation of the region, the cartographer James McCarthy undertook surveys of the distant mountainous regions claimed by Siam. Claims to these areas however were not prescribed by existing maps. As the *mandala* polity theory reflects, relationships between kingdoms of any size were underpinned by individual leaders identifying an area as belonging to their authority rather than an existing fixed boundary. Moreover, given that the allegiances of smaller kingdoms could change, areas of individual authority could extend to places that were not spatially contiguous with the kingdom's centre. With no commonly conceived location for a boundary line, McCarthy's surveys would need to give cartographic clarity to a political question that had multiple answers.

To the north, where Garnier had previously focused his gaze on the mountainous boundary between the Mekong and Chao Phraya valleys, McCarthy's surveys were carried out simultaneously with a protracted military campaign against semi-autonomous Laotian polities or *muangs*.[44] The surveys conducted by McCarthy were used to plan the routes of railway lines to connect the capital with the country's newly visible periphery.[45] From this perspective, McCarthy's map-making facilitated the transition to a centralized administration while the forced military control over the remote mountainous kingdoms would designate what would be included within the map of Siam. Nonetheless, even when the decision

42 As noted earlier, for the Siamese cartography was not traditionally used to delimit the extents of sovereignty in relation to other kingdoms. According to Winichakul however, maps of their countries were among the gifts presented by foreign envoys to the king and perhaps others in the Siamese court. On these maps the king could *see* countries, and therefore would have been aware of their power to present sovereignty as a specific geographic dimension that could potentially restrict his own authority.

43 Winichakul (1994), p. 117.

44 The military campaign, ostensibly against the *Haw* (Ho), aimed to bring these different orders of local authority directly under the king in Bangkok.

45 James McCarthy (1900), *Surveying and exploring in Siam*. London: William Clowes & sons, p. 111.

was made to include a conquered kingdom into Siam's sovereignty, the question of where that kingdom's boundaries should be drawn remained unresolved. McCarthy understood that these 'lesser' kingdoms provided tribute to multiple overlords, but also that in turn, these kingdoms dominated even smaller ones provoking similar disputes over shared sovereignty. Relying on information from locals to ascertain the boundary's position, he described multiple episodes where he was guided to the geographic feature which functioned as the "border" for a particular tribe or village in one specific location.[46] Arriving at Luang Prabang for example, which was under Siamese sovereignty he recorded that:

> *The boundary of Luang Prabang* and *Nan* [a kingdom] *was along the Nam Ta* [river] *from the Nam Se* [river]*. It then recrossed the Nam Ta, and followed a line which had always been disputed* [...] *Nan asserted its claim to the Nam Ta, while Luang Prabang, on the other hand, affirmed that the presence of Nan in the valley of the Nam Ta was an encroachment.*[47]

The rival overlapping claims over areas considered to belong to Siam were less of a problem for the surveyor whose job was to draw the country's outer frontier. But while locals defined their claims based on the areal unit of an entire valley, McCarthy could conceive of boundaries as imaginary lines that followed or crossed rivers. Given that it was his job to draw that valley and consider its position within the configuration of the cartographic frontier, this is not surprising. It shows however that there were diverging conceptions of how to constitute the domain of a kingdom's sovereignty – the areal unit or the line – which did not always correspond with each other. There were however places on the surface of maps where the geographic space assigned to the valley and the linear boundary converged. McCarthy recognized the location of boundaries on mountains ridges as *watersheds*, identifying this imaginary hydrological line with the frontiers between some smaller kingdoms. But the value of the watershed as a means of marking the frontier varied considerably and for local people was often incompatible with boundaries.[48] For McCarthy on the other hand, the frequent ascent to the crests of mountains was a fundamental part of the surveying process. From the location of the watershed, the surveyor could see the distant balloon signals that marked known points within the British geodetic triangulation. With few indisputable claims on which to base his work, McCarthy's delineation would essentially require him to speculate on where Siam's frontier could be.

What Winichakul calls "interpretations of the ambiguous territorial margins by the new code of space" is displayed on the first Siamese map to show the limits of the country on what is today recognized as the first modern map of Thailand [**Fig 2.9**].[49] Published by McCarthy in 1888 primarily for a European audience, the map showed Siam straddling both the Chao Phraya and Mekong river valleys. But while the west frontier followed with the ridges of the mountain range that had been part of La Loubère's and Walker's older depictions of Siam, the eastern frontier aligned with the ridges of the Annamite mountains which

46 *ibid*, p. 191.

47 *ibid*, p. 163.

48 In one incident the surveyor reported that stone pillars marking a boundary "*had been removed by the Lu that they might with greater boldness cross the watershed*" while in another that the "*boundary of Sibsawng Pana [Sipsòng Panna] crossed the watershed.*" *ibid*, pp. 161 and 166.

49 Winichakul (1994), pp. 124-125.

Fig 2.9 McCarthy's Siamese Siam As the first modern map of the kingdom, it is not only important for speculating on the frontiers of the country but also because it presented previously unseen topographic detail. Note that the north-south mountain range that appeared in Garnier's and Walker's maps has been "dissolved" by the topographic survey.
James McCarthy (cartographer) (1888), *Map of the Kingdom of Siam and its Dependencies*, published for the proceedings of the Royal Geographical Society, London: Edward Stanford.

had not been surveyed.[50] Significantly, the new maps appeared to "dissolve" the linear mountainous boundary dividing the Chao Phraya and Mekong which had restricted Siam's extent in European maps. Thus, in the context presented by the drawing, rather than two separate valleys the eastern limits of Siam are implicitly located on the edge of a greater *vallée du Mékong* which extended across the length of Southeast Asia. Delineated according to the same geophysical principle as Garnier, McCarthy's interpretation of what constituted the unit of the valley was equally as imaginary as the French explorer's.[51] From this perspective, the focus

50 The determination of these boundaries did not reflect any survey or the Siamese military campaign, since the escalating political conflict with France prevented McCarthy from travelling through these areas. Besides, the map's blank spaces adjacent to the Annamites clearly indicated that the consideration of where to locate this notional frontier was not based on any local information or the topography of individual valleys.

51 In contrast to the speculative determination of the eastern frontier, the survey results from the north were not visible on the map. Instead, the frontier extended indistinctly northwards to eventually disappear into the mountain (...)

on the the eastern frontier on the 1888 map could be described as just another speculation by McCarthy. But was the correlation of the Annamite mountains with the extent of Siam simply McCarthy's technically-driven imagination regarding watersheds, the expectation by the kingdom's elites that Siam encompass the entire river "valley" or a cartographic technique to counter French claims?

Winichakul reports that shortly prior to the commencement of McCarthy's surveys, members of the Siamese elite advocated specifically for the mapping of the Mekong's basin. Around the same time, the creation of Siam's Royal Survey Department, integrated the geographic 'language' of European cartography into the state's institutions. This indicates that to some extent at least, the river valley was an important reference for what constituted the geographic space claimed by the country, even though that space was not never wholly secured militarily. Furthermore, the Mekong's eastern watershed was not just the limit of the "valley" but also of the French colonies of Tonkin and Annam situated on the other side of the mountains. Placing the hypothetical frontier along this line therefore presented the Siamese claim from two sides. On the one hand it anchored Siam to the notion of the valley, whose natural boundaries were recognized by Europeans as the legitimate extent of the country. On the other, it also reflected the principle of political boundaries which - abhorring the vacuum of unclaimed terrain - required placement adjacent to existing borders. The first glimpse of a Siamese Siam nonetheless identified the kingdom with the notion of the river valley. Arguably therefore, McCarthy's map used the predominant geographic discourses, to present the country as a 'natural' part of the region's political geography.[52]

Yet although all these maps focused on interpreting boundaries with respect to the topography, the topographic representation on which the boundary-making was based did not remain unchanged. Among the sources for McCarthy's second depiction of the terrain, the surveys of the French explorer Auguste Pavie published only few years earlier, showed the ridges and valleys of the Annamite range in more detail than ever before.[53] Unlike McCarthy's fictional watershed however, the topographic complexity depicted on Pavie's map appeared to eliminate the possibility of a clear frontier delineated along the mountain's ridges. Ratified by the first of many international treaties, Siam's eastern extent was not in the end determined by McCarthy's 'mega-valley', but by the contested sovereignty over the Laotian *muangs*. Nonetheless, the internal division of the country enabled by cartography began a fundamental transformation in the relationship between the central authority and peripheral 'lesser' kingdoms. It allowed for the whole country to begin the "shift from the traditional hierarchical relationships of rulers to the new administration on an areal basis."[54]

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51 (...) areas under Chinese authority. It is not clear from McCarthy's narrative if this was a deliberate omission or the inability to mark a definitive boundary on the map that reflected political reality. Most probably it suggests a lack of urgency to determine Siamese sovereignty in relation to China, an erstwhile ally in the resistance to French colonization as well as the king's explicit desire to map the frontier as a measure to counter the French.

52 The results of the boundary surveys from the north surfaced on a different map that McCarthy prepared for publication with his account in 1900. This presented his proposal for Siam's regional administrative structure, replete with constructed and proposed railways.

53 Pavie, who travelled widely and led large teams of scientists to record the social and natural composition of the region, was stationed as French Ambassador to Siam as the treaties to determine the border were prepared. Historians have noted his opposition to showing boundaries on the map before these were confirmed by treaty.

54 Winichakul (1994), p. 120.

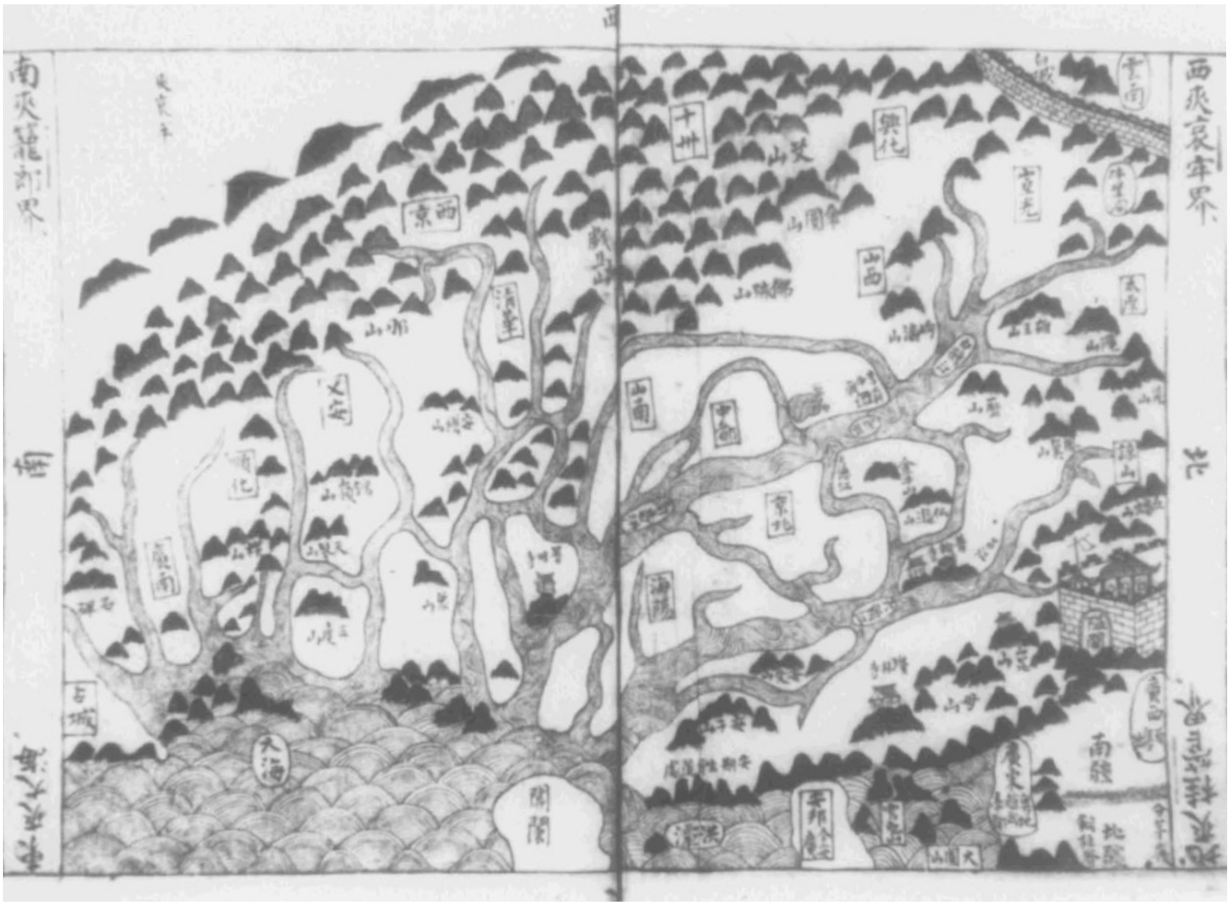

Fig 2.10 Map of Viet Nam This 17^{th} century copy of an 15^{th} century Vietnamese map shows the geography of the area under the sovereignity of the emperor in relation to China (north) and the Cham kings (south). The Empire's seat of power by the Red River is in the centre while rivers are shown flowing from the surrounding mountains to the sea. The wall (top right) is the boundary with China. Mountains are symbolised by dark-coloured ridges. Note that north is to the right.
John Whitmore (1995), p. 482.

Mountain and water

The shift towards an areal administrative structure was not unique to Siam. Having seized Vietnam through force and coercion, the French adopted a role as "protector" against Siamese aggression, upholding Vietnamese claims over the different *muangs* in the Mekong's upstream. Similar to the Siamese claims, these *muangs* paid tribute to Vietnam according to their best interests or when coerced through military force. But although the limits of individual kingdoms were difficult to determine, contact with Europeans and in particular French missionaries had allowed imperial cartographers to present their claims on the surface of the map. In Vietnam, the control of official publications including maps was centred in the imperial capital at Huế. There in 1822, the emperor Minh Mang created a new Historical Archive (*Quốc sử quán*) which over the course of the next six decades published detailed geographic accounts of the newly consolidated empire.

Although mostly textual, geographic knowledge in Vietnam had been associated with cartography since at least the 15^{th} century [**Fig 2.10**].[55] This development had followed the gradual consolidation of *mandala* polities into a new imperial

55 The earliest known examples of Vietnamese cartography are 17^{th} century copies of these 15^{th} century atlases.

organization with a clear perception of its own area of authority and a sense of the cultures that lay beyond. Among the names that the Vietnamese used to reference the geographic space under their exclusive cultural influence was *non nước*, literally *mountain and water*. John Whitmore hypothesises that the cosmographic ideas on which that name was based underpinned the "Vietnamese visual approach to spatial representation."[56] This is perhaps obvious if considered in relation to the two defining characteristics of the empire's topography which any map was bound to portray: the Annamite mountain range which stretched along the length of the entire Vietnamese domain and the numerous rivers and streams descending from the mountains to the East Sea. Vietnamese representation of these topographic features developed within the broader regional influence of Ming-dynasty China which included adoption of Confucian bureaucratic administration as well as the conventions of Chinese cartography. The tasks of the state bureaucracy included the preparation of geographic atlases that combined maps and written descriptions of settlements, mountains and rivers.

An 1833 publication on the *Geography of Imperial Vietnam* briefly covered only the north and centre of the empire but omitted the more recently annexed area around the Mekong's delta. However, as Vietnam's administration became increasingly integrated to have equal information from all provinces, maps

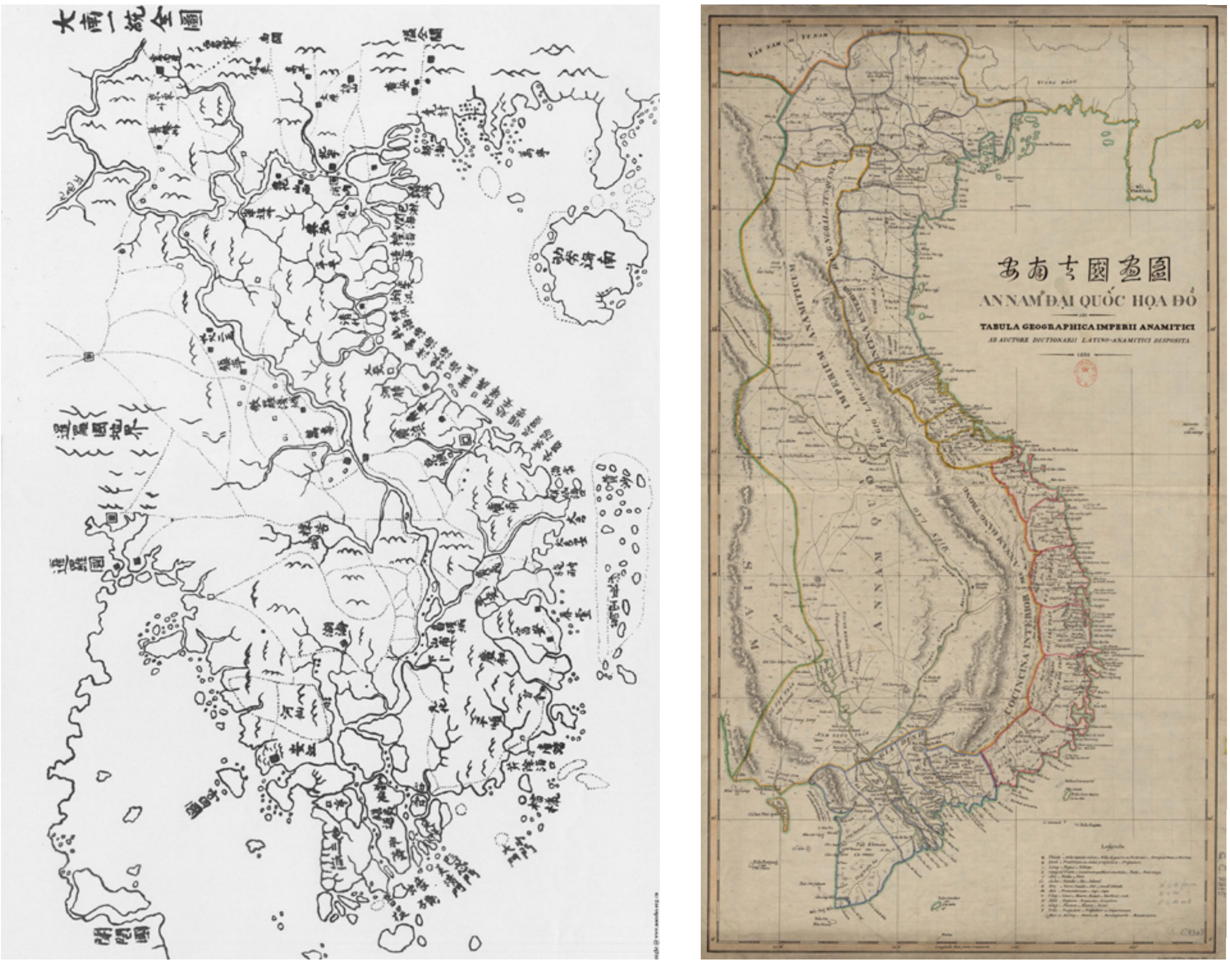

Fig 2.11 Maps of (the whole of) Viet Nam Constructed around the same time, the map on the left is by Phan Huy Chú a Vietnamese mandarin, while the map on the right is the work of the French missionary Taberd. Dotted lines on the Vietnamese map depict roads, but where applied in maritime terrain appear to display a different type of spatial continuity.
Phan Huy Chú (1834/ 1838), *Đại Nam nhất thống toàn đồ (Unified map of Viet Nam),* Huế; Jean-Louis Taberd (1838), *Annam Dai Quôc'Hoa Dô'seu tabula geographica imperii anamitici,* Calcutta.

portraying the entire extent of the emperor's sovereignty began to appear.[57] Among these, the 1838 map attributed to the Vietnamese mandarin Phan Huy Chú displays what was perceived to be the emperor's domain [**Fig 2.11**]. In a depiction that combined the European projection of the coastline with landscape features drawn in the traditional Chinese style, the drawing showed the empire's thirty-two provinces which included Cambodia as well as the names of main river estuaries along the entire coastline. The ridge-style elevations denoting mountains were depicted lying both vertically and horizontally, portraying the 'direction' of mountain ranges and in one sense enclosing the terrain into vaguely delineated rectilinear compartments. Framed by the Siamese capital at Bangkok to the west, east of the Mekong the Khorat Plateau was shown crisscrossed by roads joining the entire region. The implication of an empire perceived to extend beyond the mountainous confines of the Annamites is evident in the map's inclusion of these distant areas.

The depiction of the same subject in a distinctly European style was published the same year by the French missionary Jean-Louis Taberd [**Fig 2.11**]. Presenting the Vietnamese claims to the Mekong through the cartographic medium of boundaries, the *muangs* paying tribute to the emperor were included within a vast area labelled *Annam Quốc* (Country of Annam). Recognizing perhaps that either the linear mountain boundary delineating Siam was fictional or that Siam's jurisdiction extended beyond that limit, Taberd's depiction of Vietnam is not drawn as a valley. Distinct from the delineation of the provinces contained along the coast, these hinterlands are displayed as if part of a different level of authority, yet firmly within a perceived sphere of influence centred on the Emperor's seat in Huế. Considering that the *muangs'* allegiances could switch between the Siamese and Vietnamese crowns, Taberd's map was essentially a snapshot of the political condition at that specific time, as seen from the Vietnamese perspective.

The political narrative underpinning these depictions of the entire country was readily adopted by those in the French government seeking to extend colonial control beyond coastal areas. Growing anti-colonial sentiment and widespread condemnation of the *politique d'aventures* by the French public however halted any immediate action towards expansionism.[58] Following the annexation of north Vietnam, the arguments in support of a calculated campaign to integrate the *muangs* into colonial holdings revolved around the strategic importance of the hinterland to the coastal colonies and the wishful desire to 'steal' Siam from under British influence. Well aware of the contested suzerainty over vassal states, the French tendency to see the *muangs* that appeared on Taberd's map as part of the former empire, allowed them to imagine the extent of their own influence in the region.[59] Hampered by the French public's lack of appetite for further

56 Whitmore (1994), p. 479. Wolters argues that the Vietnamese expression *"the mountains and river"* referred to a literary association between the extent of the country signifying the *"successful and timeless protection provided by the mountains and river"*. This conceptualisation was closely associated with the idea of natural barriers. However it is not clear if these barriers included the rivers as well as, more obviously, the mountains. Wolters (1999), p. 75.

57 Whitmore (1994), p. 502.

58 A final attempt in 1880 to revive the importance of the Mekong's riparian hinterlands had failed to gather enough votes to fund a proposed railway from Cochinchina to south China through the Mekong's valley. See C. M. Andrew & A. S. Kanya-Forstner (1971), *The French 'Colonial Party': Its Composition, Aims and Influence, 1885- 1914*, The Historical Journal, v. 14, n. 1, p.99.

59 The appeals for the Chinese to intervene on behalf of the Vietnamese led to a short war with the weakened Qing-dynasty troops and a protracted campaign in the north by the Chinese Black Flags under Liu Yungfu against the (...)

adventures, the response to the situation included increased diplomatic presence in the region and an urgent search through the Historical Archives for imperial records that would support the Vietnamese claims. A persuasive case supporting France's inheritance of Vietnam's rights over this region was compiled into a 1892 report for the colonial governor, which resonated with the altruistic notion that the French were duty-bound to protect the Vietnamese people's right to settle unconstrained throughout the region.[60] According to Stuart-Fox, by acting on behalf of Vietnam, France reinforced the dubious claims over the *muangs* which had been presented on Taberd's and Phan Huy Chú's maps.

Drawn as the political struggle over these regions escalated, a new iteration of the map of Vietnam, presented the Vietnamese claims with respect to the region [**Fig 2.12**]. Although the author is not recorded, the text and style of the drawing suggest it was most likely prepared by a Vietnamese or perhaps Chinese cartographer.[61] It nonetheless presents an imperial point of view of the country rendered in a combination of Chinese and European cartographic conventions. Broadly following the cartographic framing of Phan Huy Chú's depiction, the map displays province names in red squares, with the largest square around the centre of the coastline indicating the emperor's seat at Huế. Two large blocks of red, denoted by a delicate dotted line on either embankment of the Mekong present the contested extents claimed as "Vietnamese border areas". With no other lines appearing to mark areal extents elsewhere on the map, the way these "border areas" are delineated indicates these are significant to the map's narrative and essentially something different from the other lands under imperial rule. The way Vietnam's extent is implied by the map simply through the manipulation of colour and the emphasis on landscape features - without the use of boundaries – presents a country strongly reminiscent of the *non nước* poetic cosmography. With the blue-coloured mountain ridges forming a visual continuity, rivers are depicted as interwoven with the slopes throughout: from the furthest edge descending to the sea. The striking correlation between mountain and water stands in contrast to the red border areas which with one exception are shown to be bereft of interstitial rivers or any slopes. Understood through the perspective provided by the map, Vietnam appeared confined to the mountainous lands through which rivers flowed down towards the sea, and to claim distant lands with a distinctly different geophysical configuration.

This would have been the perspective from which the French staked their own claim over an area inhabited by what their earlier explorers perceived as a distinct linguistic, cultural and ethnic group collectively labelled as Lao. As the

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59 (...) French. Anti-colonial resistance forces fleeing the French took refuge among the Mekong's *muangs*, making them a strategic liability that undermined the colony's security. Denying the rebels sanctuary became a priority for the military, giving additional impetus to the argument for direct involvement in this region. Martin Stuart-Fox (1995), *The French in Laos, 1887-1945*, Modern Asian Studies, v. 29, n. 1, p. 114.

60 *ibid*, p. 118.

61 According to the Academia Sinica Center for Digital Cultures on the map (Fig 2.12) the "*block of text at the bottom right describes Vietnam, which was divided into the south (Nam Ky) and the north (Bac Ky). It lists all the provinces and briefly describes the geography in different parts of the country, including the provincial capital Fuchun (Thuận Hóa). The text also describes land and water transportation, especially in northern Vietnam. The end of the text gives a reference to Liu Yungfu (Luu Vinh Phuc, 1837-1917, style name Yuanting) and his "old army base" which was drawn using a big red circle for easy identification. Liu was a leader of the Black Flags (Co Den), a Chinese paramilitary force that was asked by the Vietnamese government to fight the French invaders in 1885.*" Text reproduced from https://digitalatlas.asdc.sinica.edu.tw/digitalatlasen/map_detail.jsp?id=A103000026, accessed 15th February 2021.

Fig 2.12 Map of Viet Nam Drawn around 1885 the map follows Vietnamese cartographic conventions except for the delineation of the red-painted zones which are outlined by a dotted line (see magnified detail above). These outlines indicate "Vietnam border areas" on the embankments of the Mekong.
Unknown cartographer (1885), 越南全境輿圖 (*Complete map of Vietnam),* US Library of Congress.

growing geopolitical rivalry with the British revived public support in France for strategic counteraction, the relatively remote Laotian *muangs* became the subject of colonial interest and the objective of the Siamese military action in which McCarthy participated. Arbitrated by a panel of experts, the negotiation which resulted in the 1893 boundary treaty between Siam and France, located the disputed frontier along the Mekong, inevitably partitioning the smaller kingdoms for whose people the river was the centre of their domain. The sparsely populated new colonial state of Laos encompassed the areas east of the Mekong until the ridges of the Annamite range and northwards to include the kingdom of Luang Prabang until the border with China. In the French geopolitical equation of Southeast Asia, Laos appeared as a tactical 'buffer' between Vietnam and Siam but also between the productive colonial holdings along the coast of the East Sea and their rivals in British Burma. The location of the boundary between Laos and Vietnam, replicated McCarthy's watershed but this time as the internal boundary between three of the five *pays* of French Indochina rather than an outer frontier.[62]

After an additional four border treaties with the colonial powers, Siam's boundaries were 'finalised' in 1907. In their ultimate form, the frontiers were adjusted to incorporate the entire kingdom of Luang Prabang into Laos. The French position reintroduced Garnier's hypothetical line of mountains that had been 'lost' in McCarthy's detailed depictions [see Fig 2.9]. The map on which they based their position was prepared by Auguste Pavie which, following his team's detailed surveys, was considered the most accurate portrayal of the region's natural features.[63] Pavie, who had previously refused to display boundaries on his topographic depictions until these had been settled by official treaties did not show Garnier's watershed as a line [**Fig 2.13f**]. Yet, when it came to the transition between a topographic and a boundary map, despite his pretentions to scientific integrity, Pavie employed the same drawing techniques that McCarthy had used to mark the edge of sovereignty. The subtle shading of the landscape immediately adjacent to either side of the 'imaginary' frontier, appeared to claim that a ridge-line existed, highlighting the value of the natural boundary to offer a solution to disputed areas of authority [**Fig 2.13e** and **f**]. In a similar manner, Pavie's authoritative depiction of French Indochina in 1916, exaggerated the topographic 'reality' of the altered boundary giving the limit the same geographic gravity as the watershed dividing Laos from Vietnam. The natural background against which all claims were calibrated, changed accordingly to incorporate the desired political narrative.

Conclusion

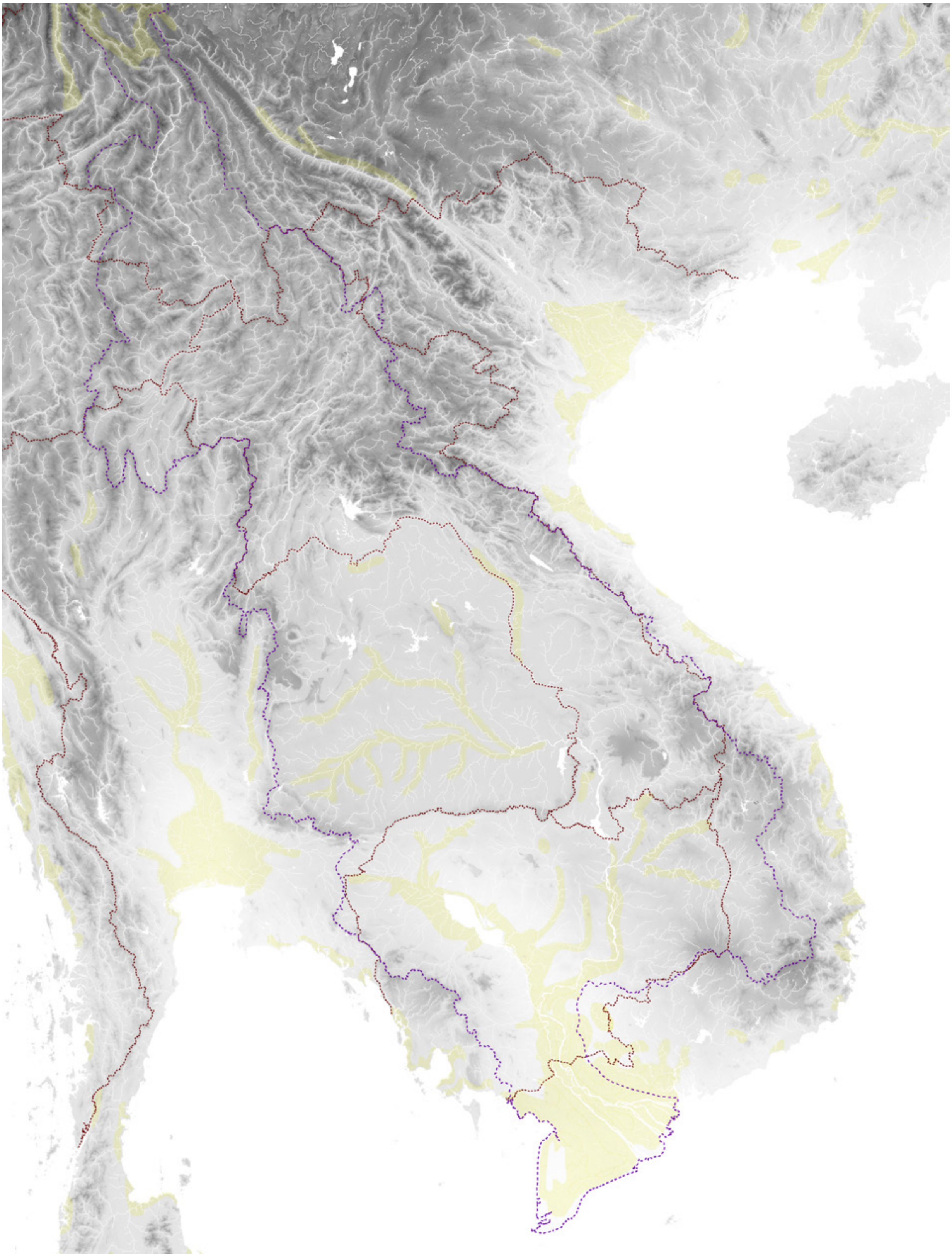
The partially fictional cartographic depictions which accompanied concepts such as the valley and catchment were not only a result of insufficient information about the configuration of the terrain. If for Buache, placing mountains where none existed upheld a theory of the basin, in Southeast Asia the river valley, basin or watershed became convenient tools for dividing the terrain into separate domains. Imposed through sometimes subtle and sometimes blatant manipulations of the map's surface, identifying the limits of authority through

62 Probably due to its 'natural' and thus non-partisan configuration, the principle of the watershed frontier was employed by other colonial powers to resolve boundary disputes. A year later the watershed demarcated Belgian Congo from British Uganda and was considered for further colonial partitioning as the African continent's hinterlands gradually became mapped.

63 Winichakul (1994), p. 128.

Fig 2.13 Map excerpts showing the Luang Prabang "curve" The top row (left to right) are French maps from 1874 (Garnier), 1889 (Deloncle) and an ethnolinguistic map of French Indochina (1904/1917). The first row below are McCarthy's maps from 1888 (**d**) and 1900 (**e**) and the second row Pavie's maps from 1895 (**f**) and 1914 (**g**). Note how the topography depicted below changes without the addition of any new information except for the position of the "intangible" boundary.
Garnier (1874), *Carte generale de l'Indochine*; Deloncle (1889), *Carte politique de l'Indochine*; Madrolle (1904/ 1917) *Indochine ethnolinguistique*; McCarthy (1888), *Siam and its dependencies*; McCarthy (1900), *Siam and its dependencies*; Pavie (1895), *Carte de l'Indochine*; Pavie (1914), *Carte de l'Indochine*.

the disposition of natural features was a European fantasy promoted by the dogma of the *frontières naturelles*. The conviction that a valley – the terrestrial interpretation of the river basin – was already there to be discovered and mapped, gave the Mekong's European surveyors a specific frame with which to rationalise what - for them - was a perplexing condition of multiple and overlapping sovereignties. And, even when the clearly identified 'wall' of the valley separating the Mekong and Chao Phraya was surveyed out of existence, new mountain ranges were born [**Fig 2.13a**] or old ones redrawn [**Fig 2.13e** and **g**] to perpetuate the idea of a geographic space unified by natural forces. Considering how scientific standards of objectivity embraced the mechanical metaphors of the industrial revolution, it is unlikely that any of the authors would recognise their own, sometimes extravagant manipulation of topographic facts. For them, the mere presence of a river implied that somewhere, a mountain would need to exist to form the edge of the inclined plane driving water towards its ultimate oceanic destination. Thus, rather than deriving the basin's limits from knowledge of how water flowed, the valley was deduced from the simple geographic fact that if there was a river there had to be an enclosing valley. And if guaranteeing the spatial integrity of the valley required ridgelines to be imagined in the flat coastal lowlands where the river met the sea, the warnings of a Eurocentric bias identified by Humboldt could be easily dismissed since the rational theorization of the catchment made it imperative that a watershed surrounded the entirety of the river system. It is therefore doubtful that between Siam's identification with McCarthy's 'mega-valley' or the French claims to the *vallée du Mekong*, someone could perceive the hydrological concepts that informed the action of water. Yet, by aligning the shaded, pictorial gravity of the watershed with the separation of authority, the areal unit derived from observing the behaviour of water became embedded in the areal unit of political control.



Map B National boundaries (red dotted lines), the Mekong's basin (purple dotted line) and the soil types which correspond to sediment deposits (yellow shaded areas) are shown against the digital elevation model (DEM). The boundaries of countries and the river's catchment align between Laos and Vietnam and between Laos and Thailand at Luang Prabang. The basin of the Mun River in Thailand's Khorat Plateau also forms the boundary with Cambodia.
Author (2022). Spatial data sources: *World water bodies* (ESRI, 2014)*; Rivers of South and East Asia* (FAO, 2014)*; DEM vie_dem_srtm* (Open Development Mekong, 2016)*; Lower Mekong Basin* (MRC, 2011); GMS_soils (Open Development Mekong, 2015)*; Country boundaries* (GADM, 2022).

CHAPTER 3 Uniting geographic space

A thousand valleys over the globe and our valley here are in this way the same: everywhere what happens to the land, the forests, and the water determines what happens to the people.

TVA: Democracy on the March, David Lilienthal, 1944

In the closest thing to an intellectual history of the idea of the river basin, François Molle argues that the manifestation of the concept after WW2 pivoted on the application of the planning principles set by the Tennessee Valley Authority (TVA).[1] Described as a "new export commodity" showcasing American technical knowledge of water control, the TVA is widely acknowledged by historians as the paradigm on which plans to exploit the resources of the Mekong River were conceived and executed during the Cold War.[2] Commenced in the United States during the Great Depression that also affected the economy of colonial Indochina, the distinct infrastructure projects implemented by the TVA were presented on maps that highlighted their relationship to the Tennessee River's eponymous valley. If appreciation of these maps would imply that the valley's cartographic outline equated to a hydrological catchment, the cartography of the river basin in the American context was not limited to the depiction of an existing natural condition. Framed as a 'unit of country', an area of infrastructural operations as well as the extent of civic participation in the regulation of water resources, references to the basin in the American context developed in concert with what maps showed. Considering the TVA's influence on the way the Mekong's cartographic basin was later instrumentalised, such distinctions matter. And, if French geographers, engineers and cartographers referencing the basin's outline on a map, could perceive a natural commons, a self-regulating equilibrium or a political subdivision, the question of what the cartographic basin represented still remained open. This chapter is therefore a parenthesis within the larger discussion of the Mekong's catchment areas. Arguing that the outline of the basin was also the extent of a plan to align human activity with the perceived workings of nature, the chapter examines the concept from the perspective of the American discourses which converged in 1933's Tennessee Valley to become the model for transforming the Mekong's flows.

1 Molle's global, diachronic examination of the river basin as a notion is unique and has been an important reference for the current research. As a water management specialist, his relatively short (but detailed) narrative, focuses on the basin from the perspective of its institutional history and operational relationship with hydraulic infrastructure and resource management. However, without distinguishing between the basin's use as a geographic limit (*areal unit*) and a hydrological continuity (*square unit*), his historical analysis cannot help to critically explain the spatial impact of the notion's application in contexts such as the Mekong. François Molle (2009), *River-basin planning and management: The social life of a concept*, Geoforum, v. 40, pp. 488–489.

2 Historians such as David Ekbladh, Jeffrey Jacobs and Thi Dieu Nguyen have discussed the influence of the TVA on the basin-level development of the Mekong. See for example, Ekbladh (2002), *"Mr. TVA". Grass-root development, David Lilienthal, and the rise and fall of the Tennessee Valley Authority as a symbol for U.S. overseas development, 1933–1973*. Diplomatic History, v. 26, n. 3, pp. 335–374.

The geology of water

A geological theory to explain the configuration of the earth's surface was famously framed by the Scottish scientist Charles Lyell in his 1838 book *Principles of Geology*. Arguing that the forces gradually shaping the globe had been diachronically present throughout the earth's geological history Lyell's theory of *uniformitarianism* implied that the present was a reflection of the past. This view resonated with observations of the earth's *natural record* that could be comprehended through the study of minerals and fossils. Considering the "action of running water" a foundational force in the earth's geological evolution, Lyell's view of rivers was specifically attuned to the topographic nuances where the hydrological cycle played out.[3] Thus, the higher regions receiving "almost all the water" from precipitation also became "perpetual reservoirs" from which the excess water descending towards the sea would "irrigate the lower valleys and plains".[4] A river's hydrographical basin was therefore not only the outcome of separate geological processes. It was also the setting in which water was still actively transforming the terrain.

Knowledge of the earth's geological structure was considered critical for inventorying the natural resources of the United States. In the belief that "the collection, mapping, and analysis of social and environmental data would lead to a rational basis for social and environmental control", multiple expeditions were organized to map the geographic space west of the Mississippi River.[5] The measurements, observations and maps generated by these exploratory missions were, as Scott Kirsch argues, critical in shaping the understanding of America's West in the political and scientific circles of distant Washington. Throughout the 1870s, veteran army officers trained in geology, simultaneously headed survey teams into the mountainous *arid regions*. Differentiated from areas of abundant rainfall in the country's temperate East, the arid region received less than twenty inches of rain per year which was considered unsuitable for the cultivation of dominant crops [**Fig 3.1**]. The way rain collected within the arid region's rivers however was different from their counterparts within the hydrographic basin of the Mississippi. With almost no surface run-off, the inclined slope that began at the crests of the Rocky Mountains and was the foundation of the basin's geographical dimension, was less important than the geologically prescribed routes taken by water on its journey to inland lakes or the ocean [**Fig 3.2**]. With rivers being amongst the only sources of fresh water to grow crops, the water scarcity entailed by this limitation was compounded by the limited number of waterways directing the melting snow to the fertile plains, and the unregulated private control of water resources.

Focusing on the exploration of the Colorado Plateau, the teams of astronomers and topographers under Major John Wesley Powell conducted geodetic surveys

3 Lyell's view broke from the established view of *catastrophism* which held that sudden planetary cataclysms were responsible for shaping continental geography. Charles Lyell (1838), *Principles of Geology*, London: John Murray, p.385.

4 *ibid*, p.330.

5 Although by the mid-19th century the upper reaches of the Mississippi River had already been recorded on maps, the majority of lands purchased from France or forcibly annexed from Mexico in the previous five decades had yet to be consistently mapped. Scott Kirsch (2002), J*ohn Wesley Powell and the Mapping of the Colorado Plateau, 1869-1879: Survey Science, Geographical Solutions, and the Economy of Environmental Values*, Annals of the Association of American Geographers, v. 92, n. 3, p. 553.

Fig 3.1 Rainfall in the United States This map by Charles A. Schott (1868) - reprinted in Powell's report - represents rainfall according to the contours of isohyet lines. The arid region is identified as the area with less than 20 inches of annual preciptation (uncoloured) which contrasts sharply with the abundant rain depicted in the East.
J.W. Powell (1879), *Report on the Lands of the Arid Region of the United States,* Washington: Government Printing Office

and gathered meteorological readings.[6] Along with reports on Native American tribes, the information conveyed by Powell to Washington described the conditions in which settlement and resource exploitation were unfolding.[7] In the final report of the Powell Survey submitted to Congress in 1879, the toponymic Basins of the region's great rivers served as the spatial references for the geographic spaces being mapped. In addition to the cartographic notion of global latitude with which the extent of western states had been delineated, rivers and the theoretically perceivable extents encompassed by their basins, suggested a specific way to comprehend an unknown region. Describing the flows of water Powell wrote:

> *All these streams combined form the drainage system of a hydrographic basin, a unit of country well defined in nature, for it is bounded above and on each side by heights of land that rise as crests to part the waters. Thus hydraulic basin is segregated from hydraulic basin by nature herself, and the landmarks are practically perpetual.*[8]

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6 A professor and geologist, Powell had gained national acclaim by exploring the Grand Canyon. Donald Worster (2009) *A river running west: reflections on John Wesley Powell*, Journal of Cultural Geography, v. 26, p. 2, p.118.

7 Powell's maps as well as those from the Wheeler and King Surveys were sent eastwards, with the initial intention to be compiled into an *Atlas of the Territories of the United States*. Instead, the urgent need for cartographic consistency among the different surveys, led to the unexpected reorganization of federal mapping efforts under the United States Geological Survey (USGS).

8 John Powell (1890), *Institutions for the arid lands*, Century Magazine, v. 40, p. 113.

Fig 3.2 Maps of hydrographical basins The areas included within the Mississippi's hydrographic basin (left) encompassed the western frontier of a United States centred on the administrative and industrial centres to the east. The map from the Powell Survey (right) presents an almost figurative representation of the Colorado Plateau's features. Rather than giving emphasis to water, the map highlights the terrain's geological structure such as escarpments, plateau edges and gorges. Joseph Nicolas Nicollet (1843) *Hydrographical basin of the Upper Mississippi River From Astronomical and Barometrical Observations Surveys and Information,* U.S War Department; U.S. Geological and Geographical Survey of the Territories, 2nd Division (1874), *Preliminary map no.2 of the country surveyed in 1872 and 1873.*

The "unit of country" bounded by the geological hand of nature was therefore seen as crucial to providing a sense of measure to the vast landscape being surveyed. Powell's interest however was in the specifics of the basin's topography. Adhering to the theory of the basin, Powell believed that detailed topographic maps along with the measures drawn from flow gauges, would be adequate to ascertain the quantity of water in each square mile of each basin.[9] The technical belief in the hydrological catchment to quantify the absolute total of water in a specific geographic extent allowed Powell to compare basins on the basis of the areal continuity these enumerations implied. Considering the Utah River Basin a "fair type of the whole", in the report the geologist distilled more than ten years of observations on the settlement of the arid region. Identifying pasturage and mining as two key subsets of possible land use, in Powell's view any agricultural activities would eventually be constrained by the water supplied by rivers. Irrigation was therefore necessary for the future needs of settlers to the region, and to ensure that the agrarian ideal which permeated discussions of American virtues was to be established in the West.[10]

Realising that the distribution of water, when already controlled by private landowners would not allow new settlers a fair share for their own use, he

9 Robert Follansbee (1994), *A History Of The Water Resources Branch, U.S. Geological Survey: Volume I, From Predecessor Surveys To June 30, 1919*, Washington: Government Printing Office, p. 28.

10 *Agrarianism* in the United States and Thomas Jefferson's idealised figure of the American "yeoman" farmer has been discussed by many authors. See for example A. Whitney Griswold (1946), T*he Agrarian Democracy of Thomas Jefferson,* The American Political Science Review, v. 40. n. 4.

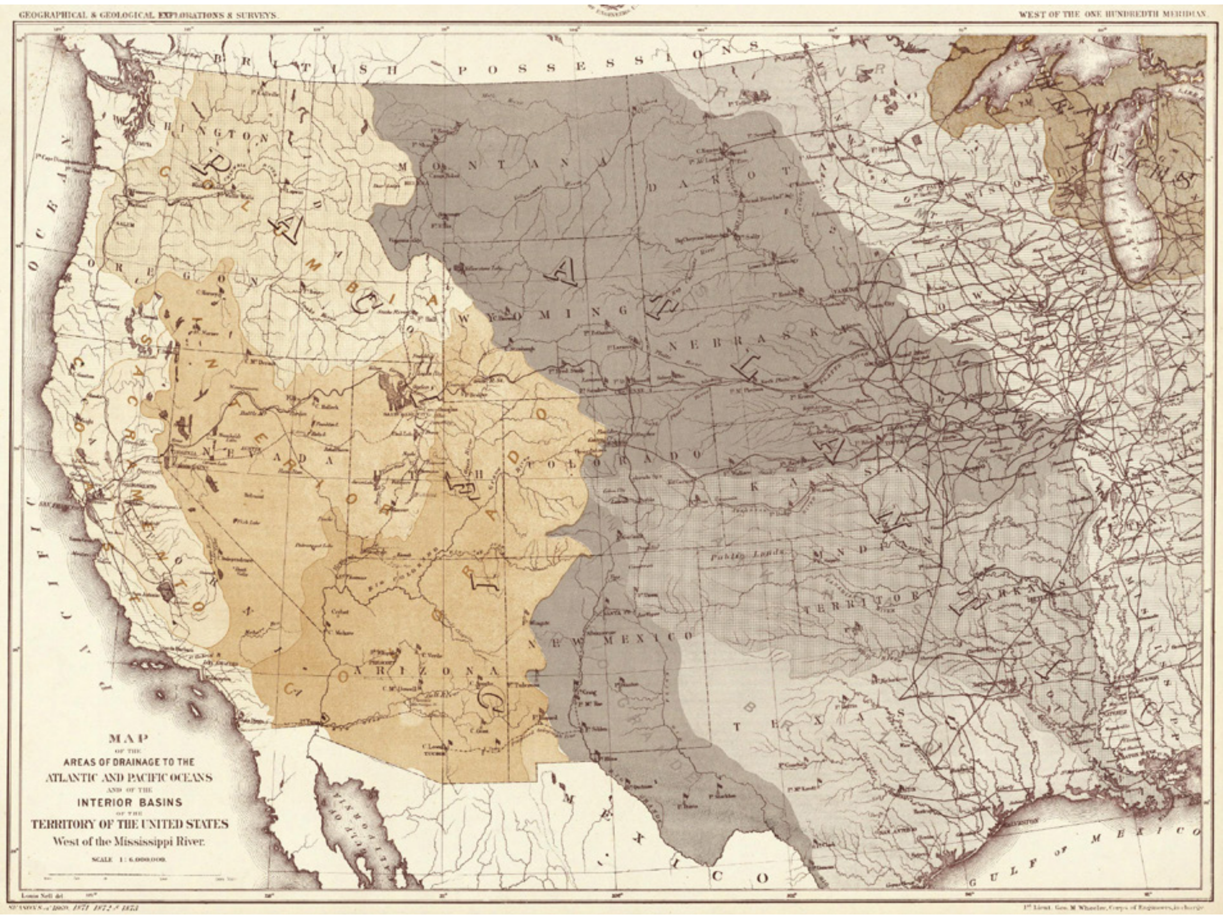

Fig 3.3 Map of drainage areas and river basins in the United States The maps prepared as a result of Wheeler's mapping expedition presented the West's drainage areas as a fundamental geographic subdivision of the vast terrain. George Wheeler (cartographer) (1889), *Topographical Atlas Projected to Illustrate United States Geographical Surveys West of the 100th Meridien of Longitude*, Washington : Government Printing Office.

considered it critical to reform the system of land parcelisation.[11] Powell's concern however was not directly aimed at the arbitrary "rectangular surveys now in vogue" or the actual "shape into which the lands were divided".[12] The new unbiased system of subdivision he envisioned should represent the interests of the greatest number of people rather than those of single individuals. Here, "the fair type" represented by the Utah Basin served as a background reference. Cooperative water management organizations known as *mutuals* collectively operated by the Mormons of Utah, served as the model of how groups of individuals could work together for communal benefit. Disregarding or perhaps idealising the cohesiveness of Mormon communities that made mutuals successful, Powell sought to organize irrigation districts throughout the arid region.[13] As he explained it:

11 The conventions of subdividing land for private use in the United States stemmed from the principles of the Public Land Survey System. The practice of orthogonal subdivision prevalent to the west of the Mississippi, was equally a matter of the convenience granted by the instruments of surveying, as much as it was the colonial principle for laying out new townships in accordance with the 1785 Land Ordinance. Lincoln's Homestead Act went further, providing a fixed plot measuring 160 acres (around 65 hectares) for anyone willing to settle in the region.

12 J.W. Powell (1879), *Report on the Lands of the Arid Region of the United States,* Washington: Government Printing Office, p. 39.

13 Lenni Benson (1982), *Desert Survival: The Evolving Western Irrigation District*, Arizona State Law Journal, v. 377, p. 380.

> *...all values inhere in the water, and an equitable division of the waters can be made only by a wise system of parceling the lands; and the people in organized bodies can well be trusted with this right, while individuals could not thus be trusted.*[14]

Therefore, to achieve an equitable subdivision of land, not only should land parcels respond to "the conditions under which the water could be distributed over them" but in addition, the settlers themselves should be given the "right" to undertake the parcelisation.[15] The sense that the people would need to be organized into groups was reflected in Powell's idea for *pasturage* and *irrigation districts*. These areal subdivisions would form the extent of an organized body's jurisdiction over parcelisation and, in the case of irrigation districts, conform to the existing 160-acre per homestead rule. As this system prevented lands from being subdivided prior to their requirement for the purposes of settlement, Powell proposed that subdivision would also require the simultaneous "adoption of a system of canals". Taking lessons from across the United States, these man-made waterways would not necessarily need to be constructed prior to occupation, but rather agreed upon as the principle on which the land's agricultural value was appraised.[16]

The proposal, however straightforward, was confounded by the scale of the endeavour and the need to accurately record each property's absolute extent and position. Moreover, maps showing mineral deposits on land formally belonging to Native Americans required surveyors to deal with political issues.[17] Returning to Congress in 1890, Powell presented a complete theory on the organizational relationship between land, water and human activity. Expanding on his previous proposal, Powell identified the magnitude of irrigation districts directly with the outline of the arid region's river basins.[18] Discussing the Arkansas Valley, he stated:

> *The whole arid region may be divided in like manner into natural districts or drainage basins, each one of which has its problems so interwoven that the entire district must be considered in planning its system of irrigation works, but which is practically independent of all other districts.*[19]

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14 Powell (1879), p. 38.

15 *ibid.*

16 *ibid*, p. 167.

17 The acceleration of settlers moving westwards, saw extensive reappraisal of Indian Reservations. Delineated according to principles of orthogonality, the straight boundaries of reservations had almost nothing to do with the configuration of hunting grounds, and only broadly overlapped with a tribe's ancestral landscape. Scott Kirsch, suggests that the often bloody conflicts between Native-Americans and settler were absent from maps. Instead, the scientific mentality governing decisions in Washington sought to employ mapping to transform "the people and their institutions into objects of study". The transformation was aided by maps compiled by Powell's surveys of tribal languages during his short tenure at the Bureau of Indian Affairs. From the scientific perspective of ethnology, it was possible that Native-Americans forcibly relocated to areas significantly distant from their ancestral lands, would still, on the surface of the map, appear to be located within the same linguistically-contingent geographic space.

18 In the Eleventh report by the director of the USGS, the term "basin" is identified as both the specific extent belonging to a river and the spatial dimension of different types of hydrological conditions. Discussing, sometime interchangeably, catchment basins (collection), storage basins (detention) as well as drainage basins (discharge), Powell's multi-faceted use of the term gives the concept a specific material resonance. However, rather than diluting the basin's terminological specificity, Powell's text appears to be attempting to align the theoretical concept with his own observations of hydrological phenomena in the arid region.

19 J.W. Powell (1891), *Eleventh Annual Report of the Director of the United States Geological Survey. Part II – Irrigation: 1889-1890*, Washington: Government Printing Office, p. 215.

Powell's reference to the basin as the theoretical basis on which to divide the arid region, shifted emphasis from the self-regulating organization of irrigation districts to the planning of infrastructure works in relation to entire geographic space they encompassed. The technical relationship between water and human activity was reflected in the pragmatic classification of individual irrigation districts. Echoing Charles Lyell's geological hierarchy that "almost all the water is first carried to the highest regions, and is then made to descend by steep declivities towards the sea", Powell identified *headwater districts* (spanning between mountains and arable downstream areas); *river-trunk districts* (that subdivided the main flow of waterways into autonomous compartments) and; *lost stream districts* (whose flow ended in the salt lakes and deserts). Within this subdivision, the individual irrigation district - delineated as the catchment area of one of the main river's tributaries - was an independent part of the basin's greater whole [**Fig 3.4**]. How these districts were classified in relation to the rivers' "steep declivities", also indicated the functions they would undertake according to the "actions of running water". Thus, for example, "storage basins" or reservoirs planned around existing mountain pools and lakes would be located within headwater districts on higher ground. By identifying water collection, detention and discharge as different aspects of the same hydrographical basin, the "actions of running water" were presented as scientifically intelligible, and therefore potentially, within the control of modern engineering.[20]

The agency of water

By the time Powell reported to Congress in 1890, the principle of a "body politic" – as he called it - organized by people with immediate interest in a consistent supply of water for agriculture had already taken political form. In California, the 1887 Wright Act incentivised farmers to form irrigation districts specified by where California's farmer-constituents had their land rather than the extent of the state's catchments.[21] Calling for "another unit of government for specific purposes" Powell's intention to empower the settlers would require reorganization of the existing limits of jurisdiction to address the interrelated concerns of people living across administrative boundaries but within the same basin. These shared concerns were not limited to water. They extended more broadly to environmental management that Powell considered critical to efficient industrial production and social well-being. The conviction that the hydrographic basin was the geographic setting where these concerns converged, led Powell to express the need for rationalisation between State and district boundaries or else face endless conflict.[22]

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20 Referring to the hydrographic basin Powell states that these "natural features would present conditions which would control the engineering problems of irrigation and which would ultimately control the institutional or legal problems." *ibid*, p. 216.

21 The 1887 Wright Act referenced in Powell's report, had legislated the formation of cooperative irrigation districts in California's counties, organized where there was a "majority of holders of title to land susceptible of irrigation from a common source." Structured to maximize local control, the Act aimed to address the financing of large-scale projects by giving these legal entities the ability to incur indebtedness for all the irrigated lands in the district, including those unwilling to participate in collective water governance. Under the existing doctrine of "prior appropriation", farmers with early access to a particular source of water, could extract an unlimited supply from rivers or wells as long as the entire quantity was utilised. The tension between irrigation districts on the one hand and capitalist landowners with unrestricted access to water on the other, was among the many reasons that early irrigation districts defaulted over the decade following Powell's report. Benson (1982), p. 384.

22 The conceptual subdivision was made even more complicated by the interdependence between the districts themselves. Following the logic of the river's flow, downstream districts sharing a single source of water would have a direct interest in the efficient management of upstream areas belonging to a different, equally independent district.

Fig 3.4 Powell's map of the irrigation districts The 140 or 150 irrigation districts distinguished in the report, were described as twice the size of ordinary counties. Compared to De Gamond's artificial synthesis of hydrologically unrelated river basins into larger regional cooperatives [Fig 2.6], Powell's plan subdivides the larger basins into their constituent tributary catchments although irrigable land was not equally distributed among these spatial units. Note that Indian Reservations (like all other non-natural boundaries) are also subdivided into parts of larger irrigation districts.
J.W. Powell (1890), *Eleventh Annual Report of ther Director of the United States Geological Survey - Part II: Irrigation.*

To prevent divergence between water rights and land ownership, the federal government's active involvement was necessary. Where a district's irrigation required infrastructure of "common use", and where that use was not limited to the constituents of the district encompassing the water's sources (such as a dam or regional canal), the government was obligated to construct, on its own land, the necessary infrastructure works. The extent to which irrigation districts could function as units of governance was therefore confined to the technical autonomy granted by infrastructure. The same type of areal, bounded and internally contiguous delineation utilised for administrative subdivision, was considered critical to differentiating irrigation constituencies as well as governmental responsibilities. From this perspective the mapped delineation of the 140 irrigation districts was the first step for the public and the politicians in Washington to 'see' the basins.[23] The requirement to map the basin's topography in detail, stemmed from the belief that cartographic knowledge of the entire system was the necessary prerequisite for the rational use of land and water [**Fig 3.5**]. However, the idea that if the basin were to be planned – albeit only from the perspective of water - then it should be planned in its totality, was not just a reflection of the need for a predetermined, scientific 'masterplan'. One of the

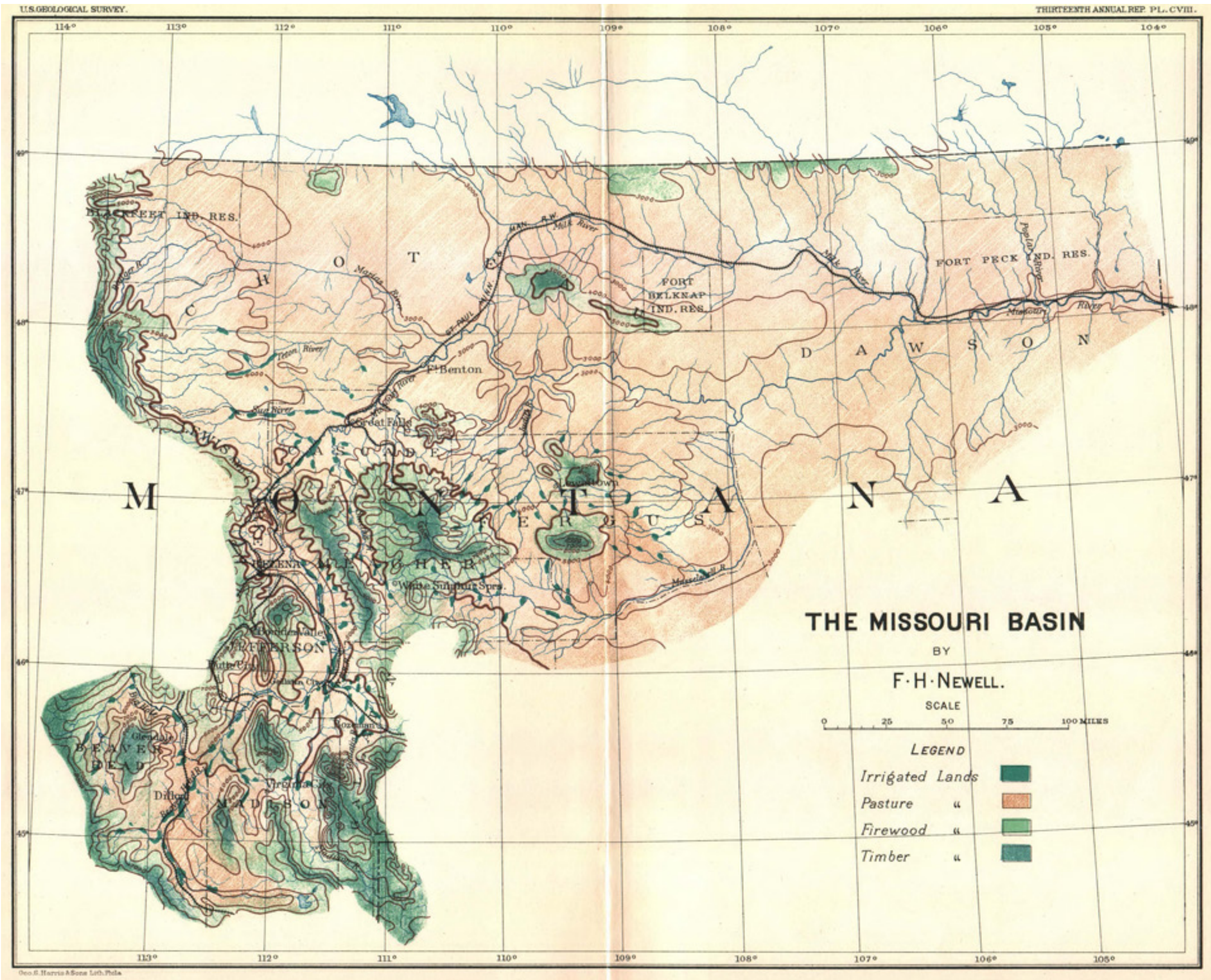

Fig 3.5 Land use map of the Missouri Basin Accompanying the 13th USGS report to Congress, similar maps outline designated areas of resource extraction (timber, pasture) and lands designated as potentially irrigable (and thus also suitable for settlement). Note the lack of an enclosing line except for the state boundary to the north. Instead, the basin appears as one segment of a larger continuity that is simply the subject of a different map.
Frederick Newell (cartographer) (1890), *Thirteenth Annual Report of the Director of the USGS - Part III: Irrigation.*

fundamentals of Powell's philosophy held that different kinds of bodies exhibited "homologies" – similarities based on theoretically similar evolutionary roots. As such all forms of rationality on earth differed only by degree and not by kind.[24] Through this "doctrine of morphology" Powell could conceivably reconcile the continuous geological forces shaping the earth's surface, with the appearance of the discrete bodies – such as basins - which constituted the subject of the USGS's cartographic inquiries.[25] The idea that among the earth's four particles, the *hydrosphere* (along with the *atmosphere, lithospehere* and *centrosphere*) was the conceptual layer through which water travelled from raindrop to aquifer, gave the planned disposition of water within the basin a planetary resonance.

William J. McGee, further developed Powell's philosophical and technical consideration of water resources across the geosphere.[26] Although in charge of anthropological studies, much of McGee's focus was on establishing the technical legitimacy of an approach to planning based on America's water resources. Considering that "the river no less than the man shapes its own valley", for McGee the hydrosphere and the molecular composition of water as H_2O, were vital "object-matters of knowledge" because of their planet-shaping agency.[27] The conception that water itself had an active, autonomous role in shaping terrestrial processes was expressed in *The Outlines of Hydrology* where:

> *As a part of the hydrosphere, the stream exists and moves; as an agency, it works; as a worker, it modifies both its environment and itself.*[28]

Jeremy Schmidt, who has analysed McGee's *oeuvre* with respect to his particular philosophy of water, has argued that "the agency of water" was formed around the idea of a basic unit or module, represented by water's chemical formula. However, unlike Rousseau's earlier meditations of an agency of nature shaping human affairs, McGee's agency of water was not only a cognitive reflection. Schmidt suggests that despite the reduction of water into its basic units, McGee's view was hardly reductionist, envisioning instead a much broader scope for what could be achieved by focus on hydrology. Redefining "water as a resource" in an eponymous 1909 essay, McGee maintained that mutual social and geological evolution were absolutely dependent on water.[29] Using information gathered by the recently

23 Understandably, what area was defined as *arid* was extremely important to the public. The broad designation of all areas "west of the 100th Meridien" as arid was problematic especially for temperate Western states such as Washington. In Congress, Powell was accused of squandering public funds on detailed topographic surveys for the entire area of irrigable agriculture including the rivers' sources and the extent of all surface water. His opponents contended that detailed maps were only needed for those areas where the government needed to construct public infrastructure. The difference between what the maps should contain, reflected the pressure from Western politicians following the suspension of the Homestead Act in the arid region until all surveys were complete. Everett Sterling (1940), *The Powell Irrigation Survey, 1888-1893*, The Mississippi Valley Historical Review, v. 27, n. 3, pp. 429-430.

24 J.W. Powell (1898), *Truth and error; or, the science of intellection*. Chicago: The Open Court Publishing Company, p. 9. See also Jeremy Schmidt (2014), *Historicising the hydrosocial cycle.* Water Alternatives, v. 7, n. 1, p. 225.

25 For Powell, bodies were not necessarily singular forms but also multiple forms working together as a system. *"There are systems of stars, and every system is a body." ibid*, p.10.

26 Initially a geologist at the USGS, when Powell was replaced as the agency's head, McGee followed him to the Smithsonian Institute's Bureau of Ethnology, taking over as director when Powell retired.

27 W.J. McGee (1908), *Outlines of Hydrology*, Bulletin of the Geological Society of America, v. 19, p. 194, 197.

28 *ibid*. p. 201.

29 Schmidt (2014), p. 227. See also W. J. McGee (1909), *Water as a Resource*. The Annals of the American Academy of Political and Social Science, v. 33, n. 3, *Conservation of Natural Resources*, p. 43.

instituted Bureau of Reclamation, McGee translated the value of water into the economic terms of infrastructure investment. Apportioned according to the spatial unit of the watershed, the suggestion was that development (in the form of dams, reservoirs or canals) reflected human agency in terrestrial evolution.[30]

Critiqued as ethnocentric for his focus on American values, McGee's views are nonetheless valuable to understand a broader trend in what contemporary scholars have called a *hydraulic bureaucracy*.[31] While irrigation does not immediately translate into a specific hierarchy or authority, the state's focus on securing and rationalising water use over its domain, necessitated an institutional transformation that highlighted the role of managers, experts and scientists. Institutional change was given a spatial dimension as states adapted their administrative practices to the representation of the country depicted in new detailed maps. As a mode of governance, the basin, or more precisely the institution of irrigation districts based on the basin, was considered better than arbitrary delineations – not only because the geographic space was coterminous with a theoretical aspect of nature, but because it functioned as the conceptual medium linking human action and geographic space. With all things (water, the planning for water, the social group controlling water) measured and controlled with respect to that one type of hydrological subdivision, the probability of all interests – both natural and man-made - converging was far higher than if each had a different spatial reference. From this perspective, even if Powell's version of irrigation districts was ultimately rejected, the technical concept of water management was institutionalised on the same terms as it was conceived by the engineers, geologists and technicians of the state. The agency of water, already implied in Lyell's geological theory of uniformitarianism, was a power to be harnessed for the benefit of the many and not the few.

Conceivably there could have been alternatives to the focus on the basin. As California's irrigation districts show, viable planning for water resources is possible locally without necessarily referencing the river's geographical extent [**Fig 3.6**]. Districts such as Imperial Valley on the border with Mexico, have been operating – today - for more than a century, based on the principles of self-governance. Yet to achieve this local autonomy, the state and its scientific elite would have had to have already intervened to make that autonomy possible. Without the diversion of the Colorado River to maintain a steady flow of water, Imperial Valley may still have been mostly desert. And, for the Colorado's diversion to have been engineered, water resources would have had to have been considered with respect to that vast area represented on maps by the river's basin. Other modes of controlled water distribution were also practiced. Native-

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30 The correlation between efficient environmental management, social relationships and the geographic space of catchments, gave cause to reconsider how water and land related in legal terms. Only seven years earlier, the call for better managed systems to protect, but also to minimize waste, had coalesced in a law that limited the maximum individual share of water for irrigating land in the West. Capped at the quantity necessary to irrigate 160-acres, the excess land law was considered necessary to justify spending public funds on infrastructure from which only private landlords stood to gain. In this sense, the right to own land did not include the right to receive an unlimited supply of water. Paul Taylor (1950), *The 160-Acre Water Limitation and the Water Resources Commission.* The Western Political Quarterly, v. 3, n. 3, p. 435.

31 State agencies such as the US Bureau of Reclamation (1902), Siam's Department of Canals (1902), Mexico's National Irrigation Commission (1926) are broadly categorized as hydraulic bureaucracies. The term is based on Karl Wittfogel's theory of *oriental despotism* linking the formation of Asian states with the control over irrigation. See for example François Molle, Peter Mollinga & Philippus Wester (2009), *Hydraulic Bureaucracies and the Hydraulic Mission: Flows of Water, Flows of Power.* Water Alternatives, v. 2, n. 3, p. 332-333.

Americans that may have perceived the value of knowing the river's sources did not map the catchment and were arguably susceptible to extreme fluctuations in annual meltwater from distant mountains. In the country's East where rain was plentiful, water management was mostly an urban affair and where irrigation engineering was consistently practiced, it referred more to the drainage of swamps or flooded fields than the supply of water. The concept of the basin was therefore far from being acclaimed as universally valuable to agricultural practices.

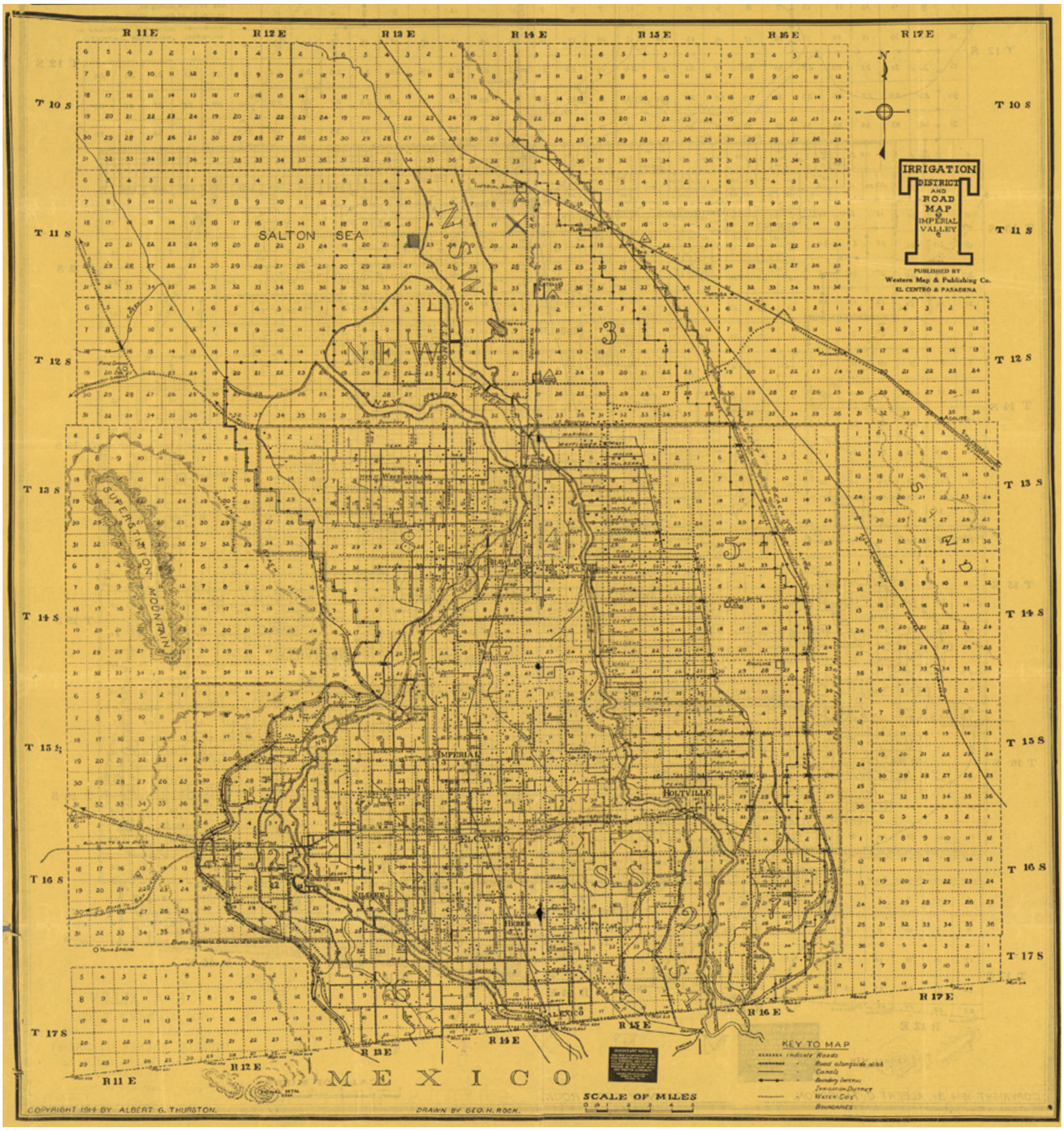

Fig 3.6 Imperial Valley Irrigation District Located at the border with Mexico, and lying below sea level topographically, Imperial Valley became an irrigation district in 1911, a decade after the diversion of the Colorado River enabled water to reach the valley's desert landscape. Note that the district's boundary follows both the gridded subdivision and the hillside topography (bottom left).
Thurston & Rock (1914), *Irrigation district and road map, Imperial Valley*, Pasadena CA: Western Map and Pub. Co.

Yet it was in the process of considering practical problems such as irrigation, that the basin's notional outline became representative of a type of control. For government scientists in positions to influence policy like Powell and McGee, this control was not *over* nature. Geology's subdivision of the West was most efficient (or least wasteful) not just because watersheds were natural and thus not beholden to the distorting politics of land. But equally, because synchronizing human actions with the agency of water, guaranteed these same actions would be coordinated with reference to the molecular motions of a nature unfolding across distinct planetary layers. Undeniably these secular, scientific views of nature were not representative of Native-American beliefs or any majority of the religiously-inclined American public. Basins were almost imperceivable as unified geographic entities from first-hand experience, and maps displaying them too rare for the concept to become popularly accepted. Even within government, only the technical and legal implications were essential for county engineers or state technicians to plan and operate infrastructure. Apportioning water, forests and even land, with reference to the basin however was not just a different way for government bureaucrats to subdivide the unknown West. If in Europe the basin was, at least temporarily, the *working object* of a new geographic science, in the United States it became the reference for the *working object* of scientific governance which espoused control of people and the physical environment through the lens of nature's laws.

The TVA's catchment

The Great Depression which began with the collapse of America's financial markets in 1929 followed almost two decades of growth in domestic agricultural production.[32] Between 1926-1940, the worst affected agricultural regions were located in America's mid-West where drought compounded the economic situation, and the dry eroded topsoil and strong winds transformed the vast plains into a 'dust-bowl'. Despite some of the highest rates of farm foreclosures recorded in mountainous, arid states such as Colorado, federal recovery efforts under the New Deal programme focused in America's Southeast. Unaffected by the drought in the west, the predominantly agricultural population of the Tennessee River's valley had experienced devastating floods. But it was the perception of wide-spread poverty in America's "backward" South – an idea that had persisted for decades before the Depression – that was the cause of different efforts to improve social and economic conditions.[33] Along the 120 km stretch of the Tennessee's mainstream known as Muscle Shoals, the shallow rapids which were considered dangerous for navigation had become the site for the new Wilson Dam, and the epicentre of proposals to produce hydroelectric power and reuse two former ammunition factories.[34] After multiple attempts to implement modernisation

32 The collapse in global commodity prices following the end of the first world war brought on a prolonged "farming crisis" that lasted until the second world war. While traded prices for cash crops partially recovered, almost a quarter of American farmers were in financial distress during the 1920s. HCM Case (1960), *Farm Debt Adjustment during the Early 1930s*. Agricultural History, v. 34, n. 4, pp. 173-174.

33 Commonly considered "backward" or even a "colony" of the industrialized North, America's South had been the target of modernization efforts since the early 1900s. Months into Roosevelt's administration, and after the president had toured the "birthplace of the confederacy", the federal government instituted a new regional development corporation aimed at improving livelihoods through planning. See Joseph Kiernan (2016), *The Age of Infrastructure: The Triumph and Tragedy of the Progressive Civil Religion*. Penn History Review, v. 23, n. 2, Article 3, p. 33; Ekbladh (2002), p. 337.

34 Completed in 1925, the dam was intended to improve water-borne transport and produce hydropower. The intention to convert two former ammunition factories in the same area into fertiliser plants had existed since the early 1920s.

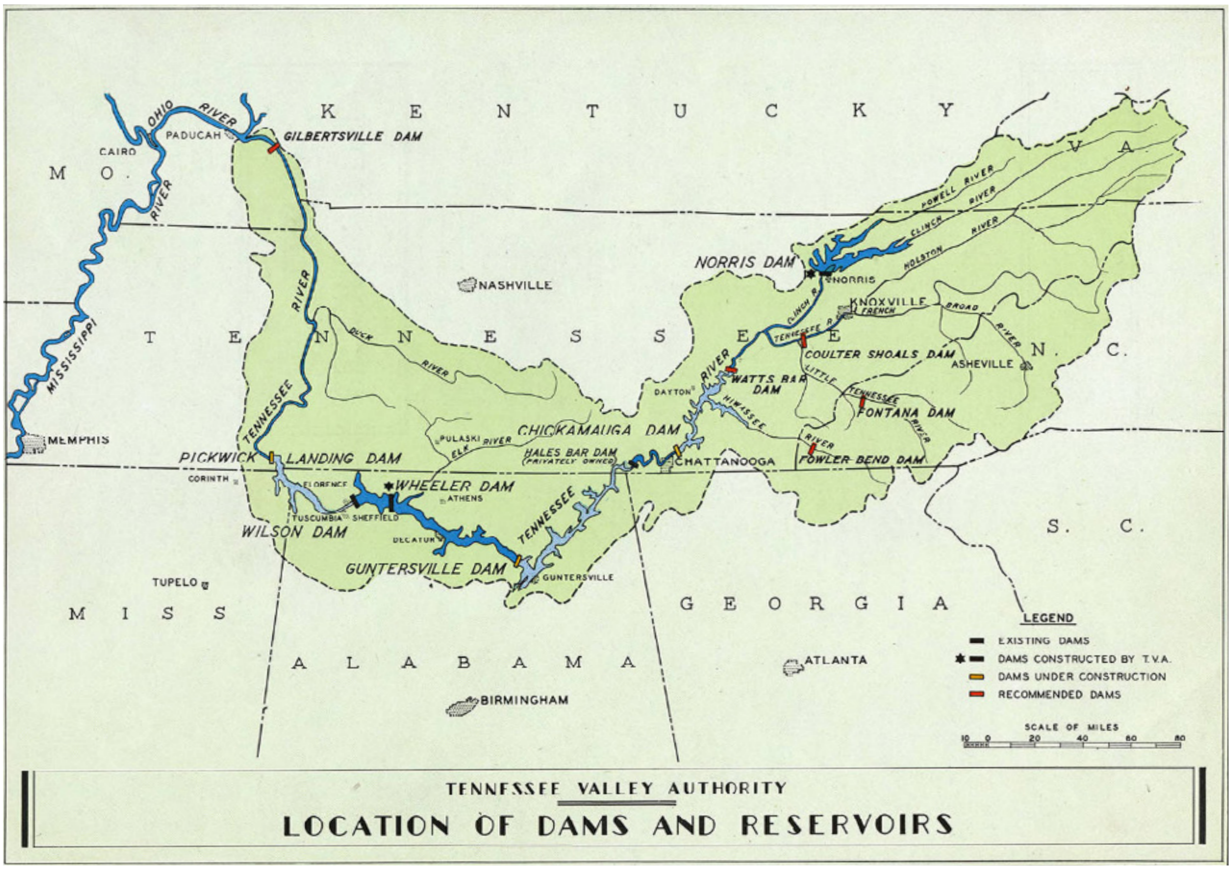

Fig 3.7 Dams and rivers of the Tennessee Valley Accompanying the TVA's infrastructure masterplan for the region, the map depicts the location of planned dams. Not labelled, the dotted delineation of the darker green area represents the limit of the river basin. Note the variation in the colour of river water between dams. The presence of the watershed conceptually redefines the content it frames, making the collection of hydraulic infrastructure and the river appear as a single system that is neither wholly natural nor wholly manmade.
Tennessee Valley Authority (1936), Report to the Congress on the Unified Development of the Tennessee River System, p. 12.

efforts with a new public organization (Muscle Shoals Corporation) were blocked by legislators, the bill authorising the formation of the Corporation was passed in 1933 to become widely known as the Tennessee Valley Authority Act.

Over the decade since its first introduction, the scope of the Act had changed from a development project aiming to improve navigation, control flooding and produce fertiliser at the former factories, into a project with multiple, intertwined goals including hydropower.[35] Drawn on maps, the infrastructure projects the TVA was tasked to construct and operate, were presented within the context of the Tennessee River's basin [**Fig 3.7**]. Symbolic of hydrological knowledge of the entire river system's flows, cartographic references to the basin's extent appeared to frame the extent of the TVA's mandate in terms of the area of water. However the geographic correlation of the basin with the full range of social, technical and environmental problems the TVA was tasked with resolving was more dubious.

35 The 1933 Act provided primarily for the river to be brought under control and to be made navigable. According to law scholar Martin, "only after the requirements of flood control and navigation should have been met, it named as a purpose the production and sale of electric power." Moreover, the only provision made in the Act concerning agriculture was the production of fertiliser at Muscle Shoals. See Roscoe C. Martin (1957), *The Tennessee Valley Authority: A Study of Federal Control.* Law and Contemporary Problems, v. 22. (Summer), p. 361, and Norman Wengert (1952), *Antecedents of TVA: The Legislative History of Muscle Shoals*. Agricultural History, v. 26, n. 4, p.141.

The issues of crop failure, poverty and soil erosion were not exclusive to the Tennessee's Valley [**Fig 3.8**]. And even events that concerned the Tennessee River itself - such as flooding or navigating shallows - were not system-wide phenomena but concentrated along particular stretches or tributaries, while inundations sometimes overflowed into neighbouring rivers. From this perspective, the question of what the river's catchment's outline represented cannot be answered by simply assuming that solutions to these problems were resolvable within the Valley or determinable through hydrological knowledge of the entire river system. The reasons why the catchment was adopted to frame the TVA's operations on maps is therefore important if the "TVA-model" and subsequent references to catchments in relation to the Mekong River are to be understood.

Perhaps the most compelling explanation for the recurrent outline of the basin on maps, is the simple fact that it represented the limits of the Tennessee Valley. Historically, the association of the Tennessee River with the geographic space of a valley emerged simultaneously with maps projecting the topography of the eponymous state. The pictographic clarity with which some early cartographers framed the passage of the river between the adjacent mountains contradicted first-hand experience of the terrain [**Fig 3.9**]. Carved into the geomorphology of the Appalachian mountains, the upper reaches of the Tennessee's tributaries descended through multiple distinct valleys that were later inhabited by isolated farming communities. Clearly, the river itself connected the valleys to each other . But to collectively perceive them as belonging to the same, continuous geographic space would require maps to 'simplify' the terrain they portrayed. While the

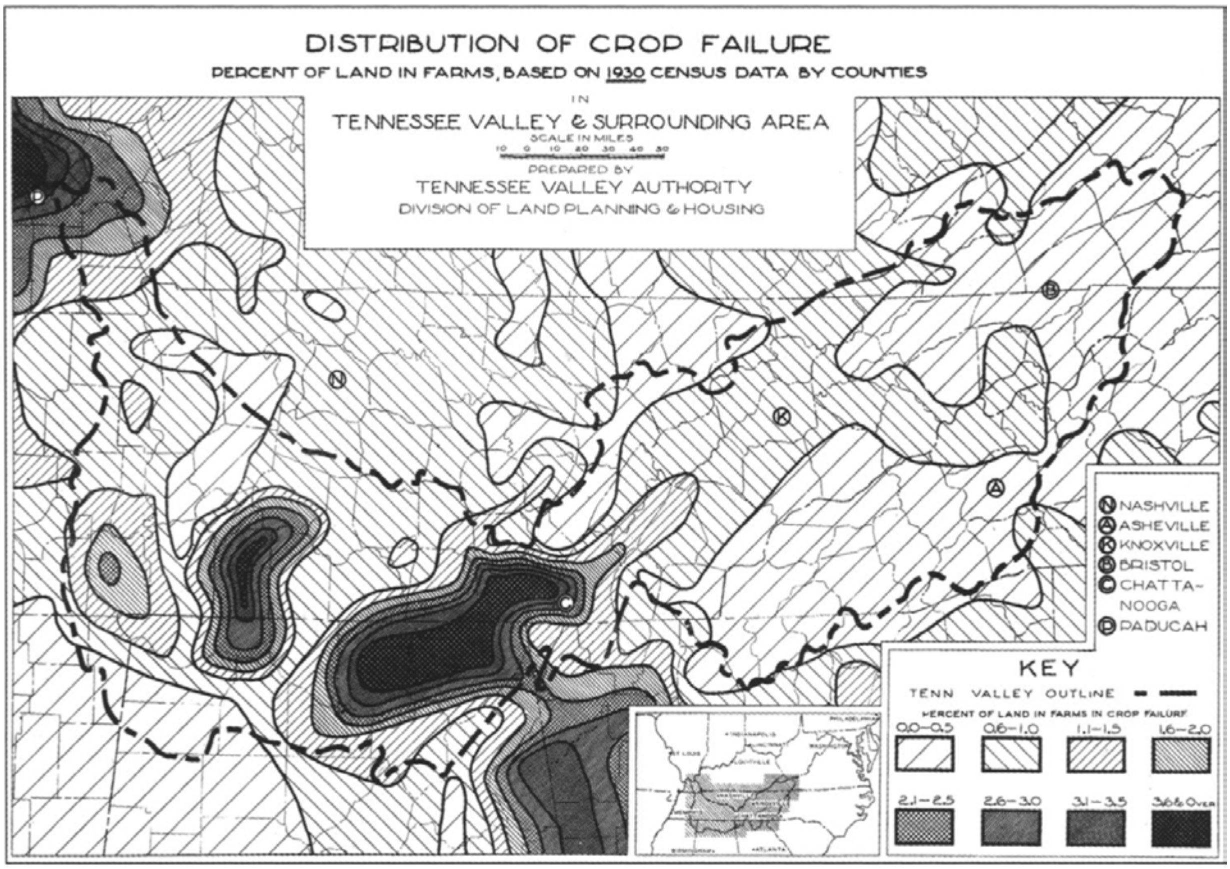

Fig 3.8 Farmland in crop failure Showing the proportion of land facing crop failure, the map suggests that the problems the TVA was created to resolve extended beyond the limits of the river basin (dotted line).
Tennessee Valley Authority (1936) from Ronald Reed Boyce (2004), p.30.

Fig 3.9 Excerpts of maps of the State of Tennessee These two maps of Tennessee show the different ways the State's terrain was conceptualised. In Carey's version (left) the mountains dividing the watersheds of the Cumberland and Tennessee rivers are accentuated suggesting one single valley, whereas Louis' map (right) displays the fragmented Appalachian geomorphology divided into multiple smaller valleys.
Matthew Carey (cartographer) (1814)*, State of Tennessee;* Samuel Louis (cartographer) (1804)*, State of Tennessee.*

epicentre of subsequent maps prepared by the TVA would remain on the river itself, the furthest edges of surveys and studies would encompass the Tennessee River's drainage basin and any "adjoining territories" deemed to be affected by the operations of the TVA. However, the geographic space over which the TVA was given the power to exercise eminent domain and "to construct dams, reservoirs, power houses, power structures, transmission lines, navigation projects, and incidental works" was defined as any point *along* the Tennessee River rather any space *within* the basin.[36] If the TVA's ability to fulfil its primary directives was limited to the works possible along waterways, then those areas furthest from rivers that described the edges of the basin would – at least in theory - remain outside the Authority's scope. Insofar as the legal language of the TVA Act could indicate the power of the governmental organization, the allusion to the length of the Tennessee's waters was much more indicative of the Authority's control than the basin's extent.

As electricity generation became increasingly viable, maps of the river became increasingly more detailed. Hydrographic surveys prepared by military engineers not only outlined the shoreline and flood extent but also indicated sections of the river suitable for hydropower dams [**Fig 3.10**]. Although the Muscle Shoals rapids were recognized as having stream flows sufficient to propel power-producing turbines, the issue of producing electricity from rivers was not merely technical. Inspired by McGee's discourse and the increasing influence of the conservation movement, the debate over the exploitation of rivers for power generation raised various arguments regarding the privatization of water resources.[37] The ideological rift between political supporters of the public ownership of dams and

36 *"Shall have power to acquire real estate for the construction of dams, reservoirs, transmission lines, power houses, and other structures, and navigation projects at any point along the Tennessee River, or any of its tributaries..."* U.S. Congress (1925). *United States Code: Muscle Shores Act*, 16 U.S.C. §§ 831-831 cc Suppl. 7.

37 Initiated under Theodore Roosevelt, the growing conservation movement adopted the viewpoint that rivers were public assets and their use should only aim to be for the greater public benefit.

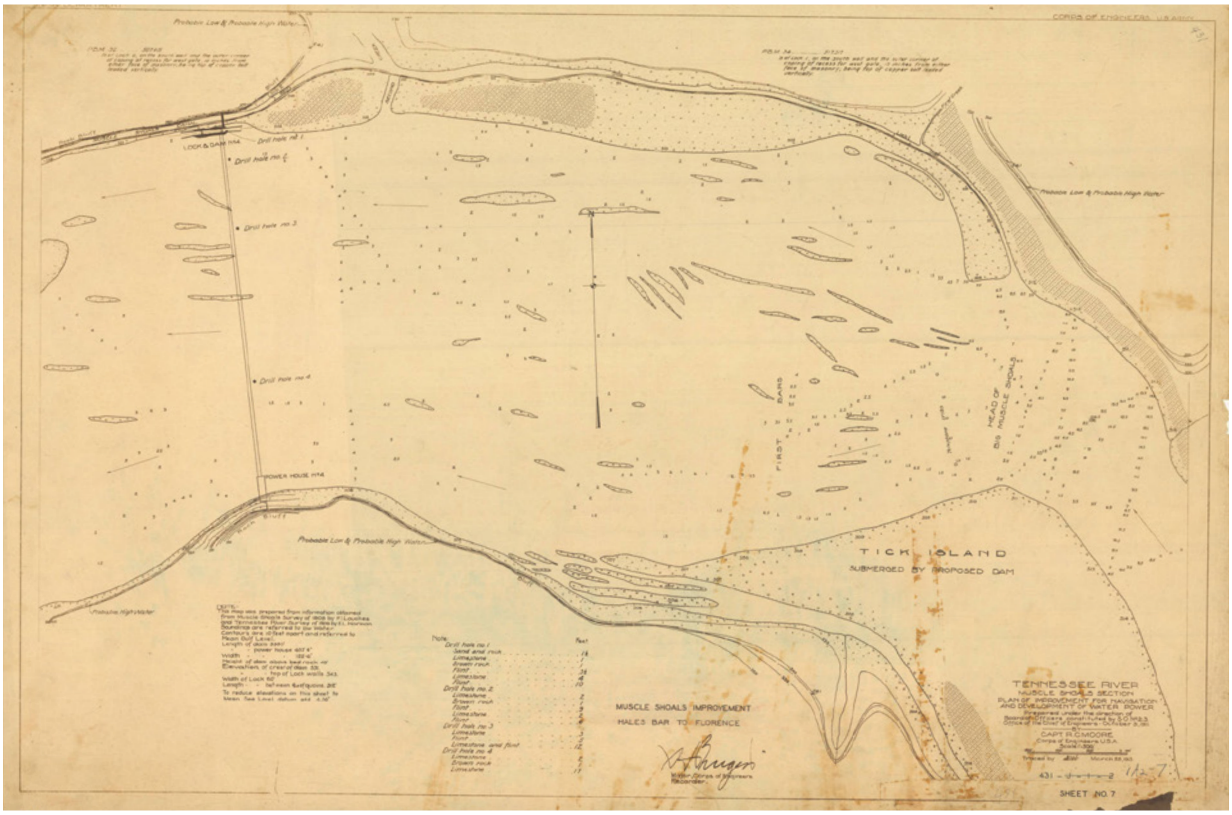

Fig 3.10 Muscle Shoals improvement plan By 1911 the US Army Corps of Engineers had completed the necessary surveys to proposed improvements to navigation and water power development along the Muscle Shoals section of the Tennessee. The map identifies the high and low water levels and notes the (permanent) submersion of "Tick Island".
US Army Corps of Engineers - Nashville District (1910/ rev. 1913), *Tennessee River Muscle Shoals Plan of Improvements Sheet 07- Drawing 431, Charts of the survey of Tennessee River made in 1909.*

private enterprise showed its full extent at Muscle Shoals. Since its completion, the Wilson dam had operated far below full capacity, providing electricity only as far as the former ammunition factories, three miles away. While investors made unsuccessful bids to exploit the dam's electricity-generating capacity few, if any, provisions were made to ensure how electricity should be geographically distributed.[38] Left to free-market capitalism, the service areas of private utilities rarely extended to dispersed agricultural homesteads, while any existing voltage lines were concentrated close to the generating source. Federal power projects would therefore need to consider the range (or area) of transmission, a geographic space that would not necessarily align with any existing mapped delineation, either political or natural.

The TVA's transmission system however proved less a technical and more an economic and political challenge. After new studies by the US Corps of Engineers confirmed initial assessments on the river's upstream hydropower potential, Southern states within transmission distance of the power plant began to demand equitable distribution, claiming equal rights to any electricity produced along the river.[39] With the prices initially comparable to those of private utilities, the

38 The 1920 Federal Water Power Act avoids any specific mention of the geography of power distribution.

39 The question of "equitable" distribution became increasingly important when the FPC's 1928 report revealed the dubious competitive practices of private utilities, convincing many politicians that government control was preferrable to a barely regulated market. Preston J. Hubbard (1959), *The Muscle Shoals Controversy, 1920-1932*. Historical Quarterly , v. 18, n. 3, p. 202.

Authority needed to encourage county and municipal administrators to connect directly with the TVA.[40] Prompted by the availability of federal loans, municipal governments constructed power distribution systems that sometimes duplicated those operated by private utilities. The situation forced a compromise that transferred existing distribution assets to the TVA, while placing restrictions on the Authority's service area, effectively differentiating where privately-run power oligopolies would dominate the market.[41] The extent of service areas was therefore not the result of planning but rather formed through a strategy of compromise between private and publicly operated utilities. In terms of electrification, the river basin was therefore neither an indication of the limit of a service area nor indeed of the system of regional power distribution.

From this perspective, maps showing electrification in the Tennessee Valley along with the Cumberland River Basin immediately to the north, are conspicuous for the pronounced display of the basin [**Fig 3.11**]. Part of a policy decision to consolidate the TVA's distribution network northwards, maps showed the Tennessee and Cumberland basins combined into one (dotted) outline. Prepared with framing conventions more common to technical plans, the map's most prominent features are the darker lines indicating the network of the TVA's transmission lines. The lines extend westwards, beyond the limits of the Valley to join the service areas of private utilities while to the east, the lines stop at the service areas of other private utilities located within the basin. By neither

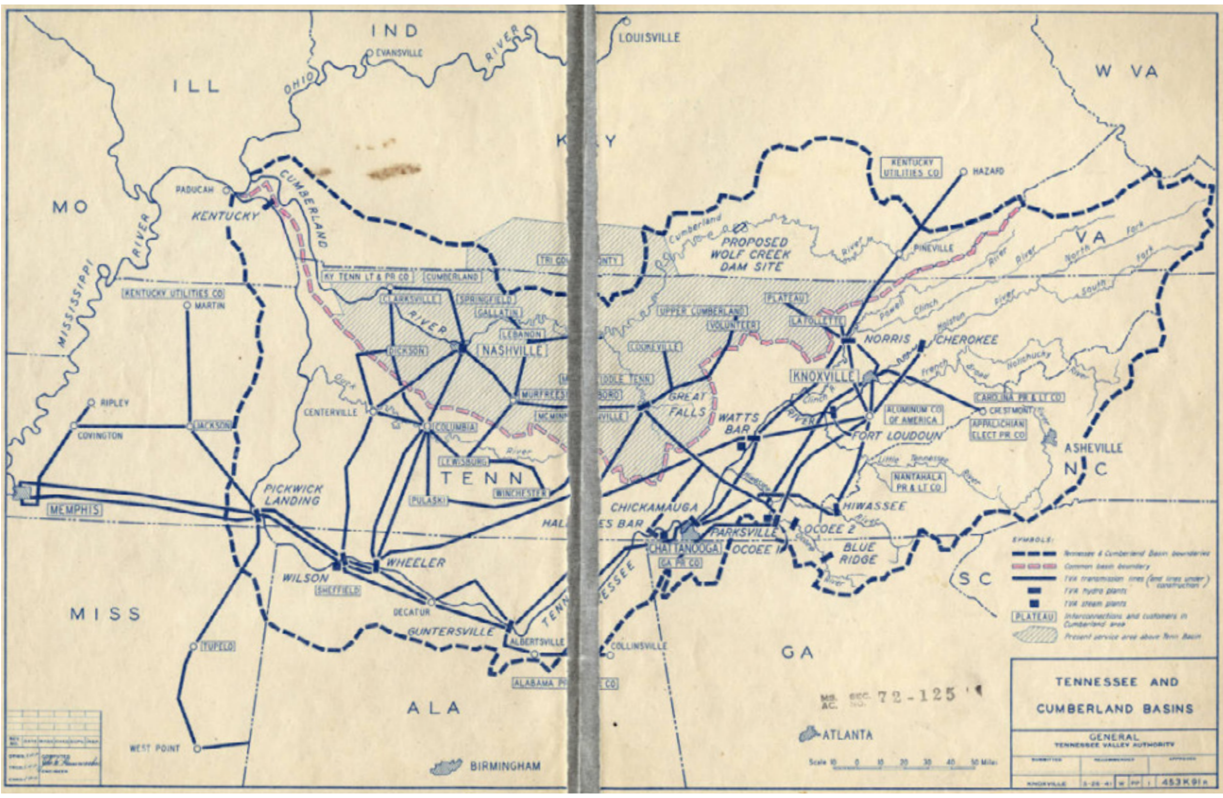

Fig 3.11 Tennessee and Cumberland Basins The map constructs a new geographic dimension for regional power generation and distribution, composed of both the Tennessee and Cumberland rivers (both draining into the Mississippi). The combined basins form the spatial reference to display transmission lines, service areas, hydro and steam plants. Note the extent of the TVA service area which extends north of the Cumberland Basin (blue hatch). Note also that the transmission lines extend westwards beyond the combined basin while the service areas of private utilities companies (with names inside rectangles) are shown within the east part of the basin.
Tennessee Valley Authority (1941), *Tennessee and Cumberland Basins.*

'containing' the TVA's service area nor excluding the service areas of other companies, the basin's outline clearly does not indicate a specific relationship with power distribution. However, the proposed amalgamation of the catchments on the map did replicate the "works boundary" of the US Corps of Engineers.[42] The organization tasked with full responsibility for the majority of water and power infrastructure projects related to the two rivers, the Corps was not involved in power distribution or the operation of hydropower facilities. References to the Corps' works boundary are therefore either coincidental or indicate the alignment of engineering concerns such as the planning of new infrastructure, with the TVA's extended area of responsibility. If this alone does not suggest any direct cause for the persistence of the basin in mapped representations of power distribution, it does confirm that what was being represented by the catchment's delineation was not related to any particular action of water. And while this depiction may not have necessarily framed a technical relationship, by illustrating power distribution in relation to the combined water volume from the two rivers, the map suggests the pictorial alignment of the New Deal's anti-recession policies with a particular extent of geographic space that was neither a county nor a state.

Where perhaps the outline of the river basin would have been expected to have had the greatest resonance was in the management of the actual water with which power was produced. Along the Tennessee River, floods were not concentrated along one particular stretch of river, with recurring disasters along both the mainstream and the tributaries. To control inundation, the designed volumetric capacity of new dams and reservoirs would include provisions for retaining floodwater during the wet season.[43] Albert Fry, the TVA's expert in flood engineering and head of hydraulic data collection described a landscape where dams had transformed almost one thousand kilometres of the Tennessee River into a series of lakes. In his words:

> *Through this system of reservoirs and the interconnecting natural channels, the run-off from the 41.000 square miles of drainage area within the Tennessee Basin is continuously flowing.*[44]

To engineer the new flood-proof 'equilibrium" of constantly flowing water in the basin, existing waterways and new infrastructure were considered collectively as part of the same hydraulic system. With each reservoir temporarily detaining

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40 Clayton Clem & Jeffrey Nelson (2010), *The TVA Transmission System: Facts, Figures and Trends*. Proceedings of the 2010 Institute of Electrical and Electronics Engineers International Conference on High Voltage Engineering and Application, October 11-14, 2010, New Orleans, Louisiana USA, p. 2.

41 Carl Kitchens (2014), *The Role of Publicly Provided Electricity in Economic Development: The Experience of the Tennessee Valley Authority, 1929–1955*. The Journal of Economic History, v. 74, n. 2, p. 395. The 1935 amended Federal Power Act made explicit references to the geographic space in which power is produced and transmitted, giving authority to the FPC to divide the country into districts for the voluntary interconnection and coordination of electric facilities. U.S. Congress (1920). *United States Code: Federal Power Act* [June 10, 1920, ch. 285, pt. III, § 321, formerly § 320, as added Aug. 26, 1935, ch. 687, title II, § 213, 49 Stat. 863]. Part II - Regulation of Electric Utility Companies Engaged in Interstate Commerce, Sec. 202 (a), p. 848.

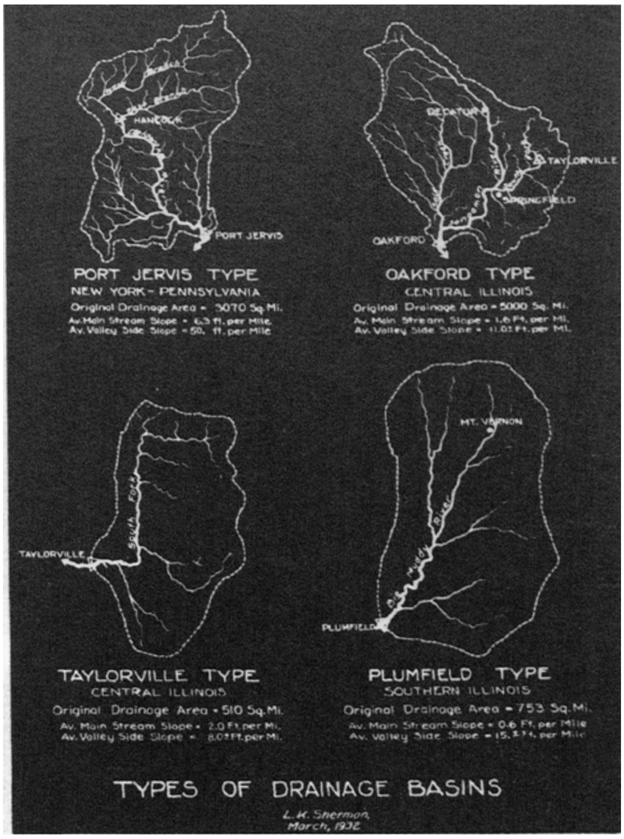
42 Based in the Cumberland section of Tennessee, the Corps' military engineers had only recently been reorganized into a single District encompassing both basins. Leland Johnson (1978), *Engineers on the Twin Rivers. A History of the Nashville District Corps Of Engineers United States Army.* U.S. Army Engineer District – Nashville, pp. *vi* and 167.

43 The worst flood in history had occurred across almost the entire Tennessee basin in 1927. However most floods were relatively localised with the town of Chattanooga or the Duck River experiencing regular inundations due to their specific location within extensive drainage areas.

44 Albert Fry (1948), *Recent Developments in Hydrology With Respect to Stream Flow Forecasting*, IAHS Congress, Oslo, p. 143.

and redirecting a calculated portion of the overall surface run-off, water control operations were distributed across the entire river catchment. Yet having made flood control dependent on manmade changes to water flows, maintaining the new equilibrium required “an intimate knowledge of all of the streams throughout the basin and their watershed and runoff characteristics.”[45] By the 1930s the determination of the quantity of anticipated flood waters relied on increasingly more sophisticated mathematical models. Of these, Leroy Sherman's *unit hydrograph* concept was the most successful and well-known explanation of river basin behaviour.[46] Developed before 1932, the hydrograph allowed the river’s overflow to be quantified assuming uniform rainfall across the entire basin. Using measures from stream gauges, the mean daily discharges of individual streams could be plotted and then extrapolated to compute the river’s runoff history for rainfall of any duration or degree of intensity.[47] While the scientific image of the basin captured by the axes of the hydrograph did not directly incorporate any parameters relating to topography, it allowed a glimpse into the invisible world of subterranean water flows which were critical for detailed flood forecasts.[48] The observed similarity between the peaks and slopes of the plotted data permitted Sherman to classify basins according to the mathematical representation of their characteristics, despite each encompassing different geographic spaces [**Fig 3.12**]. Thus having determined the graph for the original basin, Sherman’s typological classifications promised that the characteristics of other, similar basins could also be known, regardless of their actual areal magnitudes.

In the Tennessee’s valley where it had become necessary to forecast stream flows in distant locations where first-hand observations were not available, Sherman’s method was particularly useful.[49] To overcome the lack of data, the TVA defined typical, “index areas” centred on the catchments of minor tributaries for more



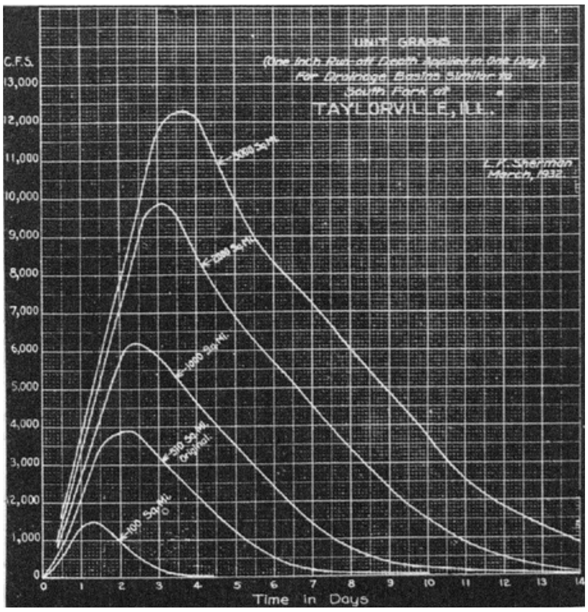


Fig 3.12 Sherman’s unit-hydrograph The graph plotted time (period of rainfall) against the volume of water per second of rainfall. Based on the depicted behaviour of water, hydrologists could forecast the anticipated impact of a weather event of any duration or intensity.
LeRoy Sherman (1932), *The relation of hydrographs of runoff to size and character of drainage-basins*, Eos Transactions, American Geophysical Union,v. 13, n. 1.

detailed study, extrapolating from these the hydrological characteristics of an "area considerably larger than that of the tributary".[50] Subdividing the basin into measurable units also helped overcome the hydrograph's other major limitation which assumed rain fell uniformly across the entire region. This had made the single hydrograph difficult for forecasting floods in regions larger than ten thousand square miles.[51] The focus on smaller units of the river flows rather than the vastness of the entire basin allowed the TVA's Hydraulic Data Division to configure the location of data collection points according to the new geography of information gathering and processing.[52] The idea that the hydrological catchment could be known through the representation of information on a graph, allowed technical decisions to be made based on the graphical configurations of data. Mapping, which would once have recorded the visible extents of pondage and overflow for individual streams, would now be accompanied - and in one sense substituted by – the geometric properties of the hydrograph's lines. Moreover, by envisioning the path to attain complete knowledge of the basin, engineers were brought one step closer to accomplishing total control of the river's resources.

Planning *unity*

Cartography was nevertheless a critical part of the TVA's technical mission. The Division of Land Planning and Housing directed by the landscape architect Earl Draper incorporated geographers and surveyors tasked with classifying land within the Tennessee's basin. This was especially important where land was to be inundated by new reservoirs. The task of the TVA's cartographers did not only require extensive data collection in remote settlements. In order to frame the data through the outline of the catchment, a consistent level of detail was also necessary over the entire basin. Reacting to the generalisations espoused by advocates of environmental determinism, practitioners of geographic science considered detailed mapping and field studies as the only way to reveal the correlation between social and environmental phenomena and therefore what could or should be done.[53] The scale of the undertaking in the Tennessee Valley however meant that a conventional plot-by-plot inventory would take decades. In an effort to accelerate the process with an acceptable loss of detail, the TVA's

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45 *ibid*, p. 143

46 Rafael L. Bras (1999), *A Brief History of Hydrology - The Robert E. Horton Lecture*. Bulletin of the American Meteorological Society, v. 80, n. 6, p. 1152.

47 LeRoy Sherman (1932), *Streamflow from Rainfall by Unit-graph Method*. Engineering News Record, v. 108 (April 11), p. 501.

48 Fry (1948), p. 148. Developed during the same period as the *hydrograph*, Robert Horton's theory of infiltration divided the study of rainfall into two distinct phenomena: surface runoff and groundwater. Having determined the volume of total rainfall not contributing to surface runoff through stream flow observations, the anticipated groundwater volumes could also be plotted across the duration of a storm.

49 *ibid*, p. 146.

50 *ibid*, p. 147.

51 For Sherman the maximum extent of basins was five thousand square miles, while after a decade of methodological improvements, Fry and the TVA had managed to successfully plot the runoff of river basins up to ten thousand square miles.

52 *ibid*, p. 144.

53 Ronald Reed Boyce (2004), *Geographers and the Tennessee Valley Authority*. Geographical Review , v. 94, n. 1, p. 26. A critique of environmental determinism in the 1930s was also expressed by Hartshorne especially for the assumption that "within areas of any particular type of natural vegetation the peoples of one major cultural group will tend to develop the same form of agriculture." See Harthorne (1936), pp. 273 and 318.

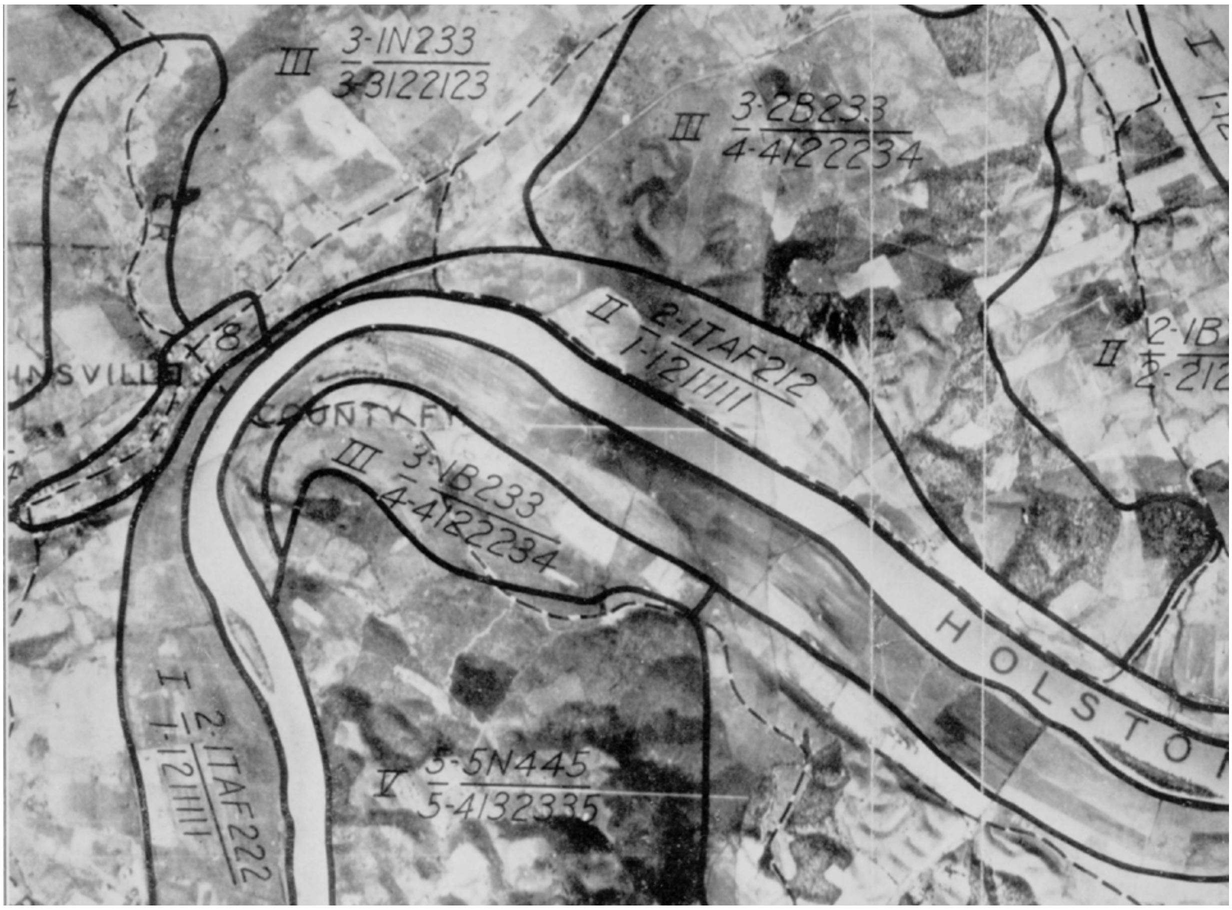


Fig 3.13 Excerpt of TVA survey map Drawn on an aerial photographic mosaic, the map shows the units and the notations describing their characteristics as noted during the field survey. The numerical (so-called *fractal*) code indicating particular physical characteristics of the surveyed area allowed the TVA to identify the use of marginal lands and determine broader regional planning interventions such as the treatment of soils, forest conservation or the location of new towns.
Hudson (1936), Fig-1.

geographers developed the "unit-area method of land classification" that would allow a single surveyor to inventory up to 50 km^2. Using orthophotographic maps as the background, the new method redefined the minimum unit of surveying as an areal extent covering eighty hectares [**Fig 3.13**]. The magnitude of the unit meant that if certain topographic or soil characteristics appeared "individually or in combination" within only one part of the unit, then the entire unit would be classified according to that specific characteristic.[54] As the only insight into the ground condition of distant locations, the multiple farms and private properties displayed in each survey unit were treated according to the characteristics of their classification. Although this method would eventually lead the TVA to purchase more land than was necessary to build dams and reservoirs, this type of spatial analysis was pertinent in dealing with the problem of land erosion.

On paper, the TVA's agricultural program was limited to the production and supply of nitrate fertilisers. In practice, the TVA also actively advised farmers on the treatment of topsoils, especially the cultivation of slopes along the basin's

54 Almost twice as large as the average homestead, maps based on the minimum unit were of limited use for the analysis of farms. Having been mandated to identify the proper use of marginal lands however, the overview of the terrain's occupancy was useful for determining the extents of broader regional planning interventions such as the treatment of soils, forest conservation or the location of new towns. Donald Hudson (1936), *The Unit Area Method of Land Classification*. Annals of the Association of American Geographers v. 26, n. 2 p. 105.

narrow upland valleys that usually resulted in deforestation and degraded faster during rain storms. Concentrated in locations sometimes at a significant distance from waterways, the agricultural practices causing erosion were critical factors in the region's economic decline.[55] Yet where maps were useful in defining the geographic extent of the problem, planning solutions stemming from the findings of surveys were never adopted. Despite the TVA's planners favouring the determinacy applied to city planning to deal with the rural environment, the possibility of delineating zones for conservation or reforestation conflicted with the narrow scope of the organization's legislative mandate and the ideology of its directors. The existence, even of cartographically accurate maps, was therefore not in itself a guarantee that identified problems would be resolved according to their specific spatial dimension. Nonetheless as geographer Torbert has argued, by identifying subregions within the Valley, the maps *did* demonstrate the misconception of treating the entire basin as one single unit, and revealed the urgency of customising planning approaches to the specifics of geographic space.[56]

Paradoxically for a planning project, the determination of the extent and location of land uses by the TVA clashed with the ideological leanings of the organization's influential director. A lawyer by training, David Lilienthal replaced Arthur Morgan as director of the organization. An engineer with pronounced racist views, Morgan had supported the use of analytical maps for comprehensive planning of the region but had faced opposition from Lilienthal who, as a member of the Board of Directors, advocated for voluntary, bottom-up participation in planning. Morgan's dismissal for supporting direct competition with private utilities, gave Lilienthal the platform to expand on his own particular interpretation of the TVA and the significance of the river basin.[57] Writing two years after assuming the TVA's directorship, Lilienthal made a retrospective case for the organization's role in demonstrating the benefits of decentralised administration. Attacking the principle of "one rule fits all", Lilienthal pointed out that the faults inherent in the "bigness" of centralised administration extended to political units.[58] As the governance model best able to respond to local needs by allowing decisions to be made "in the field", the TVA had acted to geographically distribute the powers held in Washington and to repair what he saw as a deficit in local democracy. But what had enabled the successful leap to a decentralised mode of administrative control was not just an issue of where to focus, but how that focus was constructed. According to him:

> *The area of its [the TVA's] operation, based upon geographic and economic realities rather than political boundaries, has made a decentralized administration possible.*[59]

The claim that geographic and economic relationships were perhaps more indicative of 'reality' than established forms of regional administration such as states, counties or incorporated settlements, suggests Lilienthal's critique of centralised administration was not just the absence of local participation in

55 *"The consequences, in terms of erosion and siltation, may constitute a serious hazard to the Authority's program".* From an unpublished 1938 TVA document authored by geographer E. N. Torbert. Quoted in Boyce (2004), p. 31.

56 *ibid*, p. 29.

57 Critically, with Morgan's departure, the spatial analyses prepared during the first six years of the TVA were also terminated, and several reports and maps were never published. See Boyce (2004).

58 David Lilienthal (1940), *The TVA and Decentralization.* Survey Graphic, v. 24, n. 6, p. 336.

59 *ibid*, p. 337.

decision-making. A synthesis of factors was required to define the area in which federal control was exercised, if this area was to reflect the problems collectively experienced by the region's residents. Yet unlike Powell, who defined participation as the people exercising a measure of direct control over local resources, Lilienthal was less concerned with the civic responsibilities of the region's residents. Rather, his argument to regionalise federal administrative powers was framed as a pragmatic way to coordinate the resolution of composite problems. In his opinion, the magnitude of the area of operations should be calibrated to be of "workable" size to allow close contact to the people and their problems.[60] To necessitate, but also to justify the creation of regional administrative control, these separate issues would need to be considered and resolved collectively. Calling on the *concept of integration*,[61] Lilienthal explained that:

> *The problems of the Tennessee Valley were viewed as a single problem of many integrated parts, and the program adopted for their solution was entrusted to one agency to carry out, rather than divided into many parts to fit [...] existing governmental instrumentalities.*[62]

Acknowledging that in some respects the Tennessee River system is not a self-contained unit, the Directors' 1936 report to Congress stressed that the problems the TVA was tasked to resolve were not only inter-related, but also extended across individual states.[63] What made the many parts into a single problem that could be conceptualised as a whole was, as Lilienthal admits, a matter of perspective.[64] This perspective had been established by the conservation movement's concern over the public ownership of natural resources and the realization that dams, when also considered for hydropower generation, where infrastructural investments that performed well against multiple social and economic goals. Yet consciously dealing with many problems does not immediately translate into seeing them as *integrated*, except perhaps in the philosophical sense of a broader national interest. And even if each of the many "parts" of the overall problem could be grouped, they would still have been understood to have their own unique causes.[65] Thus, except for seasonal flooding, few of the social or economic problems faced by the residents of Tennessee could be attributed to the flow of the river. If anything, the concept of integration was more convincingly framed from the perspective of governance than through the specific causes and effects of identified problems. Yet does this mean that the specific extent of the basin presented on maps was only incidental to the establishment of regional control? In other words, had the focus on the Tennessee Valley already determined the interpretation of the region's problems as

60 David Lilienthal (1944), *TVA Democracy on the March*. New York & London: Harper Brothers, p. 154.

61 It has not been possible to detect what formulation of the *concept of integration* Lilienthal is referring to when discussing the synthesis of multiple problems.

62 Lilienthal (1940), p. 337.

63 Tennessee Valley Authority (1936), *Report to the Congress on the Unified Development of the Tennessee River System*, Knoxville, TN: Tennessee Valley Authority p. 41.

64 *"I have no confidence in the elaborate rituals by which some technicians think they can determine what constitutes a region. No one can work out a formula for what is in reality a judgment that does not lend itself to such precise measurement."* Lilienthal (1944), p. 153.

65 The serious erosion threatening farmers for example was the result of cultivating the forested slopes of the narrow valleys with rain-fed row crops such as corn and tobacco, and was not limited to the region encompassed by the Tennessee Valley. Similarly, the absence of an electricity network to serve remote settlements was a result of the state-regulated power-supply market dominated by private, profit-seeking corporations.

integrated, simply by the problems coexisting (in part or in full) within the same cartographic outline?

Where administration was concerned, the TVA Act had vested federal control over resource management directly to the organisation, giving legal power to the TVA to mediate between those levels and departments of government whose jurisdictions intersected in the Tennessee Valley. From Lilienthal's point of view, the Tennessee Valley marked an area where, for the specific functions it was mandated to perform, the TVA had exclusive and non-overlapping control. What perhaps had changed in the intervening years was a shift in focus from the length of the river to the extent of the Valley. Hydrologists and military engineers claimed the basin was an environment with specific rules, that those rules could be known and that once known the basin, or rather the flows of water within the basin, could be controlled. The administrative focus on an engineerable terrain suggests that it was regionalised control that initially found a home in the shape of the basin rather than the other way around. The alignment between control and the river basin was vividly expressed by Lilienthal:

> *For the first time in the history of the nation, the resources of a river were not only to be "envisioned in their entirety"; they were to be developed in* ***that unity with which nature herself regards her resources- the waters, the land, and the forests together****...*[66]

Yet the "unity" to which the development aspired was not the creation of the nature that Lilienthal described. From the perspective of engineers such as Albert Fry, the terrain no longer resembled the hydrological operations of the basin's primordial geography but rather the mapped plans on which those operations had been transformed. With the assurance that increasing scientific knowledge of the basin's hydrology could explicate the interrelationship between the Tennessee's thousands of streams and waterways, the TVA engineered the flows of water in multiple locations to behave as a single unit. If the water, land and forests were to be considered collectively as 'nature', then this nature would thereafter be dependent on technicians closing floodgates or maintenance crews removing storm debris to maintain the equilibrium which unity implied.

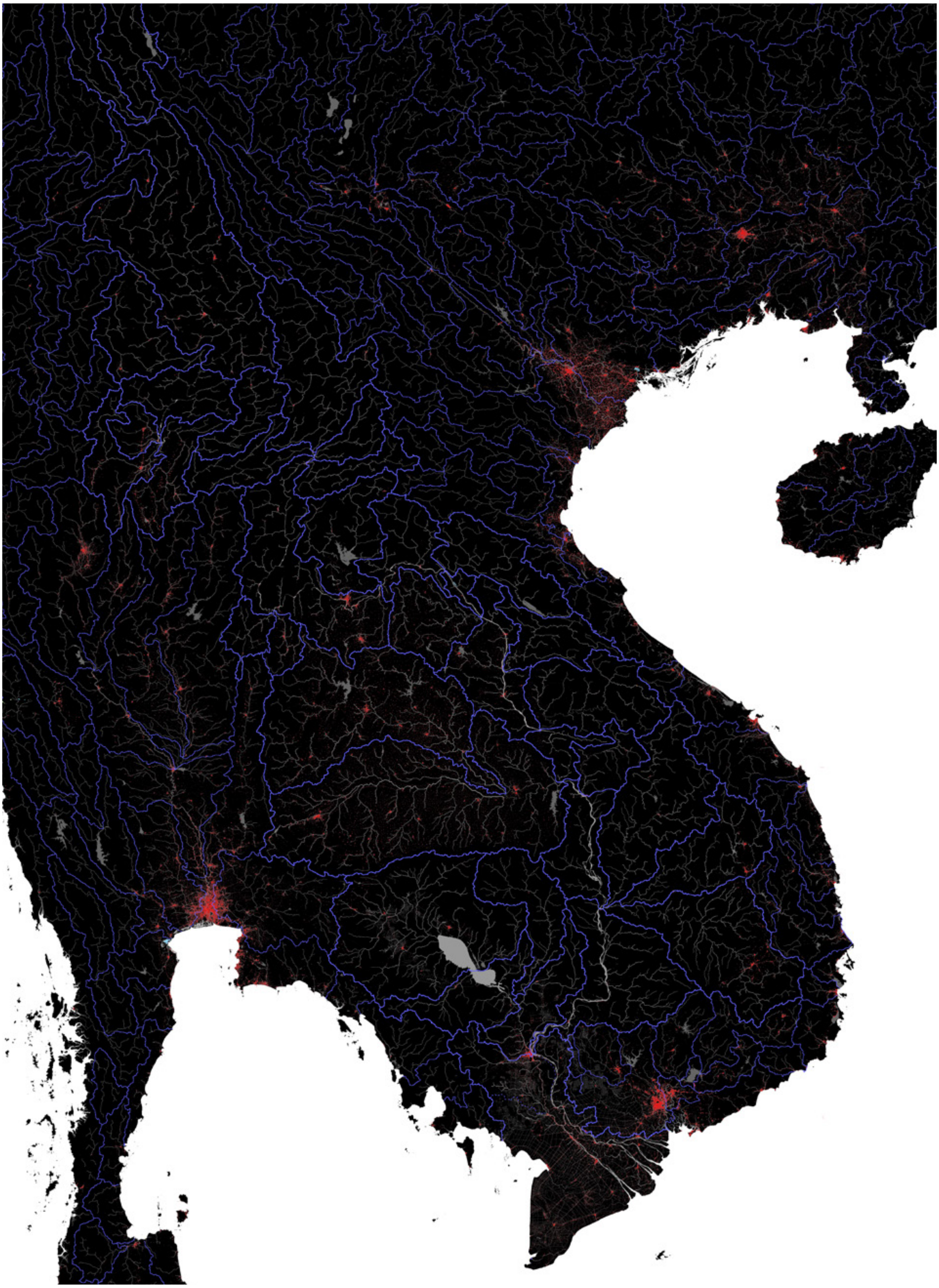
Conclusion

The Swiss geographer Claude Raffestin, has defined the condition of ecosystems that would otherwise disappear without humans to maintain them as *domestication*. Since their adaptation to both the preferences and rhythms of human utility has privileged certain characteristics and eliminated others, Raffestin suggests that domesticated ecosystems could be considered as new objects that "reflect the mark of the system of intentions framed by the culture of the group".[67] Of course, the Tennessee Valley's ecology was never uniformly contingent on the flows of the river to be considered a finite ecosystem confined within the catchment. Even so, the new interdependence between water and people *was* finite. Considered through the lens of domestication, Lilienthal's natural *unity* was observable in the shape of the basin, having been created and then maintained by the operation of the TVAs concrete dams and reservoirs. From this perspective, Lilienthal's but also Powell and McGee's invocations of the

66 Emphasis in original. Lilienthal (1944), p. 48.

67 Claude Raffestin (2012), *Space, territory and territoriality*. Environment and Planning D: Society and Space, v. 30, p. 137.

basin could be seen to be discussing a natural ‘order’. This order was apparent in the cartographic figure of the catchment that differentiated the collective flows of one specific river from all others, but also indicated how the people living and working in that geographic space would, or perhaps should, behave in relation to those flows. The administrative *area of operations* delineated by the basin on maps of the Tennessee Valley was therefore equally a reflection of the realities of geography and the regional economy, as it was the limit of a plan or a blueprint – the pictorial representation of a specific course of action. If the basin’s outline was a critical component of the ‘TVA-model’, then this plan did not just aim to control water. Expounded and applied in the Mekong region, the suggestion was that adherence to the concept of the basin would also regulate human actions according to the same scientific logic with which the natural order was made known on maps.



Map C Derived from different sources including topographic elevations, the map shows the basins of the waterways draining into the Mekong mainstream (blue line) and the extent of settlement (red shade). Rather than 'contained' within the outline of a basin, important urban centres (Bangkok, Ho Chi Minh City, Hanoi, Phnom Penh) appear to be located at the confluence of multiple catchment areas.
Author (2022). Spatial data sources: *HydroBASINS Asia (Hydrosheds, 2007); Urban footprint (DLR, 2016).*

CHAPTER 4 The river's nations

In the elaboration of this concept, as in most creations of the human mind, one can discover an element which escapes both logic and technique and which to a degree transcends both. The part played by this element, which might almost be termed mystical, has not been negligible.

Integrated river basin development, UN Panel of Experts, 1958

The reputation of the TVA as a model of global development began as the second world war ended. Lilienthal's widely distributed book *TVA – Democracy on the March* expanded on the benefits of local, "ground-roots" participation, underlining the project's paradigmatic purpose to unite "Nature and Mankind" within the "oneness" of the river's valley.[1] Stressing that implementation required the formation of an international agency structured on the TVA's "public-private prototype", Lilienthal's rhetoric of democracy and self-sufficiency found appeal among the leaders of newly independent nations seeking to legitimize their post-colonial authority with infrastructure investment. Thus while the TVA experience was never repeated within the United States, the 1940s already saw the concept of unified river basin development applied in India and Mexico.[2] The increased recognition of the river basin's value however, did not immediately translate to the concept's application in France's Asian colonies.[3] Although French Indochina encompassed a significant portion of the Mekong's riparian areas, the demand for electricity was limited and, concentrated within the colony's dispersed urban centres, could not justify exploitation of the entire river for hydropower production.[4] And, where navigation or floods were concerned, these were not universally considered problems requiring resolution through the TVA-model. Without an evident and immediate need to produce power, mitigate floods or improve water-borne transport, the incentive to study the Mekong's basin as the site for regional planning arose under different circumstances. Within a period of escalating Cold War antagonism, the appearance of "unity" offered by the outline of the basin was considered important to halt Soviet influence on the independent

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1 *"A great Plan, a moral and indeed a religious purpose, deep and fundamental, is democracy's answer both to our own homegrown would-be dictators and foreign anti-democracy alike. In the unified development of resources there is such a Great Plan: the Unity of Nature and Mankind. Under such a Plan in our valley we move forward."* Lilienthal (1944), p. 197.

2 In Europe, resolving problems related to drainage, sewerage and power generation from rivers was accompanied by institutional changes. Between the world wars, water management, either by cooperatives or by government authorities, became aligned with the geographic extent of the hydrological catchment in Germany and Spain. See Molle (2009), p. 488.

3 According to historian Vincent Lagendijk, few systematic studies of the Mekong were prepared prior to WW2, even though the river's potential was recognised. The French "model" for exploiting rivers was framed by the *Compagnie Nationale du Rhône* instituted in 1921 to develop hydropower, navigation and irrigation along one of France's longest rivers. Current scholarship however does not link the operations of the *Compagnie* with the development of water infrastructure in colonial Indochina.

4 By 1945 there were only two hydropower generators in French Indochina in relatively distant mountain regions. Electricity, mainly produced with diesel engines was distributed within proximity of the source although much (...)

countries which emerged from the dissolution of Indochina. Under the auspices of the United Nations, the determination of the geographic space encompassing the "entirety" of the river's basin was elaborated in response to political reality and the elevation of the concept as the spatial unit for international development and collaboration. Based on maps and plans prepared by the UN's geographers and engineers, this chapter examines the ideas which allowed the Mekong's basin to be considered the most suitable scale for the collective planning of water infrastructure. More importantly however, the chapter looks to understand how the imagined geographic unity implied by adherence to theory of the basin was expressed in the projects for dams and irrigation that came to characterise the post-war exploitation of the river's water.

From drainage area to development unit

The post world war elevation of the TVA into a template for world-wide water infrastructure development was not only the result of Lilienthal's book. Exemplifying an approach rooted in "technical and scientific expertise", the idea that river basins could situate the modernisation efforts of the world's least-developed countries within a specific geographic space, was promoted in various programmes and by the Agency for International Development (USAID).[5] As the historian Vincent Lagendijk argues, "TVA-like" solutions to the problems of socioeconomic distress became the cornerstone of American foreign policy, especially as Cold War tension with the Soviet bloc escalated into a battle for influence. Even as the TVA's technical concepts were "exported" from America to the planning of the Damodar Valley in northeast India, the idea that the engineering of water infrastructure within the cartographic outline of a river basin could also "help engineer peace", resonated with new global organizations such as the United Nations and the World Bank.

The conceptualisation of the basin as the setting for collaboration between opposing parties emerged where post-colonial national boundaries apportioned control of rivers according to sovereignty over the land through which the river flowed. On this principle, the division of the Kashmir Valley into Indian and Pakistani jurisdictions, had left India in control over the highland sources of the Indus River that were critical to Pakistan's vast downstream agricultural economy. Faced with an unresolvable political and military situation, the proposal to use the Indus River's basin as the basis for a common cooperative project between the two countries was proposed by Lilienthal. In an article published in 1951, Lilienthal asserted that such as project – to include new dams and diversions - would aim to develop the whole Indus system as a single unit, similar to the "seven-state TVA".[6] Claiming that the joint venture was functional rather than political, he concluded that:

> [Pakistan's] *present use of water should be confirmed by India, provided she works together with India* [...] *a joint use of this truly international river basin on an engineering basis that would* [...] *assure India's future use as well.*[7]

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4 (...) more extended networks were deployed in the flat, low-lying regions around Hanoi and Saigon. See Hugues Tertrais (2002), *L'électrification de l'Indochine.* Outre-mers, v.89, n. 334-335, *L'électrification Outremer de la fin du XIXe siècle aux premières décolonisations*. pp. 591-592.

5 Vincent Lagendijk (2019), *Streams of knowledge: river development knowledge and the TVA on the river Mekong*, History and Technology, v. 35, n. 3, p. 321.

6 David Lilienthal (1951), *Another Korea in the Making?*, Collier's Weekly, August 4, 1951, p. 58.

7 *ibid*.

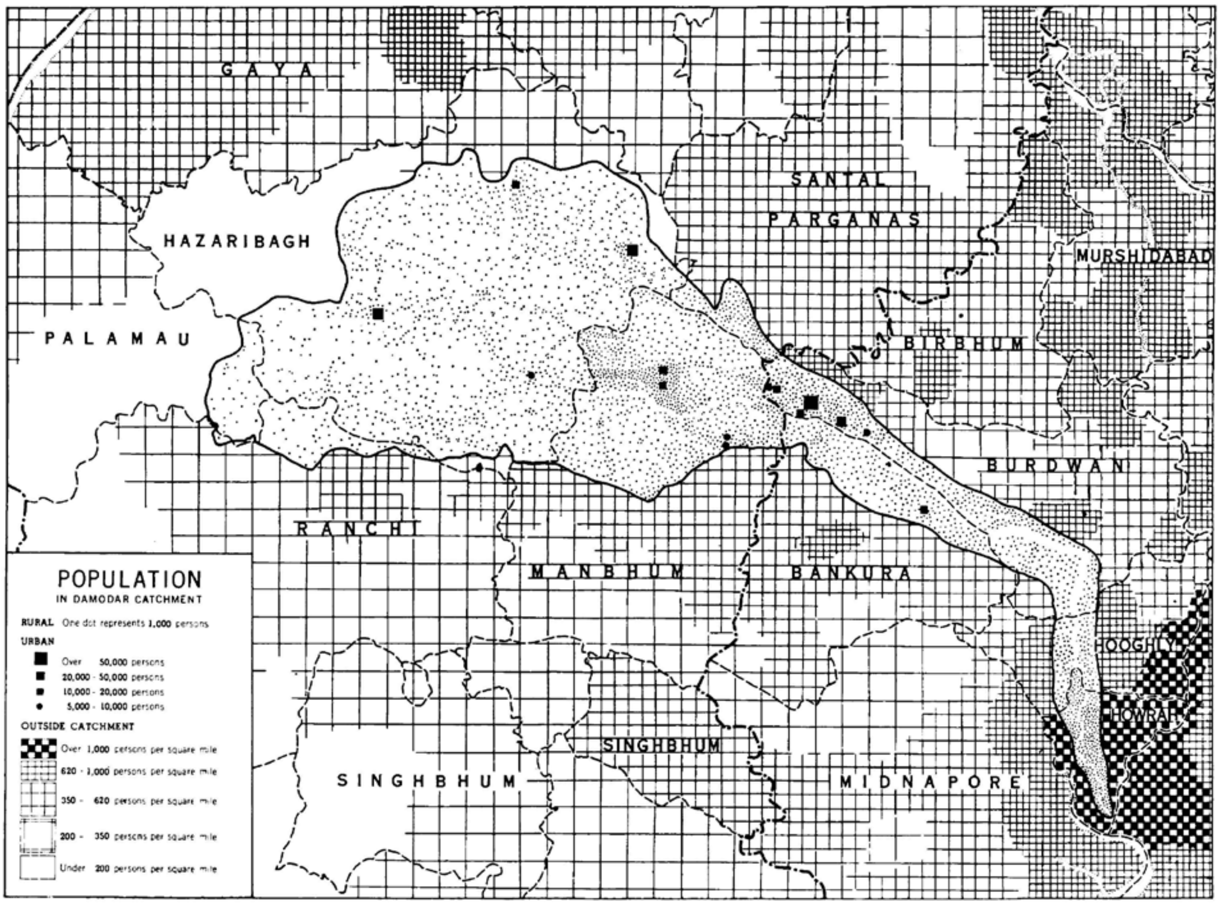

Fig 4.1 Population in the Damodar Valley The map shows the urban and rural population of the Damodar Valley. The basin runs diagonally through the centre of the drawing. Dots within the Valley indicate settlements of 5,000 persons. Kirk (1950), Figure 6.

Lilienthal's idea was adopted. But even though joint work on planning the Indus Valley commenced under the auspices of the UN, the optimism that engineering could in some way mitigate the political deadlock over Kashmir, was perhaps premature. Seen from the UN's perspective, international cooperation was a prerequisite for economic growth and social stability.[8] The continental scope of organizations such as the UN's *Economic Commission for Asia and the Far East* (ECAFE), sought to generate a "common interest" between Asian countries contending with significant food shortages inherited from vastly different experiences of Western colonization and Japanese wartime occupation.[9] The post-war multiplication of internationally recognized sovereign jurisdictions and the fragmentation of internally interdependent colonial economies, meant that for the UN, the reconstruction of Asia would necessarily involve more than supporting a single state. But with international funding and technical support usually delivered through central governments, the geographic extent of multilateral

8 The terms of reference for the ECAFE for example, were the reconstruction of Asia and raising the level of economic activity among and within member nations. See Victor Purcell (1948), *The Economic Commission for Asia and the Far East,* International Affairs (Royal Institute of International Affairs 1944-), v. 24, n. 2, p. 182.

9 In the ECAFE's first session, President Roxas of the Philippines clarified the position of several Asian nations *"...we cannot forget that for centuries we were never free to direct, much less to control the course of our lives." The 'colonial economy' must now be completely discarded. The agricultural economy of the region must be rapidly complemented by sound industrial development, and Asia must not be content merely to produce raw materials to fill the tables and supply the factories of others." ibid*, p. 186.

assistance more often aligned with the limits of national sovereignty. With the single basin framing the possibility of collaboration across multiple national jurisdictions, the concept acquired a diplomatic aura.

Perhaps not surprisingly, the political dimension of basin-scale development remained secondary to the social benefits that the technical control of water could produce. Writing in 1957, the geographer Gilbert White attempted to define the global principles that multi-purpose river development had adopted over the past twenty-five years. Already a consultant with the United Nations on river development, White defined the ideally regulated stream as one that would:

> *…fluctuate in its main channels only to meet fluctuating human demands, the natural variations having been evened out.*[10]

Attempting to clarify the relationship between river systems and human settlement, the two criteria allowing a river "development" to be considered complete and a river fully regulated were the perennial availability of water for all feasible productive uses such as agriculture or manufacturing. Acknowledging that these criteria effectively idealised the power of engineering, White's analysis illustrated the overwhelming technical focus of most river development projects. Influenced by his appreciation of the TVA's social programmes that had supplemented federal hydropower production and flood protection, White argued that planning according to the extent of the entire catchment was not only a technical concern. On the contrary, the engineered control of rivers was only one of several possible instruments including land use regulations that would serve the greater purpose of development.[11] Accordingly, the goals of basin planning such as accelerating food production or distributing electricity, took precedence over the total physical control of the river. Thus rather than the river's volume or seasonal flow, a new set of calculable indicators were adopted to estimate the power generated by a stream, to define the land area irrigated by a waterway and to quantify consumptive uses.[12] With each waterway classifiable by its definitive maximum power output and its potential maximum consumption, the role of planning would be to efficiently organize the achievement of these practical objectives. Determined with reference to the entire hydrological catchment, the enumerated aims of production and consumption were not simply the goals of a specific planning exercise undertaken at particular historical moment by particular people. Given that once a waterway was regulated it would subsequently underpin economic or social changes, the impact of regulating the entire collection of waterways within the basin would be permanent.

For the purposes of planning, the areal outline of the mapped basin did not only depict the extent of an existing geographic area, as suggest the model for the construction of a new one in which the river's flows were organized to serve societal needs. Concentrated within that area, diverse phenomena such as settlement or infrastructure could be evaluated according to their relationship

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10 White (1957), p. 158.

11 *"The distinction […] between engineering works which are planned and carried out with the sole purpose of gaining the direct benefits, such as power production or flood damage reduction from the water regulation, and engineering works which are intended to promote basic changes in the quality of life of the residents of the region." ibid*, p. 174.

12 *"…the total amount of electric power which a stream is capable of generating may be calculated: the amount of power is a function of volume of natural flow, fall, and regulation. It is possible, as well, to calculate the total acreage of land which may be irrigated from a stream, if fully regulated, taking into account the consumptive use made by different assumed crops and cropping practices." ibid*, p. 158

with water. And since rivers could be controlled, it was entirely possible to imagine the control of water could also determine how those other phenomena changed. Acting as both the reference from which objectives were derived and results evaluated, as well as the unit of planning through which those measures were operationalised in various distinct projects, ensured that - in theory at least - the outcomes of planning aligned with the objectives. The analytical distinction which identified river basin development as the collection of projects designed with reference to the same hydrological catchment, revealed the challenge of applying the concept across multiple jurisdictions. On the planetary background of maps accompanying the discussion of basin development, White depicted the world's international drainage basins covering a significant proportion of the continents' surface [**Fig 4.2**]. Yet among these, only nine of the world's great rivers were "free from the complication of crossing man-made borders", while none were considered effectively planned across frontiers.[13] As White argued, the complexities of jurisdiction were magnified by the idea of multiple-use regulation in which a project would address different functions. With each function potentially referencing economic, social or political relationships that could extend beyond the basin's limits, the idea of a unified – that is international - administration controlling a river's waters, inspired "more controversy than imitation".[14]

Even so, White's maps were not just illustrative of the underexploited potential of international rivers. Although they essentially referenced the extents of hydrological catchments, these catchments were presented as "drainage areas" on one map and as "basins" on the other. Despite these terms being synonymous in the text, in their cartographic articulation "drainage areas" were depicted as vast surfaces of continental extent whose scale dwarfed the individual countries they encompassed. "Basins" hosting integrated development on the other hand, were displayed compartmentalised into technically manageable subdivisions that reflected the scale if not the shape, of national or regional administrative units. Inasmuch as these maps were primarily pictorial clarifications of the text, they also suggested that basins and the world's vast, unharnessed drainage areas were registered in different spatial categories. Taken as a sequence of two maps, the delineation of basins appeared to represent the spatial extent of an amorphous drainage area's domesticated portion. Thus while nominally depicting the same type of geographic space, the cartographic representation expounded a pictorial argument in which together global geography and technical knowledge produced a particular unit of the earth's surface.

If alone these maps did not explicitly present the basin as the spatial unit of international development, a similar pictorial argument accompanied the UN's recommendations on *integrated river basin development* published one year later. In the report co-authored by White, two separate maps outline the global extents of river basins with one entitled *Major Drainage Areas of the World* and the other *International River Basins* [**Fig 4.3 and 4.4**]. Without the overlap in the displayed information making one of the two maps redundant, each drawing expands on different aspects of the argument. Drainage areas displayed in relation to arid or permafrost regions in one map evoked habitability, the propensity for a specific type of geographic space to host human activities enabled by a regular

13 *ibid*, p. 180.
14 *ibid*, p. 183.

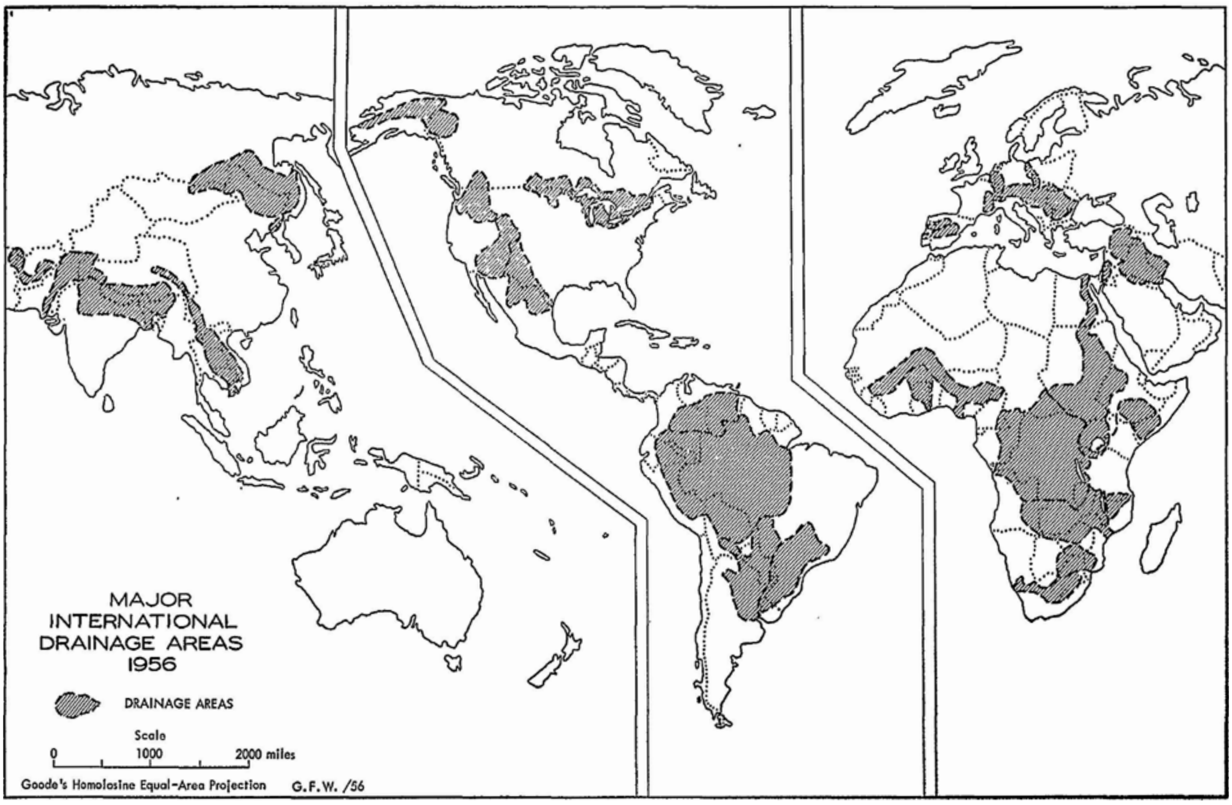
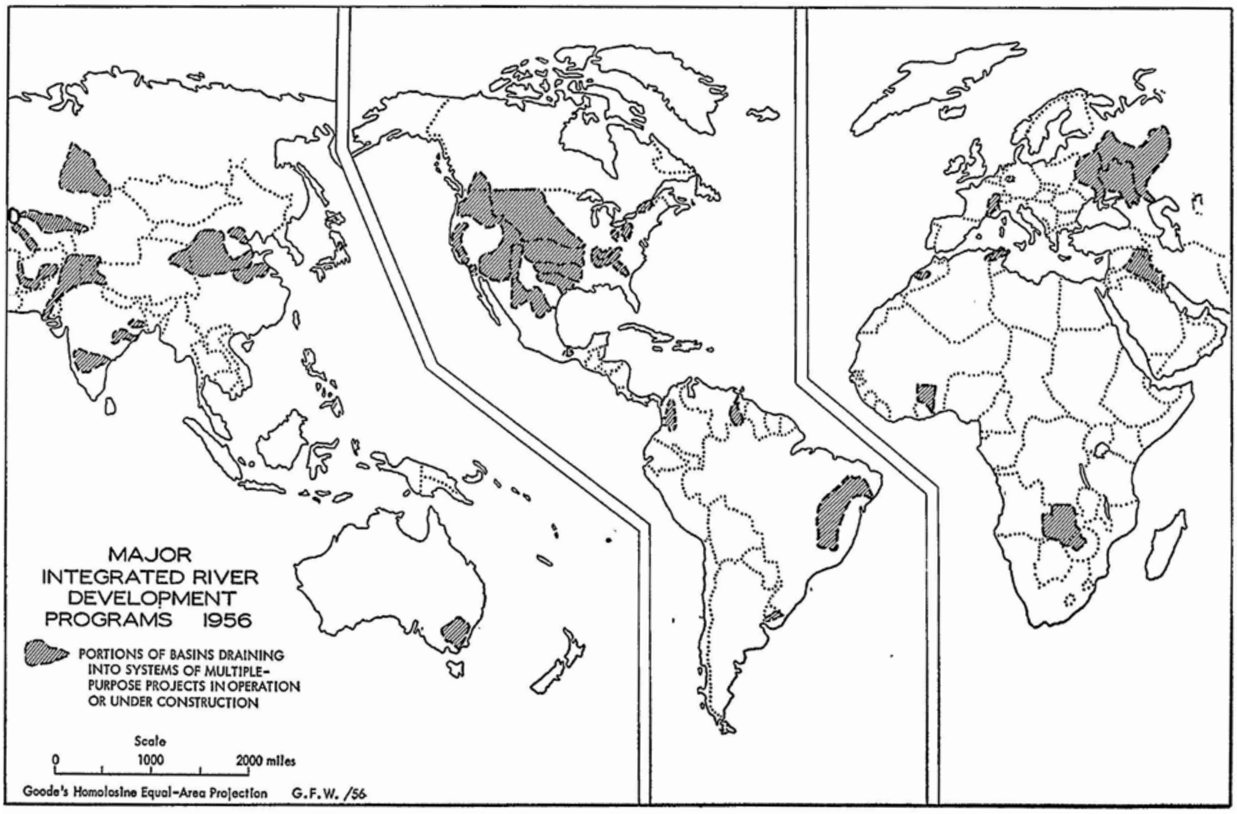


Fig 4.2 Global distribution of drainage basins The maps indicate international river basins (above) and the basins of rivers with established development programmes (below). While above the combined shaded areas are used to denote more general "drainage areas", the map below presents only the planned portion of drainage basins. Considered together the two maps visualise the spatial transition from naturally occuring catchments to the more specific, technical units of river basin development. Note the absence of the Mekong basin in the collection of river development programmes below. Gilbert White (1957), *A Perspective of River Basin Development,* Law and Contemporary Problems, v. 22, n. 2, pp.185 (above) and 187 (below).



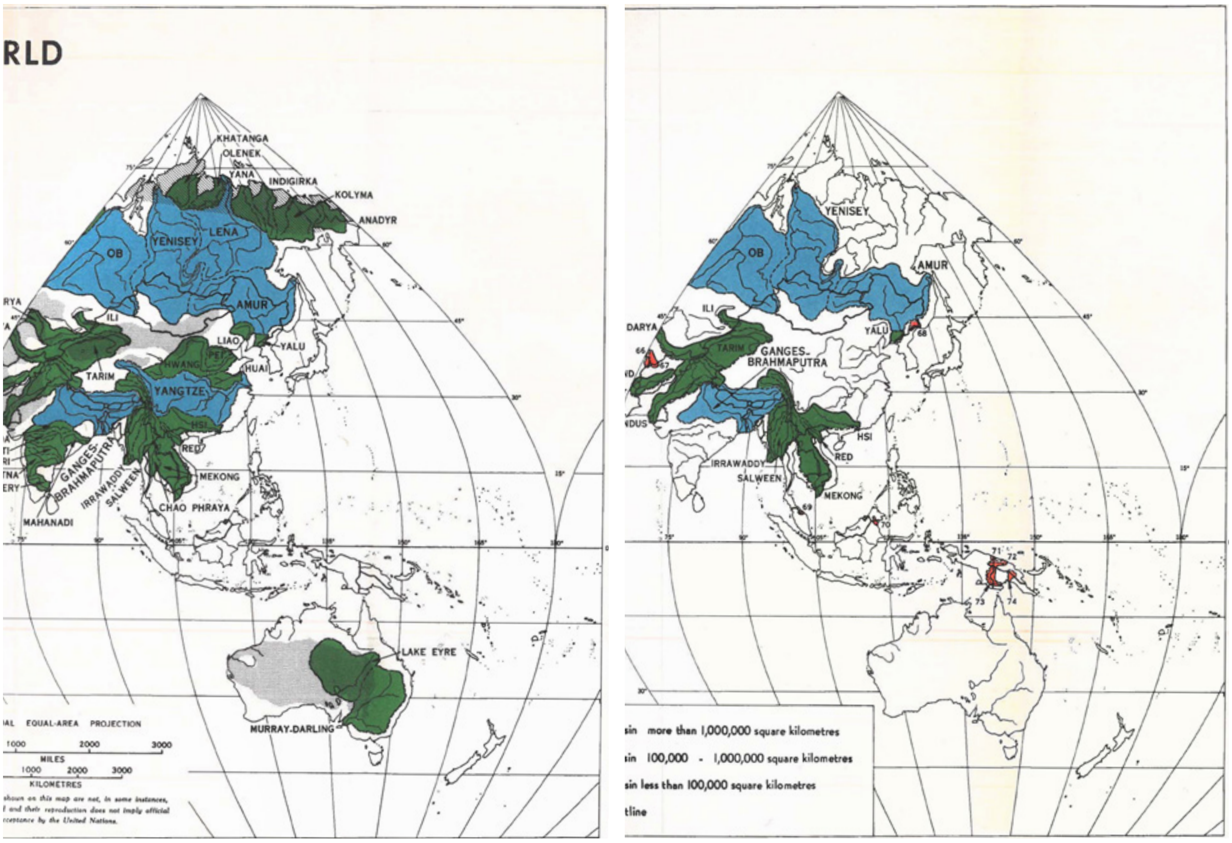


Fig 4.3 Excerpts from maps of major drainage areas and international river basins - 1958 The two maps accompanied the UN's first recommendation on integrated basin development. On the left *Major drainage basins of the world* and on the right *International river basins*. From the perspective that technically, they both represent drainage basins, the major difference in the configuration of the drawings is the emphasis given to a specific magnitude (100,000 to 1,000,000 km^2) of international river basins (right). These include the Indus as well as the Mekong rivers.
U.N. Department Of Economic And Social Affairs (1958), *Integrated River Basin Development. Report By A Panel Of Experts*, New York: UN.

supply of water. The depiction of only international river basins on the other map, appeared to highlight their geostrategic location. Especially over Asia, the focus on catchments of a specific magnitude, defined regions whose extents crossed between the geological space of otherwise Cold War adversaries.[15] Acknowledging that such regions and even individual projects were impossible to develop simultaneously to their full capacity, the report recommended phasing, or alternatively concentration on the largest basins that were "so large that for certain planning purposes their sub-basins can be developed with a large degree of independence".[16] The idea that the implementation of the planning of a larger basin could involve semi-autonomous compartments under potentially different jurisdictions, was indicative of a possible strategy. By focus on the local project, the report's authors anticipated a chain of development that would eventually accelerate implementation of the main project.[17] Thus an entire basin could have an integrated plan, but one designed to be executed within separate geopolitical domains.

15 Within the category of *mid-sized basins* emphasised by the map, 880,000 km^2 separated the smallest (Maroni river) from the largest basin (Tocantins). U.N. Department Of Economic And Social Affairs (1958), *Integrated River Basin Development. Report By A Panel Of Experts.* New York: United Nations, p. 7.

16 *ibid*, p. 6.

17 *ibid*, p. 30.

As the most influential global organization leading the multinational agenda, the UN's recommendations served to inform governments and initiate discussions on potential new projects. Translated versions of these reports were disseminated globally, the maps serving as valuable pictorial tools to transmit information, especially to those government officials whose technical grasp of the organization's official languages was incomplete.[18] Following its publication, the report was adopted by the UN Council with particular attention given to the formulation of legal principles for the use and joint development of international rivers.[19] During the 1958 conference of the International Law Association in New York, interest in basins crossing legal jurisdictions prompted a new definition of this geographic space to emerge. As the UN understood it:

> *The global concept of "river basin" includes not only surface water, whether running or stagnant (lakes), but also the contiguous ground water, and even the meteoric waters (clouds, etc.) which may influence the physical and economic characteristics of the river basin.*[20]

With this definition in mind, the UN's global maps of basins not only represented a 'horizontal' areal extent but also indicated the epicentre of discrete vertical relationships that bound together subterranean and atmospheric space with the earth's surface. From the perspective that neither the extent of aquifers nor the position of clouds were 'contained' by the basin's mapped outline, what the river basin referred to was not just a transnational geographic space but also a process bound to the terrestrial theory of the hydrological cycle. Notwithstanding the multiple legal regimes such an expansive definition of the term would have needed to comply with, the basic suggestion was simple: a specific basin was only one possible delineated relationship emerging from the juxtaposition of continental surface flows, groundwater reserves and meteorological patterns.

With the scale of developmental considerations no longer centred within a single state's boundaries, rather than the aggregation of regions from different countries, the river basin equally appeared to be a single geographic space locally partitioned into geopolitical units. The dialectic between basin development and state organization went even further with the UN urging the adjustment of administrative but also social and economic structures to the "system of integrated basin development".[21] Modifying these structures did not necessarily imply adoption of a different areal configuration or even that adjustments would have spatial repercussions. Yet the idea that a manmade development "system" rather than the existing, natural basin itself, could potentially initiate structural changes in a state's internal organization, arguably shifted attention to who was responsible for the design of the system to begin with. If administrative boundaries or the location of planned settlements were to be modified to fit

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18 Cartographers at the United Nations had been producing maps since 1946, and a *Cartographic Unit* was established in 1951 with a limited team of three. According to the cartographic department's logbook, the UN's first map was entitled *Drainage Basins, Aridity and Irrigation* produced in July 1946. See Ayako Kagawa and Guillaume Le Sourd (2017), *Mapping the world: cartographic and geographic visualization by the United Nations Geospatial Information Section (formerly Cartographic Section)*. Proceedings of the International Cartographic Association, n. 1, p. 3.

19 United Nations Office of Public Information (1959), *Yearbook of the United Nations 1958*. New York: United Nations, p. 155.

20 U.N. Economic Commission for Latin America (1959), *Preliminary Review of Questions Relating to the Development of International River Basins in Latin America (E/CN.12/511)*. Panama City: United Nations, p. 2.

21 *"More vital even is the need to adjust existing social, economic and administrative structures to any system of integrated river basin development."* U.N. Department Of Economic And Social Affairs (1958), p. *vi (Foreword)*.

the organization of water control, awareness of the principles underpinning the development's design were equally as important as the maps on which those principles were drawn.

Formulating the *lower* Mekong's basin

The introduction of multi-purpose river development to Southeast Asia was not the result of the direct transfer of technical knowledge from America. When the headquarters of the ECAFE moved from Shanghai to Bangkok, two Chinese engineers followed. Having envisioned the flood control of the Yangtze River, Dr Shen-Yi and P.T. Tan founded the ECAFE's *Flood Control Bureau*. And, after Mao's communist army consolidated power in China, the two scientists turned their attention to the Mekong.[22] Mirroring the objectives of the TVA, engineering flood control in Asia was presented by the Bureau as an opportunity to also consider the benefits of "harnessing" the river. Unlocking the full value of rivers however would require postcolonial states to invest their limited resources to construct new dams, sluice gates and canals. Calibrated according to the period's technical knowledge, the infrastructure proposed to control wet season flood waters across the Mekong's vast geographic extents, could also produce electricity, improve navigation and irrigate fields. Although often motivated by Cold War imperatives, finance through the World Bank and engineering expertise from international scientists became increasingly available.

Under Dr Shen-Yi, the Bureau published a manual for multiple-purpose river basin development to indicate the need for both the coordinated planning of hydraulic infrastructure as well as the "unified" control of a river's waters.[23] From this perspective, the Bureau's *Manual of River Basin Planning* attempted to formulate a specific methodology for the planning of water infrastructure. Structured on the development principles of the TVA, the manual was prepared by the Indian engineer Kanwar Sain, and reflected his own experience with water resource planning, having previously worked on the colossal Damodar Valley scheme in northeast India.[25] Modelled on the TVA's administrative model, the Damodar Valley Corporation had only recently began generating power to

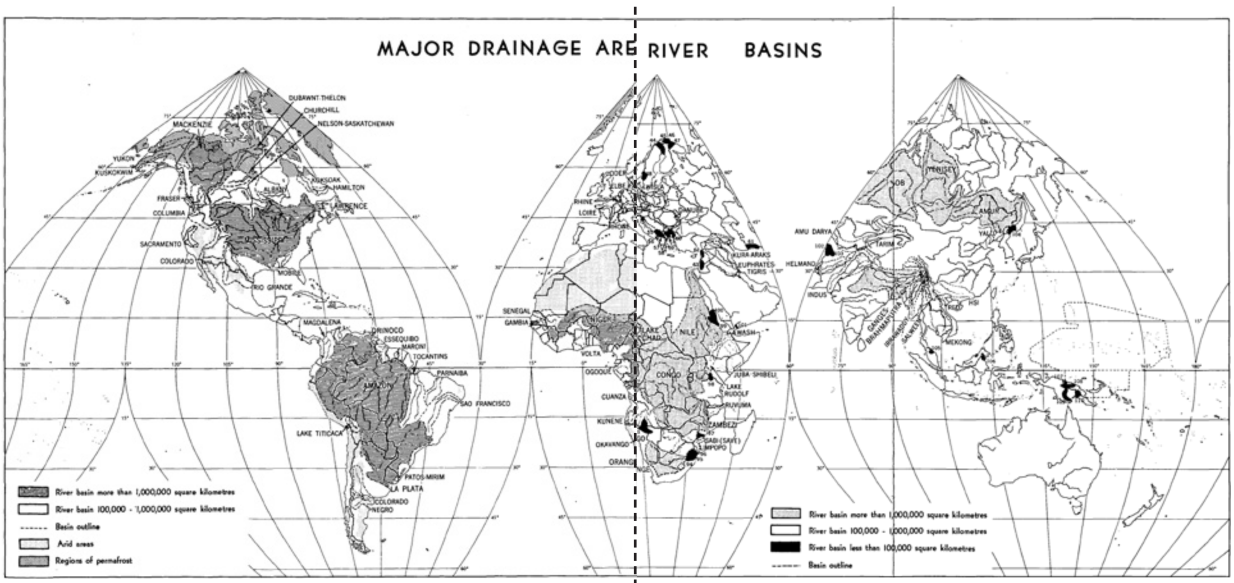

Fig 4.4 Excerpts from maps of major drainage areas and international river basins - 1970 The two maps accompanied the UN's updated recommendation on integrated basin development. While the text of the new report is a copy of the 1958 version, the maps differ. In the depiction on the right (*International River Basins*) visual emphasis is given to the smallest basins, that could be considered more technically manageable than the larger basins emphasised in1958.
U.N. Department Of Economic And Social Affairs (1970), *Integrated River Basin Development. Report By A Panel Of Experts*, New York: UN.

the west of Calcutta. Adherence to the principles of the TVA therefore did not necessarily mean these were solely the product of the New Deal experience. American engineers had consulted on the construction of hydroelectric dam facilities across the Dnieper river in the Soviet Union, while Japanese engineers had built a dam on the Yalu River during their pre-war colonial dominion over Korea.[25] As Lagendijk argues, the diverse, international authorship of publications such as the manual "cross-fertilized TVA-ideas with experiences elsewhere".[26] Since the purported goal of multi-purpose development was ultimately to improve social and economic conditions, selecting the multiple "purposes" according to local needs, was critical for the success of the endeavour. Yet, while "unified" implied the river's waters were governed mutually and for mutual benefit, for at least some of the UN's Asian members floods were not typically considered threatening. Even where exceptional inundations were periodically recorded, they were more often reported when they had catastrophic impacts on settlements and crops.[27] As far as floods were concerned, the common 'problem' shared by Asian nations, was not the relatively remote risk of damage from inundations. With flood protection institutionalised, the control of rivers was presented as an acceptable trajectory for economic development and famine alleviation.

For those areas far from large settlements, knowledge of the Mekong's flows depended on maps prepared during the colonial era. However, the dearth of detailed hydrological information of both the mainstream and the Mekong's longest tributaries, limited what could immediately begin to be designed. Led by Tan, concerted attempts to survey the river and its surrounding geology began with a reconnaissance mission in 1951. Nonetheless, the spatial configuration of regional political interests born during the conflict on the Korean Peninsula, meant that the basin could not be known as a single space. International recognition of the nationalist Chinese government based in Taiwan excluded Mao's mainland China from participation in the UN and ECAFE.[28] Thus neither hydraulic data nor updated maps could be obtained for the entire stretch from the Mekong's sources in the Tibetan glaciers to the tropical rainforests marking the border between China and Laos. As a result, the Lancang – the Mekong's Chinese section - along with its corresponding catchment area was excluded from international surveys. Partitioned according to the realities of politics rather than the inclined plane directing the flows of water, the exclusion of almost a quarter of the entire

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22 Hiroshi Hori (2000), *The Mekong: Environment and Development*. Hong Kong: United Nations University Press, pp. 93-94.

23 Gilbert White (1957), *A Perspective of River Basin Development*. Law and Contemporary Problems, v. 22, n. 2, River Basin Development, note 3, p. 161.

24 A year later Sain took part in the reconnaissance mission under Wheeler and later became Director of the Mekong Secretariat. Vincent Lagendijk (2019), pp. 323-324.

25 For example Hugh Lincoln Cooper, architect of Wilson Dam on the Tennessee River, was lead engineer of the vast Dnieprostroi dam in the Soviet Union in the 1920s. *ibid*, p. 319.

26 *ibid*, p. 324.

27 In a 1957 comparison to ten other major rivers in east Asia, the Mekong's recorded ratio of high-water (wet season) to low-water (dry season) discharge was among the lowest, meaning a relatively low propensity for major floods. UNECAFE (1957), *Development of water resources in the Lower Mekong Basin*, United Nations: Bangkok, p. 18.

28 *"The term ECAFE region [...] excludes mainland China, Mongolia, North Korea and North Viet-Nam, all centrally planned economies for which adequate information or comparable statistics are not available."* Even not including the people of those excluded countries, the estimated population encompassed by the ECAFE was about half the world's total living on about a fifth of the total land. United Nations (1968), *Economic Survey of Asia and the Far East 1967*, Economic Bulletin for Asia and the Far East [E/CN.11/825], Bangkok: United Nations, p. *iv*.

Fig 4.5 The UN's ECAFE region Initially conceived with a focus on the economies of east Asia, the ECAFE's area of operations would later change to reflect political conditions. Note that post world war Japan is still excluded in 1948, just as mainland China is still included, a situation that would be reversed within a few years.
ECAFE (1948), *Geographical scope of the Economic Commission for Asia and Far East*. In United Nations (2014), *Economic and Social Commission for Asia and the Pacific (ESCAP) Asia and the Pacific: A Story of Transformation and Resurgence,* Sales No. E.14.II.F.6., p. 1.

basin's square area, was inconsistent with the calculability promised by the theory of the hydrological catchment. As only one part of the basin's entirety, a new conceptual basis became necessary, that would allow engineers, planners but also politicians to operationalise the river's southern portion as an internally coherent – if not totally autonomous – geographic whole.

On maps, this geopolitical condition was reflected most vividly in the cartographic construction of the *Lower Mekong Basin*. A relatively typical geographic notation for rivers in Western cartography, the conceptualisation of the Mekong as having an upper and lower section was not simply the result of excluding the Lancang. The 'lower' part of the Mekong had been highlighted since colonial days, initially to describe the French section of the Mekong. As France expanded her influence into Southeast Asia, 'lower' came to distinguish the fertile agricultural region where the river emerged from the highlands of Laos to drain through the riparian lands administered by Siam. Thus, while the area encompassed by the specificity of the basin's hydrological delineation overlapped with the historically contested extent of the Mekong Valley, what was considered the lower portion of the river was essentially determined by the mountainous land borders established decades earlier between colonial France and Qing-dynasty China.[29] Shifting cartographic focus southwards, maps presented the Lower Mekong Basin within a new pictorial

29 Post-colonial Laos and Burma did not renegotiate their borders with China. John Prescott, Herold Collier & Dorothy Prescott (1977), *Frontiers of Asia and Southeast Asia*, Melbourne: Melbourne University Press, p. 60.

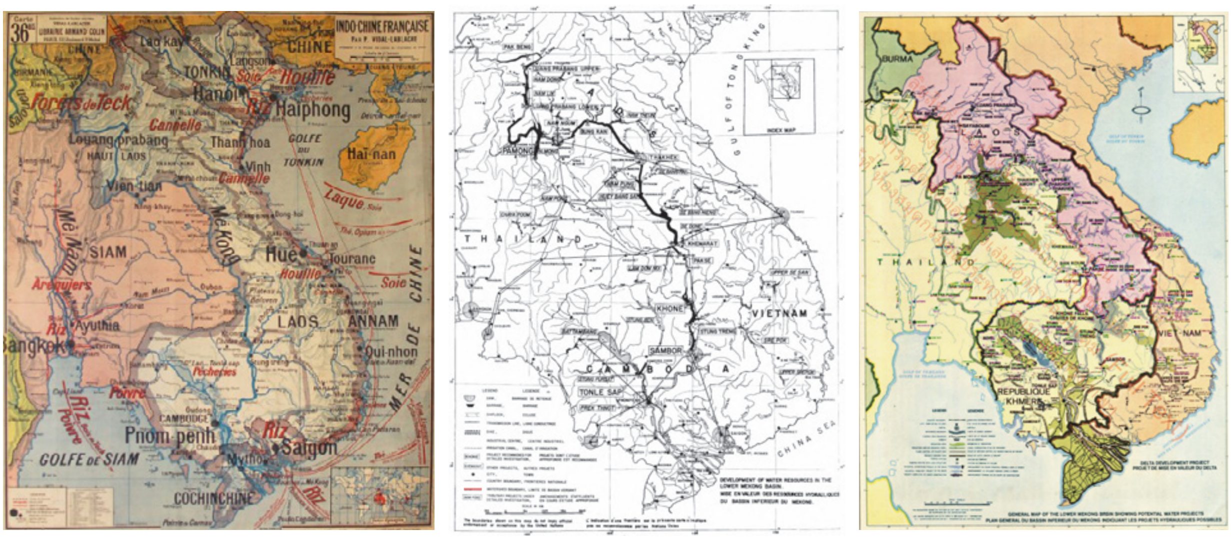


Fig 4.6 Framing the Lower Mekong Basin Extracted from documents produced by the international *Committee for Coordination of Investigations of the Lower Mekong Basin* the maps in the middle (1964) and right (1972) show the major change in the cartographic frame. The 1964 map positions the top edge of the frame south enough to avoid acknowledging China, and the 1972 iteration positions the same edge above Laos' northermost boundary. Compare with the cartographic frame of Indochina (left), which places the edge at the northernmost limits of Vietnam.
Paul Vidal Lablache (1936), *Indochine*; UNECAFE (1964), *Development of water resources in the Lower Mekong Basin*; Mekong Committee (1972), *The Mekong Project 1972*.

frame deliberately cropped to exclude the geographic jurisdiction of communist China to the north [**Fig 4.6**]. As a consequence of this abrupt 'cut', maps of the river failed to show portions of the catchment included within the discursive notion of the Lower Mekong Basin.

The argument that the north-south division of the river while not ideal, was an acceptable compromise for geographic as well as cartographic reasons was supported by Gilbert White. Examining the Lancang's steep mountainous terrain from the distance of military maps, White argued that the upper basin offered few opportunities for dense settlement. As such, mainstream flows reaching Laos from China would be relatively unaffected, even if, as he conjectured, dams were to be constructed there in the future.[30] Thus while a hydrologically convincing distinction between the upper and lower basins was almost impossible to formulate, White presented the basin's geopolitical partition as a reflection of social and economic issue linked to land availability, development potential and population. Although these relationships did not terminate at the land border, establishing the primary beneficiaries of the river's flows as those people living within the basin's defined outline, conferred onto the construct of the lower basin a concrete statistical reality [**Fig 4.7**]. With the distinction between those using the river's water visually confirmed through the reality presented by maps, the two quantifiable groups of flows could be considered separately, each in reference to the beneficiaries within its own domain. More a cartographic frame than an outlined extent, references to the Lower Mekong Basin suggested a distinct if not internally coherent geographic area, an assumption nonetheless contingent on the flows of the Mekong north of Laos remaining forever unchanged.

30 *"The excluded territory is so high and dissected that it offers little opportunity for agriculture or dense settlement and is therefore unlikely to make heavy demand on the flow of water. There are sites for large-scale hydroelectric power installations, but if these did not involve diversion of water, they would affect the river regimen chiefly by storage during periods of high flow and thus would be helpful to water management downstream."* Gilbert White (1963), *The Mekong River Plan*. Ekistics, v. 16, n. 96, p. 310.

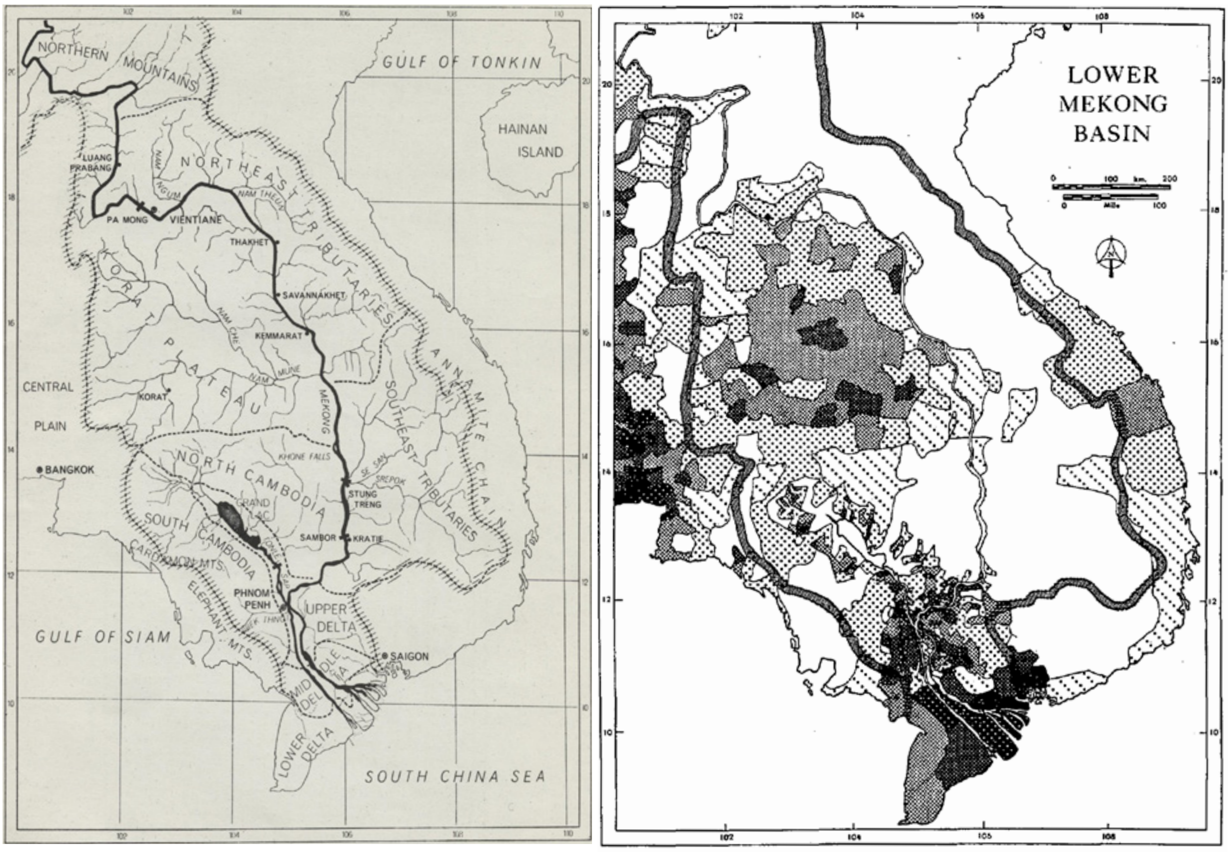


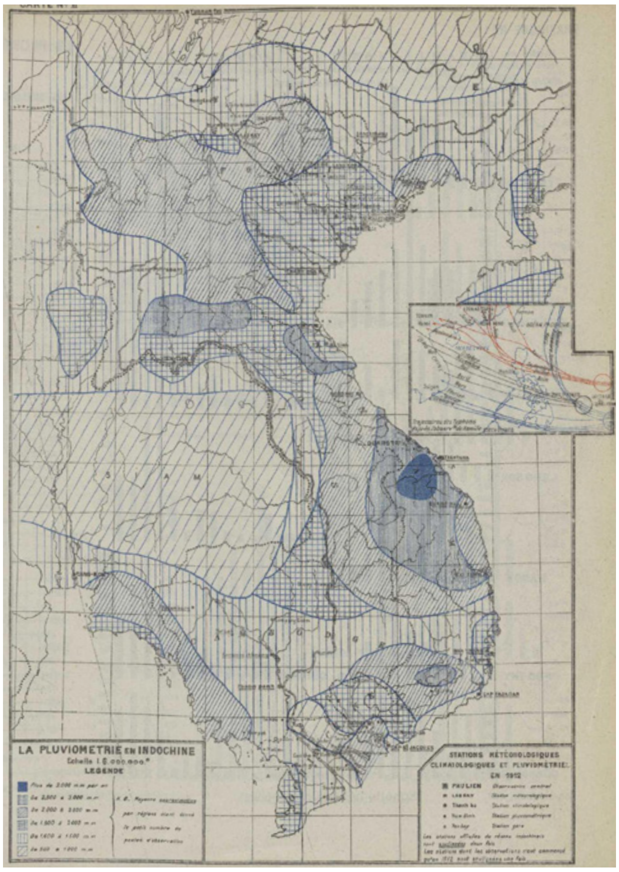
Fig 4.7 Knowledge of the Lower Mekong Basin The outline of the Mekong's basin is presented in relation to its topography (left) and the population density in 1960 (right). In the demographic map, the absence of a statistically detectable population in the Northern Mountains, allows the viewer to perceive the displayed inhabited clusters as distinct areal continuities with no relationship to what is happening further north. Note that the northern boundary of the "lower" basin is not delineated on either map.
Gilbert White (1963)*, The Mekong River Plan,* Ekistics, v. 16, n. 96, p. 310; Gilbert White, Egbert de Vries, Harold Dunkerley & John Krutilla (1962)*, Economic And Social Aspects of Lower Mekong Development,* p. 4.

The basin as project

Confirmed as the extent of international involvement in the development of the region's water resources, the Lower Mekong Basin created a common political interest between the four countries whose mapped sovereignty overlapped with its geographic area.[31] With the majority of Laos and Cambodia as well as a significant portion of South Vietnam encompassed within the Lower Mekong Basin, development of those countries and the river became almost synonymous. Firmly backed by local elites, following the confirmation of the independence of Indochina's constituent regions with the Geneva Convention, the pace of investigation into the basin's topography accelerated.

The first comprehensive survey launched with a reconnaissance visit in 1956. Led by General Wheeler of the American Corps of Engineers, the survey team included the directors of Japan's largest engineering company as well as Canadian and Indian engineers, and saw the return of French hydropower experts to the region. Travelling to the few identified locations where the volume of flowing

31 *"...from a broad political viewpoint, the present cooperation of the four riparian countries in asking for a United Nations survey and in looking ahead toward the ultimate development of the great river was said to be one of the important political developments in the harnessing of international rivers...".* United Nations (1958), *Completion of the Mekong Field Survey.* Ekistics, v. 5, n. 30, p. 149.



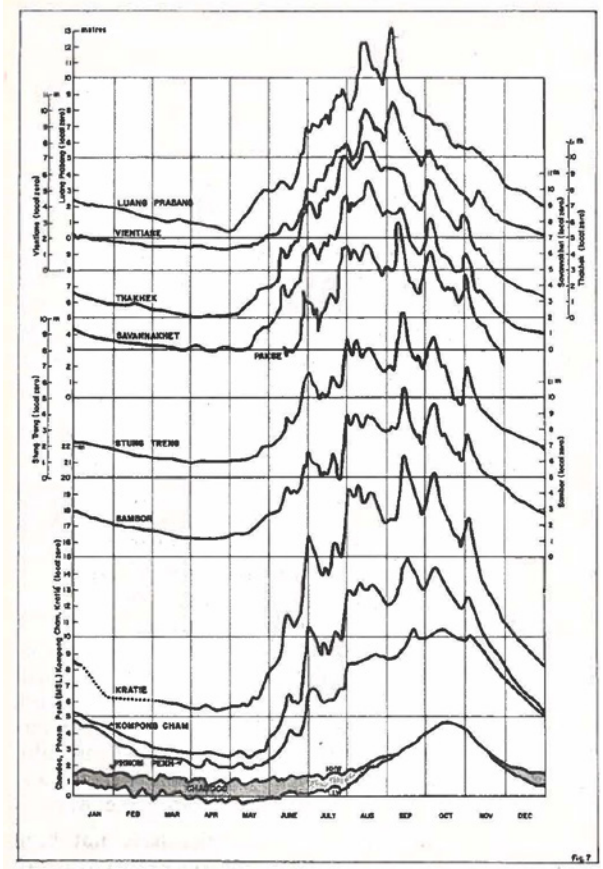


Fig 4.8 Climate and flood On the colonial precipitation map (left), the Mekong is shown coursing through areas with different rainfall levels. Exposed to seasonal cyclones, the Annamite mountains along Indochina's east coast received the highest quantities of rainfall, of which a significant quantity flowed into the Mekong's mainstream. The chart of the Lower Mekong's stage hydrographs (right) shows peak water flows at measuring points along the river. Note the variability in the maximum water volume in each location, suggesting the uneven severity of flood levels within the river's basin.
Henri Brenier (1914) , *Essai d'atlas statistique de l'Indochine française*, Hanoi: Impr. d'Extrême-Orient, p. 4. UNECAFE (1957), *Development of water resources in the Lower Mekong Basin (E/CN.11/457)*, p. 13.

water and the slope of the ground offered a low-risk opportunity to construct dams, the survey team had the opportunity to glimpse how people interacted with the wet, monsoonal terrain. The survey report noted that protective measures against flooding were rare in the places visited. In fact, the authors claimed local people had "adapted" to wet season inundations, relying on them for fishing, for replenishing soil nutrients and for transport.[32] Appearing to contradict the urgency with which the ECAFE's Flood Control Bureau framed the need to control of the river, the report concluded that "flood control was found to not be of interest in the Mekong basin."[33] This was, however, not due to people's indifference for technical solutions, nor because of an absence of catastrophic floods. Major floods, while not uncommon, were always due to both local meteorological phenomena such as typhoons as well as the particularities of the topography [**Fig 4.8**].[34] Thus a significant inundation in one part of the

32 US Bureau of Reclamation (1956), *Reconnaissance Report: Lower Mekong River Basin.* United States Department of the Interior, Bureau of Reclamation, p. 27.

33 *ibid,* p. 26.

34 From 1924 to 2008, the MRC lists ten "extreme" floods at two measuring locations along the river's mainstream. These are flood events in which the annual maximum discharge of the river (water volume) exceeds 120% of the average annualised discharge. MRC (2015), *Annual Mekong Flood Report 2013,* Mekong River Commission, p. 26.

basin would affect a downstream section of either the Mekong's or its tributaries' basins differently. With some governments' officials even asking for more flooding rather than containment or diversion, a uniform, basin-wide approach to dealing with the river was not apparent to the reconnaissance team. And with inadequate topographic surveys and only sparse records of actual discharge levels, the enormous task of mapping the river at a consistent level of detail would need to precede the commencement of any planning.

Through multilateral contributions towards their expense, the ECAFE's Committee for Coordination of Investigations of the Lower Mekong Basin

Fig 4.9 Survey areas in the Mekong Basin Showing those sections of the river General Wheeler's team of experts had identified as needing detailed survey work, the map nonetheless does not outline the river basin. The survey terminates to the north at the Burma border which marks the limit of the Mekong's basin "lower" section.
UNECAFE (1958), *Report of the Committee for Coordination of Investigations of the Lower Mekong Basin,* Ekistics, v. 6, n. 36, p. 121.

(henceforth *Mekong Committee*) was able to finance an international collection of experts to map the region. While the reconnaissance of major tributaries was taken up by a Japanese team, the task of capturing images of the terrain from the air, interpreting and then converting the aerial photographs into topographic maps was taken up by a Canadian team with Filipino cartographers.[35] Primarily responsible for surveying the Mekong's tributaries, the team needed to establish the reference system of controls almost from scratch from which to map over 46,000 km^2, about one twelfth of lower basin [**Fig 4.9**]. The majority of these were photographed at a scale of 1:40,000, and an area totalling about 160 km^2 surrounding three potential dam sites was mapped at a scale of 1:2000. The baseline information compiled through the surveys of Pa Mong, the Khone rapids and Sambor, underpinned thematic maps for hydrology or geology that would accompany preliminary technical studies of the water infrastructure itself. Yet unlike the cartographic focus of Powell's USGS seventy years earlier, none of the new collections of topographic data covered the extent of an entire river basin.

Mapping the topography therefore solved only part of the problem. Producing quality information regarding water volumes, sediment loads, precipitation and evaporation was equally as important as knowing the contours of submerged river sections. Ideally, data collection required uniform geographic distribution of measuring instruments to achieve an isotropic understanding of the entire basin's seasonal wetness. Intended to record measures in relation to both the length of the river (flow, sediment) as well as the area of the basin (volume, precipitation), redistributing existing gauges or creating new measuring points was necessary to guarantee the data could support assessments and planning.[36] Following the turmoil of the world war and anti-colonial war however, only 135 gauges were still in operation throughout the lower basin. More than half of these were located in Thailand and around Tonle Sap, concentrated along major rivers flowing into the Mekong. Conversely, information about rivers in the highland areas of Laos where precipitation was highest was sparse. Thus while existing data was considered of good quality, the limited coverage meant that vast geographic spaces within the basin were poorly known or effectively not known at all. And, even if data would begin to be collected immediately, it would take years of repeated measurements for the information produced to reliably model a mountain stream's hydraulic behaviour.

The long-term commitment to any basin scale planning was recognised by the four countries sharing the Mekong's 'lower' catchment, and in 1958 they officially agreed to cooperate on the investigation and development of the river's resources. Granting a degree of autonomy to the group of experts already coordinating regional surveys and cartography, the Mekong Committee continued to operate under the auspices of the ECAFE. Drawing international attention to the Lower Mekong Basin's "development", the Committee prepared an initial plan for the region focused on the river's mainstream. Intended to guide further investigations and feasibility studies rather than act as a definitive technical

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34 From 1924 to 2008, the MRC lists ten "extreme" floods at two measuring locations along the river's mainstream. These are flood events in which the annual maximum discharge of the river (water volume) exceeds 120% of the average annualised discharge. MRC (2015), *Annual Mekong Flood Report 2013*, Mekong River Commission, p. 26.

35 R.A. Brocklebank (1961), T*he Mekong Survey.* The Canadian Surveyor, March issue, p. 404.

36 The longest continuous period of collected streamflow data in 1956 was less than fifty years and only for limited portions of the river system. US Bureau of Reclamation (1956), p. 50 and Appendix A (4-21).

document, the plan depicted the river organized into regulated compartments [**Fig 4.10**]. With each manmade section controlled by a dam, electricity would be generated from the flows, while the reservoirs enabled navigation and the stored water irrigated adjacent command areas. Situated in relatively remote stretches of the Mekong, proposed hydropower facilities were nonetheless paired with new industrial centres, each only nodes within a network providing electricity to major cities within and beyond the basin's limits. Considering potential projects along tributaries were intentionally excluded pending further surveys, the mainstream's visual prominence in the drawing is not surprising, nor in itself a sign that the plan's subsequent iterations would be limited to interventions along the mainstream. Incomplete though the plan may be, the relationship it framed between the basin, the river and the region is consequential. With the value of the Mekong's linear continuity depicted as superseding the separation of national boundaries, the mainstream's flows were shown subsumed within the engineered subdivisions created by water infrastructure. From this perspective the plan, rather than merely

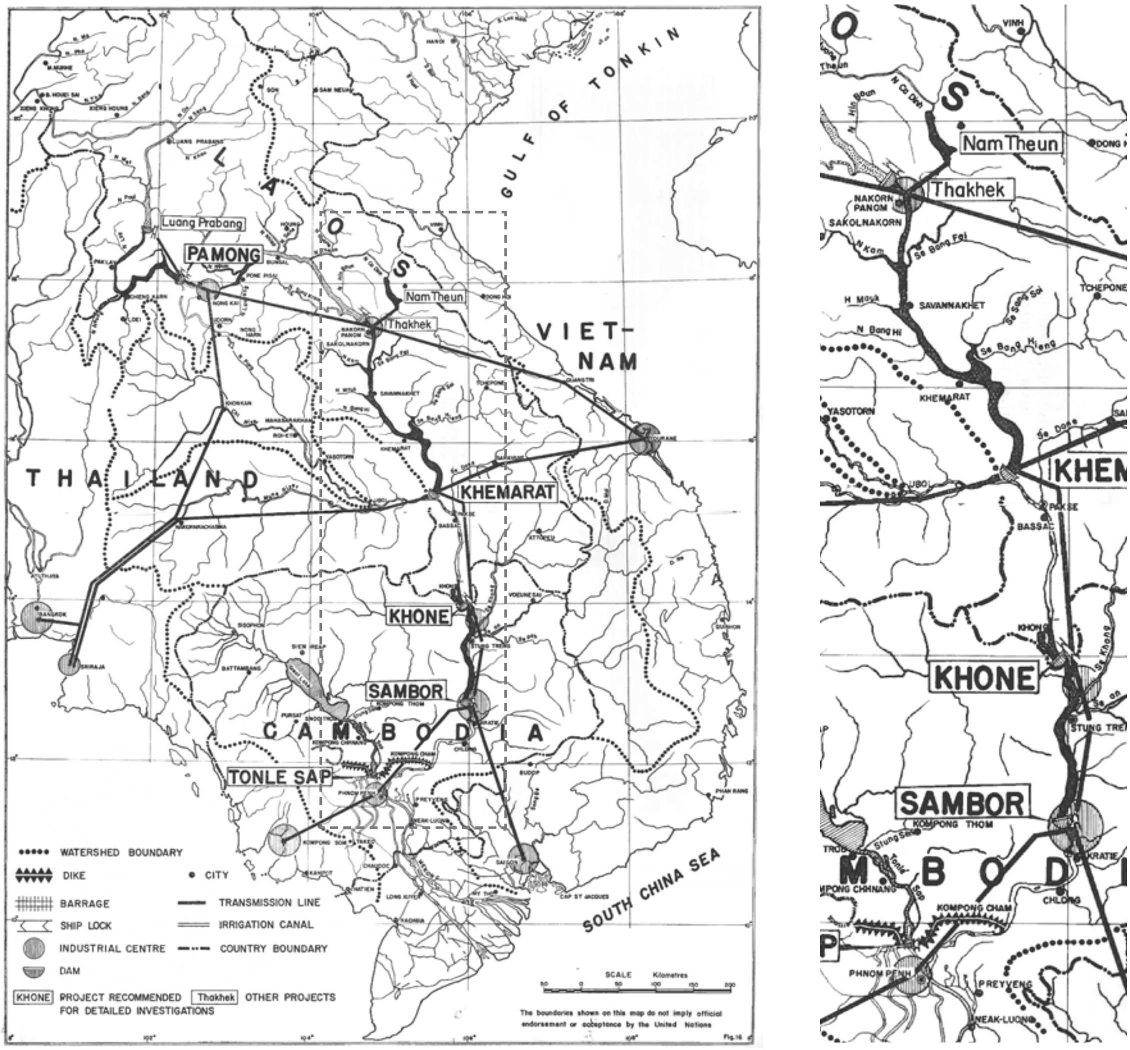

Fig 4.10 Location of recommended development projects and projected mainstream traffic flow The map displays the Mekong's mainstream compartmentalised into discrete, navigable sections by the six proposed dams. Note the similarity of the depicted river segments (detail right), including the alternating colours/ shades of the mainstream, with the Tennessee Valley in Fig 3.7. Transmission lines extend to existing regional industrial/ logisitcs centres (Saigon, Bangkok, Sihanoukville and Da Nang) beyond the "watershed boundary". In the hierarchy of lines the "watershed boundary" is highy visible and differentiated from national borders.
UNECAFE (1957), *Development of water resources in the Lower Mekong Basin (E/CN.11/457)*, p. 45.

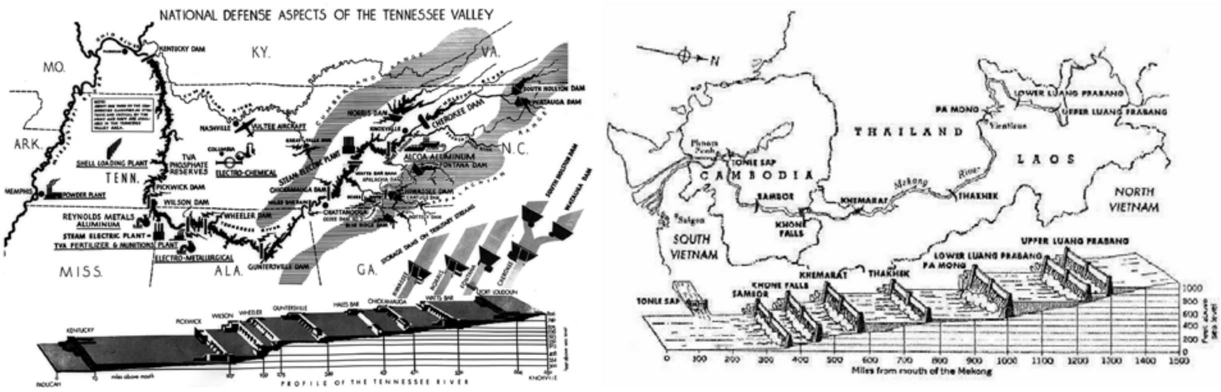

Fig 4.11 The "cascade" of integrated basin development On the left, the TVA's dams are shown in section and their location is shown above in plan. The same combination of diagrams are presented in relation to the Mekong on the right. First considered by Gamond, the concept of the *escaliers hydraulique* connected dams with particular levels of the basin's topography, presenting multiple discrete developments joined by the cascading flows of the river towards the sea.
Tennessee Valley Authority (1941), *National Defense Aspects Of The Tennessee Valley*; Japan's Overseas Technical Cooperation Agency (1966), *Mekongawa No Kalhatsu,* in Satoru Akiba (2010), *Evolution and Demise of the Tennessee Valley Authority Style Regional Development Scheme in the Lower Mekong River Basin, 1951 to the 1990s*, Waseda Business & Economic Studies, n. 4b, p. 79.

reflect geopolitical reality, appeared to create the conditions for the spatial integration of the larger geographic space impacted by development of the river, extending from the mainstream to the existing industrial centres beyond the limit of the basin.[37] If the concept of integration was intended to underpin planning on the scale of the catchment, then the proposal's focus did not so much confirm the importance of the geographic space encompassed within the basin, as draw attention to the river's significance for development in the broader Southeast Asia region.

Collectively considered as the Mekong Scheme, as the components from which an integrated plan was composed, individual projects symbolized the international collaboration promoted by the UN.[38] Represented as one continuous cascade with each dam contributing to the river's cumulative regulation, the idea that projects planned, built and operated in distant locations and over a period that could stretch into decades, could nonetheless be coordinated to optimise output, underpinned the notion of a common endeavour [**Fig 4.11**].[40] Throughout the 1960s, even as new topographic maps and hydraulic data were compiled, more detailed proposals for controlling the flows of both the mainstream and tributary rivers emerged. Early implementation of dams on the three sites surveyed first, was intended to catalyse industrialisation and stimulate modern irrigation

37 The report from which the plan is drawn interprets integration as almost a voluntary act of technical coordination between different projects: "*It is desirable that plans for the development of the tributaries* [...] *should be properly co-ordinated and integrated with those for the main river, thus forming a comprehensive plan for the entire lower basin.*" U.N. Department Of Economic And Social Affairs (1958), p. 42.

38 W. R. Derrick Sewell (1968), *The Mekong Scheme: Guideline for a Solution to Strife in Southeast Asia.* Asian Survey, v. 8, n. 6, p. 452.

39 For example in a 1968 review of the Scheme for the periodical Asian Survey, the author notes that while in different countries, basins and hundreds of kilometres apart "Co-ordination between the Pa Mong and Sambor operations, for example, will permit much greater power production at the latter project than would otherwise be possible." *ibid,* p. 453. Similarly a different article reporting on the Scheme stated that the "Sambor and Pa Mong dams will function together, and during the dry season the water released upstream will maintain the level in the Sambor reservoir, preventing a reduction in its power output". David Jenkins (1968), *The Lower Mekong Scheme*, Asian Survey, v. 8, n. 6, p. 457.

40 Chris Sneddon (2012), *The 'sinew of development': Cold War geopolitics technical expertise, and water resource development in Southeast Asia, 1954-1975.* Social Studies of Science, v. 42, n.. 4, *Water Worlds*, p. 577.

development. Proposed by the Mekong Committee, of the three, the Pa Mong project's significance was from a basin-wide perspective. Discussing the Pa Mong reservoir's potential to store and then discharge enormous volumes of water during the dry season, the Committee wrote:

> *Such an increase of perennial flow would add tremendously to the power production capacities of all four multi-purpose projects located downstream, as well as materially increase the* [water flows] *available for navigation and reduce the extent of salt water intrusion.*[41]

Even if only conceptual, in addressing issues such as salinization in the distant delta, the project's impact appeared to extend thousands of kilometres away, revealing at the same time the strategic value of a dam that could be used to exercise control across the entire downstream. Straddling the river along a relatively narrow gorge shared by Thailand and Laos, Pa Mong was conceived to be, by far, the largest of all the proposed projects. Composed of three dams on the mainstream and two tributaries, the reservoir would detain more water than Tonle Sap, storing enough to irrigate 1,000,000 ha and to produce more electricity than was demanded.[42] Promoted by the US State Department under the premise that rapid deployment of technical assistance could be used to influence regional Cold War ideologies, the project's planning was undertaken by the engineers of America's Bureau of Reclamation. Famous for the construction of the Hoover Dam, the Bureau's global reputation had been built on control of the arid region's Columbia River.[43] The promises of integrated basin development were therefore approached cautiously, at least until new surveys and maps could confirm initial projections.[44]

With the project's value established both by its magnitude but also its strategic upstream location, a team of Bureau engineers began work with the support of Thai and Laotian technicians. Divided into a preliminary and a more detailed feasibility stage, one of the main goals of the Pa Mong study was to identify irrigable land on Thailand's Khorat Plateau which would benefit from the planned reservoir's stored water. One of the driest areas in Southeast Asia and the poorest in Thailand, existing irrigation on the Plateau was traditionally concentrated at valley bottoms, where streams were diverted to rice fields using earthen structures.[45] To efficiently distribute the reservoir's enormous capacity however would require the equally extensive tracts of irrigable land to be consolidated into spatial units, similar to California's irrigation districts in which farms could share infrastructure. The task of identifying a million hectares of arable, non-forest land was underpinned by the Bureau's bespoke system of land classification

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41 Mekong Committee (1961), *Brief description of the Pa Mong project.* Bangkok: UN, p. 2. Quoted in Sneddon (2012), p. 577.

42 Originally estimated at 1,800 MW, the production capacity of Pa Mong's hydroelectric facilities was subsequently revised after more detailed planning to 5,400MW. *ibid,* p. 577.

43 In comparison to the US Corps of Engineers, the Bureau of Reclamation had not been directly involved in the planning of the TVA.

44 Sneddon (2012), p. 572.

45 The Khorat Plateau was already the subject of a separate Bureau study that recommended damming the upper courses of almost every single tributary flowing into the Chi and Mun rivers before they joined the Mekong's main flow. See François Molle, Philippe Floch, Buapun Promphakping & David Blake (2009), *The 'Greening of Isaan': Politics, Ideology and Irrigation Development in the Northeast of Thailand*, p.271. In François Molle, Tira Foran & Mira Kakonen (eds.), *Contested Waterscapes in the Mekong Region: Hydropower, Livelihoods and Governance.* London & Sterling, VA: Earthscan.

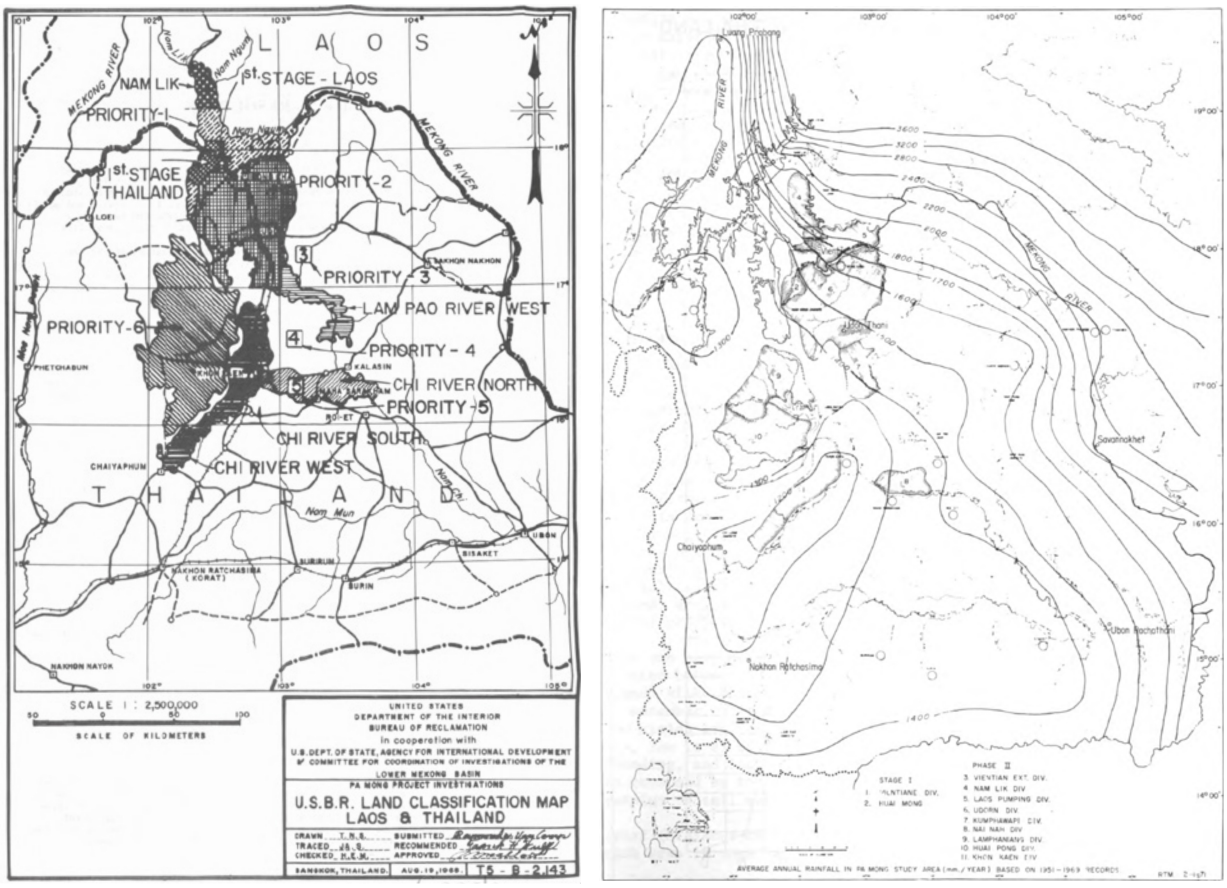

Fig 4.12 Pa Mong land classification of irrigable areas Framed to include the entire Khorat Plateau, the maps depict the irrigable areas that would be serviced by the Pa Mong reservoir. The land classification map (left) presents the discrete command areas which also appear on the annual rainfall map (right). Note that the delineated extents are different in each map, possibly as a result of new surveys.
US Bureau of Reclamation (1969), *Pa Mong Project Lower Mekong River Basin, Stage One Interim Report*, Figure IV-1, p. IV-2.; US Bureau of Reclamation (1972), *Pa Mong Phase Two, Appendix I - Land Resources*, Figure III-3, p. III-9

developed during their period of intense involvement in America's arid region [**Fig 4.12**]. Factoring economic conditions, soil chemistry and the potential of irrigated land to provide an adequate standard of living, the delineation of arable lands was needed to make project-level decisions regarding financing or canal arrangement.[46] In the case of Pa Mong moreover, the geographically articulated irrigable areas would need to provide land for resettlement of the estimated 250,000 people displaced by the reservoir. Identifying what constituted arable and subsequently irrigable land became critical to the success of the project.[47]

Similar to the TVA's unit-area method of land classification, the process involved the determination of a "service unit" of irrigation within which a farmer "may exercise major control over the distribution of water and drainage provided by the government irrigation project".[48] Sized according to water management

46 Subsequently adopted by the UN's Food and Agriculture Organization (FAO), basic instructions for classification were described in the Bureau's 1951 manual. David G. Rossiter (1994), *Lecture Notes: "Land Evaluation", Part 7 : Non-FAO Land Classification Methods.* Cornell University College of Agriculture & Life Sciences, Department of Soil, Crop, & Atmospheric Sciences. See also http://www.fao.org/3/x5648e/x5648e0c.htm retrieved 20 September 2021.

47 Catherine McDole (1969), *A Report on Socio-Cultural Conditions in the Pa Mong Study Area of Northeast Thailand*, A.I.D. Contract No. AID- 493-461, Bangkok: USAID, p. 21.

48 US Bureau of Reclamation (1970), *Pa Mong Stage One Feasibility Report, Appendix V – Plans and Estimates*. v. 1, Denver, CO: United States Bureau of Reclamation, p. IV-40.

practices in the US as well as the success of "common irrigator" units in Taiwan, an extent of around 50 hectares supporting 20 or more families was calculated as a viable extent for a single service unit.[49] Theoretically applicable across both Laos' Vientiane plain and the Khorat Plateau, demonstration farms based on the unit were set up to conduct irrigation impact field surveys and provide farm management data under irrigated conditions.[50] However technically competent, the rationale determining the service unit did not account for the hilly terrain on which traditional agriculture was based. Following completion of the project's first stage of surveys, new topographic maps revealed that a significant proportion of those areas were not suitable for irrigation. As a result, an additional 30,000 hectares would need to be surveyed to replace the 'lost' service units.[51] Yet unlike the studies of the Tennessee's Valley which recorded and codified an existing condition on which planning would be based, the Bureau's land classification determined - as well as depicted - the terrain, by selecting which areas would ultimately receive water. Designed to efficiently distribute water throughout the year, the project's command areas would ultimately modify the ground from seasonally dry, to a condition that permitted cultivation. Yet Pa Mong's planning did not just serve to irrigate farms around existing villages. Rather, the project's operation would initiate a process that would change settlement distribution and socioeconomic conditions within, but also presumably beyond the perimeter of irrigated areas. The new dependency between infrastructure and terrain that would result from bringing the river to the land meant that the operation of Pa Mong would create and maintain its own localised context, an *area of operations* defined by the extent of cultivation rather than the boundaries of local tributary basins. From this perspective land, as well as water, could be identified as the main resources the infrastructure controlled.

Producing geography

The first stage of the Bureau's Pa Mong study confirmed earlier estimations and even surpassed them. As the scholar Chris Sneddon asserts, the Bureau's expertise "thus played a key role in co-producing and legitimizing an imagined Mekong geography".[52] The keystone in a "cascade" of downstream projects, Pa Mong certainly epitomised the aspirations of planning a unified system of water flows. The idea that individual projects could, because of their location within the same basin, ultimately operate in relation to each other was critical to the thesis of an imagined geography associated with the coordinated control of water and the distribution of power. But while the Bureau's reports often cited coordination or integration with downstream facilities, Pa Mong's specific role in

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49 The USAID funded study in 1969 pointed out that average farm size in the Pa Mong Study Area was around 37 *rai* (around 6 hectares), more than double what a single family would be fairly allocated in a service unit. McDole (1969), p. 12.

50 US Bureau of Reclamation (1969), P*a Mong Project Lower Mekong River Basin, Stage One Interim Report.* Denver, CO: United States Bureau of Reclamation, p. IX-10.

51 As described in the report for the Pa Mong dam: *"Shortly thereafter the topographic maps began to arrive. When these were studied, it became apparent that a large proportion of the lands of Stage l initially considered arable could not be economically served owing to the rolling nature of the terrain. This is due to the fact that isolations not observable because of dense forest and brush were disclosed by the topographic maps. The result of this acreage loss is that about 30,000 hectares of additional land will require mapping to feasibility-grade survey in order to find replacement lands to cover the deletion."* According to the interim report, around 100,000 hectares were classified within the project area and an additional 2 million hectares more broadly surveyed beyond that extent. *ibid*, p. IV-3.

52 Sneddon (2012), p. 572.

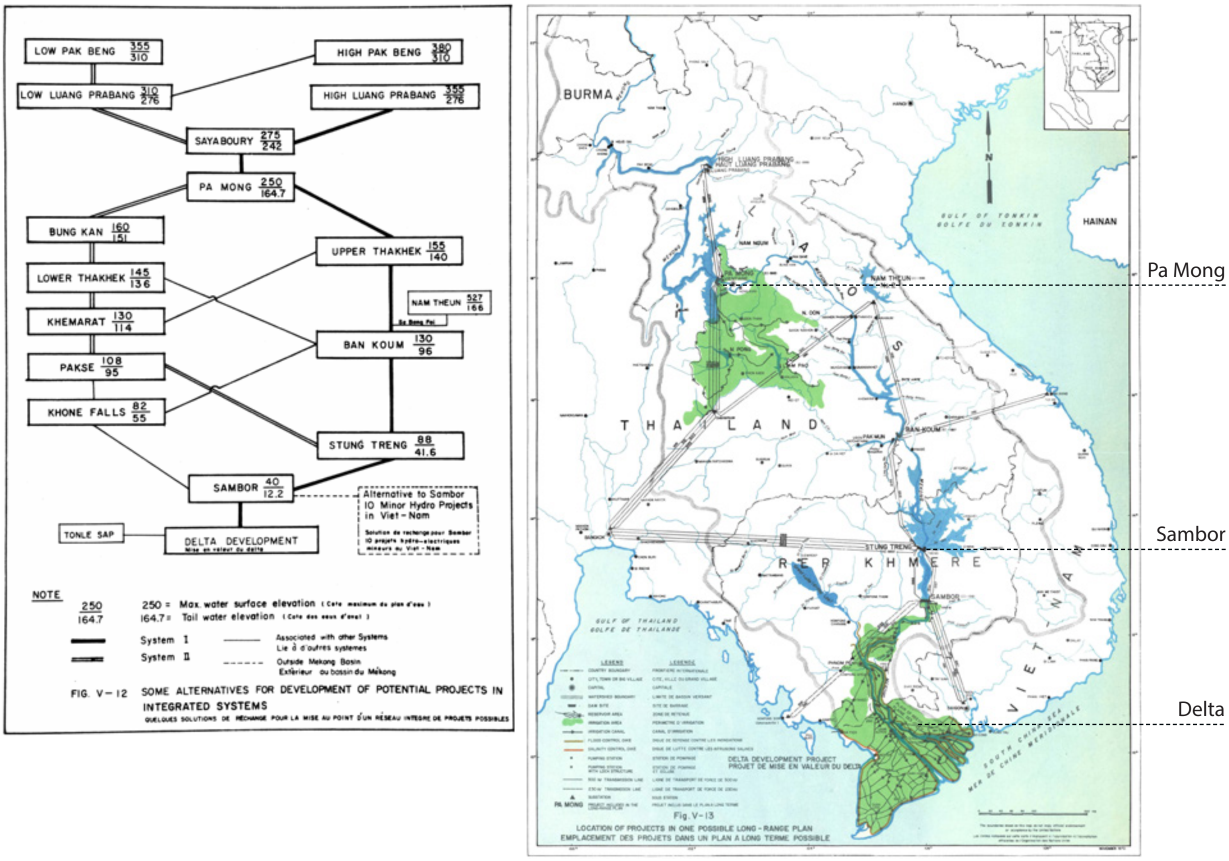

Fig 4.13 Planning of mainstream's development sequence The map (right) presents the ultimate configuration of one possible scenario of dam and irrigation construction (left). The choices on offer were conceived so that under any scenario power generation would satisfy projected regional demand for electricity.
Mekong Committee (1970), *Report on Indicative Basin Plan* (*E/CN.ll/WRD/MKG/L.340)*, Bangkok: UN., Fig V-12 and V-13.

any overall system was not determined when the project was designed leaving the relationship between individual projects and the cumulative objective of developing the basin for later studies.[53] Published in 1970, the Committee's *Indicative Basin Plan* compiled the new hydrological, meteorological and social investigations from the preceding ten years to propose more than one hundred separate projects, aimed at collectively satisfying the anticipated demand for power over a period of 30 years.

Divided into short-term and long-term strategies, the implementation sequence of the Basin Plan was organized around three core projects: Pa Mong, Sambor and the development of irrigation in the delta.[54] Upstream from Pa Mong and downstream to Sambor, combinations of hydropower dams were selected for implementation based on their cumulative capacity to generate power [**Fig 4.13**]. Between projects, what the plan termed *hydraulic integration* would relate upstream water releases to downstream power generation or irrigation

53 As the Bureau itself admitted: *"In the future, assuming that the Pa Mong Project becomes the first of several such developments in the Lower Mekong Basin, it will be necessary to fit the operation of Pa Mong into a basin system, which will mean that optimum future operation could be greatly different than that envisioned for a single unit."* US Bureau of Reclamation (1969), p. VIII-1.

54 For the entire basin, an alternative sequence was also prepared that deferred Pa Mong, concentrating instead on the Nam Theun dam on one of the Mekong's Laotian tributaries. The report found both scenarios equally capable of satisfying the objective of long term power supply. Hori (2000), p. 134.

requirements.[55] The operation of projects along the same watercourse or that encompassed the same catchment area, was therefore contingent on when and if, a different project would be implemented elsewhere.[56] This suggests that the issue was not only deciding where and how the reservoir's water would be distributed. Based on their location, each installation would need to consider a different catchment area.[57] Thus to calculate the annual anticipated volume of water detained by the reservoir, engineers would base their estimations on the entirety of upstream flows from where the dam intersected the river. Those working on projects located downstream along the same waterway would undertake reciprocal alterations, reconfiguring the extent of the catchment area they needed to consider in relation to the upstream diversion. The connection between upstream and downstream established by a single project would therefore affect - to different degrees - all subsequent proposals that relied on the same, fixed total volume of water to operate.[58] In the context of the basin's planning, *integration* therefore referred to the projects' cumulative capacity to produce power, as well as the adaptation of a single project to the conditions engendered by its location within a definable collection of water flows.

The plan's spatial interpretation of *integration* can be discerned in the configuration of the map accompanying the planning report [**Fig 4.14**]. Presenting the location of all the proposed infrastructure projects - including those that a specific implementation sequence would exclude - the drawing depicts with a significant degree of specificity the new water bodies that would be formed from the simultaneous operation of all the dams. These are especially prominent in the mountains of Laos as well as the enormous surface of the Stung Treng dam's reservoir in Cambodia which appears to dwarf Tonle Sap.[59] Clearly defined, extensive irrigated areas are shown surrounding the Pa Mong dam, the delta and Tonle Sap which - apart from countries - are individually the largest continuous coloured surfaces denoting a particular geographic space. These are also located far from the mainstream, where projects in the upper reaches of the Se San and Sre Pok rivers in the Annamite mountains appear to irrigate nearby valleys. Coloured green, irrigated areas retain their areal integrity to contrast with adjacent, presumably unaffected, geographic spaces. The specificity of water infrastructure allows individual projects to be distinguished from each other. Central to the hypothesis of coordinated control, in the map, the delimitation of the watershed boundary is almost imperceptible. The careful articulation of surface water and irrigation suggests that the map displays the relationship

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55 Committee for Coordination of Investigations of the Lower Mekong Basin (1970), *Report on Indicative Basin Plan: A Proposed Framework for the Development of Water and Related Resources of The Lower Mekong Basin, (E/CN.ll/WRD/MKG/L.340)*, Bangkok: United Nations, p. V-146.

56 For example, in relation to downstream development, the plan considered that *"...full development of the floodplain may proceed by two phases successively if Pa Mong comes into the system before Stung Treng; and the two phases concurrently if Stung Treng comes before Pa Mong" ibid*, p. V-85.

57 *"Streamflow at project sites on tributaries has been determined by proportioning the catchment area and rainfall with respect to tributary area, using an appropriate runoff co-efficient" ibid*, p. V-15.

58 Preserving the water balance within a tributary's basin was considered vital to limit consequences on the overall basin from withdrawals. *ibid*, p. V-50.

59 The Committee's Japanese Chief Planning Engineer Hiroshi Hori explained that many of the dams, especially those planned in the Laotian highlands were mostly theoretical "paper plans" that would require further technical substantiation before moving ahead with their design. In this sense they were conceived to fulfil part of a cumulative purpose. Hori (2000), p. 151

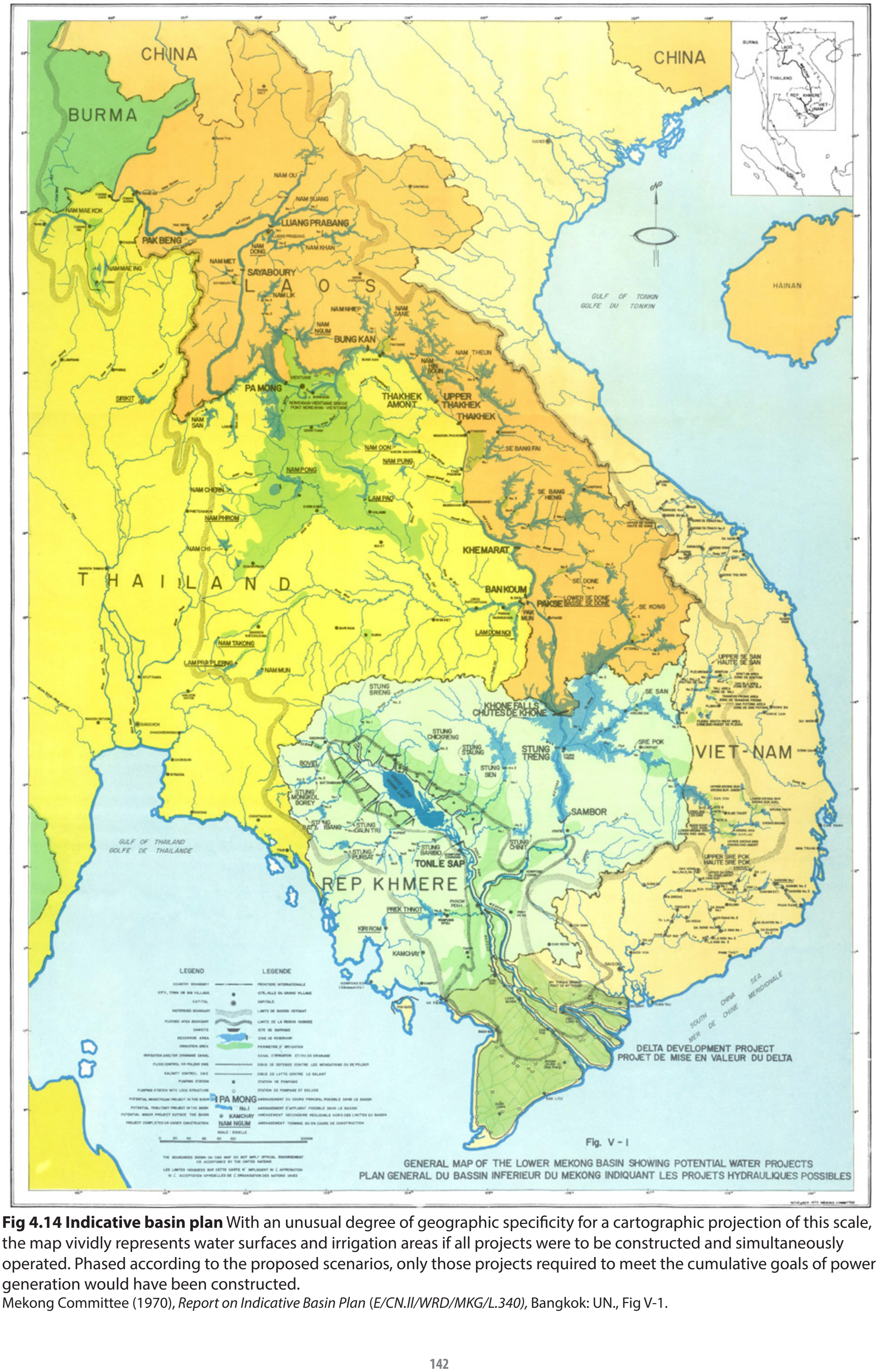


Fig 4.14 Indicative basin plan With an unusual degree of geographic specificity for a cartographic projection of this scale, the map vividly represents water surfaces and irrigation areas if all projects were to be constructed and simultaneously operated. Phased according to the proposed scenarios, only those projects required to meet the cumulative goals of power generation would have been constructed.

Mekong Committee (1970), *Report on Indicative Basin Plan* (*E/CN.ll/WRD/MKG/L.340)*, Bangkok: UN., Fig V-1.

between distinct projects and their local context including their location along tributary rivers and national sovereignty.

When considered as collections of projects however, a different pattern emerges. Unlike the groups of hydropower dams in Laos whose product would be distributed far from the project itself, irrigation implied intensified agricultural production. Consequently the concentration of settlement as well as the economy of these specific areas would also be affected. As such, due in no small part to their magnitude, irrigation areas along with their accompanying reservoirs, appear to denote specific (sub) regions within the basin. Shown crossing national boundaries between the delta and Tonle Sap (Cambodia and Vietnam), on both of the Mekong's embankments at Pa Mong, (Thailand and Laos) and across the highlands around the Sre Pok river, these subregions assert a degree of geographic autonomy. Along with the reservoir formed by dams at Stung Treng, Sambor and Khone (shown extending between Cambodia and Laos), the implication is of a different scale or order of relationships that does not adhere to national subdivisions. From this perspective, the indicative plan presents a new scale of geographic space articulated by the impact of individual projects (dams, reservoirs and canals) operating collectively.

Two different *areas of water* can therefore be identified. On the one hand the extent of the river basin, which dictated the total volume of water in the catchment and thus a project's relative value in the system, but which also allowed maximum power production to be estimated and demographic impacts to be measured. And on the other, the geographic aggregate of catchment areas - modified by infrastructure - dependent on each other for their operation rather than the entire river's flows. On the surface of the map, the area occupied by these interrelated notions overlapped. Tonle Sap's extensive irrigation area was considered from the perspective of the discrete group of canals, dikes and reservoirs designed to contain floods and distribute water from surrounding rivers, but also in relation to upstream storage at Stung Treng and flood control at Sambor. Thus, if an imagined geography had emerged from the cartographic construction of the Lower Mekong Basin, it reflected a spatial subdivision produced by the deployment of infrastructure rather than the compartmentalisation of national boundaries or the configuration of the topography. This is not to imply that the basin had become what Richard White, in relation to the development of the Columbia and Tennessee basins calls an *organic machine*, an organizational hybrid that adopted the contradictory characteristics of nature and human society.[60] The aspirational *unity* Lilienthal imagined seeing in the Tennessee Valley was a better description of the result of the TVA's concerted technical manipulation of water than a general condition inherent to basins. And unlike the (technocratic) approach of state engineers in America that allowed them to see the basin as a unit of a (single) country, what constituted 'nature' much less 'society' across the entire extent of the Mekong's waterways was arguably non-uniform and highly differentiated.[61] Maps portraying the Lower Mekong Basin therefore presented a potentially new, albeit discursive geographic cohesion. The cartographic framing of Southeast Asia through the lens of the 'lower' basin allowed the geographic space 'enclosed' by

60 See Richard White (1995), *The Organic Machine: The Remaking of the Columbia River.* New York: Hill and Wang.

61 With regard to the regional differentiation of society in the Mekong's basin see Gilbert White, Egbert de Vries, Harold Dunkerley & John Krutilla (1962), *Economic And Social Aspects of Lower Mekong Development (report for the Committee for Co-Ordination of Investigations of the Lower Mekong Basin).*

the watershed to be visualised as a specific geographic unit – the domesticated portion of the entire drainage area.

Conclusion

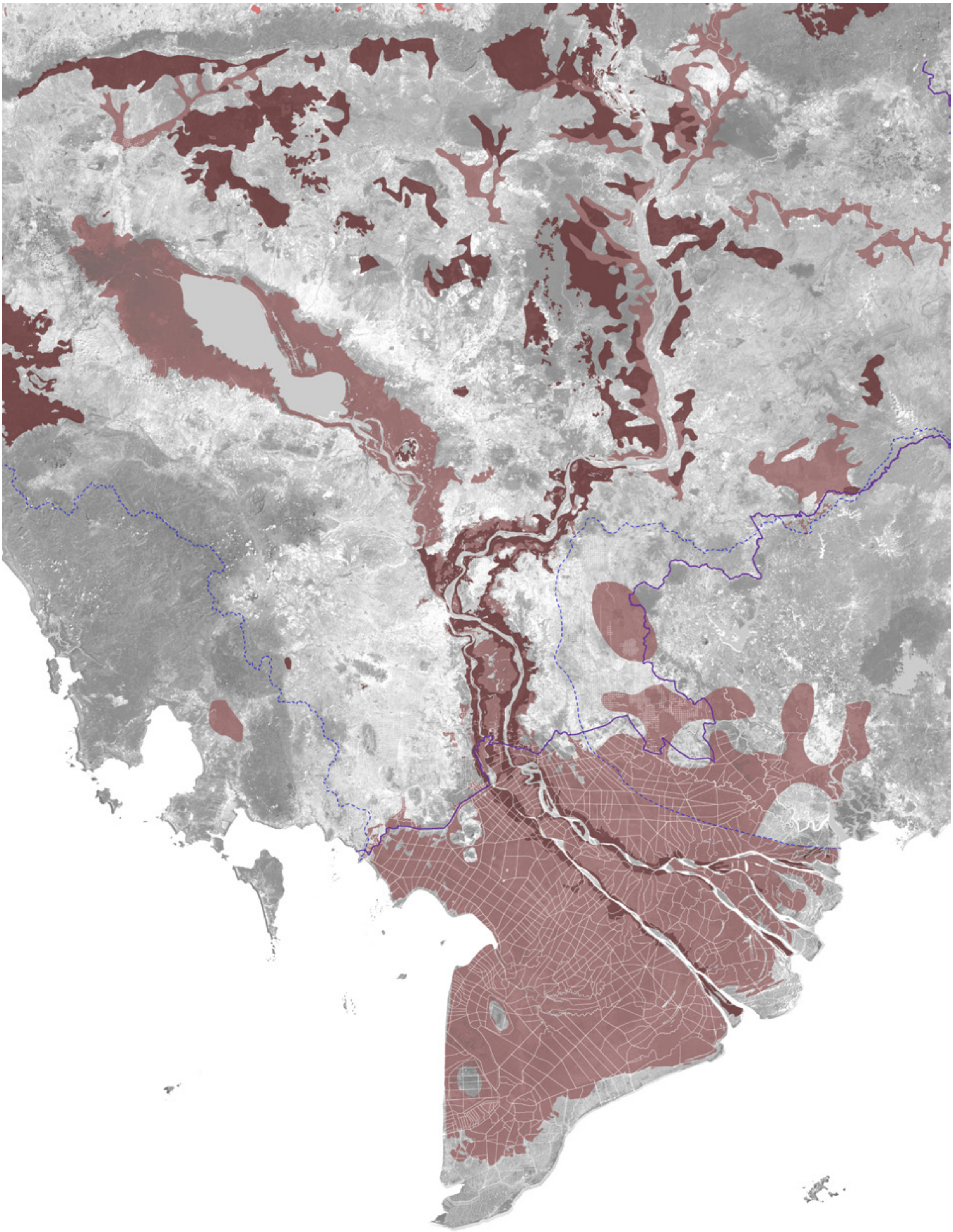
Writing about the utilitarian state in the context of Europe, Scott suggests that "the vocabulary used to organize nature typically betrays the overriding interests of its human users".[62] From this perspective, the repeated use of two maps to expand the UN's global thesis of integrated basin development was not merely illustrative of a natural condition of a river's flows. Between the depiction of a 'drainage area' encompassing multiple national jurisdictions and an 'international basin', the fundamental difference was in the vision to transform a natural phenomenon into a system of relationships that collectively exploited the river's water for human benefit. In this sense, the creation of the Lower Mekong Basin repositioned the geographic centre of focus rather than outlining a specific region's definitive limit. Thus despite Cold War geopolitics determining what was included or excluded from this cartographic construct, what actually constituted the reference for infrastructure planning was the 'lower' basin's hydrological catchment. An extent made known through the compilation of surveys conducted along the length of the mainstream and its most important tributaries rather than in terms of an entire *area of water*, this hydrological reference was equivalent to the cumulative total of all catchment areas encompassing the Mekong's flows. Yet, while the areal total of the units into which the basin could be subdivided was numerically equal to the combined total of all hydrological catchments, the components from which each total was computed did not remain the same. Modified according to the locations of upstream dams and the volumetric capacity of reservoirs, the catchment areas referred to by individual projects encompassed a different geographic extent from what maps of the terrain's inclined slopes depicted. And, where groups of infrastructure installations were coordinated to irrigate land or to contain floods, the cumulative impact of these alterations arguably manifested around new regional entities, distinct from adjacent geographic spaces insofar as infrastructure was needed to maintain the appropriate level of wetness on the ground. A geographic unit denoting the interaction between human users and the water resources it encompassed, the cartographic basin represented the natural order which would emerge once the river was controlled.

62 James C. Scott, (1998), *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven, CO: Yale University Press, p. 13.

PART TWO

DELTA

Along with the water added to the collected flows of the river, a single stream also contributes land. Washed across the inclined terrain by seasonal inundations, particles of soil sometimes far from rivers, eventually join the Mekong's mainstream. As these particles travel downstream they are gradually deposited, accumulating into sand banks or islands that eventually displace water as the dominant condition describing the ground. Yet this configuration of wet and dry is only transitional. Incremental and sometimes imperceptible, as soil displaces water the river's course shifts and as a result, the location of sediment accumulation changes. If such numerous accretions of land describe a ceaseless geological process, like many rivers the sedimented lowlands of the Mekong only incidentally resemble the archetypal landform signified by the Greek letter Δ. A delta's association with the mathematical geometry of a triangle however has notional implications. The imaginary, aerial viewpoint denoted by the triangle, alludes to a geographic space that is differentiated from its immediate surroundings, encompassing a distinct, internally coherent entirety. The planimetric conception of the delta on the other hand, suggests the importance of cartography and the eye of the map-maker to make such distinctions visible. Yet unlike valleys demarcated by the visible crests of mountains, in the flat lowlands formed by the river's sediment the identification of a delta's extent is not just a matter of identifying where the river's sediments are deposited. Historically related with the inhabitation of the most agriculturally fertile extent of riparian land accessible from the sea, the geographic delta determined by hydrology and topography and the inhabited geography *of* the delta prescribed by boundaries and infrastructure, appear to describe two different notions. Either as the stable conceptual frame within which human activities unfold or as the surface area shaped by the unceasing action of water, the intersection of these ideas within the outline of the delta suggests the interpretation of phenomena presented on maps. Which part of the Mekong's lowlands became labelled or identified *as a delta* is, for the purposes of this thesis, equally as important as the reasons why the cartographic depiction of sediment deposits, waterway networks and settlement patterns could differentiate the extent of a delta on the Mekong River from all other geographic spaces.



Map D The map shows two soil types, projected on an aerial image of the terrain. Fertile *cambisols* are shown in the darker brown and *gleysols,* which require drainage to be productive and deteriorate in quality if constantly submerged, in the lighter shade. While cambisols are found along the Mekong River or spread on Cambodia's mountains, gleysols define the surroundings of the Tonle Sap and the Mekong's outflows into the East Sea, appearing to be concentrated within the national boundaries (purple line) of Vietnam.
Author (2022). Spatial data sources: *Irrigation canals* (MRC, 2008); *gadm36_Vietnam_0* & *gadm36_Cambodia_)* (GADM, 2022); Soil types of the LMB - mrc.SDE.SOILS_b_soil (MRC, 2008); World Water Bodies (ESRI, 2016); Basin boundary of the Lower Mekong Basin (MRC, 2008).

CHAPTER 5 A map of water

The third branch or Anterior River […] *forms four arms at Vĩnh-long and flows into the China Sea through six mouths forming a delta.*

Petit cours de géographie de la Basse-Cochinchine, Trương Vĩnh (Petrus) Ký, 1875

Quite different is the regime of the second basin, that of the western rivers: it is the delta of the Mekong with its wide and deep arms, having its own well-marked and regular slope throughout the whole extent of Cochinchina.

Étude d'un projet de canal entre le Vaico et le Cua-Tieu, Excursions et reconnaissances, Jacques Rénaud, 1880

If today numerous maps, hydrological studies, sociological as well as environmental research are focused on the people, the water and ground conditions of the Mekong River's delta, the extent of geographic space these refer to would have been perceived differently on the eve of French colonization. This is not only due to the ceaseless accretions of sediment that transform the topography depicted on maps. Presenting rivers as wet and land as dry provides only one perspective of the way references to water construct an identifiable geographic area. For the Khmer villagers living along the Mekong's tidal waterways, streams are conceived as salt water conduits extending from the ocean.[1] For Vietnamese settlers on the other hand, the 'garden lands' (*miệt vườn*) between the river's main flows have long been considered the most fertile regions for cultivation and the preferred location for settlement. The diverging significance of waterways and the sedimented land they create, suggests that in order to hypothesise that a particular extent of the Mekong's lowlands could be differentiated from its surrounding terrain and identified as a delta, the interconnected water flows displayed on maps would need to be thought of as collectively forming a discrete part of a river system. Yet in order to deduce that multiple waterways, in different locations and coursing through varied terrains could constitute a distinct geographic space would not be possible without prior knowledge of how water connects (or divides) the areas through which it flows. Such knowledge is derived equally from direct observation of the area in question as well as by comparison with a paradigmatic condition which displays all the common properties considered necessary for such distinctions to be made.[2] Before the Mekong's outflows were collectively perceived as a delta, the archetypes used as the basis for comparison by the Khmer, Vietnamese and French were based on different principles. Thus, while in European atlases the Mekong's outflows were considered in relation to the inhabited extents of the Nile's cultivated sediments, the Khmer kingdom that nominally exercised authority over the same area, ascribed value to the cosmographic cartography of water embedded in the architecture of Angkor. For the Vietnamese on the other hand, maps presented the Mekong as the southernmost part of a strategic domain

1 Philip Taylor (2014), *Water in the Shaping and Unmaking of Khmer Identity on the Vietnam-Cambodia Frontier*, TRaNS: Trans –Regional and –National Studies of Southeast Asia, v. 2, n.1, p. 114.

2 Marine Simon, Alexandra Budke & Frank Schäbitz (2020), *The objectives and uses of comparisons in geography textbooks: results of an international comparative analysis.* Heliyon, n. 6, p. 2.

centred on the network of military infrastructure stretching to the outflows of the Red and Perfume rivers further north. Considering that these viewpoints effectively differentiated the same geographic space, the value assigned to waterways either as limits or as conduits has arguably played a role in the way the delta's extent is imagined today. Divided into three parts that correspond to geographic, cosmographic and strategic perspectives, the chapter asks what was being mapped in the cartographic depictions of the Mekong's lowlands that later would appear on maps as the river's delta.

Curating cartographic knowledge

Even though a *delta* is probably the first Western geographical technical term, its use to describe a particular type of ground condition was derived from the place-name denoted by the perceived triangular form of the Nile River's Delta.[3] Associated with pharaonic Egypt's most fertile agricultural region, the Delta was the historical reference to an inhabited domain that notionally began at the mainstream's bifurcation, and ended at the Mediterranean coast [**Fig 5.1**]. Encompassing extents of desert as well as ground watered by the annual flood, the Delta was located between the dynastic kingdom's upstream centres of power and the outside world of merchants and invaders. For the foreign visitors

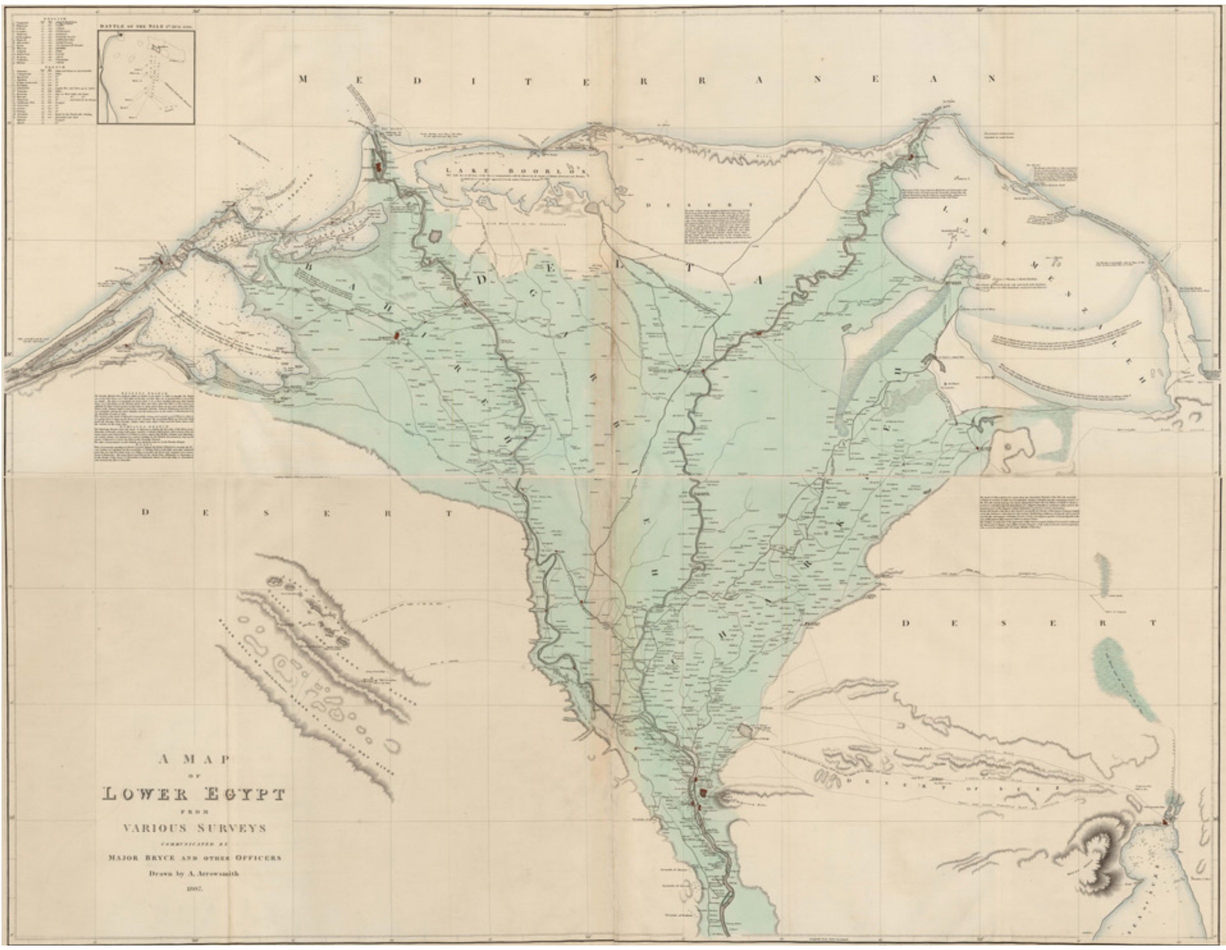


Fig 5.1 The Nile's Delta The typical frame within which the Delta was presented in European cartography included the bifurcation of the Nile to the south, extending northwards to the Mediterranean. The Delta's geographic space did not only encompass the arable, irrigated lands which produced Egypt's grain surpluses but also the coastal deserts.
Arrowsmith (cartographer) (1807), *A Map of Lower Egypt, drawn from various surveys,* London: Published by author.

that visualised the Nile's Delta as a triangle, the vast breadth of cultivated land would have appeared in sharp contrast to the upstream settlements clustered between the mainstream and the desert. As Francis Celoria argues in his analysis of ancient Greek literature, the need to describe the distant lands conquered by Alexander the Great's army possibly led contemporary writers to compare the outflows of rivers such as the Indus, with the geometric form of the Nile.[4] Yet if focus on the areal morphology of the river's flows described a specific relationship between land and water, the comparison between an Egyptian civilization situated along the banks of the Nile and the polities located along the Indus, framed the geographic space of the delta from the perspective of a broader inhabited region that extended far upstream.

Despite the notions indicated by a *delta* within the classical literature which formed the basis of European scientific knowledge, the term only became part of geographic nomenclature in the 18th century.[5] Usually replacing or appearing alongside the idea of a river's 'mouth' (*embouchure*), geographic discussions of deltas adopted a similar comparative approach to those used two thousand years earlier. As cartographers increasingly attempted to visually record information about distant locations on the earth's surface, such comparisons were enabled by the use of maps. The most prominent French cartographer during the mid to late 18th century, Jean-Baptiste Bourguignon d'Anville became famous for compiling maps based only on information that could be verified from multiple sources.[6] As a result, his maps were quite often devoid of details and toponyms, especially in the uncharted hinterlands of continents located far from the coast. Structuring the descriptive narrative accompanying his maps within the scope of these limitations, the dimension of the Nile Delta became the basis for considering similar phenomena in parts of the world that had been only sporadically mapped [**Fig 5.2**]. Concerning the location of an ancient town in north India for example he declared that :

> *Its location on the Ganges is remarkable, in that it is the place where this river divides into two main branches, by which it goes to the sea,* [...] *forming a delta much larger than that of the Nile…*[7]

Acquiring geographic knowledge through comparison, brought locales on different continents into simultaneous focus. This allowed readers to develop an understanding of geographic conditions through specific features (such as the bifurcation of the river) that geographers like D'Anville considered important characteristics. As more recent studies have argued, the objectives of the comparative method in geography are both *nomothetic* and *idiographic*.[8] As such,

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3 According to Celoria, the concept of the triangular Delta was not apparent in the various combinations of Egyptian hieroglyphs which denote the place, and was therefore a notion distinctly Greek. Francis Celoria (1966), Delta *as a Geographical Concept in Greek Literature*. Isis, v. 57, n. 3, p. 385.

4 *ibid*, p. 387.

5 Celoria points out that one of the earliest citations for the word delta is attributed to Edward Gibbon, author of the Rise and Fall of the Roman Empire, in the late 18th century. *ibid*, p. 385.

6 Christine Marie Petto (2007), *When France Was King of Cartography: The Patronage and Production of Maps in Early Modern France*, Lexington Books, p. 80.

7 *"Sa situation sur le Gange est remarquable, en ce que c'est l'endroit où; ce fleuve se partage en deux bras principaux, par lesquels il se rend à la mer,* [...] *formant un delta beaucoup plus considérable que celui du Nil..."* J.B.B. d'Anville (1753), *Éclaircissemens géographiques sur la carte de l'Inde*. Paris: Impri. Royale, p. 61.

8 Simon *et al* (2020), p. 2.

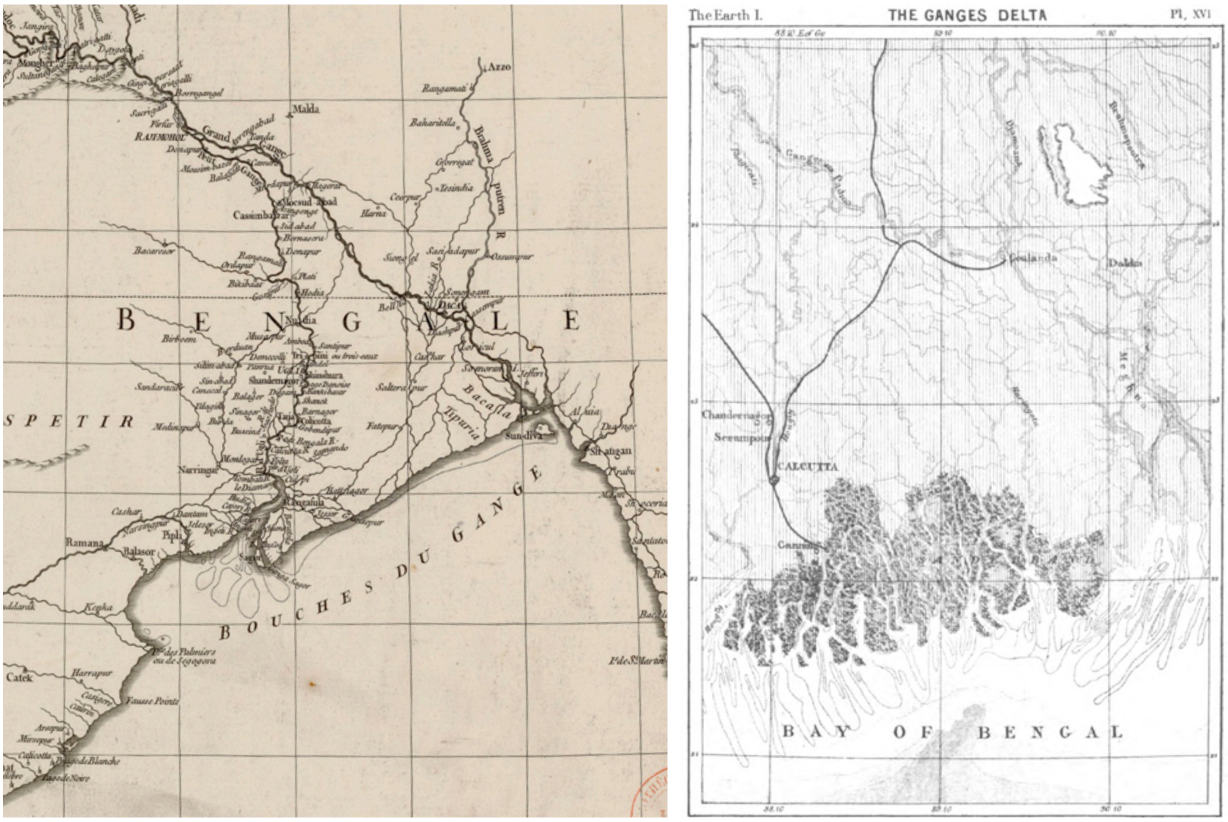

Fig 5.2 The Ganges' delta On the left d'Anville's depiction of the Ganges' *mouths*, suggests a relationship between the river's entire "body" and its "head" at the outflow to the sea. The map emphasises the courses of the two main branches that together form a triangle in relation to the coastline. On the right, Élisée Reclus' map of the Ganges' delta focuses on the composition of the ground, with sediment accretions shown with a darker shade, suggesting a localised relationship that unfolded within specific extents of geographic space .
Jean-Baptiste Bourguignon d' Anville (cartographer) (1752), *Carte de l'Inde*; Élisée Reclus (1894), *A New Physical Geography, Volume 1 – The Earth*, New York: D. Appleton & Company, Plate XVI.

comparing and contrasting places provides universal explanations and establishes *ideal-types,* while at the same time demonstrating the uniqueness of observable phenomena in different regions. With the proliferation of printing allowing an increasingly broader audience to access scientific knowledge, a geographer's written description of distant places, usually accompanied newly prepared maps or collections of maps compiled within a single book. Known as *atlases,* books of maps generated meaning for the reader on two levels.[9] On the one hand, within the cartographic frame of a single map, depictions of coastlines, towns, rivers and the limits of sovereignty presented information regarding the physical and political characteristics of geographic space. On the other, the selection, framing and sequential arrangement of maps within the pages of an atlas, as well as the textual, encyclopaedic descriptions which referenced collections of maps, structured knowledge according to the cumulative experience of reading a book. Within what Ackerman calls the 'metaspace' of an atlas, maps and the places they represented became comparable to each other and thus allowed different conclusions to be reached than what was possible through the appreciation of a single map.[10]

9 James Akerman (1995), *The Structuring of Political Territory in Early Printed Atlases*, Imago Mundi, v. 47.
10 *ibid*, p. 139.

For geographic spaces known solely through the information compiled within such volumes, the textual and visual relationship established between places could - on occasion - be significant. Inside the pages of Conrad Malte-Brun's early 19th century *Universal Geography* for example, the narrative descriptions of China and India were followed by consideration of continental Southeast Asia's entire extent as a single geographic unit.[11] The details of a European expert's reasoning with regard to people and cultures that he had never experienced matter less than the reasoning that allowed this specific group of kingdoms that were neither part of the description of China nor categorizable as religiously affiliated with Hinduism, to be considered collectively rather than as any other possible regional configuration.[12] As different meanings intertwined within the pages of the book, the value of a collection of maps or textual descriptions was potentially greater than the sum of its parts. Daston and Galison have observed, that the mission of scientific atlases was not simply to inventory but also to characterise phenomena, replacing raw observation with the "digested" knowledge provided by the expert's eye.[13] The strong association between the cartographic depiction of a geographic space and the facts the depiction represented, reinforced concepts that consistently appeared within an atlas' pages. Through those pages, an idea such as the delta arguably emerged as an archetype that could be consistently recalled throughout the narrative. With the gradual adoption of the classificatory registers characteristic of Enlightenment scientific thought, knowledge of deltas, not as a collection of individual jurisdictions or specific terrains but as an entirety apparent only on a map, was formed by analogy. As printed atlases became an increasingly popular means of understanding the world, the qualities of lowland regions around the outflows of the Indus and Ganges could be deduced according to the characteristics inherent to the Egyptian delta.[14]

If by the beginning of the 19th century the term delta had become part of the language of geography, the relationship with the river from which it emerged was yet to be definitively established. Alexander von Humboldt's critical commentary on Buache's delineation of basins along ridgelines, emphasised the conceptual flaw in considering the lowlands where multiple streams merged as part of the same hydrological system that subdivided the globe. Von Humboldt's observations

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11 Malte-Brun writes *"The only region which remains to complete our description of Asia is that situated between China and Indostan, comprehending the Birman empire, the kingdoms of Tonquin, Cochin-China, Cambodia, Laos, and Siam, and the peninsula of Malacca."* Realising that "*[w]e have at present no generic name in universal use for this region*", the Danish author argued that despite the use of the term Indo-China, the term Chin-India was a more accurate characterisation since Chinese influence was more pronounced. M. Malte-Brun (1827), *Universal Geography or a Description of All Parts of the World on a New Plan, According to the Natural Division of the Globe, Volume 2,* Philadelphia PA: Anthony Finley, p. 264

12 Malte-Brun had translated into French, John Barrow's book on his travels to Cochinchina, and according to Hahn, had been responsible for coining the term Indochine, which many of his contemporaries considered unsuitable. H. Hazel Hahn (2013), *Abstract Spaces of Asia, Indochina, and Empire in the French Imaginaire.* In Vimalin Rujivarcharkul, H Hazel Hah, Ken Oshima & Peter Christensen (eds.), *Architecturalized Asia.* Hong Kong: Hong Kong University Press, p. 89-90.

13 The authors refer specifically to anatomical atlases and not to collections of maps. The principles of compiling knowledge through a sequence of visual images however are immediately relevant to cartographic atlases. Daston & Galison (1992), p. 84.

14 For example in Malte-Brun's Universal Geography first published in the early years of the 19th century the Indus "*gives off lateral streams as it approaches the sea, it does not form a Delta exactly analogous to that of Egypt*" or *"the land near the mouth does not possess the fertility of the Delta of the Nile, or the Ganges."* Conrad Malte-Brun (1829), *Universal Geography.* Philadelphia: Anthony Finley, p. 115.

of the Orinoco River gave him cause to express doubts as to the universality of a delta's physical characteristics. From his perspective the land was so low that:

> *...it appears to me difficult to attribute the delta of the Oroonoko, and the formation of it's soil, to the accumulated mud of one river.*[15]

From first-hand observation, the countless bifurcations of rivers into smaller channels as they approached the sea, was where alluvium deposited. However not all these sediment deposits had the same hydrological origin. Between *oceanic deltas* such as the Ganges where an existing maritime gulf was gradually filled by a river's sediment and *tributary deltas* created further inland at the confluence of streams, the consideration given to deltas was equally a question of water flows as it was one of land.[16] Rather than a single geographic ideal-type with multiple variations, for von Humboldt the delta referred to multiple overlapping processes of land formation, that while distinct to each individual body of water would eventually merge in the lowlands to become indistinguishable from each other. As such, deltas did not so much undermine the dependence between a river and sediment accretions, as suggest that a river's water was a substance that created rather than simply occupied the dry land shown on the surface of a map. In a period when Europeans' knowledge of geography accelerated through exploratory missions, mercantile activity and military conquest, drawing the distinction between water and land was critical to movement, trade and defensive strategy. Yet what may have been common to all maps - seeking to define geographic space through the pictorial delineation of the edges of coasts or rivers - was redundant where the delta's shifting ground conditions were concerned.

The river's deltas

In the European context, the questions surrounding the mapping of the delta are demonstrated in the cartography of the Rhône in the south of France. By the early 19th century, the extensive coastal lowlands located at the outflows of the Rhône River had already been the subject of maps for at least 500 years.[17] With only two access points until the 18th century, the vast region of marshes known as *Camargue* experienced frequent floods, and was sparsely inhabited except on the more stable ground along its edges.[18] Hydrologists studying the sequence of the region's historic depictions on maps have pointed out the extensive changes to the locations of sediment and alterations to the courses of rivers within relatively short periods of time. In relation to previous maps, a 1778 depiction of the river presented new accumulations of sediment that had formed into new islands only within the previous six decades.[19] As a result docks, lighthouses and other structures could often end up situated far away from their intended

15 Alexander von Humboldt 1814-1829 (1827), *Personal narratives of Travel to the Equinoctial Regions of the New Continent during the years 1799-1804 by A. de Humboldt and Aimé Bonpland with maps and plans, translated by H.M. Williams*. 2nd Edition. 7 Volumes. London: Longman, Hurst, Rees, Orme and Brown. Volume 5. pp. 720-721.

16 Von Humboldt's detailed discussion of deltas unfolds across a significant portion of Humboldt's personal narratives from his travels in South America in which comparison of similar phenomena is used to interrogate the process of sediment formation rather than the cartographic form resulting from the process.

17 R. D. Oldham (1925), *The Portolan Maps of the Rhône Delta: A Contribution to the History of the Sea Charts of the Middle Ages*. The Geographical Journal, v. 65, n. 5, p. 404.

18 Georges Pichard (2005), *La découverte géologique de la Camargue, du XVIe siècle au début du XIXe siècle*. Travaux du Comité français d'Histoire de la Géologie, Comité français d'Histoire de la Géologie, 3ème série (tome 19), p. 115.

19 In the same period the coast had receded more than 2 kilometres, after having progressed around the same distance in four preceding decades Georges Pichard, Mireille Provansal & François Sabatier (2014), *Les embouchures du Rhône*. Méditerranée, n. 122, pp. 11-13.

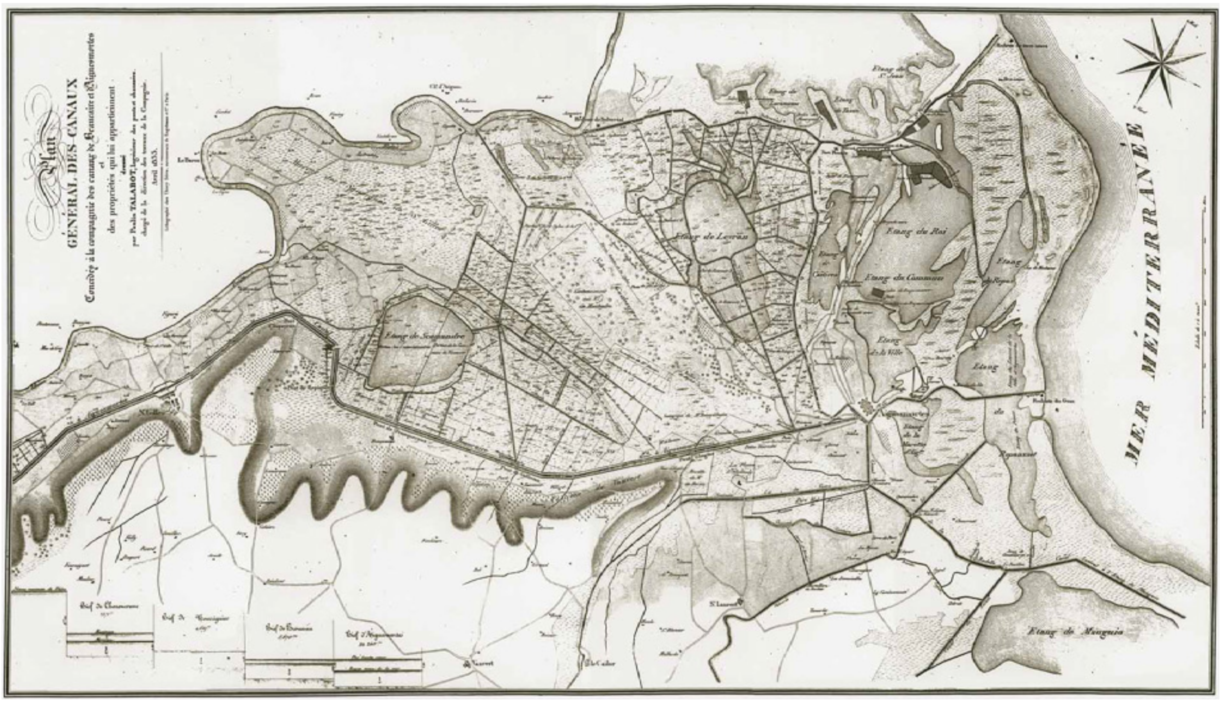

Fig 5.3 The Rhône's lowlands This map of the water infrastructure to the west of the Camargue lowlands shows the Canal du Rhône à Sète and the Canal de Capette (flowing just below the large pond in the centre of the map). The 1823 *Traité des Marais* concerned part of the geographic space depicted on this map.
Paulin Talabot (cartographer) (1833), *Plan general des canaux*.

coastal location. The reasons for these changes were not always due solely to the forces of nature. Dikes and canals had been constructed in the saline lowlands as well as upstream marshes where fresh river water was the predominant source of the ground's wetness. In places this had resulted in the diversion of fresh water inflows allowing salt water to reach the marshes in certain seasons.[20] With most infrastructure in this period constructed by private initiative, canals could therefore become the source of conflict between local power centres, as the changes they induced – improving agricultural land or affecting the rights of existing landowners – could alter the balance of economic and thus political power [**Fig 5.3**].[21] To the extent that manmade waterways, or a dike could isolate or connect topographically distinct extents, the infrastructure that appeared on maps was not just illustrative of water control but in one sense, also of the subdivision of the Camargue's geographic space.

With the lines denoting the edge of water only accurate within short spans of time, understanding the phenomenon of land accretions around the Rhône's outflows became the focus of concerted scientific study. Georges Pichard's research of the history of the Camargue's geology, has pointed out the importance of maps in the formation of scientific theories about the changing condition of the ground.[22] Written in 1731, Virgile de la Bastide's observations of the Rhône's mudflats theorised that the ground was composed of horizontal layers which

20 Raphael Mathevet, Nancy Lee Peluso, Alexandre Couespel & Paul Robbins (2015), *Using historical political ecology to understand the present: water, reeds, and biodiversity in the Camargue Biosphere Reserve, southern France*. Ecology and Society, v. 20, n. 4:17, p.7. and Fig 3.

21 *ibid*, p .7.

22 Georges Pichard (2005), p. 113.

Fig 5.4 Geological map of Gard Prefecture Showing the geology of the Camargue, the beautifully detailed map depicts geographic space in relation to the characteristics of the ground's subsurface. Unlike the topmost *créments* affected by floods, tides and rainfall, the transformation of subsurface geology was far more gradual, suggesting that geological maps of the Camargue revealed the long-term or "permanent" condition of the ground.
Émilien Dumas (1850), *Carte géologique du département du Gard*, Paris : Lemercier.

he called *créments*. Characterising *créments* according to their qualities and as either salty or sweet, he concluded that the Camargue was once part of the Mediterranean and had been formed by both the sea and river depositing sand and silt.[23] By the end of the 18th century, the engineer Hubert (Henri) Gautier had already attempted to understand the rate of alluvium accumulation in the river's marshes through *profilage* (profiling), from which he was able to calculate the ratio of solid (suspended matter) to liquid as one part in 2000.[24] The consideration of sediment accumulation from the perspective of geology allowed early scientists to conjecture on the formation of the ground. As the outcome of multiple processes, the delta encompassed a singular geographic space extending from the sea to the bifurcation of the Rhône at Arles [**Fig 5.4**]. Viewed through the diachronic lens through which consecutive layers accumulated, the delta being mapped made immediate references to the past, the passage of time visible in the permanently displaced lighthouses of the Camargue.

23 Pichard (2005), p. 114. It is difficult from Pichard's thesis to understand if the maps he refers to are to be understood as accurate depictions of the terrain during a certain period, or also subject to the period's cartographic conventions and surveying limitations.

24 Following the principle that the grains of land had, like Humboldt's oceanic deltas, gradually silted an existing maritime bay, he calculated the geological period of this process as 35,000 years. Pichard *et al* (2014), p. 7.

Having conceived of deltas as the areal magnitude of accumulated silt and sand deposits, the use of the term to denote a particular portion of the Mekong's river system was demonstrated in the written accounts of military officers taking part in the colonial occupation of south Vietnam. For lieutenant Oswald Taillefer, the colony of French Cochinchina was "almost entirely formed by the delta of the Cambodge [Mekong]."[25] Visualising the ground in terms of layered *créments*, he described the river's sediment deposits situated on top of soils left by a retreating sea which, when reaching the surface, produced "real islands of extraordinary fertility".[26] Comparing these islands with the Camargue, Taillefer imagined an agricultural landscape where canals could regulate floods and provide irrigation to make rice production a profitable enterprise. Similarly, for the frigate captain Paulin Vial the sight of the inextricable network of rivers and arroyos carrying people and goods across the vast region occurred within:

> *...the six provinces which form the colony, that is to say this delta of the great river, whose lands watered by the regular floods of the Mekong are so splendid and so rich that after having visited them, an admiral wrote: It is the delta of the Nile, but much bigger and much more beautiful.*[27]

The suggestion that the new colony encompassed a geographic space that was comparable with the Nile and could be characterised in terms of a single geophysical phenomenon, resonated with the idea that deltas were conducive to permanent settlement. Thus what geographic space a delta on the Mekong River referred to was not so much visible in the configuration of the terrain's physical characteristics but rather a conjecture articulated in relation to the mapped boundaries differentiating the colony from the sovereignty of neighbouring kingdoms. For the Vietnamese linguist and teacher Petrus Ky however, the delta was not equivalent to the entire colony. Written in French for use in colonial schools, Ky's *Petit Cours de Géographie* described the geographic space around the Mekong's lowlands:

> *Most of the territory of this region is alluvial soil, formed by the mud and sand brought by the action of water and stopped or retained by roots of the cây đước, vet, gîa, bân etc...*[28]

Having grown up in one of the southern region's major towns before colonization, Ky's statement described the essential processes associated with sediment accretion at the river's outflows. Yet if conceptualising land (*territoire*) as a

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25 "*La basse Cochinchine est presque entièrement formée par le delta du Cambodge.*" Oswald Taillefer (1865), *La Cochinchine : ce qu'elle est, ce qu'elle sera : deux ans de séjour dans ce pays de 1863 à 1865.* Perigeaux: Impri. Dupont, p. 45.

26 "*Ces sables se rencontrent partout à des profondeurs variables, et ils atteignent parfois la surface, où ils forment de véritables îlots d'une fertilité extraordinaire.*" *ibid.* Soon after completing his military service Taillefer returned to the colony and formed a company to grow and export rice.

27 "*...les six provinces qui forment la Basse-Cochinchine, c'est-à-dire ce delta du grand fleuve, dont les terrains arrosés par les crues régulières du Mékong sont si splendides et si riches qu'après les avoir visités, un amiral écrivait: C'est le delta du Nil, mais bien plus grand et bien plus beau.*" Paulin Vial (1874), *Les Premières années de la Cochinchine. colonie française.* Paris: Challamel Aine, p. 285.

28 "*La majeure partie du territoire de cette contrée est un terrain d'alluvion, formé par la vase et le sable apportés par l'action de l'eau, et arrêtés ou retenus par les racines des cây duoc, vet, gîa, ban etc....*". Trương Vĩnh (Petrus) Ký (1875), *Petit cours de géographie de la Basse-Cochinchine*. Saigon: Impri. du Government, p.12. Educated in the Jesuit seminary in Penang, Ky spoke eight languages, working as translator and teacher in Saigon. In the book, he uses the term *territoire* exclusively in association with jurisdiction (eg territoire du Cambodge). In this sentence however, I am assuming *territoire* alludes to terrestrial land rather than geopolitical authority.

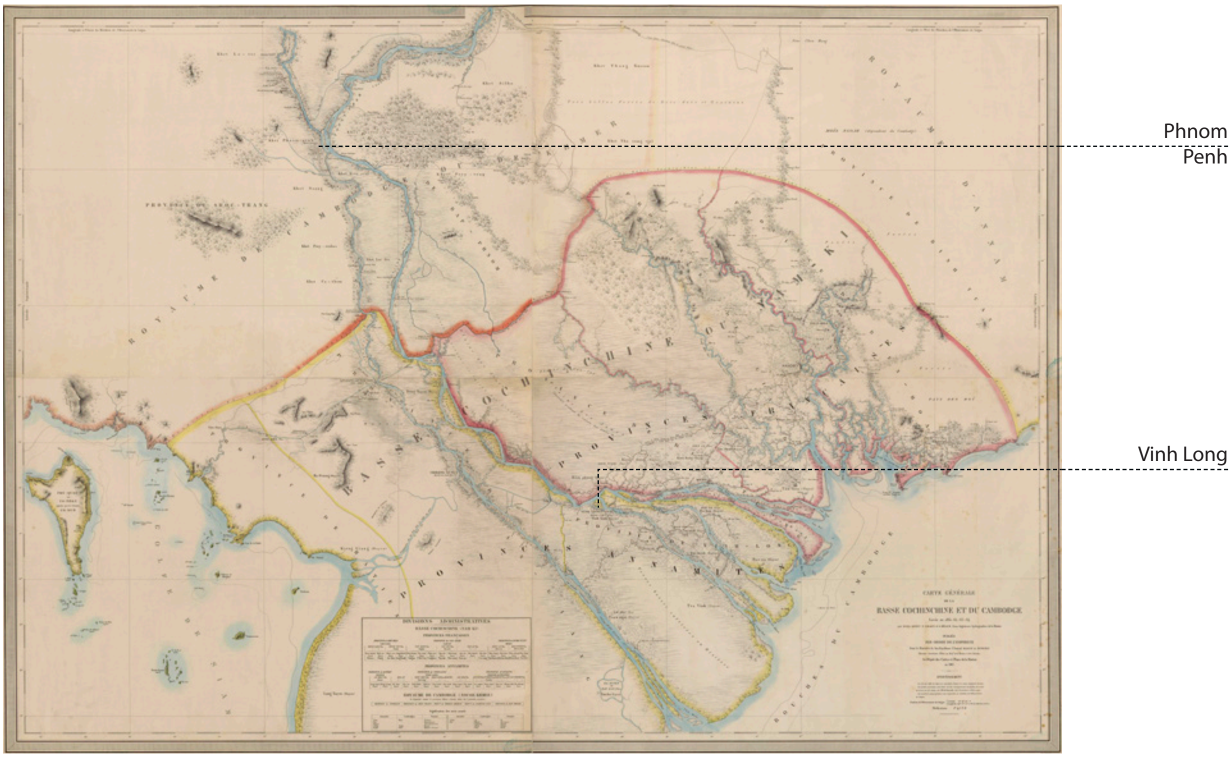

Fig 5.5 The Mekong's deltas Under different lenses, the geographic extent of the Mekong's delta was either the majority of the region depicted on this map, the riparian lands up to Phnom Penh, or a more limited extent that began at the mainstream's bifurcations at Vinh Long and continued until the coast. Note the red boundaries representing the colony's limits in the early years of French occupation and the yellow boundaries denoting areas still under Vietnamese control.
L. Manen, F. Vidalin & G. Héraud (cartographers) (1867), *Carte générale de la Basse Cochinchine et du Cambodge.*

function of the "action of water" made the "alluvial soil" specific to the Mekong, the ground where these characteristics were present was not collectively known as a delta. Of all the alluvial soil, the extent encompassed by the delta was downstream from the town of Vinh Long where the Mekong's "six mouths" flowed into the sea [**Fig 5.5**].[29] The same region where Taillefer's "real islands" were located, Ky's roughly triangular delta was known among the Vietnamese as *miệt vườn*, 'garden' lands with highly productive agriculture soils, farmed by multiple settlements.[30] Considering Ky did not think it worthwhile to include "delta" in his dictionary or his translation of geographic terms from French into Vietnamese, it is not unlikely that what phenomenon or geographic space a *delta* signified was unimportant, at least in terms of determining a particular dimension for the "alluvial soil".[31] Thus while in theory Ky and the French officers referenced the

29 *"La troisième branche ou fleuve Antérieur[...] forme à Vïnh-long quatre bras et se jette dans la mer de Chine par six embouchures formant un delta." ibid*, p. 25.

30 In a period in which the colony's educational system was organized to train interpreters and secretaries and to replace use of Chinese characters and the Confucian principles of local Vietnamese administrators, the definitions in Ky's textbooks formed part of the material used to train bureaucratic staff during the first 25 years of colonial administration. See Luong Quang Hien (2020), *French Educational Reforms in Indochina Peninsula and the Appearance of the Western Intellectual Hierarchy in Vietnam in the Early Twentieth Century*. American Journal of Educational Research, v. 8, n. 4, p. 210.

31 In his later *Précis de géographie* from 1887 which translated French geographical terms for use by the colony's Vietnamese bureaucrats, Ky translates the *basin* (triềng sông) and the river's mouths (vàm sông) but omits the word delta, a term which is also omitted in his 1884 French-Vietnamese dictionary.

same geographical technical term, the area this notion occupied on the surface of maps was different. If the deployment of the word delta was intended to indicate a technical geographical relationship, then this was not necessarily confined to the observable condition of the ground. Correlating human activity with the action of water, the Mekong's delta could be perceived in the cartographic limits of colonial authority or in the cultivated orchards of the 'garden lands'.

Cosmographic flows

While clearly tools for developing cognition of the world's geographic as well as political structure, in the European setting atlases were not intentionally prepared to support administrative control.[32] In parts of the geographic space named *Indo-China* however, collections of maps compiled into books had been a tool of governance since at least the 15th century. Centred on the embankments of the Red River, the Vietnamese Empire's Lê rulers chose to adopt a visual rather than textual approach to describe the geography of their domain.[33] Having reorganized the state bureaucracy to reflect the administrative structure of their Ming dynasty contemporaries to the north, books of maps compiled using Chinese cartographic conventions depicted, on separate spreads, the provinces through which imperial control was exercised. Prepared by regional administrators tasked with recording mountains and rivers as well as landmarks, routes and strategic areas, the maps were sent to the capital to be redrawn in the visual language of the atlas.[34] The atlas provided the Court with a way of visualising an Empire founded on, but not confined within, the productive agricultural land formed by the Red River's sediment deposits. Noting the physical features related to water as well as the location of settlements, the geography of the Empire was nonetheless not only composed of what could be observed and recorded visually on maps.[35] In the geomantic tradition within which Chinese cartography had evolved, expert geomancers could deduce the "land's principles" and how these principles supported inhabitation of the land. Within this conceptual framework, features of the terrain were underpinned by what Kelley calls "arteries or nodes" of geomantic energy. [36] These energies intersected at the capital Hanoi, which had been auspiciously relocated to "...where the earth lies spacious and flat and high and clear, where the inhabitants are not oppressed by flooding, where the earth is fertile and prosperous..."[37] The emperor's control of the geomantic centre and the surrounding areas allowed food surpluses to be produced, arguably imbuing the terrain with political as well as cultural significance. Expanding southwards, the emperor's authority eventually encompassed multiple coastal regions created from the riverine accretions of soil. Geographic knowledge in the furthest south

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32 Ackerman makes the argument that the way an atlas displayed boundaries in conventional single maps and composed the "mapping unit" (the cartographic frame), were both critical in manipulating political territory. Although individual maps became critical to the governance of European kingdoms, atlases were mostly prepared by private cartographers that were only occasionally employed by the state. Ackerman (1994), p. 139.

33 Whitmore (1995), pp. 481-482.

34 *ibid.*

35 *ibid*, p. 484.

36 Liam Kelley (2016), *From a Reliant Land to a Kingdom in Asia: Premodern Geographic Knowledge and the Emergence of the Geo-Body in Late Imperial Vietnam.* Cross-Currents: East Asian History and Culture Review (E-Journal), n. 20, p. 27. Retrieved from http://cross-currents.berkeley.edu/e-journal/issue-20, on 18 October 2021.

37 Quote attributed to Emperor Thái-tổ that in 1010 moved his capital to the same area where the Tang dynasty's provincial government ruling Vietnam had its base. John Whitmore(2012), *Transformations Of Thăng Long: Space And Time, Power And Belief.* International Journal of Asian Studies, v. 10, n. 1, p. 3.

however was limited. As the Nguyen dynasty emerged to challenge the power of the Hanoi-based Trinh rulers, sets of maps were compiled into atlases that followed an itinerary of travel. Sequentially arranged according to the experience along a specific route, maps of journeys notionally originated within the Nguyens' domain and ended at the Mekong, where Cambodia began.[38] *Itinerary-style* maps as Whitmore calls them, were meant to serve as guides, indicating the days needed to travel between locations and were useful for the planning of military expeditions or used by imperial officials that were expected to travel throughout their jurisdictions. Confined within the north-south corridor of land flanked by the Annamite range and the coast, the cross-section of geography portrayed on maps of the empire's provinces typically encompassed the lowlands, the rivers and their hinterlands, 'bounded' at the top of the page (west) by the painted silhouettes of mountains.

At the southern terminus of the itinerary however, the pictorial combinations of mountain, land and coast ended. Drawn relative to the medieval capital of the Khmer Empire at Angkor rather than any mountains, the lowlands surrounding the Mekong River were considered a frontier by both the Vietnamese emperors and the Khmer kings [**Fig 5.6**].[39] If an edge to imperial authority, for the Chinese,

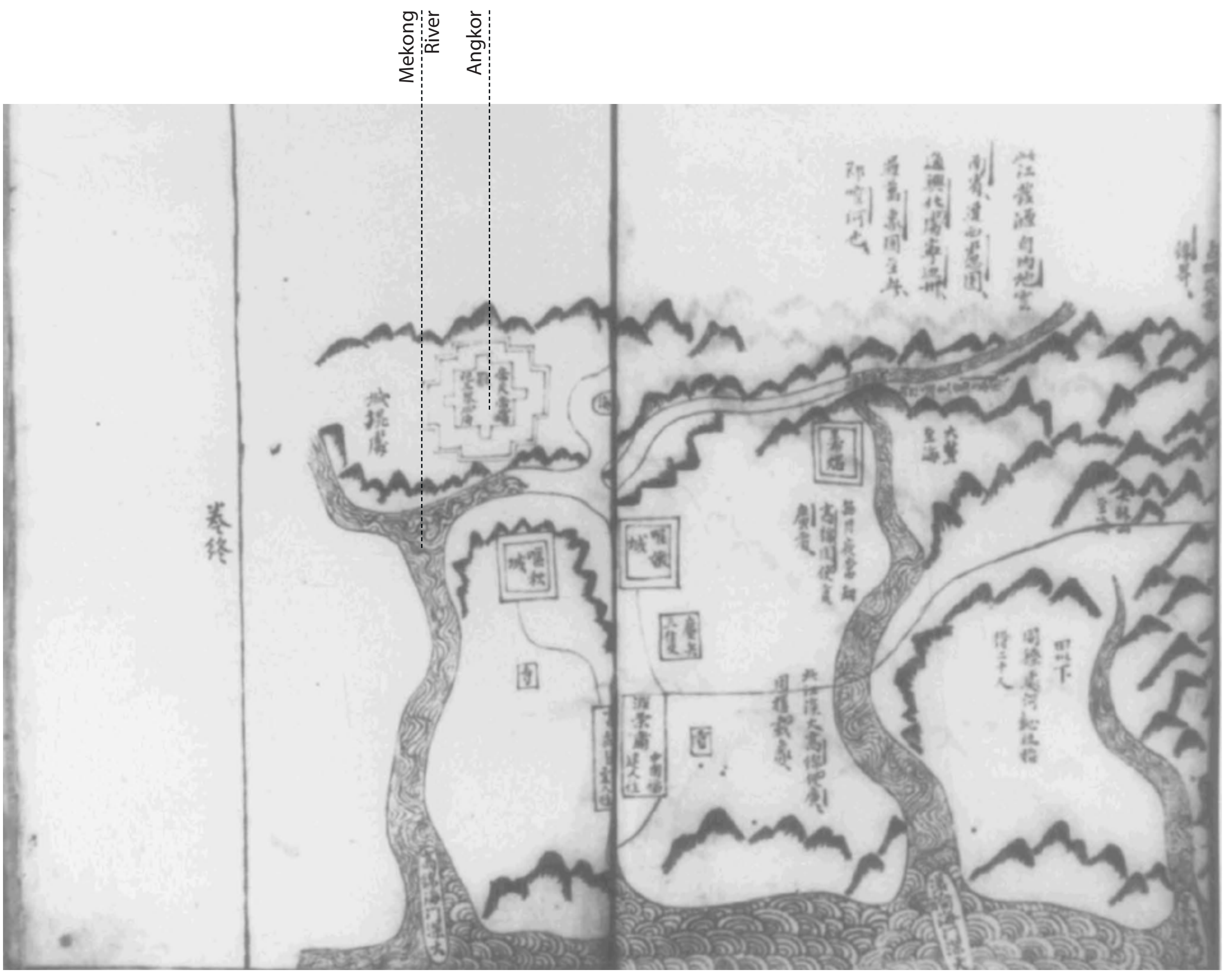

Fig 5.6 The Mekong's outflows The Vietnamese map is the final in an itinerary spread across 28 maps. These collectively depicted the Nguyen dynasty's domain up to the border with Cambodia. The map provides information about the Mekong's hinterland showing routes, major settlements and the medieval Khmer capital at Angkor. Note that ridge-lines are drawn to emphasise dry land rather than indicate mountains.
Unknown cartographer (1654?), *Bình Nam Đô (Maps of the pacification of the south).* From Whitmore (1995), p. 494.

Vietnamese, Malay, Cham and Cambodian merchants, farmers or technicians, the sparsely inhabited interconnected waterways formed by the Mekong's sediment were the crossroads for trade. Comparing the overlapping trading and cultural interactions across the surrounding shores of the South China Sea with the Mediterranean, the scholar Tana Li has argued for the historical existence of a single economic zone pivoted on Chinese junk traders that stretched from the Mekong's estuaries southwards to the Malay Peninsula.[40] Nonetheless, even as late as 1798, imperial mapmakers looking south portrayed the Mekong in relation to rival powers such as Siam.[41] Conflict over control of Cambodia and the Mekong's lowlands had pitted Vietnamese armies against the Cambodian as well as the Siamese military in separate incidents throughout the 18th century.[42] Having emerged victorious in the civil war against their northern rivals, the Nguyen gradually reasserted control over the 'southern region' (*Nam Bộ*), eventually taking over as rulers of the entire Empire in the early 1800s. Relocating the royal Court to their ancestral home in Huế, the site of the new imperial capital realigned geomantic energies to converge on the coastal lowlands of the Perfume River.[43]

But while the view southwards from Huế began to see the Mekong's lowlands as the endpoint of the empire, from the perspective of the Cambodian rulers in their capital at Oudong, the Vietnamese were intruding on the southern edge of a domain inherited from Angkor's mythical "circle of kings". Unlike the Vietnamese, the view of the Cambodians regarding the extent of their ancestral domain was not constructed on the principles of Chinese geography and geomancy. Based on the evidence of Sanskrit inscriptions as well as the architecture of religious centres, historians of Southeast Asia such as Wolters and Whitmore concur that the Khmer founders of Angkor had been predominantly influenced by the beliefs and cosmology of India. Yet if what formed the medieval kingdom's geographic extent was ever recorded on the surface of conventional maps, those maps have not survived. Among scholars of the region's cartography however, the cosmographic concepts that underpinned the layout of temples at Angkor Wat are considered part of Southeast Asia's cartographic corpus.[44]

Where Hindu cosmology appears most pertinent for attempting to understand Khmer conceptions of the Mekong's geographic space is the role given to water and rivers in the subdivision of the world. As well as symbols of the archon's political power, Hindu temples such as the vast complex at Angkor Wat were

38 Whitmore (1995), p. 490.

39 Li notes that specific Khmer as well as Vietnamese place-names in the Mekong's lowlands refer to a frontier or border. Tana Li (2004), *The Water Frontier : An Introduction,* p.1 , in Nola Cooke & Li Tana (eds.), *Water Frontier: Commerce and the Chinese in the Lower Mekong Region, 1750-1880.* Singapore: Rowman & Littlefield.

40 A key destination for commerce in this zone, the Khmer town of Prey Nokor was occupied by the Vietnamese and transformed into Gia Dinh (Saigon), becoming a significant port for overseas trade. *ibid*, pp. 2-4.

41 In his informative *Cartography of Vietnam*, John Whitmore presents a Vietnamese map of the Kingdom of Siam (*Đại-man quốc đồ*) drawn by the mapmakers of the rival Tay-son emperor that would be defeated by the Nguyen a few years later. Whitmore (1995), p.498.

42 Attacks focused on overpowering the garrisons of populated centres such as the port of Ha Tien situated on Gulf of Thailand, that at different times during this period was controlled by Cambodians, Vietnamese and Siamese.

43 Whitmore (2012), p. 17.

44 Joseph Schwartzberg (1995a), *Introduction to Southeast Asian cartography*. In *The History of Cartography*, v. 2, b. 2, *Cartography in the Traditional East and Southeast Asian Societies*. Chicago IL: University of Chicago Press, pp. 693-696.

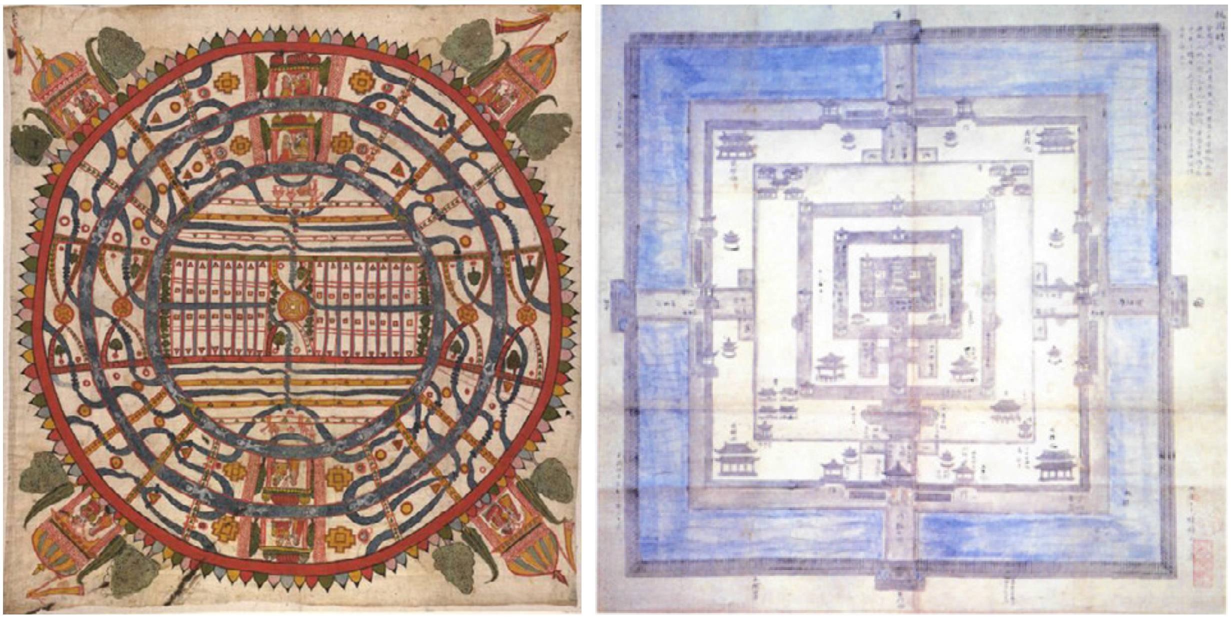

Fig 5.7 Cosmographic plans The drawing on the left depicts the key elements of the cosmos shared by Buddhist, Jain and Hindu traditions. Mount Meru is depicted in the centre and alternating rings of ocean form the edges of the continents. Linear bands of blue representing rivers connect the waterways to the *axis mund*i. On the right, the Japanese map of Angkor Wat is defined by the vivid blue of the perimetric moat which is believed to symbolize the encompassing oceans. Unknown painter (1890s), *Manusyaloka, map of the world of man, according to Jain cosomological traditions;* Fujiwara Tadayoshi (cartographer) (1715), *Jetavana (Plan of Angkor Wat)*, in Yoshiaki Ishizawa (2015), *The World's Oldest Plan of Angkor Vat: The Japanese So-Called Jetavana, An Illustrated Plan of the Seventeenth Century*, UDAYA, Journal of Khmer Studies, n.13, Fig. 2.

spatially arranged to mirror the geography of the cosmos [**Fig 5.7**].[45] Not only does the central tower represent – as in all Hindu temples – Mount Meru, but more uniquely for a project of this scale, the surrounding moat is also assumed to represent the encompassing Ocean.[46] At 250 metres long, the sandstone causeway bridging the width of the moat would have taken minutes for an average person to walk across before entering the temple's grounds. Contemporary analysis of the numerological significance of the moat's width have concluded that relative to other dimensions within the temple, the distance travelled over water symbolised one of the four Hindu time cycles and more specifically the Kali Yuga, the current and "most decadent age of man".[47] If the experience of moving through a specific time period that this implied was a design characteristic not unique to crossing the moat, it is important to note that these cosmic dimensions did not begin within temple grounds but included the body of water. This suggests the moat, and by extension the water it contained, was a constituent component of the temple's ritual space rather than a symbolic separation between opposing spatial notions such as sacred and profane or inside and outside.

45 Common to Buddhism, Jain as well as Hindu traditions, the cosmic 'axis mundi' was mythical Mount Meru located in the Himalayas. Arranged symmetrically, in concentric circles around the centre, continents such as Suvarnadvipa – identified with Southeast Asia – appeared separated by oceans. How this geometric conception of the world translated into material form is evident in the configuration of Angkor Wat.

46 Schwartzberg (1995a), p. 695.

47 The detailed study on the astronomical and cosmological calibration of Angkor Wat's architecture, elaborated on the distance between entrances and gateways along the East-West route through the temple and its surrounding grounds. The enumerated relationship between movement through the temple's space and passage through time was deduced by comparison of absolute measurements with mythical chronology. Robert Stencel, Fred Gifford & Eleanor Morón (1976), A*stronomy and Cosmology at Angkor Wat.* Science, New Series, v. 193, n. 4250, p. 285

Spaces of water flows

One of several manmade structures used to retain water, moats as well as temple ponds, canals and the colossal rectangular *baray* (reservoirs), collectively defined a hydraulic network that had symbolic as well as practical significance. The rulers of what the French archaeologist Bernard-Philippe Groslier called the *cite hydraulique*, deployed infrastructure to remedy the uncertainties of the monsoon, accumulating and then redistributing water to the rice fields during the dry season.[48] Constructed over a period of three centuries, the reservoirs have been considered part of this network.[49] With the largest *baray* extending nearly 8 kilometres on its longest side, for an observer, the king's overwhelming command over the elements evident in the geometry of water infrastructure, would have had cosmogonic implications. As Groslier argued, the kings' power to shape "the waters of the primordial Ocean" in the same way gods shaped the universe, implied that Angkor was itself a representation of the universe.[50] From this perspective, the monumental reservoirs evoking the cosmic seas were not just vast deposits of water. Just as the moat was part of the temple's ritual space, the *baray* may also have been perceived as part of the architectural ensemble comprising the ceremonial centre that included the collection of palaces and temples. Yet, considering this was the centre of a boundaryless *mandala* polity based on the personal relationship between the king and regional leaders, it would be contradictory to try to understand Khmer ideas about geographic space by thinking in terms of limits.[51]

Beyond the ceremonial centre, the hydraulic network that secured biannual rice harvests, physically connected settlements possibly much further than 20 kilometres away [**Fig 5.8**]. Working on the assumption that the water system's profound, regular and immediate impact integrated a terrain composed of inhabited mounds, land routes, natural streams and manmade waterways into a "single operational system", archaeologists have described Angkor as a "low-density city".[52] The conceptualisation of the city as a singular entity that is nonetheless inclusive of peripheral settlements is not as old as Angkor. The perception of the relationship between settlement patterns and a selected collection of manmade infrastructure (such as roads, railways or communications) in terms of a singular network, stems from 20th century studies that conceived of cities organised in terms of *metropolitan regions*. The existence of such a specific type of regional construct was itself built on multiple observations. Employment patterns as well as economic and social relationships were – to some extent – spontaneously formed and supported by the use of infrastructure across an extended geographic space.[53] The idea that these phenomena, however

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48 Bernard-Philippe Groslier (1974), *Agriculture et religion dans l'Empire angkorien*. Études rurales, n. 53-56, p. 99.

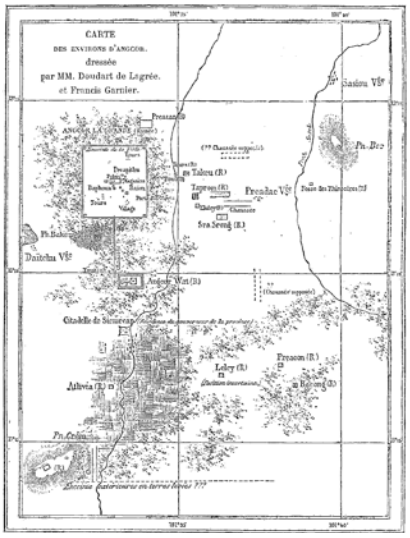
49 Storing millions of cubic metres of water, the *baray* rested on the surface of the terrain, and were constructed out of earthen walls that varied in height according to the terrain's slope. Robert Acker (1998), *New geographical tests of the hydraulic thesis at Angkor*. South East Asia Research, v.6, n. 1, pp. 9-11.

50 *"Les Khmers ont ensuite implante leurs temples par rapport a l'axe est-ouest, ou encore nord-sud de leurs baray, de meme que leurs enceintes d'eau symbolisant l'Ocean cosmique."* Groslier (1974), p. 113.

51 As Wolters clarifies *"a ruler's Siva-like prowess was bound to extend into unlimited space"* and thus a *mandala* polity was, in one sense, unbounded or rather boundaryless. Wolters (1999), p. 217.

52 D. Evans, C. Pottier, R. Fletcher, S. Hensley, I. Tapley, A. Milne & M. Barbetti (2007), *A comprehensive archaeological map of the world's largest preindustrial settlement complex at Angkor, Cambodia*. Proceedings of the National Academy of Sciences, v. 104, n. 36, p. 14279.

53 Although by the 1960s Jean Gottman, among others, had identified the regional extent of agglomerations based on observation of America's East Coast, the implications of increased regional connectivity at the metropolitan (...)



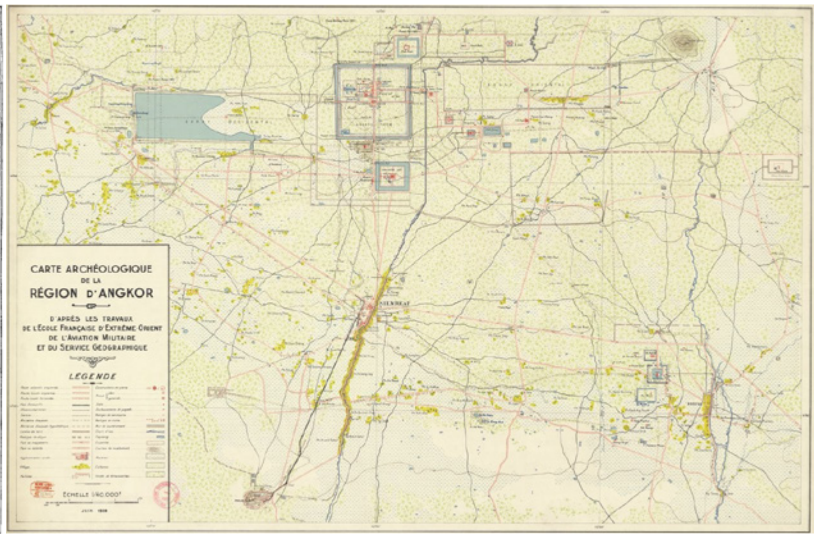


Fig 5.8 The extents of Angkor Which collections of buildings constitute the archaeological site of Angkor has changed as knowledge of the terrain has improved, but also as appreciation of what consitutes a single *city* in the context of medieval Southeast Asia has expanded beyond the ceremonial centre. Garnier's map to the left shows only a fraction of the ceremonial centre and does not depict the *baray*. The French School's archaeological map to the right includes the outlines of the reservoirs and extends to the shores of Tonle Sap. Mapped using images from LIDAR, the map below places the *baray* at the cente of a region of water flows in which the identification of raised earthen mounds in close proximity to waterways or pathways, has allowed archaeologists to conclude that the settlement extended over more than 1,000 km^2.
Francis Garnier (1885), *Voyage d'exploration en Indo-Chine*, Paris: Libraire Hachette et co., p. 11; École française d'Extrême-Orient (1939), *Carte Archeologogique de la Region d'Angkor,* Service géographique de l'Indochine; NASA/ Jet Propulsion Laboratory (JPL) (2007), *A new archaeological map of Greater Angkor*, Evans *et al* (2007), p. 14280.

distant from each other, were part of the same settlement unit, was undoubtedly reinforced by looking at the spatial concentration of these relationships on maps. Focused on the largest cities, the emergence of metropolitan regions as units of governance, reflected the realisation that new forms of regulation were needed after massive investment in transport infrastructure had increased geographic mobility and decentralised production. Projected backwards into history, a model inclusive of the 'sprawl', 'diffuse' or 'edge' conditions that define most urban agglomerations today, becomes relevant only when the network that theoretically underpinned the locational decisions of individuals, was regulated to achieve a particular outcome, and controlled with regard to a specific geographic reference. Given the magnitude of the network that recent mapping of the terrain has revealed, its operation as single system would have been a complicated effort. Yet without the entirety of the network visible on maps, what control was really possible in Angkor?

Discussions of an “Asiatic mode of production”, which originated in Marxist debates, have framed the historical formation of states as a function of water management. Conceiving of Asian states as highly centralised bureaucracies that regulated excessive rains during the wet season and drought in the dry, the influential *hydraulic despotism* thesis of historians such as Carl Wittfogel presented the power of the monarch as equivalent to the control of water.[54] But as attractive as relating political power to water infrastructure would be for understanding Angkor’s geographic extent, the emergence of the medieval Khmer state as a consequence of the need to control water does not agree with the sequence of archaeological evidence.[55] For water to have been centrally 'regulated' not only suggests the presence of the technical means for detention and distribution, but also the administrative organization to coordinate the continued maintenance and operation of the network’s multiple parts in service of flood-protection, drainage or irrigation. Unfortunately the degree of the state’s participation in how the network was managed has not been determined.[56] However, the moat’s inclusion in Angkor Wat’s ritual space, the ceremonial centre’s calibration in relation to the *baray*, and the deployment of water infrastructure linking the two into a broader network of settlement and agriculture suggest a conclusion relevant to cartographic analysis. Along the edge of Tonle Sap’s vast floodplain, the physical diversion of water underpinned the way a particular geographic space was differentiated from its surroundings without making the element into a boundary that distinguishes between spatial conditions.

Most certainly when encountered as a river or stream, water was also a barrier. But as Philip Taylor has pointed, temple tanks, water wells and village reservoirs have been critical to the survival and social cohesion of Khmer farming

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53 (...) scale for social relationships (eg Manual Castells) or employment (eg Hall and Pain), have only been relatively recently confirmed.

54 Karl Wittfogel (1981), *Oriental despotism*. New York: Random House. For a rounded critique of Wittfogel’s theory see Jeffrey Banister (2014), *Are you Wittfogel or against him? Geophilosophy, hydro-sociality, and the state,* Geoforum, n. 57, pp. 205-206.

55 Evans *et al* (2007), pp. 14281-14282.

56 Roland Fletcher, Christophe Pottier, Damian Evans & Matti Kummu (2008), *The Development of the Water Management System Of Angkor: A Provisional Model*. Bulletin of the Indo-Pacific Prehistory Association, The Indo-Pacific Prehistory Association, p. 66.

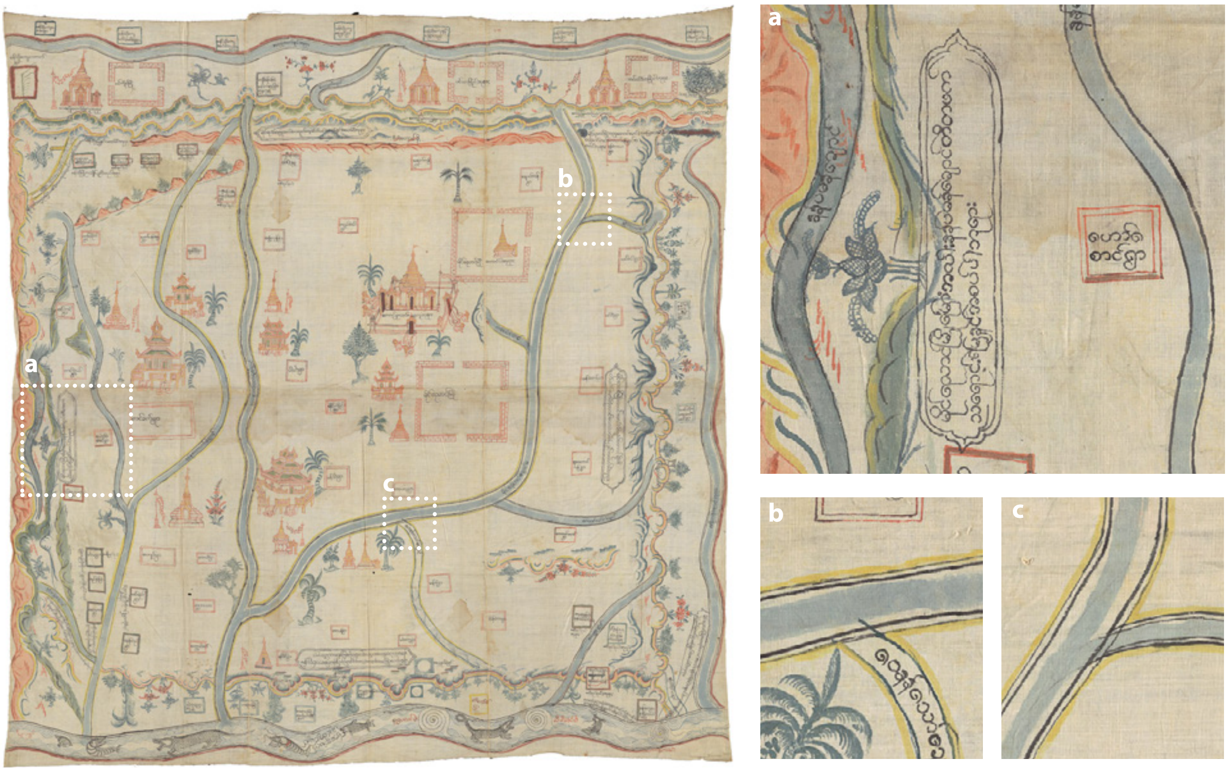

Fig 5.9 Map of an area in north-west Burma The centre of authority - Maingnyaung - is represented by the red brick planimetric walls with four "gates". Double ink lines articulate the main river drawing visual attention to the central portion where the capital is situated. Information on natural landmarks to locate boundaries (a) is positioned along the furthest edges of the cartographic frame. Linework depicting the river's branches overlaps with the mainstream (b, c) while branch (c) is not highlighted with blue ink, suggesting these streams were drawn later and perhaps in relation to other features already depicted on the map, rather than solely with reference to the environment being portrayed.
Unknown cartographer (~1860), *Map of the Maingnyaung region in Upper Burma,* Cambridge University Library Special Collections.

communities, as far away as the Mekong's coastal lowlands.[57] And while it would be an exaggeration to claim water storage was the centre of these settlements, it is also clear that rivers and streams were not an edge. A map drawn from the Burmese cartographic tradition provides an insight into the way the depiction of water can structure the cartographic frame without denoting the limits of a particular geographic space. With influences from both China as well as the Hindu cosmographic tradition, the map displays many features common to Burmese cartographic depictions [**Fig 5.9**].[58] Presenting the settlements paying tribute to the leader of Maingnyaung, political boundaries are not depicted but rather described in text in relation to natural landmarks.[59] To the extent that red squares and also red pagodas and red stupas indicate a single domain, the extent of the jurisdiction being presented is not contingent on rivers for its delineation. Rather, the thickness of the rivers appears to denote the relatively higher importance of

57 Taylor (2014), p. 103.

58 These common features include the abundant vegetation, the pagodas which serve as visual landmarks and the depiction of settlements as squares. Joseph Schwartzberg (1995a), p. 689 and Joseph Schwartzberg (1995b), *Southeast Asian Geographical Maps*, in *The History of Cartography,* v. 2, b. 2, *Cartography in the Traditional East and Southeast Asian Societies*, Illinois: University of Chicago Press, p.761

59 In the map, red squares depict settlements paying tribute to the leader of Maingnyaung, the town shown in the centre with four gates. Consequently blue squares show either autonomous settlements or those paying tribute to other leaders. Typical of Burmese maps, boundaries are not depicted but textual notes referring to the identification of boundaries with natural landmarks are shown in blue-outlined rectangular boxes on the four edges of the (...)

the portion of land where the capital is located. To assess if this emphasis was intentional, consideration should be given to the river's depiction. Even if the main river was, in terms of first-hand experience, proportionally wider than the other waterways depicted within the cartographic frame, the equal width of the waterway before *and* after its division into two branches, does not appear to convey information about the distance between the river's embankments. Rather than showing the viewer a map of the river, the depiction of the river is deployed in service of representing the geographic structure of power. In this sense, even if rivers do not visually delimit the area of Maingnyaung's authority, they do confer a particular hierarchy to the depiction of the terrain that favours the dominant political hierarchy.

Apparent similarities between Burmese and the hypothetical Khmer cartography based on Angkor, should not suggest a common 'Southeast Asian' approach to the significance of water in the conceptualisation of geographic space. Indeed rivers did, in places, act as the border between kingdoms, and thus water was not inconceivable as the limit of authority.[60] Where the pre-colonial extents of power are concerned however, this appears generally to be the exception rather than the rule.[61] If not the limit, then the characteristics making water the reference to differentiate a particular region from another, allowed Tang-dynasty Chinese accounts to describe Angkor as having emerged from a predecessor polity called Chenla. Split into *Land* (northern) and *Water* (southern), Chenla became part of the region's historical imagination after the influential French archaeologist Georges Coedès published his theory of the prehistoric kingdom.[62] Criticised as both anachronistic and overly dependent on information distorted by the Chinese perspective of his sources, Coedès' thesis is more valuable as an insight into what Claude Jacques calls an early 20th century preoccupation with "the history of events" rather than a definitive description of a *mandala*-polity.[63]

59 (...) map. Judging from the way these notes are uncoordinated with the map's geographical background, they were likely drawn last and perhaps as an afterthought. Two separate river systems flow through the map. The bifurcation of the "main" river in the map's centre into two branches of equal width subdivides the cartographic frame into three sections. The central, and largest portion is where Maingnyaung and other landmarks are located. Based on translations of the map's text by scholar Allegra Giovine. https://cudl.lib.cam.ac.uk/view/MS-MAPS-MS-PLANS-R-C-00001/1 retrieved 21 October 2021.

60 Before the British assumed overlordship of Burma for example, the boundary between Siam and the Burmese state of Tenasserim was located along rivers and mountain ridgelines. Prescott *et al* (1977), p. 54.

61 It should be clarified that Angkor-era inscribed stone stelae suggesting either the limits of the king's authority, or the differentiation of the Khmer people from neighbouring rival polities such as the Cham and Mon have been discovered in Cambodia, northeast Thailand and southern Laos. According to Lowman however, the Lolei inscription's claim that "the land protected by [the Cambodian king] was measured from the border with China to the sea" was more a boast than the description of the king's authority. Ian Lowman (2011), T*he Descendants of Kambu: The Political Imagination of Angkorian Cambodia*. Unpublished PhD thesis, University of California, Berkeley, p. 9.

62 The historiographic tradition connecting the emergence of the Khmer empire with the pre-Angkorean polity referred to by the Chinese as *Chenla*, divided the broader geographic space which was controlled by Angkor's god-kings into separate domains characterised either as land or as water. With a perspective formed when viewing the empire from Angkor, the Chinese associated the region that included the Mekong's lowlands with the domain of *Water Chenla*. This was not necessarily centred around the Mekong River, but as some have speculated may have been part of maritime kingdom based on Sumatra. Historians Claude Jacques and Michael Vickery have argued that "*the history of pre-Angkorean Cambodia was [...] reconstructed much more on the basis of Chinese records than on that of [Cambodian] inscriptions*" which provide little evidence of the existence of such a distinct kingdom among the region's multiple, overlapping mandala-polities. Michael Vickery (1994), *What and Where was Chenla?* Recherches nouvelles sur le Cambodge, École française d'Extrême-Orient, Paris, pp. 6-7.

63 *ibid*, p. 6.

In this sense, while the notion of a distinct geographic space defined by the wetness of the ground is important, the concept was a foreigner's description of the lowlands through which merchants and ambassadors sailed upstream from the East Sea to reach Angkor.[64] Even though the gap in cartographic evidence from Cambodia allows only limited conjecture of what waterways could have signified in relation to geographic space, it is possible to speculate that rivers and more generally waterbodies were not merely the reference in relation to which settlements and social relationships evolved. Beyond water's cosmographic or geomantic resonance, inundations, floods and droughts were issues that had to be managed, while inland kingdoms were vulnerable to invasion via rivers linking to the sea. Either pictorially, by denoting relative importance between places, physically by linking people along a liquid route or operationally by irrigating from a distant dry-season source, the flows of water made discrete, distant locations conceptually dependent on each other. Projected onto the amorphous accumulations of the Mekong River's sediment, the idea that waterways could characterise land is valid less for the floodable extents between two individual waterways and perhaps more for the sequence of distinct geographic space connected by them.[65] Conceptualised without the areal delineation that would allow direct comparison to the hydrological catchment, the geographic space denoted by water was not necessarily singular, uniform and perhaps not even contiguous.

Engineering an imperial geography

The conceptualisation of waterways in the Mekong's lowlands as a single system emerged as the Vietnamese empire consolidated their military presence in the new southern region (*Nam Bộ*). With the technical support of the French, the Nguyen dynasty's leaders begun modernizing their army according to the principles of Europe's military.[66] As well as weapons, the influence of European ideas was visible in the spatial organization of the Vietnamese armed forces. Beginning in 1790 with the fortress in Gia Dinh (Saigon), 32 citadels were constructed throughout the country. [67] Based on the principles established by the French military engineer Sébastien Le Prestre de Vauban, the design of individual

64 Examining the Chinese records, Wolters concludes that what the Chinese were attempting to describe was the geographical subdivision of a larger domain rather than a specific domain confined in a specific geography. O.W. Wolters (1974), *North-Western Cambodia in the Seventh Century*. Bulletin of the School of Oriental and African Studies, University of London, v. 37, n. 2, pp. 380-381.

65 Considering that boats as well as buildings on stilts or artificial mounds allowed inhabitation without necessitating the ground's dryness, for residents of the delta "land" was not determined as the opposite of "water".

66 French military officers had supported the Nguyen's campaign to seize power. Scholar Trọng Minh Nguyễn has described how in the first three decades of the 19th century, the imperial court facilitated the acquisition and application of Western military scientific and technical knowledge. This led to significant changes in the military technology wielded by the Vietnamese soldier as handguns were introduced, while cannons started to be produced at the casting facilities in Huế. Trong Minh Nguyen (2021), T*riều Nguyễn với việc tiếp thu tri thức, áp dụng kĩ thuật quân sự phương tây giai đoạn 1802-1858 (The Nguyen dynasty and the acquisition and application of Western military technology between 1802-1858).* Tạp Chí Khoa Học ĐHSP TPHCM (Science Journal of Ho Chi Minh City University of Education), v. 18, n. 1, p.108.

67 Despite only the citadels in Saigon and Nha Trang designed by French military engineers, these were so successful in their respective military contexts that the imperial stronghold in Huế was also fortified as soon as the Nguyen ascended the throne. Vietnamese adjustments to the French model also had cultural purposes. Associated with the centres of power in Huế, Hanoi and Saigon, the geometric clarity of the rectangle preferred by Vietnamese geomancers was more predominant in the citadels built in those three cities than the polygonal star-shaped layout. Frédéric Mantienne (2003), T*he Transfer of Western Military Technology to Vietnam in the Late Eighteenth and Early Nineteenth Centuries: The Case of the Nguyễn*. Journal of Southeast Asian Studies, v. 34, n. 3, p. 528.

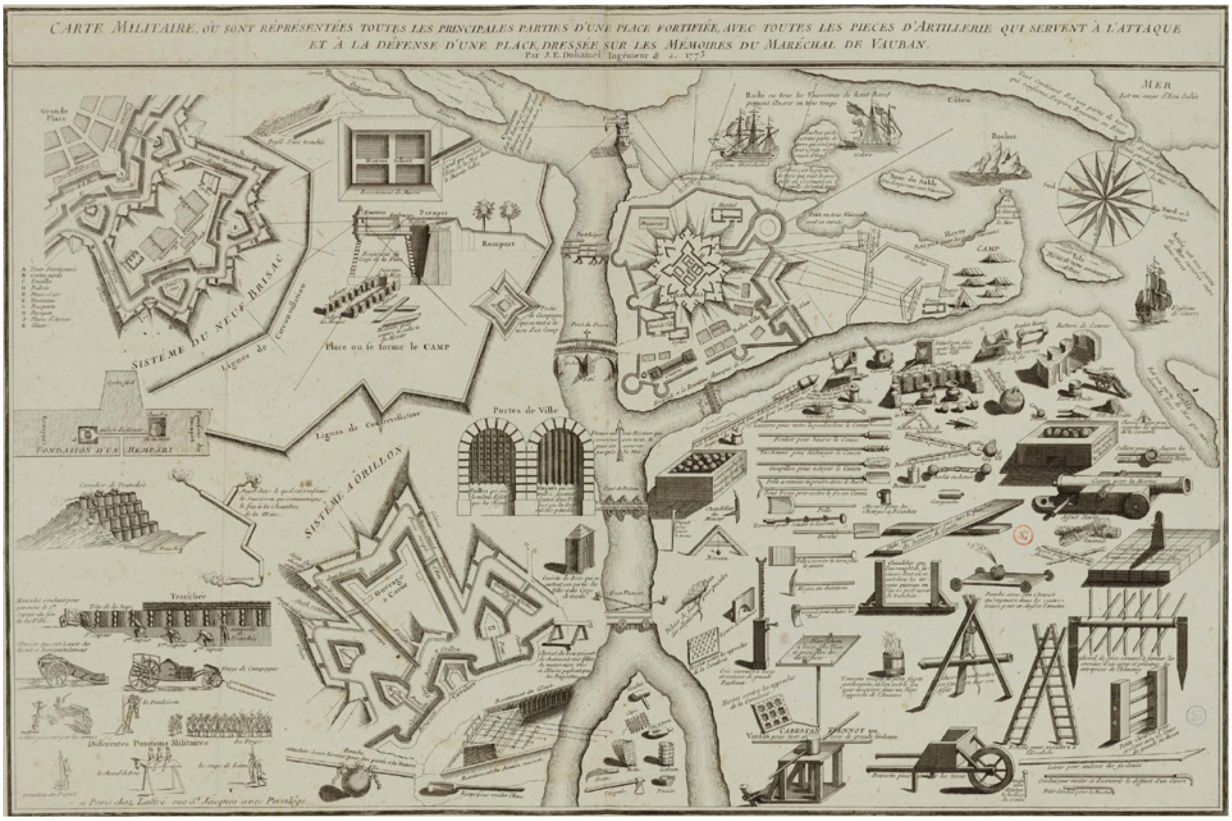

Fig 5.10 Design principles for fortifications Drawn against a hypothetical background, the map presents Vauban's design principles and the main components of fortifications as well as the equipment needed to destroy them. Mantienne claims this map was still available in Vietnam in 1921, along with Vietnamese translations for the different parts depicted.
J.E. Duhamel (1773), *Carte militaire, où sont représentées les principales parties d'une place fortifiée*, Paris : Chez Lattré.

citadels referenced the 'star-shaped' fortresses that had been built to defend France. Conceived by Vauban, the *pré carré* which structured France's national defence strategy, consisted of fortified centres linked by waterways and roads that in the event of attack could mutually support each other.[68] Systematised to a degree that allowed Vietnamese engineers to reconfigure basic elements such as bastions and walls, Vauban's principles were reworked and adapted to the specific conditions of Vietnam's strategic geography [**Fig 5.10**].[69] Part of the military infrastructure centred on the defence of the capital in Huế, seaports, fortresses and military plantations were collectively intended to consolidate and maintain control over an extent of geographic space extending several days travel from the centre of power.[70]

Direct contact with the French military, arguably also influenced Vietnamese representations of geography. Monique Pelletier notes that in France, the engineers responsible for fortifications were among the first group of trained experts who proposed that maps be used as tools for planning.[71] In terms of

68 Lepage (2010), p. 144.

69 Mantienne (2003), p. 528.

70 Bang Đỗ (2011), *Hệ Thống Phòng Thủ Miền Trung Dưới Triều Nguyễn (Central Defence System Under the Nguyen Dynasty)*. Hanoi: NXB Khoa Học Xã Hội (Social Science Publishing House), p. 12.

71 Monique Pelletier (2007), *Representations of Territory by Painters, Engineers, and Land Surveyors in France during the Renaissance.* In David Woodward (ed.), *The History of Cartography* v. 3, part 2, *Cartography in the European renaissance*, p. 1530.

Fig 5.11 Map of Gia Dinh Drawn in 1815 this Vietnamese map shows the citadel of Saigon and the surrounding area. Buildings are depicted as rectangular blocks while the waterways appear to be carefully delineated and proportional in magnitude to manmade structures. Influenced by Western cartographic conventions, the map presents the terrain's strategic value depicting land and water-based routes in relation to defensive structures. Note that south is at the top.
Trần Văn Học (1815/ 1816), *Bản đồ Gia Định năm (Map of Gia Dinh)*, Museum of Ho Chi Minh City.

representation, geographic engineers (*ingenieurs des camps et armees*) prepared maps that not only provided information of the terrain but also the resources on which soldiers could survive.[72] With these goals, engineers would pay particular attention to the visual expression of topography, using colours and linework to distinguish important features such as the roads and paths accessible to armies.[73] The attention to detail of geographic engineers is evident in the depiction of Saigon and the surrounding Gia Dinh region by Vietnamese general Trần Văn Học [**Fig 5.11**]. As John Whitmore notes, Trần had worked with military engineers Theodore Lebrun and Victor Olivier de Puymanel on the Gia Dinh fortress and became the main architect for later construction.[74] The planimetric view of the region shows carefully delineated waterways (both the Saigon River and smaller streams) as well as roads in relation to defensive structures and the building clusters of Saigon and Cholon. Considering the significance of waterways as transport routes for soldiers and invading enemies, the mapped edges of rivers and streams indicated both the terrain's physical qualities, but also the strategic value of that terrain. Compared to Vietnamese cartographers' depictions, mountain silhouettes are not used to confirm the presence of land, and specific buildings with cultural, political or religious significance such as temples are not highlighted. Even if, as Mantienne asserts, the citadel's site fulfilled the main

72 Monique Pelletier (2003), *L'ingénieur militaire et la description du territoire : Du XVIe au XVIIIe siècle*. In *Cartographie de la France et du monde de la Renaissance au Siècle des lumières [en ligne].* Paris : Éditions de la Bibliothèque nationale de France, p. 57.

73 *ibid*, p. 58.

74 Whitmore (1995), p. 500-501.

requirements of geomancy, the geographic space depicted by the map appears to have been considered as a function of the citadel's defensive value, and only incidentally as the mystical convergence of the terrain's vital energies.[75]

The projection of strategic value onto geographic space extended beyond the perception of a single citadel's control over its surroundings. Although the importance of the terrain in planning military strategy was known to Vietnamese mandarins for centuries through the classical writing of Chinese general Sun Tzu, maps presented new opportunities to organize defensive strategy based on the depiction of the terrain. With settlements situated overwhelmingly on coastal lowlands accessible via river estuaries, the network of military infrastructure was adjusted to control movement along waterways [**Fig 5.12**]. This involved situating fortifications, moats and citadels in relation to the threat posed by enemies travelling over water but also - referencing perhaps the principles of Vauban's *pré carré* network of national defences – ensuring availability of routes for soldiers from garrisons in other citadels to support a besieged defensive post elsewhere.[76] The calibration of defensive strategy in relation to the terrain, inserted new barriers, waterways or other fortifications that, if not necessarily permanent, redefined the terrain both pictorially and physically. In this sense, rather than just representations of an existing condition on which strategies were based, maps were also plans - pictorial elaborations of a specific course of defensive action. Perception of the Empire's geography through maps was therefore not limited to appreciation of the depicted terrain's physical attributes. For the Emperor,

Fig 5.12 Excerpt from a map of Đà Nẵng Situated at the Han River's estuary, the map depicts the fortifications defending the waterways of the settlement of Tourane (today's Đà Nẵng). Apparently taken from a Vietnamese general's house most likely during the French siege of the city, text on the map is in Chinese characters with translations to the left. Ramparts, walls, guardhouses, forts as well as a chain fence blocking passage upstream, structure a terrain stretching almost 4 kilometres (the distance represented between the top and bottom of the excerpt). Note the moats on both embankments which along with the river chain, notionally delineate the portion of land to the south.
Unknown cartographer (1859), *Carte de Tourane trouvée chez un mandarin militaire en 1859,* Paris: Musée des Archives nationales.

the military generals and possibly many of these regions' inhabitants, what made the geography *imperial*, was the military infrastructure underpinning the maintenance of authority regardless of distance from the centre of power.

Strategic conduits The military infrastructure was expanded substantially to secure the frontier region around the Mekong's outflows against outward but also internal threats. Stretching from the coast of the East Sea to the floodplain shared with Cambodia, the Vietnamese established six administrative districts demarcated by the flows of rivers. Sparsely populated, these districts were not so much areas of bureaucratic management as they were the jurisdictions of military mandarins tasked with organizing defence on behalf of the Empire.[77] Emulating the logic of France's *pré carré*, the Vietnamese system of defence was planned on the principle that troops stationed in one encampment could mobilise in support of other defensive positions.[78] Thus while the defence and control of a settlement and its immediate surroundings was effected with the presence of citadels and roads, control of distant geographic spaces within Nam Bộ's six military districts was contingent on the army's ability to transport troops (quickly) over a variety of ground conditions.

A map from the early years of French colonization appears to display the configuration of military and civic infrastructure deployed by the Vietnamese along the Mekong's waterways [**Fig 5.13**]. Drawn in 1861 across three panels, the map names settlements and their hierarchy within the administrative structure.[79] The map portrays the permanent waterways in a region encompassing Tonle Sap at the top of the first panel, to Saigon at the bottom of the third panel. These are shown in relation to settlements, defensive fortifications, garrisoned plantations (*đồn điền*), and citadels. Without showing the boundaries which differentiated specific royal domains, the drawing displays the geographic organization of defence, structured on the control of particular waterways.[80] Along the Saigon River, sets of defences located on opposite embankments appear to be positioned to monitor traffic along the river and to regulate upstream access to the citadels and naval bases.[81] The presence of a powerful navy able to operate in the region's numerous waterways suggests that apart from the roads and the main

75 Mantienne (2003), p. 528.

76 Trần Thị Thanh Thanh & Dương Thế Hiền (2016), *Ý Nghĩa Chiến Lược Của Vùng Đất An Giang Trong Thế Trận Phòng Thủ Biên Giới Tây Nam Của Chính Quyền Nhà Nguyễn Thời Kì 1802 – 1867 (The strategic role of An Giang in the Southwest border's defense formation of the Nguyen regime during the period of 1802-1867)*, (Science Journal of Ho Chi Minh City University of Education), v. 2, n.80, p.71.

77 According to Trinh, the Vietnamese word *dinh* used to name administrative units (such as Gia Dinh where Saigon was located), also meant "army". Trịnh Ngọc Thiện (2014), *Tìm Hiểu Tổ Chức Quân Đội Việt Nam Thời Kì Chúa Nguyễn Và Vương Triều Nguyễn (Từ cuối thế kỉ XVI đến nửa đầu thế kỉ XIX) (A study of Vietnam's military organization during the reign of Nguyen Lords and Nguyen dynasty (from the end of 16th century to the first half of 19th century)* Science Journal of Ho Chi Minh City University of Education, n.63, p.104.

78 Trần & Dương (2016), p. 71.

79 For example the map uses the terms *huyen* (town) and *phu* (prefecture) to differentiate what are essentially the same red squares – the cartographic notation for settlements.

80 The map subtly differentiates the terrain using colour according to what subsequent maps would label as the provincial districts annexed by France. While some of these are delineated along the courses of rivers, other limits appear to be less situated in relation to the terrain. Considering this map was a French construction, the district outlines may have been indicated to the cartographer based on oral information collected from local informants.

81 Saigon's shipyard constructed armed vessels based on a fusion of Vietnamese and European design. On the Vietnamese navy and Saigon's shipyards see Mantienne (2003), pp. 530-531.

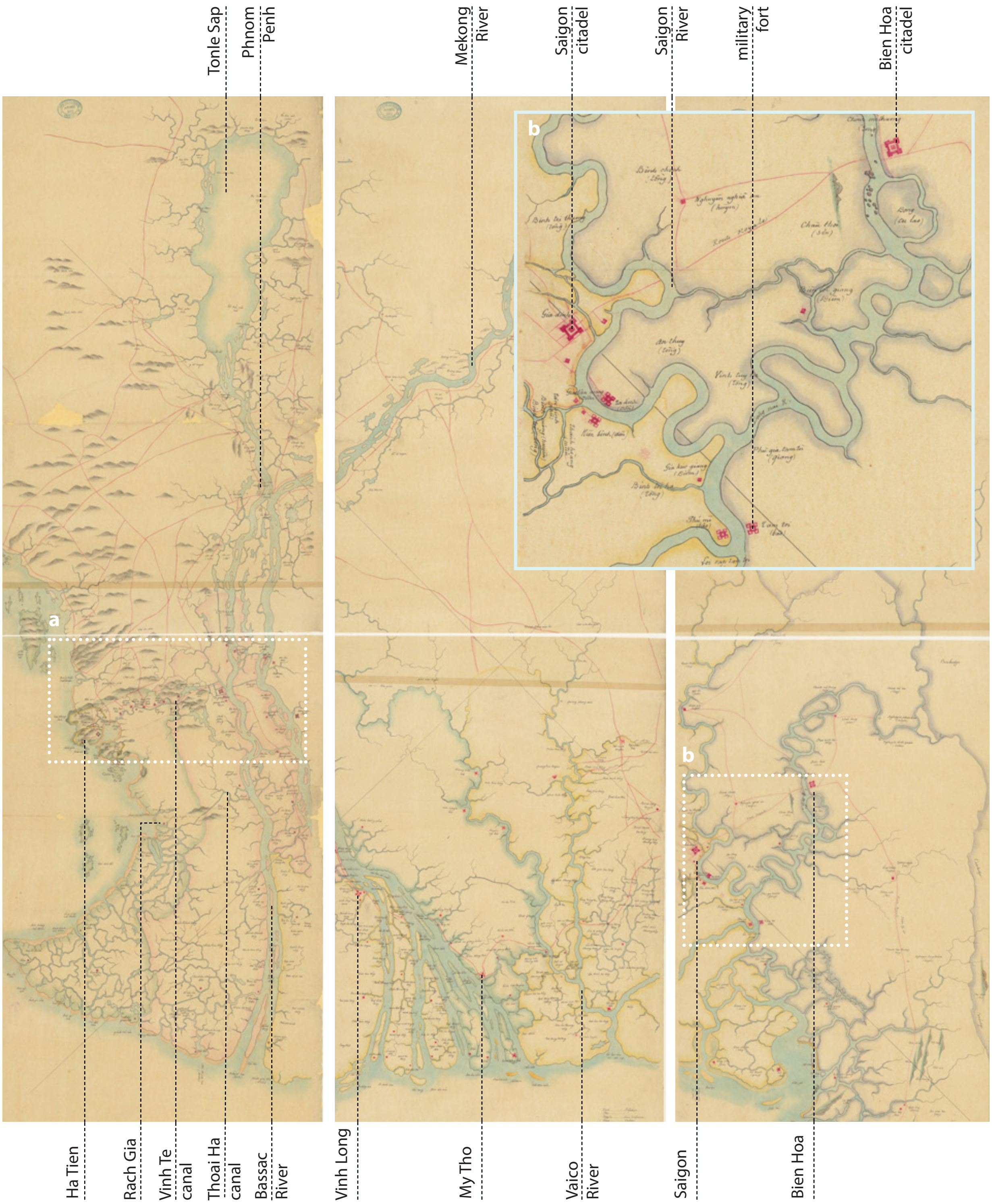

Fig 5.13 Fortified waterways Representing a geographic extent that includes the Tonle Sap (top left) and Saigon (bottom right), the map depicts the Vietnamese military infrastructure as understood by the cartographer. The Gulf of Thailand is shown to the left, while the cardinal directions are shown by the diagonal lines crossing all three panels (south is to the bottom left). Citadels, permenent army encampments as well as settlements are drawn in relation to the region's waterways which are the primary medium connecting these dispersed locations into units of mutual defence. The extents of these defence "units" is subtly delineated with colour but a border with the Kingdom of Cambodia is not shown. However, the location and grouping of military infrastructure appear to display the actual extent of control that the Vietnamese army could exercise directly through the deployment of the army.
Unknown cartographer (1861), *Carte de la basse Cochinchine*, Service hydrographique de la Marine, div. 2, por. 180.

river, secondary water routes such as the one shown connecting the river's two branches in the vicinity of Saigon, were also considered strategically valuable. Similarly in the middle panel, multiple military camps are located along the course of the Vaico River's two branches, which are also connected to each other via a controlled interstitial waterway. Further left on the panel, citadels at Vinh Long and My Tho, are positioned to control movement along the Mekong river. Together, these fortified centres appear to have regulated access to the geographic space formed by the bifurcations at the river's "six mouths", associated by Petrus Ky with the extent of the delta. Considered collectively, these groups of fortifications, settlements, roads and interstitial streams could be perceived to construct defensive interrelationships pivoted on the access of troops to different locations via the military infrastructure. A coastal port like Rach Gia could therefore be considered secure because it was accessible to reinforcements from as far away as the citadel in Saigon. The maintenance of imperial control described geographic relationships that were based - almost exclusively during the dry season – on the paths prescribed by waterways.

Dependence on naturally-occurring waterways however left particular defensive positions unconnected. Coastal trading towns along the Gulf of Thailand were separated by more than 50 kilometres of water-logged and sometimes hostile terrain from the Bassac River. This meant that in the event of an invasion, reinforcements would be slow to arrive in defence of Rach Gia, but also that goods transported from the coastal port to upstream markets, were vulnerable to attack. To provide permanent routes connecting these settlements to the defensive and trading network, the Vietnamese state initiated a concerted programme of

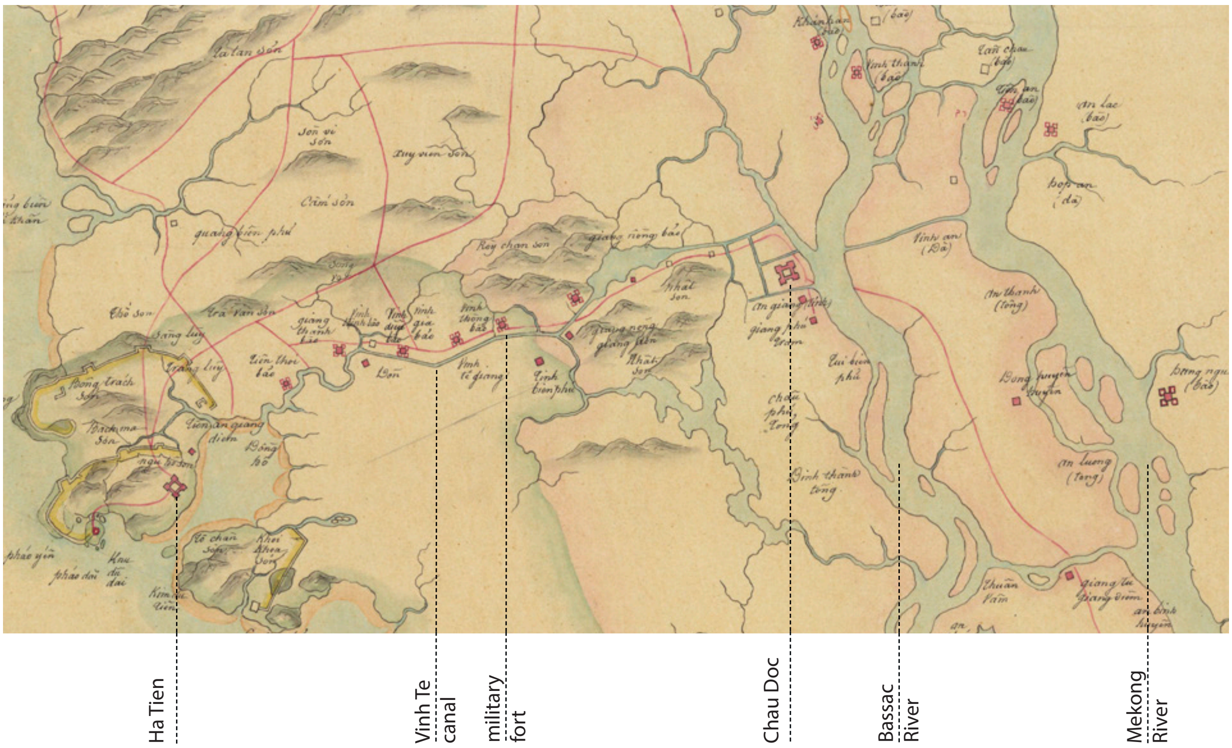

Fig 5.13a Vinh Te Canal This part of the map in Fig 5.13, displays the Vinh Te Canal and the military infrastructure connecting the coastal fortified settlement of Ha Tien with the citadel at Chau Doc. Military encampments to the north of the canal form a line of continuous armed presence along the length of the manmade waterway. Encampments further upstream (top right on the map) appear to positioned to control the movement along the main river from Cambodia.
Unknown cartographer (1861), *Carte de la basse Cochinchine*, Bibliothèque nationale de France.

Fig 5.14 Thất Sơn This excerpt from a map of Basse Cochinchine, displays the mountain outcrops known as *Thất Sơn* or *Bảy Núi* (Seven Mountains) in Vietnamese which characterised the region of An Giang. Between 20 and 700 m in height, these outcrops are still inhabited around the edge of their bases. The map shows the Vinh Te canal as well as the provisional border (dotted line) between the French colony and the French Protectorate of Cambodia which appears positioned to encompass the majority of the mountainous landscape.
Unknown cartographer (1861), *Carte de la basse Cochinchine*, Bibliothèque nationale de France.

infrastructure construction that culminated during the 1820s with the completion of three new waterways.[82] Among them, the 87 km Vinh Te Canal linking the citadels of Ha Tien and Chau Doc was a significant transport conduit [**Fig 5.13a**]. Inhabited by mostly Khmer villagers, the interstitial terrain through which the Vinh Te canal was 'threaded' was composed of groups of distinct mountainous outcrops rising from the lowland plains.[83] Called *Thất Sơn*, this area was considered particularly dangerous by the Vietnamese [**Fig 5.14**].[84] For the army, the canal made the entire journey between the citadels possible via water but also allowed soldiers access to the hostile area between the citadels at any point along the waterway. Access to the interstitial terrain was accompanied by perhaps up to twenty new settlements, established along the eastern side of the canal after its completion.[85] At the same time, the map [**5.13a**] indicates that at least six army bases were distributed along the canal's western side facing Cambodia. Along with the citadels on either end of the canal, the waterway, settlements and army bases collectively structured what could be considered as a defensive "line" along which two opposing sides confronted each other. Rather than a line with

82 Prior to the 1800s the most significant waterway improvement in Nam Bộ had been the work carried out on a natural stream connecting the town of Tan An just south of Saigon, with the town of My Tho located on the embankments of the Mekong's mainstream.

83 The canal was constructed by thousands of forcibly conscripted Khmer as well as Vietnamese labourers, whose treatment was the source of resentment and violent uprisings during and after construction.

84 Trần & Dương (2016), p. 75.

85 Vu Duc Liem (2017), *Boundary on the move: Border making in Vietnamese-Cambodian frontier, 1802-1847*. Mekong two sides however, the manmade waterway did not separate the Cambodian and Vietnamese areas of authority but made the presence of the state permanent and visible in the contested Thất Sơn region.

Nonetheless, as the French consolidated their colonial holdings over Nam Bộ, the need to establish European-type boundaries with adjacent kingdoms gave the Vinh Te canal a new significance. Having initially annexed the three Vietnamese provinces situated closest to Saigon, French claims to Nam Bộ were included in the peace treaty offered by the Nguyen emperor in 1862.[86] Writing only a year before embarking on the exploratory journey to the sources of the Mekong River, Francis Garnier situated the colonial endeavour within the expanse of geographic space he identified as the *Delta du Cambodge*.[87] For Garnier, the toponymic Delta extended upstream as far as Phnom Penh, and had been controlled by the Cambodian throne before the Vietnamese had taken over the southernmost portion.[88] Garnier's assertion that the Mekong Delta was the terrain being contested juxtaposed a geographic understanding of the river's sedimentation with a strategic evaluation of the terrain. Yet the idea that the Delta was a singular geographic extent which different parties sought to control, was not a reflection of local claims over particular sections of the Mekong's lowlands, which were neither framed in terms of a delta nor as any singular common characteristic of the terrain. Considering colonial *Basse Cochinchine* was forcibly seized, the thought of the Vietnamese trespassing on the singular entirety of the *Delta du Cambodge* over which the Cambodians held a hereditary claim, justified French involvement beyond the Vietnamese area of authority. In this sense, Garnier's conceptualisation of the Mekong Delta was in relation to French political influence and only incidentally concerned with the geographic space formed by the river's sediment.

Militarised margin

The limit of direct French political influence was determined by the colony's provisional boundary. A protectorate of France, Cambodia's authority was formalised by treaty which saw culturally significant areas for the Khmer such as Angkor and Battambang ceded permanently to Siam. The Cambodian attitude towards the borders with Siam however was diametrically different from that of a boundary with Cochinchina that appeared to be deliberately shaped to include the entire Thất Sơn.[89] The permanent border with Cochinchina quickly emerged in Cambodian discourse as *terra irridenta*.[90] Not only did any boundary across the Mekong's lowlands separate what was considered the southern end of the Cambodian kingdom, but since the lines were drawn in relation to Vietnamese claims, they obliquely legitimised the violence with which those claims had been

86 Biggs (2012), p. 25.

87 *"...on peut, par des mesures d'ensemble bien combinées et une grande rapidité d'exécution, prendre sans coup férir, tous les points importants du Delta du Cambodge et en prononcer l'annexion à la Cochinchine française."* G. Francis (1865), *De la colonisation de la Cochinchine*. Paris: Challamel Aine, p. 13.

88 *"...on'sait que tes Annamites eux-mêmes ont toujours considéré les six provinces comme formant un tout indivisible, et que la conquête du territoire de Bien-Oa sur le royaume du Cambodge les a fatalement entraînés à celle de tout le reste du Delta."ibid*, pp. 7-8.

89 According to the historian of modern Cambodia Jean-Michel Filippi, the Khmer and Thai shared a certain cultural and religious kinship which did not pose a problem when Khmer populations were included in the Siamese area of authority.

90 Jean-Michel Filippi, *Frontières du Cambodge: de l'absence à l'obsession [online article]* www.publikam.com/pages/histoire/histoire-moderne/frontieres-cambodge-absence-obsession.html accessed 22 November 2021.

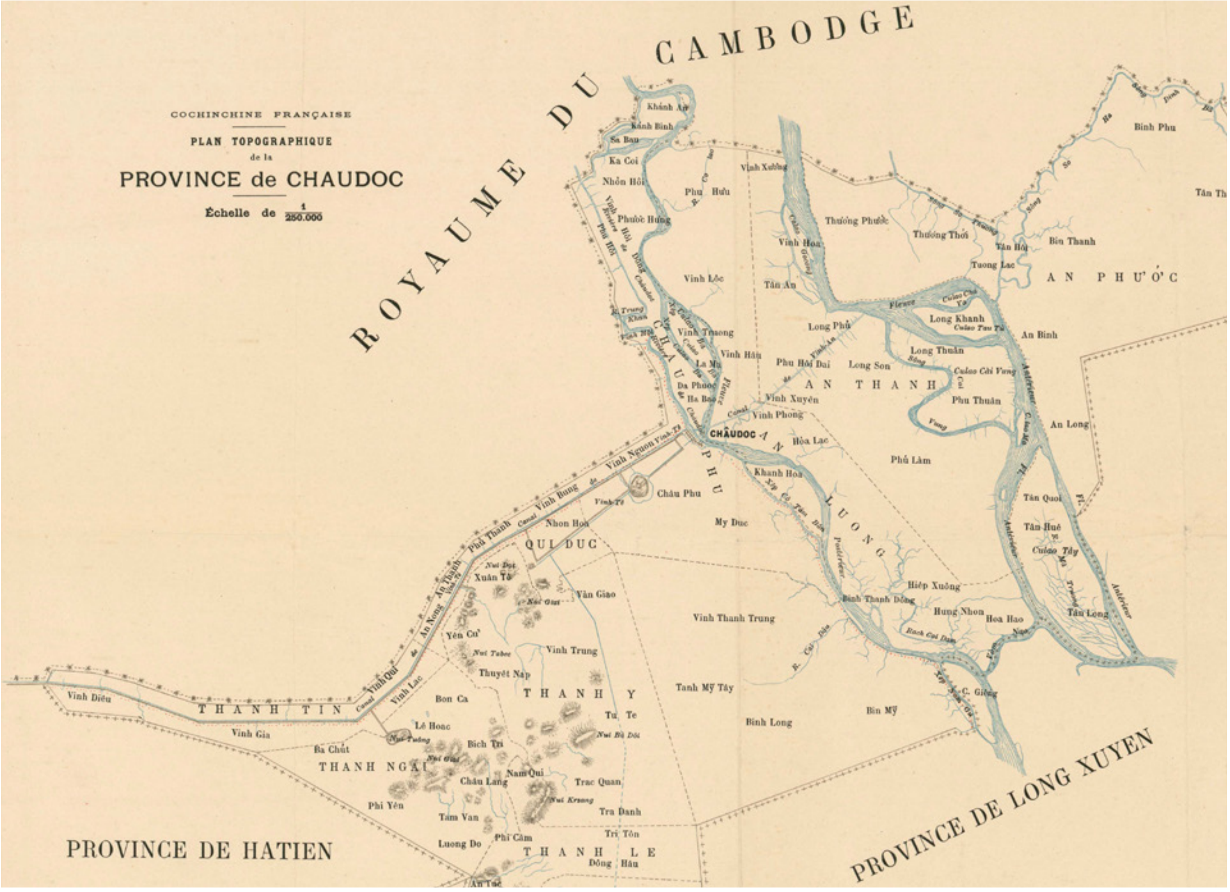

Fig 5.15 Waterway boundary The finalised boundary between the colony and Cambodia was set parallel to the canal effectively dividing the Thất Sơn region between the two jurisdictions.
Unknown cartographer (1890), *Plan topographique de la province de Chaudoc*, Bibliothèque nationale de France.

imposed.[91] Reconfigured by a new treaty in 1873, the numbered posts marking the border would be "placed approximately 1,200 m to the north of the Vinh-té canal..."[92] Given that Khmer villages were spread throughout the Thất Sơn, the regularization of the limits of authority to follow parallel with the waterway, made almost no concessions to the composition of the region's residents. Instead, with the Vinh Te's liquid surface acting as a barrier to movement, the retreat of colonial forces to the canal's defensive line would place them within shooting distance of the border [**Fig 5.15**]. The adoption of the canal to form the border can therefore be viewed as having favoured the French army's strategic command of the seasonally inundated terrain.

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91 Giving some small degree of consideration to the Cambodian perspective, the 1870 and 1873 agreements between France and Cambodia finalised the exact location of the boundary, reshaping limited parts of the earlier border to fit the ethnic origins of the population's majority. As stated in the treaty *"...le Cambodge conservera tout le pays actuellement habité par les Cambodgiens des provinces de Prey Veng, Boni-Fuol, Socthiet. La limite ser tracée ultérieurement, et on réservera pour les possessions françaises la bande de terrain longeant le Vaïco, qui est occupée par les Annamites ou exploitées par eux."* Bulletin Officiel de la Cochinchine française (1870), *Décision du Gouverneur de la Cochinchine du 9 Juillet 1870 portant délimitation des frontières du Cambodge.* p. 247.

92 *"La frontière entre la Cochinchine française et le Royaume du Cambodge sera marquée par des poteaux numérotés et portant une inscription indiquant leur objet. Le nombre de poteaux sera de 124. Le n° 1 sera placé à l'extrémité Est de la frontière et la graduation sera continuer vers l'ouest dans l'ordre naturel des chiffres jusqu'au poteau 124, placée à 1.200 m environ au nord du canal de Vinh-té et du village annamite Hoa-thanh." Convention entre S.M. Norodom et le Gouverneur de la Cochinchine du 15 Juillet 1873 portant détermination de la frontière entre le Cambodge et la Cochinchine française*. Accessed 22 November 2021 from http://ki-media.blogspot.com/2012/06/border-convention-history-of-cambodia.html

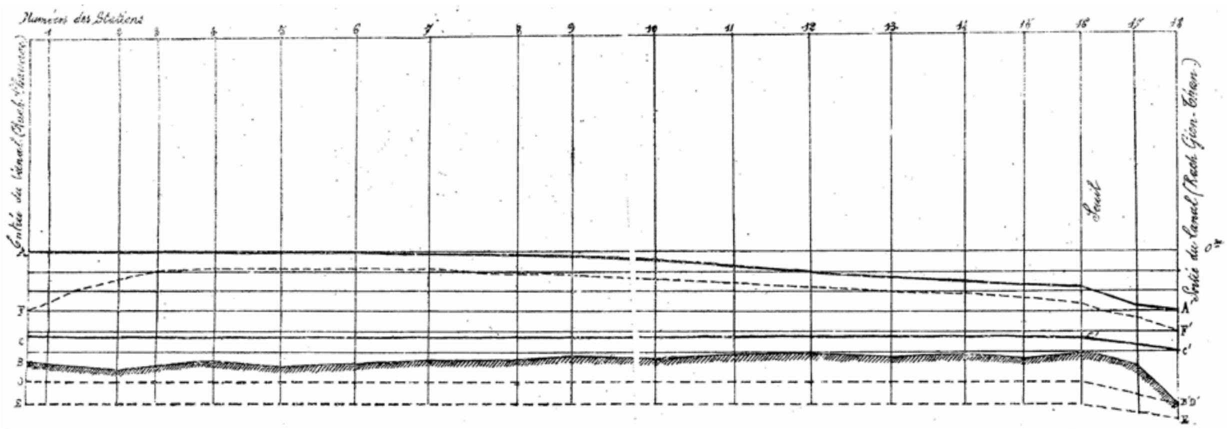


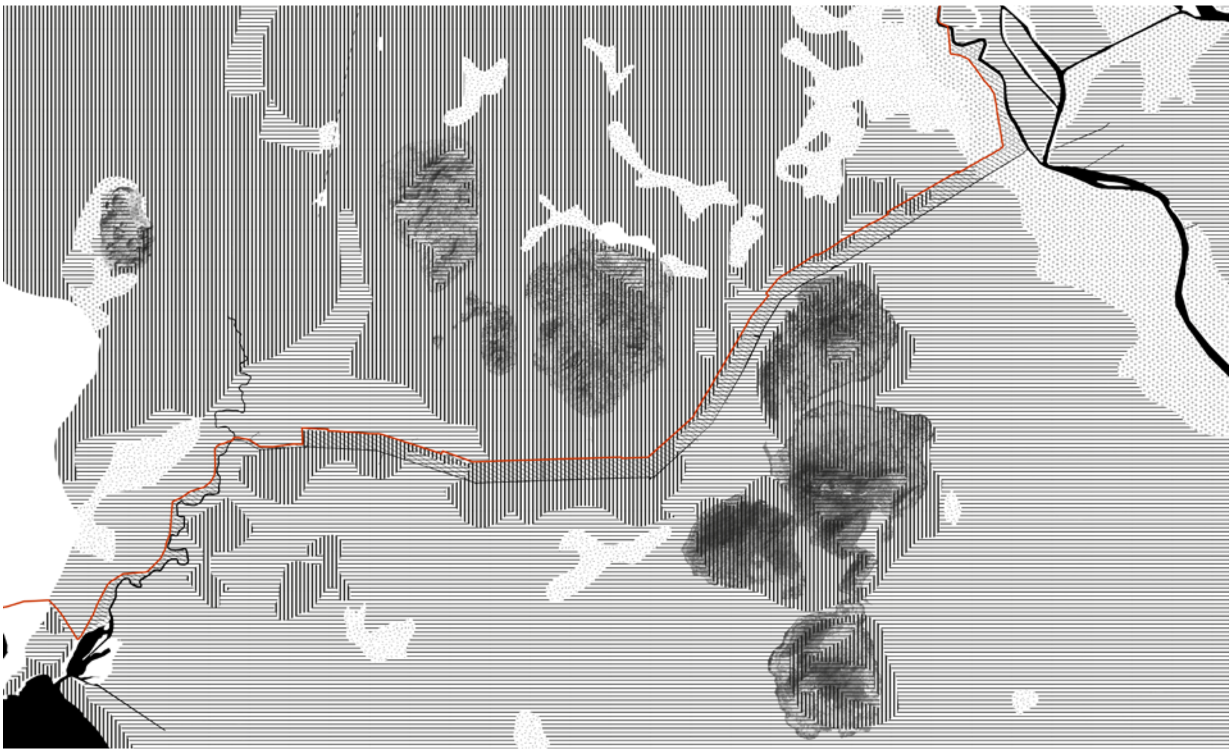
Fig 5.16 Longitudinal profile of the Vinh Te Canal The section shows the 4.5 metre difference between high and low water levels (black continuous lines) in relation to the 80-kilometre canal's depth profile. The thicker hatched line is the actual profile of the waterway while the two dotted lines beneath it show variations of the improvements that could be achieved by dredging. Note that the vertical and horizontal scales are not the same.
Rénaud (1879), Planche III.

Yet the Vinh Te did not only act as an edge, nor just 'funnel' armies, merchants and settlers through a hostile area. It also diverted a proportion of the water that would otherwise have pooled in the Thất Sơn's forested swamps or been slowly discharged through smaller streams. Noting how the behaviour of water changes according to the tides and the annual flood, the engineer Jacques Rénaud examined the canal within its hydrological rather than political context. Tasked to plan the improvement of the waterway after years of neglect, Rénaud illustrated how the Vinh Te was submerged during the wet season [**Fig 5.16**].[93] Outlining a phenomenon which occurred across an "immense horizontal space", his longitudinal section of the Vinh Te canal traced the profile of the canal's depth in relation to high and low water levels which differed by more than 3m between the two ends of the waterway.[94] The idea that a canal *affected* and was *affected by* forces that occurred across a different dimension of geographic space highlighted a relationship that was relatively common in the Mekong's lowlands. The imperceptible slope across a vast extent of accumulated sediment, meant that even modest changes to the height or width of a canal or dike, were likely to have an impact on the condition of the ground further downstream or even in adjacent areas. Subtle variations in the slope would have been especially important over the several months when floodwaters gradually receded. Either as a result of being discharged via waterways to the sea, or through the evaporation of the water detained in topographic depressions, the rate at which water drained informed cultivation practices as well as affecting the quality and productivity of the soil. Thus while the quantity of deposited sediment per volume of river water may have been more or less equal across a specific extent of geographic space, the canal's embankments and its capacity to divert water have meant that the

93 Acting less as an edge between kingdoms and more as a conduit between the Gulf of Thailand and the Bassac River, Siamese forces supporting the Cambodian rebels gained entrance to the canal resulting in the capture of Chau Doc. The susceptibility of the military infrastructure to attack via the new canals, significantly decreased the urgency of maintaining these waterways, leading to their gradual abandonment. Biggs (2012), p. 68.

94 "*Les eaux du canal allant du Bassac au bassin du Gien-than doivent traverser cet immense espace horizontal; aux hautes eaux la montée du Bassac de 4 m. 50 cent., le profil en long des eaux ne suit nullement le profil du fond ...*" Jacques Rénaud (1880), *Étude d'un projet de canal entre le Vaico et le Cua-Tieu,* Excursions et reconnaissances n.3, p. 72.

Fig 5.17 Flooded boundary The map above shows the surface water (blue) in late August 2018 around the Vinh Te Canal. The floodwaters detained adjacent to the waterway on the Cambodian side are visible closer to the Bassac River (right). The map below shows the geographic spaces occuppied by different major soil types (according to the FAO classification). Vertical hatched lines represent areas where *acrisols* are predominant - oxidized clays that require continuous treatment to retain their productivity. Horizontal lines represent *gleysols*, which only require adequate drainage to become suitable for rice cultivation. While it is impossible to definitively ascertain, considering the Thất Sơn was once a continuous, unobstructed floodplain the differentiation in soil types is probably not due to a prexisting condition. The correlation between the soil type and their location on either side of the waterway, may be related to the many decades over which the annual flood has been detained on its route southwards, gradually changing the composition of the ground.
Author (2021). Spatial data sources: *Soil types of the Lower Mekong Basin* (MRC, 2008); *Satellite Detected Surface Waters Evolution in Southern Provinces of Vietnam* (UNOSAT, 2018); *World Water Map* (ESRI, 2014).



way that sediment is distributed has changed in relationship to the infrastructure that became a boundary [**Fig 5.17**].[95] If what originally characterised the notion of the *Delta du Cambodge* was a particular strategic perception of the terrain that aligned with Mekong's sediment deposits, the Vinh Te Canal did not just change the way that terrain was controlled. By redefining where these deposits accreted, the cumulative impact of the canal as a barrier, a boundary and a conduit also redefined the terrain being controlled. Perpetuated by recurring environmental processes linked to the flows of water, the alignment of the limits of authority with a manmade waterway have made the conceptual separation presented on early maps a tangible reality.

Conclusion

Criticised for reducing the complexity of specific places to the characteristics of the archetype, *nomothetic* comparisons have been condemned by 20th century geographers for distorting the interpretation of first-hand observation.[96] Considered an *ideal-type* associated with the geographic space around a river's outflows, the nomothetic hypothesis expounded by references to the Nile's delta pivoted on the idea that the riparian lands located downstream from the river's bifurcation were conducive to agriculture and settlement. Comparison with the Nile, allowed Europeans to conjecture that because of their apparent similarities in relation to the river's 'body', places as far away (and unknown) as the Mekong's lowlands, belonged to the same typology of geographic space. Identification of a delta at the Mekong's outflows however had less to do with the geological explanation of layered *créments*, as it did with the range of human activities enabled by the fertility of the soil. The ability to cultivate a delta, indicated the potential to support inhabitation on these unknown hinterlands. And if the technical control of water through dikes and canals in the Camargue was possible, it was not impossible to imagine that an analogous condition in Southeast Asia could also be the subject of similar water control techniques. Similarly for the Vietnamese, the inclusion of the Mekong's lowlands into atlases and itinerary maps, presented the southernmost parts of their expanding empire in terms of their distance from the centres of power located along the fertile lowlands of the Red and Perfume rivers. Tasked with depicting this unknown terrain, map-makers in Huế described a ground condition that resembled the deltas in the distant north. If the presence of Angkor on maps hinted at the overlapping claims of different kings that were unique to the Mekong, the conceptualisation of Vietnam's defensive infrastructure in terms of a network of fortified centres not only assigned a strategic value to waterways but also determined a limit to the

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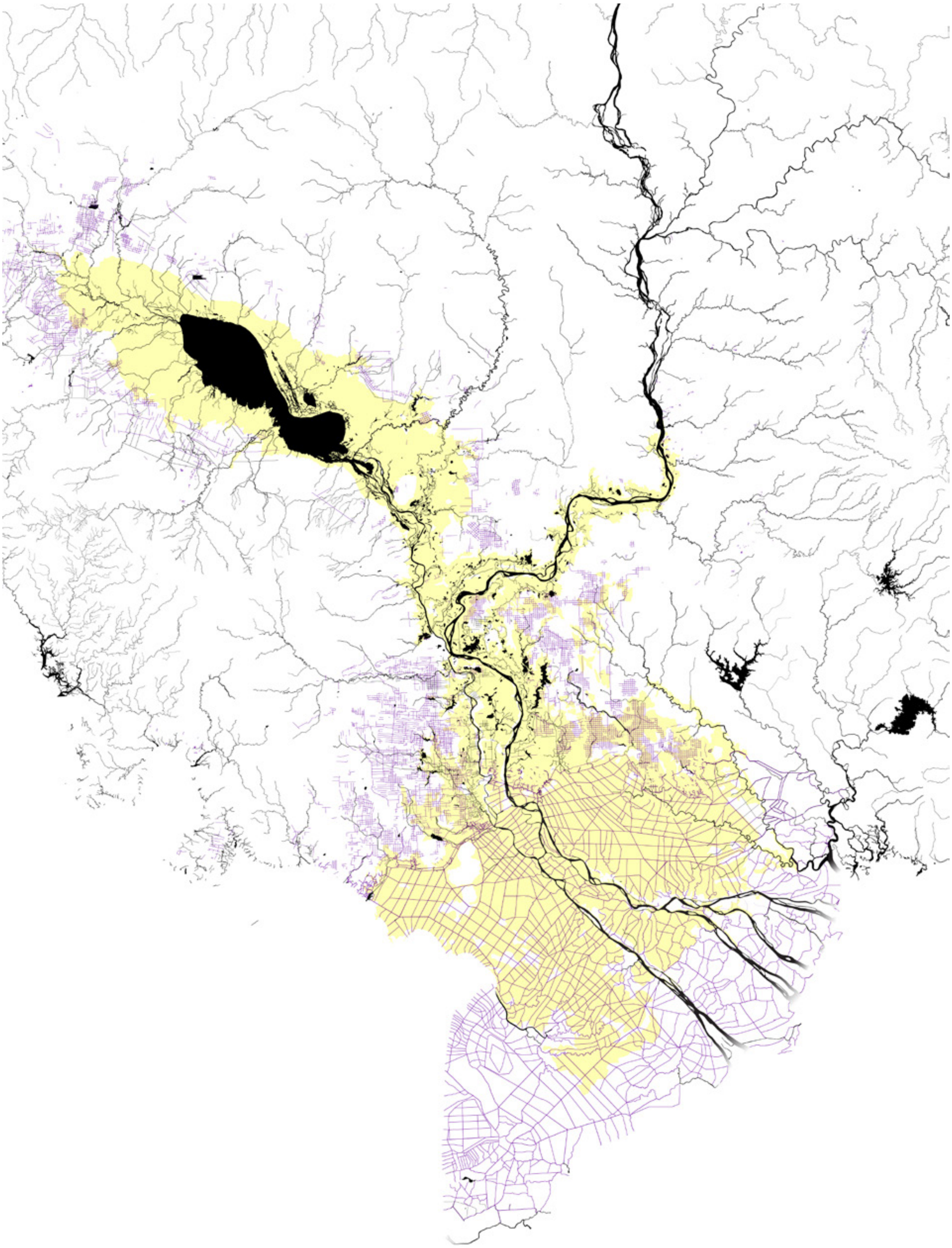
95 Recent studies of this area's hydrology have indicated that flood flows from the north, crossing over the Vinh Te canal, contributed around a quarter of total annual flows entering the waterways of the broader floodplain in the year 2000. Hydrological modelling of the Vinh Te within the waterway network has pointed out that the high embankments on the canal's edges limit runoff from Cambodia "causing a significant decrease in maximum water level" compared to the "natural regime". Such a conclusion should be viewed in light of the separate trajectories of agricultural development that have informed the configuration of water infrastructure on either side of the canal and thus the total volume of floodwater flowing from Cambodia southwards through Vietnam's delta area. See Q. T. Vo, D. Roelvink, M. van der Wegen, J. Reyns, H. Kernkamp, G.V. Vinh & V.T. Linh (2020), *Flooding in the Mekong Delta: the impact of dyke systems on downstream hydrodynamics*. Hydrology and Earth System Sciences, v. 24, p. 198 and V.T.V. Le, H. Shigeko, H.H. Nguyen & T.C. Cong (2008), *Infrastructure Effects On Floods in the Mekong River Delta in Vietnam.* Hydrological Processes, v. 22, p. 1372.

96 The tendency to promote the archetype as the exemplar model of a particular condition has led scholars to critique the nomothetic comparative approach as an 'imperial methodology' "marked by ethnocentrism and neo-colonialism". See Simon *et al* (2020), p. 2.

emperor's control. Thus, any perceivable 'distortion' of observable facts was not necessarily in the erroneous appreciation of the terrain's physical characteristics. Related to a specific course of action, the identification of waterways with a network of riverine flows could protect from invasion, attribute cosmographic significance or determine habitability. If a delta could therefore be perceived in these maps it was not in the planimetric differentiation of one geographic space from another. Rather, the delta emerged from the internal coherence alluded to by considering the waterways as defining characteristics of a controlled domain, a network of settlement and a cultivated terrain.



Map E The map shows natural waterways (black) and manmade canals (purple) in relation to the maximum flood extent (yellow shade) recorded in 2000. Constructed in different periods and state administrations, the distinct networks of visible interconnected waterways are far more extensive to the south, where they regulate surface flows during the annual flood season. The dense clusters of waterway grids in Cambodia are a product of the violence and forced labour imposed by the Khmer Rouge regime and were reportedly designed to align with the reference grid of 1: 50000 topographic maps.
Author (2022). Spatial data sources: *Irrigation canals* (MRC, 2008); World Water Bodies (ESRI, 2016); Cambodia canals (OCHA, 2018); Maximum flood extents - mrc.SDE.INUNDATE_b_ex_mj (MRC, 2008).

CHAPTER 6 Shaping the delta

The idea of grouping rural populations, of "centralizing on chosen points the exploitation of the soil" is not new, and the advantages are known [...] *cohabitation is tightened by "the need to unite for the development of water, the construction of wells, the maintenance of certain works, the accommodation of an environment favorable to crops". This is how Vidal de la Blache condemned* [low density] *housing; President Ngô-dinh-Diêm is inspired by an identical conception.*

Les paysans vietnamiens et la réforme rurale au Sud Viêt-Nam, Roger Teulières, 1962

The site of strategic, technical and political considerations before and after the establishment of French Cochinchina, the Mekong Delta is often discussed as the geographic setting for historical events. Historical references to the Mekong Delta suggest that this particular geographic space was diachronically appreciated in relation to the qualities that distinguish a river's coastal lowlands from any other extent.[1] Even if neither the name nor the extent of the region have remained unchanged across history, to imagine this particular geographic space was always defined as being a delta or part of one, is not just to accept that such physical and conceptual distinctions were possible but also necessary. Considering the same geographic space was the southern portion of an empire stretching to Hanoi for the Vietnamese, part of the Cambodian king's ancestral area of the authority, and the sedimented mouth of a river flowing from China for French explorers, correlating this region's identity simply in terms of a natural phenomenon, would be to deny that the delta was far from the common perception of the Mekong's lowlands until the beginning of the 20th century. And while this argument would appear to privilege the significance of the name over actual events, it is important to consider the archetypal value of the delta was not simply its geophysical specificity, but also the term's ability to convey meaning about a particular place through its notional resemblance to a larger "family" of inhabited deltas. As increasingly more settlers built permanent homes among the Mekong's waterways however, what extent of geographic space was perceived to constitute a continuous region called a delta would also need to account for how and where people lived. Especially after the first detailed maps of Cochinchina had been completed in the 1920s, recurring references to settlement on the lowlands' different terrains became entwined with geographic discourses. Promulgated by geographers following the theories of Vidal de la Blache, the correlation between the patterns of inhabitation visible on maps and distinct ground conditions suggested that the extent of any delta was related to groups of people adapting to

1 Providing a wealth of information regarding the role of engineers, political and administrative agents in transforming the physical environment, Biggs' collection of historical events with the *Mekong Delta* as the geographic focus, presents the deltaic environment as the background on which these events unfolded even while acknowledging that these events transformed what geographic space the Mekong Delta denotes. From this perspective, maps are less tools which presented alternative deltas with reference to settlements or infrastructure and more depictions of past conditions, indicating what settlements or infrastructure the Mekong Delta "contained". Although Biggs is clear that the Mekong Delta is only one part of the larger delta, in the map called *Ecoregions of the Mekong Delta* he equates the Mekong Delta with administrative and national limits. David Biggs (2010), *Quagmire: Nation Building and Nature in the Mekong Delta*. Seattle: University of Washington Press, p. 19.

specific qualities of the terrain. Shaping the delta therefore alludes to two notions. On the one hand the adaptation of settlement in response to specific ground conditions which colonial geographers classified to make a specific delta 'legible' for state administrators, even as new canals redefined which ground conditions were responsible for the observed adaptations. On the other, the intentional construction and modification of existing settlements by South Vietnam's post-colonial government seeking to control a military threat by concentrating people in *agglomerations* and expanding cultivated land around them. Approached from these two perspectives, the chapter argues that the delineation of a delta on the Mekong River was not only a conclusion drawn from observation of the ground, but also an outcome of theories that imagined settlement as the proxy for a region's limits.

The extent of inhabitation

Perhaps the most important change in the condition of the ground during French colonial rule was the construction of new waterways. A means to promote exploitation of the Cochinchina's fertile soils, from the point of view of the colonial authorities, canalization was effective in extending small and large scale agriculture into remote terrains, whose eventual transformation into rice paddies was considered critical for the colonial economy's health [**Fig 6.1**].[2] Canal construction became an important policy for the colonial government, and by 1930, the length of primary and secondary canals constructed in the preceding 35 years exceeded 4,000 kilometres.[3] Designed primarily to connect between

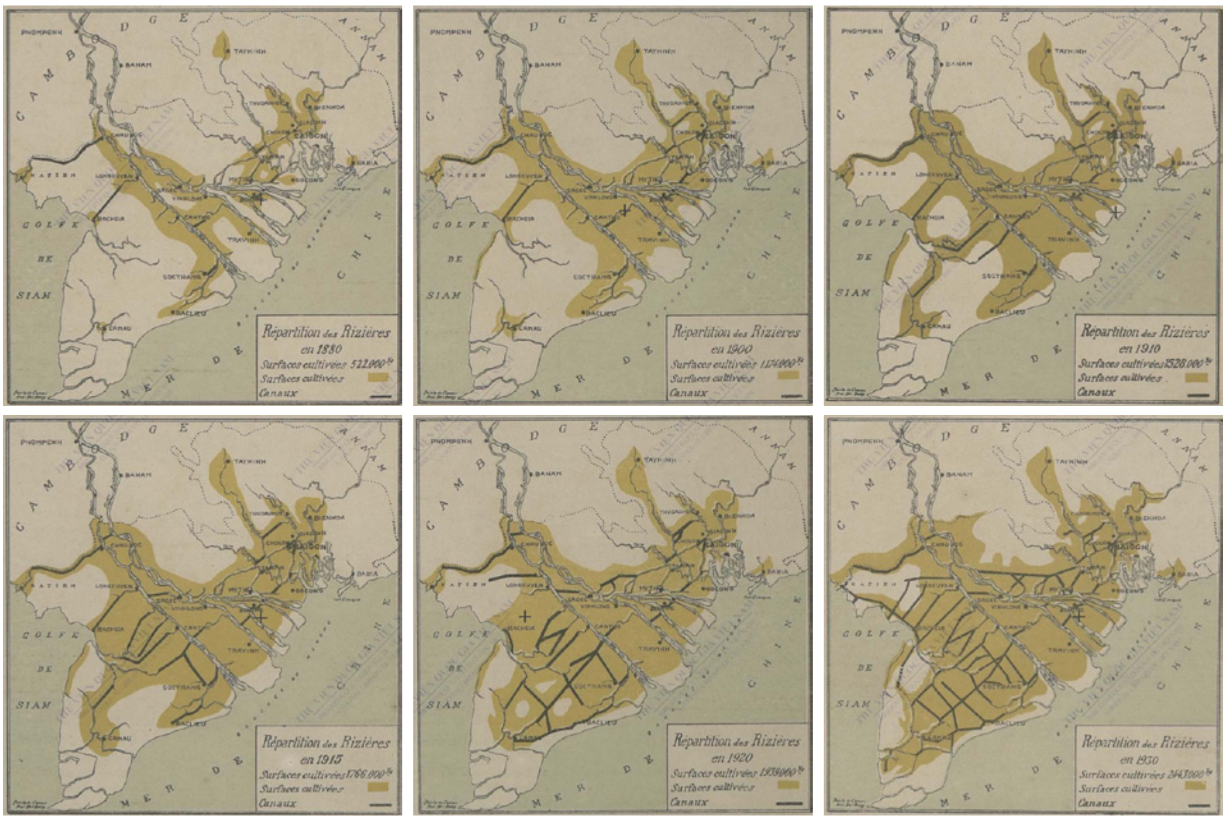


Fig 6.1 Canal construction Drawn in increments of between 5 to 20 years, the map series shows the relationship between canal construction and the area (brown shade) utilised for cultivation from 1880 (top left) to 1930 (bottom right). The magnitude and continuity of the shaded area is greatly exaggerated in relation to the areal extent it represents. Unshaded areas later became the settings for resettlement projects initiated by the colonial government.
Inspection générale des travaux publics (1930).

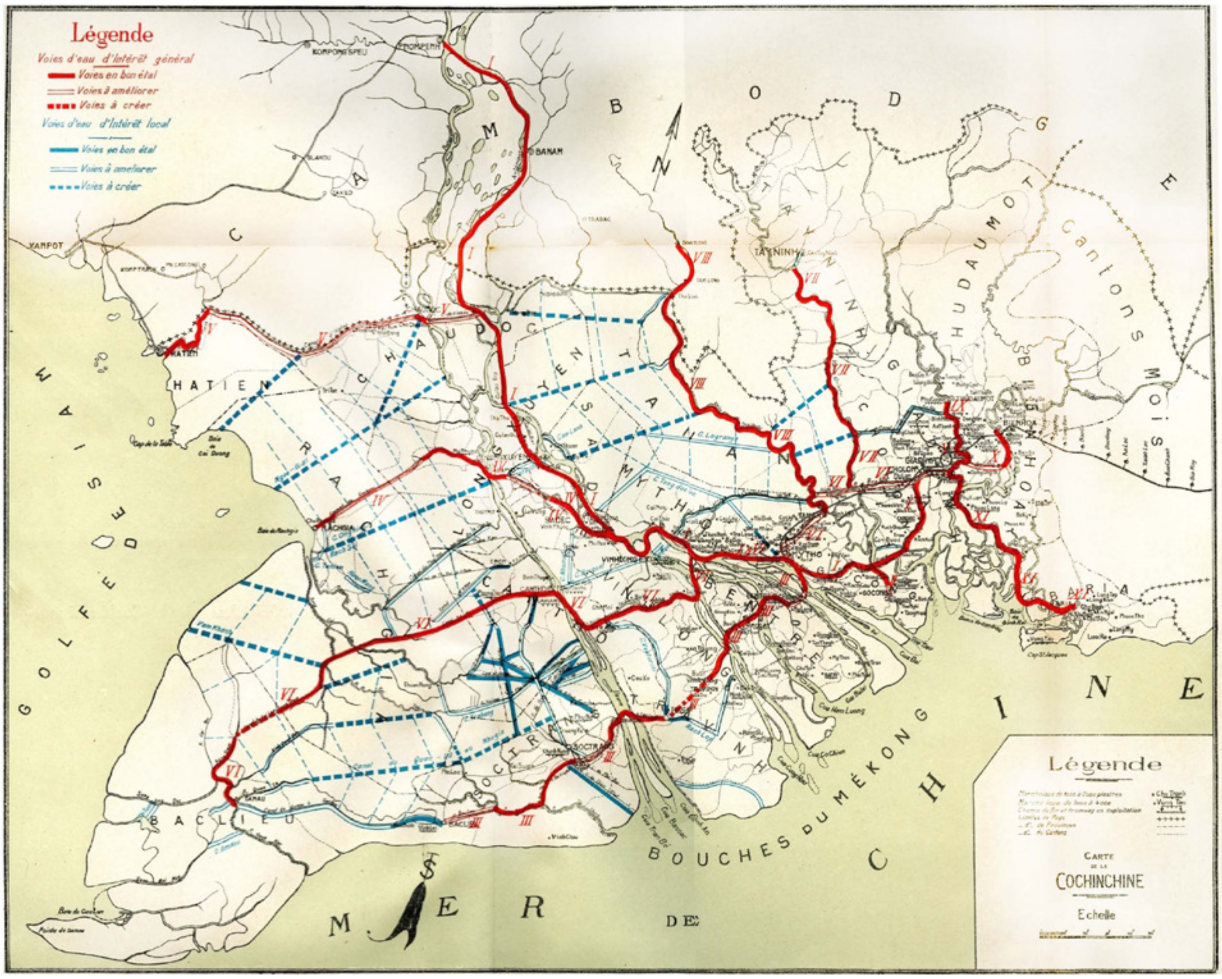


Fig 6.2 Waterway network Drawn by Albert Pouyanne who would subsequently become Chief Engineer of public works in the colony, the map shows the relationship between regional (red) and local (blue) waterways. Proposed canals (dotted lines) are arranged to intersect at regular intervals and appear to extend to the limits of the colony's jurisdiction.
Albert Pouyanne (cartographer) (1911), *Voies d'eau de la Cochinchine*, Saigon: Impri. nouvelle.

destinations, each individual canal's contribution to the wider system of hydraulic flows appeared to resemble part of a regularly spaced grid of waterways that extended to the limits of the colony's jurisdiction. The cartographic depiction of Cochinchina's waterways would suggest hydrological knowledge was on the level of the entire colony [**Fig 6.2**]. However, the impact of canals had not been fully anticipated by the engineers responsible for their design. Along with the several million cubic metres of dredged soil stacked alongside their embankments, canals redirected the flows of surface water, transforming what could once have been the edge of a marsh into farmland, or flooding fields that had previously been drained by existing streams.[4] The failure to anticipate the impact of canalization was

2 More useful in demonstrating the geographic extent of the state's power rather than indicating the location of rice fields, the uniformly coloured shapes in Fig 6.1 cover almost a third of the colony's map by 1930, implying that the construction of waterways had transformed the French colony into a productive and therefore habitable land. In the report where these maps appear, the ratio between the area of rice paddies and number of residents, was used as an indicator that population and cultivation were functionally balanced in relation to each other.

3 Inspection générale des travaux publics (1930), *Dragages de Cochinchine. Canal Rachgia-Hatien*. Saigon: Gouvernement général de l'Indochine, p. 19.

4 These conditions led to multiple appeals for colonial justice by existing residents, especially when mechanical steam dredgers cut new canals through cultivated lands, violating existing property rights. Biggs (2012), pp. 78-80.

attributed to both problems in the execution of secondary infrastructure, and the fundamental complexity of the lowlands' hydrology.[5] Thus even though waterways were planned in response to the geographic space encompassed by the colony's boundaries, the actual behaviour of water within the network they created was only partially understood.

Despite triggering geophysical processes that gradually transformed the quality of agriculture soils, the regularly spaced intersections between canals became the favoured points for the foundation of new villages and hamlets by tens of thousands of migrants arriving in Cochinchina every year. Dimensioned to accommodate French patrol boats, new waterways were excavated in lines that run completely straight for several tens of kilometres, providing access to interstitial lands far from their confluences [**Fig 6.3**]. The historian Pierre Brocheux, has described how individuals following the paths of mechanical dredgers, laid claim and cultivated plots adjacent to manmade waterways.[6] Some farmers however later discovered that the marshes and forests they had converted into viable agricultural fields were already legally claimed by others, leaving them essentially landless or without land to cultivate close to their homes. The number of tenant farmers (*tá điền*) cultivating land owned by others culminated during the years of the Great Depression.[7] As such, the ownership of land along a navigable conduit did not correlate with the cultivation of rice by individual households whose members would sometimes work on farms several kilometres away from their homes.

Describing such a settlement near his birthplace, the Vietnamese scholar and writer Sơn Nam related that the village *(làng*) appeared to stretch for 30 km along an even longer waterway and that "when enough numbers were reached, the remote hamlets" on the village's extremes "became new villages".[8] Even if only metaphorically comparable to the 'splitting' of a single organism known as *fission*, the creation of three new villages through the subdivision of an existing one, was not directly contingent on the distance between its furthest buildings.

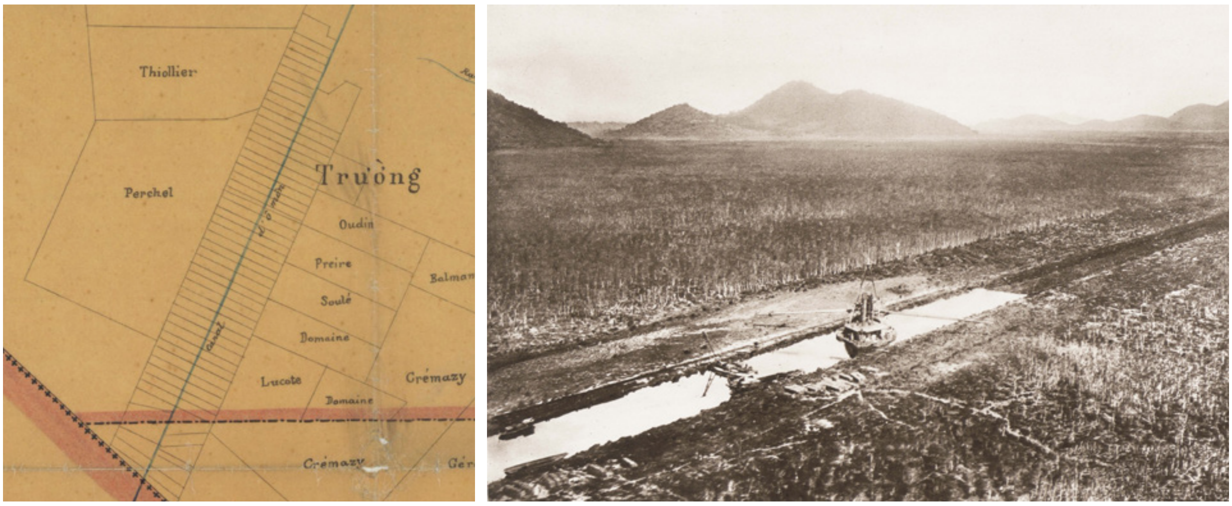


Fig 6.3 Waterway settlement An excerpt from a provincial map of Cochinchina, the drawing on the left shows the property limits around a new canal. Along the waterway, plots are subdivided into rectangular "strips" and are shown belonging to a single landowner (Trương) that would presumably be sold on to individuals. The larger properties adjacent to the waterside plots are most likely French plantations. To the right, the photograph shows a dredger on the Ha Tien - Rach Gia canal against the backdrop of the Thất Sơn's mountain outcrops. Note the flat, cleared land adjacent to the waterway which settlers occupied and on which dredged soil was stacked.
Service Géographique de l'Indochine (1910), *Carte de la Province de Cantho;* Aviation militaire Indochine (1930s), *Canal Rachgia-Hatien*, Centre de documentation et de recherches sur l'Asie de sud-est et le monde Indonesien

Uncultivated 'wasteland' between clusters of buildings could be considered sufficient to initiate the subdivision of an existing settlement into new taxable entities, as was the distribution of markets, educational facilities and spaces for communal gatherings.[9] Taken as the relationship between individual buildings and the focus of a community's social activities, the centrality that was apparent around confluences or in organized villages built on higher ground, was dispersed along kilometres of navigable, manmade waterways. Popular for his histories of the Mekong's delta, Sơn Nam grew up on one of the canals designed by French engineers. Rather than a village, he described having spent his early childhood "near the 4th canal" of an area known locally as *miệt thứ*.[10] Composed of numbered canals flowing from the melaleuca forests of U Minh to the Gulf of Thailand, the *miệt thứ* was perceived to form a particular region. Yet this was not just because the manmade waterways provided access to a previously remote geographic space already perceived as distinct. Built in groups which local residents gradually extended, canals allowed the Khmer farmers and Vietnamese migrants living in dispersed households and small hamlets to trade and communicate with each other. At the same time, by changing surface flows, the canals cutting through the melaleuca forest initiated changes in the habitat areas of snakehead and catfish, that became a source of income, farmed locally and sold for a high price far away.[11] Underpinned by the access provided by such networks of waterways, floating markets, schools and temples were not just features of individual villages. Examining Khmer villages closer to the coastal lowlands of the East Sea, Philip Taylor has highlighted the role of communal fresh water tanks in Theravada Buddhist temples that were the centres of "dispersed riverside settlements", whose inhabitants cooperation in common tasks formed distinct social groups.[12] Circumscribed by canals creating a 'local' network, the geographic space reachable by boat collectively described a habitable region encompassing multiple settlements, as well as the sometimes more remote households in between. For different inhabitants the same waterway could form the centre of social activity, function as a fishery, join distant towns, connect individual houses into villages and unify distant villages into settlements encompassing regions. Thus with few exceptions, the extent of geographic space within which the inhabitants of groups

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5 *ibid*, p. 80

6 Pierre Brocheux (1995), T*he Mekong Delta: Ecology, Economy, and Revolution, 1860–1960*. Madison, WI: Center for Southeast Asian Studies, pp. 122-123.

7 According to Pierre Gourou, up to four fifths of all agricultural land was cultivated by landless peasants. See Trần Hữu Quang & Nghị Nguyễn (2016), *Reframing the "Traditional" Vietnamese Village: From Peasant to Farmer Society in the Mekong Delta*. Moussons [Online], v. 28, p. 68.

8 *"In case the village is too large like Dong Thai village which was 30 km long, when enough population numbers were reached, the remote hamlets were separated and three more villages established, Dong Hung, Dong Hoa and Dong Thanh in 1914." (Trường hợp làng quá rộng như làng Đông Thái dài 30 cây số, dân đến cư ngụ lần hồi, khi đủ số thì những ấp ở xa trở thành làng mới, tách ra lập thêm ba làng là Đông Hưng, Đông Hòa và Đông Thạnh từ năm 1914.)* Sơn Nam (1973), *Lịch Sử Khẩn Hoang Miền Nam (A history of settlement in the South) (online version)*. Born in 1926 under the name of Phạm Minh Tày, Sơn Nam spent his childhood in the far south of Cochinchina. He published many books on the *đồng bằng sông Cửu Long* - the Vietnamese name for the Mekong Delta – collecting observations of the terrain, oral histories and linguistic nuances of the local dialect into historical accounts and popular adventure novels.

9 *ibid*.

10 Pascal Bourdeaux (2014), *Sơn Nam ou la dualité d'une oeuvre. Évocations poétiques et ethnographiques du Viêt Nam meridional.* Moussons, n.24, para. 41.

11 Sơn Nam (1973), p. 79.

12 Taylor (2014), p. 105.

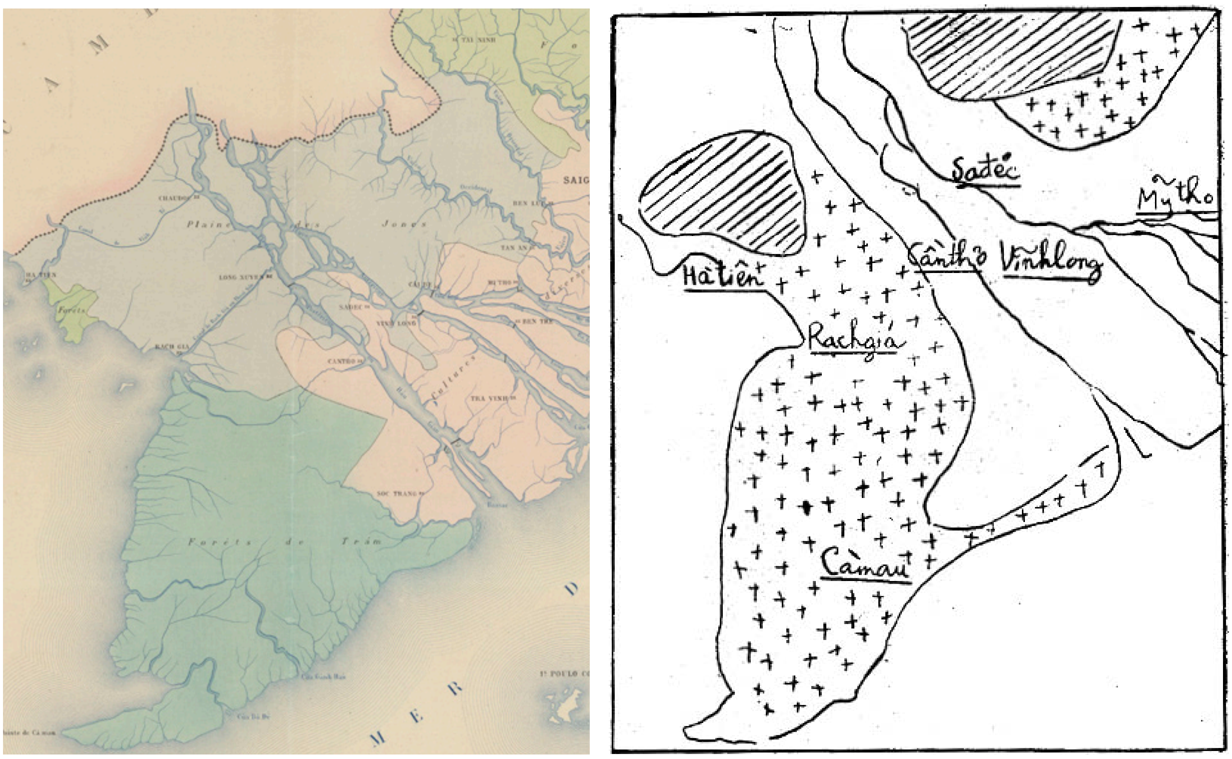

Fig 6.4 Inhabited topography On the left, Bertaux's map of the region's geographic zones was prepared before steam dredgers were introduced to excavate canals. It identifies forested extents (green), floodplains (light blue) and a particular zone around the Mekong and Bassac characterised by the diversity of agriculture (*cultures diverses*). On the right, Sơn Nam's map from 1970 divides the terrain into swamps (diagonal lines), garden lands (no colour around the river's flows) and inhabited lowlands (crosses). While the main content of these maps is not determined by administrative boundaries, neither are they strictly representing geophysical differences. Rather these depictions combine ideas about inhabitation and topography - more evident in Sơn Nam's "Garden civilization" on the right, but equally visible in Bertaux's choice of limits for the region of cultivated lands around the river's outflows.
M. Bertaux (1882) (cartographer), *Carte de la Cochinchine française divisée en quatre zones*, Service topographique; Sơn Nam (1992) (cartographer), *Văn minh miệt vườn (Garden Civilization)*, Thành Phố Hồ Chí Minh: Nhà Xuất Bản Văn Hóa, p. 22.

of villages operated, did not correspond with the limits of any single pre-existing geophysical condition that could be distinguished on a map [**Fig 6.4**].

The village's area

Specifying the cartographic dimensions of villages was nonetheless an important tool for governance. A measure of population and property, what government officials considered a distinct settlement in the Mekong's lowlands had been critical to Vietnamese administration, where in matters such as taxation and *corvée* labour, the state dealt with the village as an entity rather than with individuals.[13] As the Vietnamese historian Đỉnh Đâu Nguyễn has observed however, the village units entered into cadastral records did not uniformly correspond with typical settlement designations such as *xã* (commune) or *thôn* (hamlet).[14] Especially far from towns, where the location of households and farmsteads converged with the embankments of waterways or the edge of topographic depressions, which buildings collectively comprised a specific settlement and which streams or inundated plains constituted the identifiable

13 Trần & Nguyễn (2016), p. 65.

14 Conducted in 1836, the most comprehensive survey of Nam Kỳ prior to French colonization recorded over 1,600 separate settlements as well as information – agreed with the landowners - regarding individual plots such as boundaries, land quality, crops and property rights. Nguyễn mentions multiple examples of settlements whose (...)

geophysical extent on which they were constructed, were considered in comparison to settlements in the distant north where the empire's bureaucratic codes had been developed.

Typical of the lands created by the Red River's sediment, the socially autonomous villages of Tonkin have been described by various scholars as "isolated islands" with their own lands, property, justice and customs.[15] These villages were sometimes demarcated in relation to the lowland terrain with physical structures or bamboo hedges, which were symbolic of the limit of the emperor's direct control over the village's residents. Although villages were used as bases of armed resistance when the French invaded, the abolition of special privileges by the occupying regime and a new population census, increased taxation and eroded their autonomy.[16] If, as Jeanne Haffner suggests, the establishment of the French protectorate of Tonkin had as its main purpose the control of taxation, villages were critical to the government's income.[17] Considering taxation was calculated according to the number of inhabitants and plots of land, knowing the magnitude and population of a village was therefore a financial, as well as geographic operation, requiring state surveyors to relate particular extents of either uncultivated or farmed land to a specific group of people.

The areal relationship of villages to geographic space was an important feature of new maps. Established with support from the Army's Geographical Service in 1899, the *Service Géographique de l'Indochine* was tasked with mapping the colony's five types of geographic environments.[18] Among plains, plateaus and mountains, *deltas* occupied a prominent place, and as the most heavily populated of all these environments were the focus of extensive surveys. First published in 1909, the *Cartes des Deltas de l'Annam* set a new standard for depictions of the colony's terrain [**Fig 6.5**]. Unlike the 1 to 100,000 scale used for mountainous areas, maps of French Indochina's coastal lowlands were prepared at the scale of 1 to 25000 which was considered necessary for planning water infrastructure as well as the cadastral operations which determined taxation.[19] Depicting a geographic space that extended about 40 kilometres inland, a characteristic of this series was the representation of settlements.[20] With individual built structures visible, villages were distinguished from cities, towns and other clusters of buildings and shown to occupy a specific delineated extent. Drawn on a separate layer from the topography by the Service's cartographers, the green shaded limits of villages emulated the vegetated clusters of village orchards which

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14 (...) origins were farms (*trai*), corporate villages (*phuông*) or formed by navy veterans known as t*huyên* (*boat*). He concludes that *"Si l'on traduisait xâ en commune et thôn en hameau, cela ne cadrerait pas avec la réalité."* Đînh Đâu Nguyễn (1991), *Remarques préliminaires sur les registres cadastraux (địa bạ) des six provinces de la Cochinchine (Nam Kỳ Lục Tỉnh).* Bulletin de l'École française d'Extrême-Orient, v. 78, pp. 275 and 280

15 Quang & Nguyễn (2016), p. 65.

16 Kim Munholland (1981), *'Collaboration Strategy' and the French Pacification of Tonkin, 1885-1897*. The Historical Journal, v.24, n. 3, p. 649.

17 Jeanne Haffner (2013), T*he View from Above. The Science of Social Space*. Cambridge: MIT Press, p. 19.

18 Les Armées Françaises D'outre-Mer (1931), *La Carte de l'Empire Colonial Français, Exposition Coloniale Internationale,* Paris: Impri. Georges Lang, p. 100.

19 Gouvernement Général de l'Indochine (1931), *Service géographique de l'Indochine : son organisation, ses méthodes, ses travaux. Exposition Coloniale Internationale*. Hanoi: Impri. d'extrême-Orient, p. 14.

20 Including the maps of Cochinchina and the Tonkin Delta, a total of 277 maps are reported to have been prepared at a scale of 1:25000. However, I have not been able to locate the series of maps pertaining to Cochinchina. Les Armées Françaises D'outre-Mer (1931), p. 118.

Fig 6.5 Excerpt from the *Maps of the Deltas of Annam* Prepared at a scale of 1 to 25,000 that allows individual built structures to be distinguished, this map of Tourane (Đà Nẵng) depicts the lowland areas adjacent to the Han River. The map differentiates the city (red building footprints) from other settlements. Villages are represented within a green-coloured cartographic space, distinct from other clusters of buildings (on the coast or along roads).
Service géographique de l'Indochine (1908), *Carte des Deltas de l'Annam, n. 39, Tourane au 1 : 25000,* Collection Patrimoine Cham.

appeared more like "masses of greenery" rather than agglomerations.[21] Their areal dimension made villages and their residents into 'visible' entities subject to specific legal obligations, but also made local people wary of cooperation with the Service's mapping operations.[22]

Yet even with the support of local inhabitants, mapping deltaic lowlands was considered a delicate operation. Surveyors needed to account for a level terrain whose flatness and lack of vertical landmarks challenged accurate levelling and whose planimetry was "overloaded with details".[23] The topographic homogeneity and dense geodesic canvas however, made deltas suitable for the deployment of a relatively new cartographic technique. Beginning in the 1920s the Service introduced the use of aerial photography for surveys throughout the colony.[24] Unlike the detailed mapping of Indochina which started in Cochinchina two decades after Tonkin, the aerial views of the topography provided by military

21 "*….Service Géographique de l'Indochine attribue un vert spécial aux surfaces occupées par les villages parce que ceux-ci apparaissent dans le paysage beaucoup plus comme des masses de verdure que comme des agglomérations de maisons. Mais lorsque les jardins disparaissent le vert village disparaît également ce qui pour résultat de diminue* […] *sur nos cartes importance de emprise humaine.*" Pierre Gourou (1942), *La population rurale de la Cochinchine.* Annales de Géographie, v. 51, n. 285 Footnote 1, p. 23.

22 Gavin Bowd & Daniel Clayton (2003), *Fieldwork And Tropicality in French Indochina: Reflections On Pierre Gourou's Les Paysans Du Delta Tonkinois, 1936*. Singapore Journal of Tropical Geography, v. 24, n. 2, p. 161.

23 Les Armées Françaises D'outre-Mer (1931), p. 104.

24 Taken at scales similar to the desirable level of cartographic detail, photographic proofs would be sent to the Service's specialist laboratory in Hanoi where technicians would confirm their location in relation to geodetic reference points, and trace over identified features with a pencil. Gouvernement de l'Indochine (1931), p. 23.

airplanes, did not require surveyors to access remote or hostile regions. This significantly accelerated the pace of surveys and, by expanding the geographic coverage of maps at the same level of detail, revealed recurring visual relationships between farms, settlements and topographic features. Interpreted as patterns by geographers, the apparent repetition of particular features across an extent of geographic space, supported scientific arguments that framed the 'region' as a function of the interaction between people and their environment. The most influential French geographer of the period, Paul Vidal de la Blache's approach posited that these regions could encompass valleys, coastal plains or entire river basins. Focused on the scientific study of "places", for Vidal the region's "character" which geographic science aimed to identify and explicate, was inseparable from the practices of the people concentrated within that particular region.[25] Based on observations derived from maps, his thesis was particularly attuned to the relationship between human habitats and the qualities of soils that enabled different agricultural techniques. Observing that homogeneous soil conditions propagated the same type of village, he concluded that "the hamlet type and the village type seem to correspond well to geographical differences."[26] The correlation between a group of people and particular features of the cultivated terrain, resonated with geographers working in the colonial regions of Indochina.

In his monumental study of the villages in the Tonkin Delta, the Tunisian-born French geographer Pierre Gourou argued for a unity between people, settlements and the surrounding environment that was made apparent through mapping and aerial imagery. Published in 1936, Gourou's anthropological research was prepared after several years of intensive fieldwork carried out in collaboration with his Vietnamese colleagues at the University of Hanoi.[27] Following the principles of Vidal's geography, the delta's "natural" topographic uniformity was presented as critical to the creation of the "human unity" represented by village communities.[28] The methodological axis of his studies on settlements pivoted on each village's discernible form (*forme*) in relation to the topography. Using photographic reduction techniques and colour tints to distinguish building clusters, Gourou constructed maps on which he claimed even the smallest hamlet was visible [**Fig 6.6**]. Depicted in solid black, these maps focused attention on the planar arrangement of buildings, that while important, were only one of the characteristics – including communal lands - that defined a *làng xã* as a state-recognized entity. Examining the settlements on the maps he described how:

> *... one is at first glance struck by the innumerable multitude of black spots which represent the villages* [...] *It seems at first that these spots are thrown*

25 Hartshorne (1936), pp. 161 & 200.

26 *"L'habitat dispersé et l'habitat aggloméré, le type hameau et le type village y semblent bien correspondre à des différences géographiques."* Paul Vidal de la Blache (2015), *Principes de géographie humaine: Publiés d'après les manuscrits de l'auteur par Emmanuel de Martonne.* Paris: ENS Éditions, p. 152.

27 Gourou acknowledged his Vietnamese collaborators after the publication of the research. Among them Tran Van Giap, whose strategic battle planning was critical in the French army's defeat and withdrawal from Indochina. See John Kleinen (2005), *Tropicality and Topicality: Pierre Gourou and the Genealogy of French Colonial Scholarship On Rural Vietnam*. Singapore Journal of Tropical Geography, v. 26, n. 3, pp. 347-351.

28 *"Dans ce pays pétri d'humanité, où l'homme a créé partout le paysage tel que nous le voyons, cette unité de la population paysanne est un puissant facteur d'uniformité; et l'uniformité naturelle d'un pays deltaïque n'a pas peu contribué à créer cette unité humaine. uniformité naturelle et unité humaine, en s'aidant l'une l'autre, ont cree un pays remarquablement homogène et une nation parfaitement cohérente."* Pierre Gourou (1936), *Les Paysans Du Delta Tonkinois. Etude de Géographie Humaine*. Paris: EFEO, pp. 14-15.

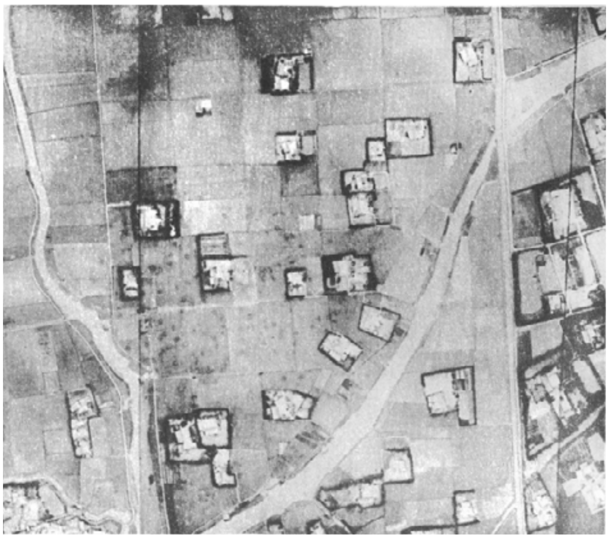

Fig 6.6 Discerning villages The map and aerial image display two examples of "dispersed settlement" (*peuplement dispersé*) in different parts of the Tonkin Delta. Derived from processing aerial images, they present building footprints in relation to infrastructure. Unlike villages which had a specific political relationship with the state, not all clusters of buildings could be clearly defined as forming discrete settlements.
Gourou (1936), p. 246 and Planche XVIII.

> *in disorder* [...] *But very quickly guidelines appear; the habitat study will consist of highlighting these guidelines and determining the different types of villages.*[29]

Thus while individual settlements were presented as distinct entities with their own history and customs, the idea that common rules or guidelines could underpin the spatial arrangement of a group of villages, redirected emphasis to the collective form of the buildings depicted on the map.[30] Yet where a planted bamboo hedge or an extent of uncultivated communal land gave villages a discernible areal extent, not all guidelines correlated with the limits and magnitude of building clusters. Especially in agricultural areas where the distance between farmhouses varied considerably and communal land was non-existent, the dikes and canals subdividing the Tonkin Delta conferred a semblance of structure to the disorder and individualism apparent on the map. Called *casiers* by the French, dikes encircling a particular extent of geographic space were a typical feature of the Delta, with each village - rather than the state - responsible for the maintenance of their own flood-control structures [**Fig 6.7**].[31] While not equally distributed throughout the region, the unit of geographic space encompassed by dikes was considered emblematic of north Vietnam's agricultural

29 *"...l'on est au premier regard frappé par l'innombrable multitude des taches noires qui représentent les villages et par la surface très importante qu'elles occupant sur la carte. Il semble tout d'abord que ces taches sont jetées avec désordre, comme tracées au hasard par un insecte qui aurait trempé ses pattes dans l'encre. Mais très rapidement des lignes directrices apparaissent; l'étude de l'habitat consistera à mettre en valeur ces lignes directrices et à déterminer les différents types de villages." ibid*, pp. 237-238.

30 *"...les lignes directrices sont les mêmes, constituées par des digues parallèles aux rivages et des canaux perpendiculaires aux digues, maisles villages sont faits d'éléments dispersés [...] qui révèlent plus de désordre et d'individualisme." ibid*, p. 246.

31 David Biggs (2011), *Aerial Photography and Colonial Discourse on the Agricultural Crisis in Late-Colonial Indochina, 1930–1945*, p. 116. In C.F. Ax, N. Brimnes, N.T. Jensen, & K. Oslund (eds.), *Cultivating the Colonies: Colonial States and their Environmental Legacies*. Athens: Ohio University Press.

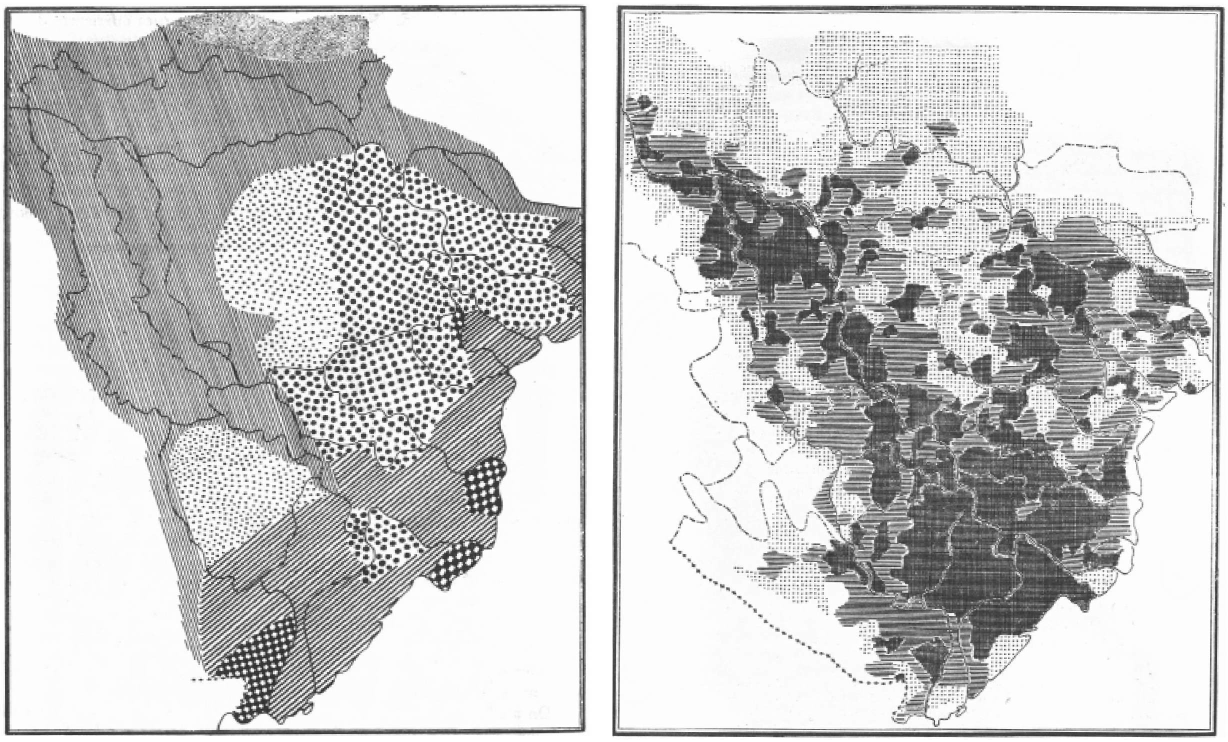

Fig 6.7 Village distribution and population concentration in the Tonkin Delta The map to the left shows the distribution of key village types in the Tonkin Delta, while on the right the map shows the population density in shades that correspond to the outlines of groups of settlements. Note that while all villages are accounted for in the density map, not all settlements are shown on the map of village types. Except for the coastline and parts of the administrative boundary of *Bắc Kỳ*, the outer limit is determined by the type of terrain guiding the form of village typologies.
Gourou (1936), pp. 258 and 152.

landscape.[32] Thus, although dikes had altered the hydrological regime by detaining floodwater even after inundations had subsided elsewhere, water infrastructure was associated with a pastoral ideal that was characteristic of Vidalian human geography.

The order which was visible on the planar views of settlements however, was not limited to the impression that waterways simply 'enclosed' clusters of buildings. Rather than considering the village as an areal form equivalent to the mapped lines of a *casier*'s dikes, as the observable outcome of a process taking place over decades, Gourou's maps suggested that the collective disposition of houses within the *casiers* was also underpinned by particular rules.[33] Groups of buildings confronted with similar conditions such as higher ground on a lowland plain or a linear flood-defence structure, appeared to coalesce into distinct areal

32 As David Biggs suggests, for Gourou and indeed many other colonial scientists, the hydraulic compartmentalisation of the Delta's topographic "uniformity" and the labour required to build and maintain a village's *casiers*, reflected the heroism of the hardworking Tonkin peasant.

33 The way "guidelines" could have affected the accretion of buildings into villages, was described by the Japanese architect Fumihiko Maki three decades later. Analysing what he called "group form", Maki examined villages as a general settlement-type whose configuration emerged from certain *generative elements*. Rather than a "skeleton" of physical infrastructure in relation to which buildings clustered however, what made a settlement into a coherent group that could be discerned as a village, was the repeated use of certain physical features such as walls or gates in the sequential accretion of houses. According to Maki the geographic concentration of these basic elements defined an "environmental space" which could be added to (or presumably subtracted from) "without changing the basic structure of the village". Fumihiko Maki & Masato Ohtaka (1964), *Investigations in Collective Form, Special publication,* n. 2, St Louis: Washington University School of Architecture, p. 14-19.

forms, allowing Gourou to conjecture that waterways and other topographic features were responsible for their arrangement. The classification of villages into types reflected this notion. Referencing the relationship of the settlement with the topography, the disposition of buildings along river banks or along the edges of hills were classified under different registers.[34] To the degree that village morphology was suitably adapted to the conditions of the deltaic topography, where particular village types were concentrated on the map also indicated the prevalence of particular topographic conditions [**Fig 6.7**].Especially around the edges of the Delta's geophysical determination, the presence of small settlements challenged the way the region's extents were delineated.[35] Drawn on maps, the grouping of these "isolated islands" into coherent systems helped explain complicated social phenomena. The areal magnitude of villages in relation to the number of their inhabitants for example, exhibited population densities that were thought to exceed the capacity of the land to feed its residents [**Fig 6.7**].[36] Based on these observations, the cause of poverty in the Tonkin Delta was attributed to "overpopulation" *(surpeuplemen*t) rather than the economic impact of the Great Depression or the colonial taxation system.[37] According to scholars of Gourou's work, these conclusions affected French officials that began to consider mass migration to Cochinchina as the solution to the "problem" of density.

Applying his cartographic methodology to the lowlands of the Mekong River, Gourou's 1942 study of Cochinchina's rural population was prepared under the colonial Vichy administration. Unlike the years of fieldwork which had contributed to his previous study however, the Cochinchina he described was based almost exclusively on maps and statistics, of which only relatively few were as detailed as Tonkin's.[38] Arguing that density was the most important factor dictating the difference in conditions between *Cochinchine deltaique* and the *Delta du Tonkin*, the narrative of his report divided the colony into subregions that differed primarily in the enumerated spatial concentration of residents [**Fig 6.8**].[39] With

Fig 6.8 Measuring Cochinchina's population density The map presents the concentration of the region's population within areas that correspond to municipalities and according to the physical boundaries of natural regions. It shows the highest densities concentrated in a continuous zone starting at Saigon and following the main river towards Cambodia. Gourou (1942), pp. 8-9.

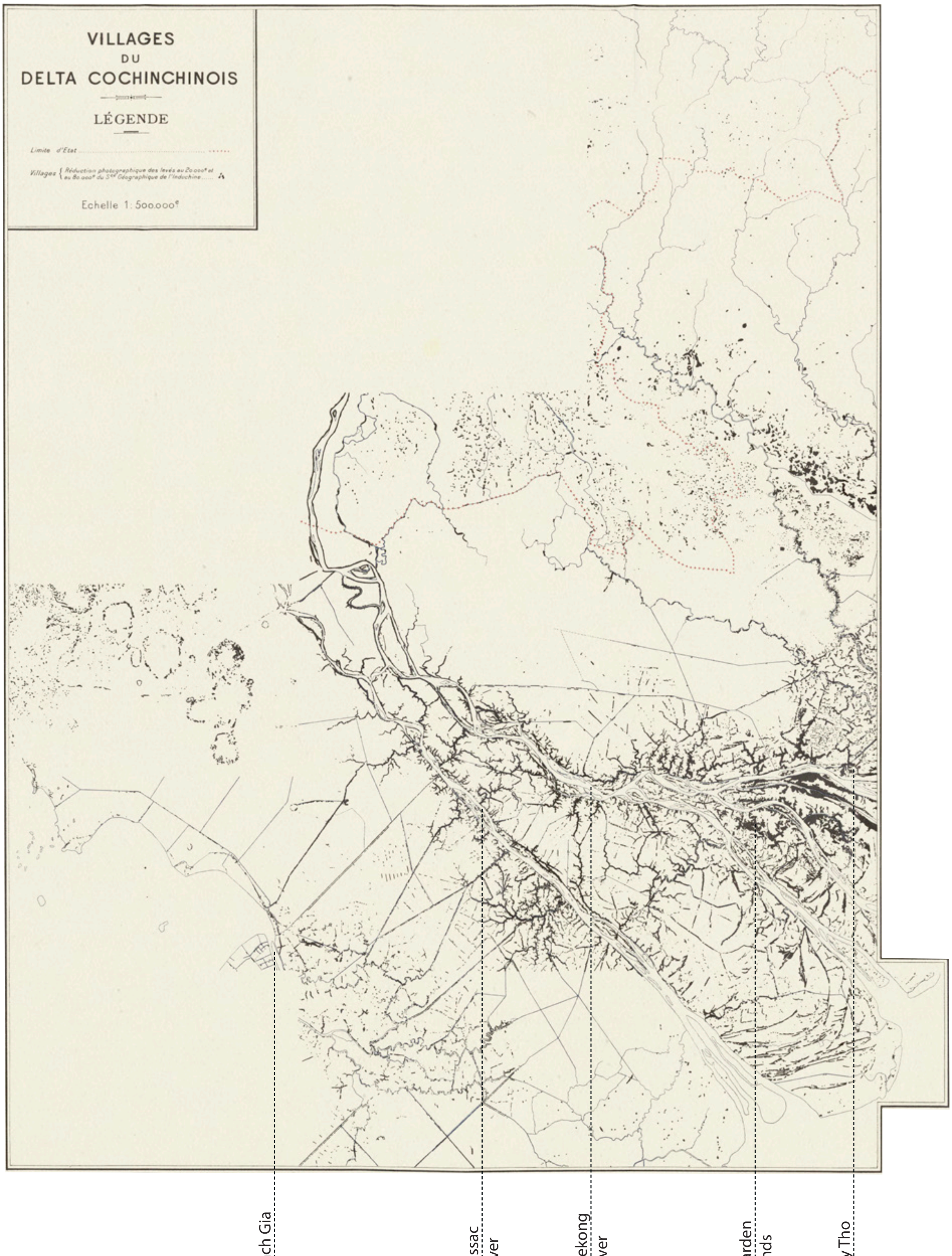

Fig 6.9 Villages of the Cochinchinese Delta Coloured black, the map displays built areas in the French colony against a background of perennial waterways depicted with fine blue lines. Although there is considerable exaggeration of the magnitude of built areas due to the techniques employed in the map's preparation, their distribution along waterways represents the condition of settlement in the region. The most uniform coverage of built areas appears between the main rivers in the areas known as garden lands (*miệt vườn*) due to their fertile soils.
Service Géographique de l'Indochine (1940), *Villages du Delta Cochinchinois.* In Pierre Gourou (1940), *L'utilisation du sol en Indochine française,* Paris: Centre d'études de politique étrangère.

the "east" appearing far more populated than the "west", and "central" areas having an "optimum" population, the distribution of the region's inhabitants was interpreted as showing the "underpopulated" portions of geographic space with the capacity to host migrant resettlement from the north. Prepared using the same mapping technique employed in Tonkin, the map of Cochinchina's delta's villages, depicted only the extent of villages [**Fig 6.9**].[40] Projected onto a background of fine blue lines representing the embankments of perennial waterways, the blocks of black ink depicting "villages" displayed the geographic distribution of inhabitation. Seen through the configuration of ink on paper, the map's striking correlation between settlement and waterways was not of the same fine grain of detail as Gourou's previous study, and at 1 to 250,000 tended to exaggerate the magnitude and continuity of built areas. Articulating village form would therefore have been inconceivable without assuming that just like in Tonkin, guidelines underpinned the visible patterns of built areas. Given the observable but general relationship between settlement and waterways, the two main village types discerned from the black shapes indicating built areas were those following the sinuous turns of rivers and streams (*villages arroyos*) and those built on the flat and relatively drier alluvial plains closer to Saigon (*villages de relief*) [**Fig 6.10**]. Using the map as the guide, Gourou distinguished multiple variations of these types, as well as more contextually unique arrangements of buildings throughout the region. Inasmuch as a settlement's planimetric morphology aligned with the embankments of waterways or clustered behind riparian sediment deposits (*bourrelets*), Gourou believed that as inhabitation adapted to particular topographic conditions, villages collectively adopted the *areal form* of natural regions.[41] That mapped villages could be interpreted to signify where certain geophysical relationships began, suggests that the geographic space discernible as a distinct region acquired, at least in part, its own cartographic form by the way

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34 Gourou's three main categories of "relief villages" located settlements according to river banks, the edges of hills and coastlines. *ibid*, p. 238.

35 *ibid*, p. 236.

36 Biggs (2012), p. 115.

37 During the Great Depression, Indochina's entire export economy was centred in the south. The plummeting global price of rubber was followed a year later by a substantial drop in the politically-inflated price of rice. A staple food, as well as the colonial economy's most valuable commodity, rice was also a common way to pay land rent and wages. The drop in the exchange rate for rice affected the livelihoods of farmers and their families as well as the elite class of French and Vietnamese plantation owners. Bankruptcies, land-seizures and indebtedness were more pronounced in those southern areas where exports had directly linked production with world markets. The political discontent against French colonial rule that had begun before the depression's onset, became expressed in a "general unrest that reinforced the communist view of the imminent collapse of world capitalism." See Irene Nørlund (2001), *Rice and the Colonial Lobby: The Economic Crisis in French Indo-China in the 1920s and 1930s*, p. 208 as well as Pierre Brocheux (2001), *The State and the 1930s Depression in French Indo-China*, p.268. Both are published in Boomgaard & Brown (eds.), *Weathering the Storm: The Economies of Southeast Asia in the 1930s Depression.* Institute of Southeast Asian Studies (ISEAS) Publishing (online publication).

38 The 1 to 25,000 maps of Cochinchina were initially limited to the most densely inhabited parts of the colony. With the introduction of aerial photography approximately 30,000 km^2 were recorded in images and from 1928 onwards, photo-topography was also applied to the cadastre. Les Armées Françaises D'outre-Mer (1931), p. 115.

39 "*...la Cochinchine et le Delta tonkinois présentent des conditions tout fait différentes puisque les parties deltaïques de la Cochinchine ont une population rurale de 100 par km2 tandis au Tonkin la population rurale atteint une densité moyenne de 430 par* km^2*.*" Gourou (1942), Footnote 2, p. 17.

40 The specific technique involved printing the green plates which the Service géographique used as a coloured overlay to demarcate villages on 1: 100,000 maps of the region (see Fig 6.5). The map's scale was then accurately reduced with photographic prints to obtain a map with the built area overlain on a background of the region's waterways.

41 "*Le village ou plutôt ensemble des villages épousé la forme même du plateau et arrête á ses limites.*" *ibid,* p. 25.

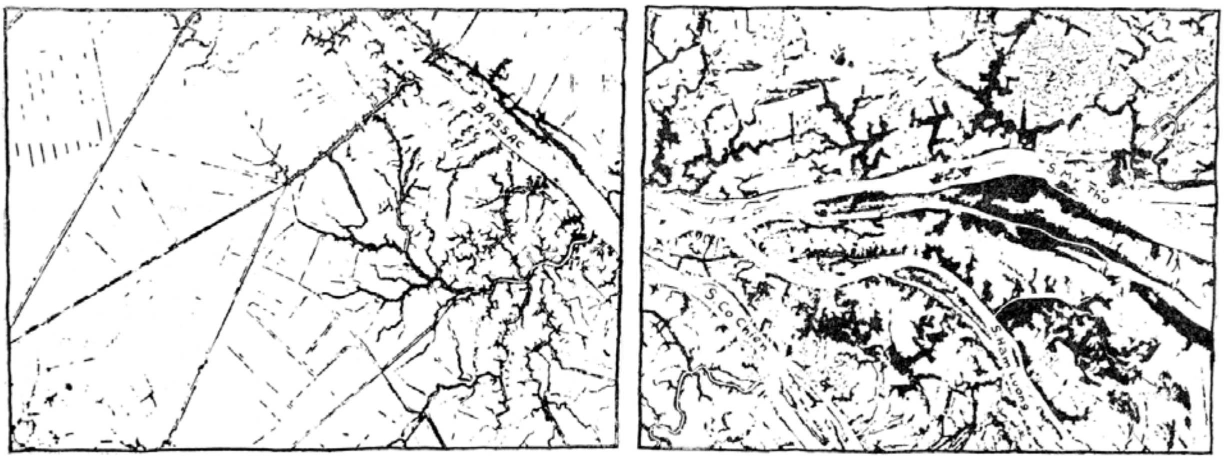

Fig 6.10 Village typologies Two extracts from the main map (Fig 6.9) used by Gourou to illustrate the village types he identified in the patterns of villages and topographic features.
Gourou (1942), Fig 5 & Fig 6.

it was assumed to be inhabited. Considering that on the flatness of the Mekong's lowlands the topographic limits of a swamp or an alluvial depression were only determinable by their subtle differentiation with adjacent areas, for Gourou the cartographic dimension of settlement reflected, but also appeared to define, the delta's natural geographic limits.

Gourou's cartographic distinctions between Cochinchina's settlement types implied a correlation between human inhabitation and specific qualities of the terrain which constituted the delta. This relationship did not account for the countless manmade modifications which underpinned the hydrology and ground conditions experienced by Sơn Nam. Inhabitants burned and cleared forests accelerating the processes initiated by canalisation that dried brackish swamps or allowed tides to funnel salt water inland. And with demand exceeding the supply of available plots, recent migrants settled wherever possible, requiring the colonial government to reserve the land up to one kilometre from intersections for civic uses.[42] Gourou's hypothesis concerning the typological arrangement of villages therefore reflected only part of a settlement's relationship with waterways. By following the logic of Tonkin's self-contained villages, the hypothesis concerning the adaptation of villages to the delta's geography could not directly account for the fact that the geography itself was also a variable and not the stable background in relation to which groups of people adapted their practices. Yet in suggesting that a group of villages constituted distinct regions, the black blocks of ink representing built areas were able to convey an idea of a specific delta. Thus even if the apparent configuration of settlement was the consequence of the terrain's characteristics, the ability to alter these characteristics by building and inhabiting new waterways gave inhabitants, but also the state, the agency to also physically construct what constituted a distinct 'region'. If the delta of the Mekong was therefore apparent on Gourou's map, it was not the same delta that could be described with reference to sediment accretion, or the boundary with Cambodia. The delta constructed through the cartographic discourse on villages and population density appeared less as an extent of geographic space and more as an *areal unit*, whose geographic magnitude was coterminous with its inhabitants' social relations.

42 Biggs (2012), p. 111.

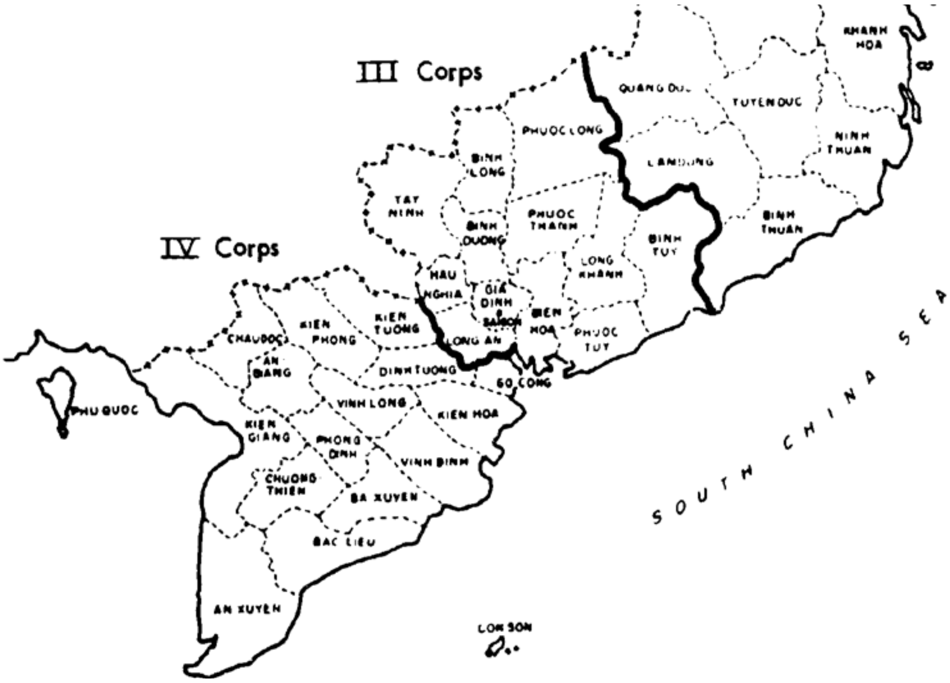

Fig 6.11 Tactical regions of South Vietnam The map shows the subdivision of South Vietnam into military (tactical) regions (Corps), based on the outlines of administrative provinces. The 4th Corps encompasses the country's portion of the Mekong River's delta.
Croizat (1969), *The Four Corps Areas of South Vietnam.*

Hinged terrains

If the changes in hydrology inadvertently initiated by canal-building made Gourou's thesis redundant as a way to explain the way people adapted to specific qualities of a constantly changing delta, the idea that settlements shaped the terrain around them remained significant. Less than 20 years after Gourou's study of Cochinchina's villages was published, the post-colonial regime of South Vietnam incorporated "resettlement" into a new policy of agrarian reform that was conceived in response to multiple problems confronted by the newly independent country.[43] Announced in 1957, Agricultural Development Centers called *Dinh Điền* in Vietnamese, would not only increase the overall land available for cultivation and support diversification of crop production. They would also contribute to local "self-sufficiency" and more importantly to the national security of a state in an escalating conflict with North Vietnam's communist government [**Fig 6.11**].

Closely associated with the personal beliefs of the country's President Diem, the Vietnamese interpretation of self-sufficiency and *community development* promoted by the government, reflected an emerging UN practice for "aided self-help in small communities with modest technical services".[44] Where schemes such as the TVA occupied one extreme of a range of planned modernization processes, for the UN, community development was considered far more adaptable to the specific requirements and aspirations of local residents. From the perspective of

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43 Although French engineers and planners had proposed several plans for moving 'surplus' people from the overpopulated villages of Tonkin to the underpopulated areas of the Mekong Delta, these were only partially implemented.

44 United Nations Educational, Scientific And Cultural Organization (UNESCO) (1956), *The Definition of community development.* Working paper n. 3, p. 1. For South Vietnam's viewpoint see Edward Miller (2013), *Misalliance: Ngo Dinh Diem, the United States, and the Fate of South Vietnam.* Cambridge MA: Harvard University Press. p. 164.

South Vietnam's leader however, rather than just the government assisting local residents to raise their own standards of living, agricultural communities would also be mobilised to actively contribute to the construction of public projects. Inhabitants of Dinh Điền were tasked not only with clearing unutilised land for farming and building houses for little or no pay, but in the face of existing areas of anti-government resistance, also organizing their own security.[45] Due partially to the high proportion of tenant farmers that were considered vulnerable to communist propaganda, the deltaic areas south and west of the capital Saigon were targeted for more than 26 settlements called *khu trù mật* or *agrovilles* by the Vietnamese [**Fig 6.12**].[46] Located along major roads and canals, the *agrovilles* would be positioned to monitor movement through the terrain on the one hand, and serve to expand the extent of agricultural land on the other.[47] Acting as what the Vietnamese called *hinge cities* (*villes charnières*), these settlements were conceived as a "happy compromise" between rural and city life.[48]

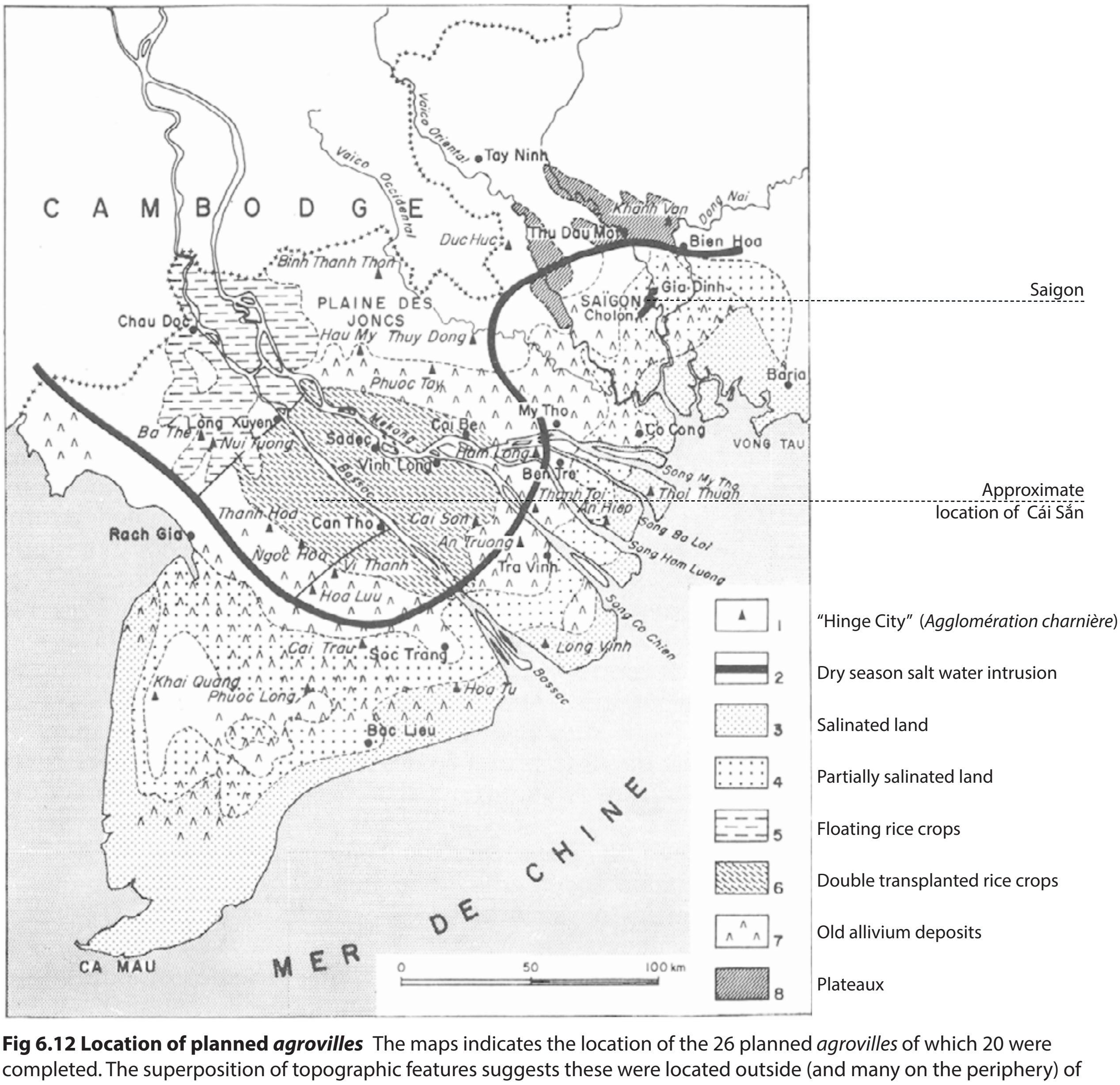

Fig 6.12 Location of planned *agrovilles* The maps indicates the location of the 26 planned *agrovilles* of which 20 were completed. The superposition of topographic features suggests these were located outside (and many on the periphery) of the most productive agricultural land where two crops of rice were grown annually.
Teulières (1962), *Carte de Nam-Phân*, Fig 2, p. 78.

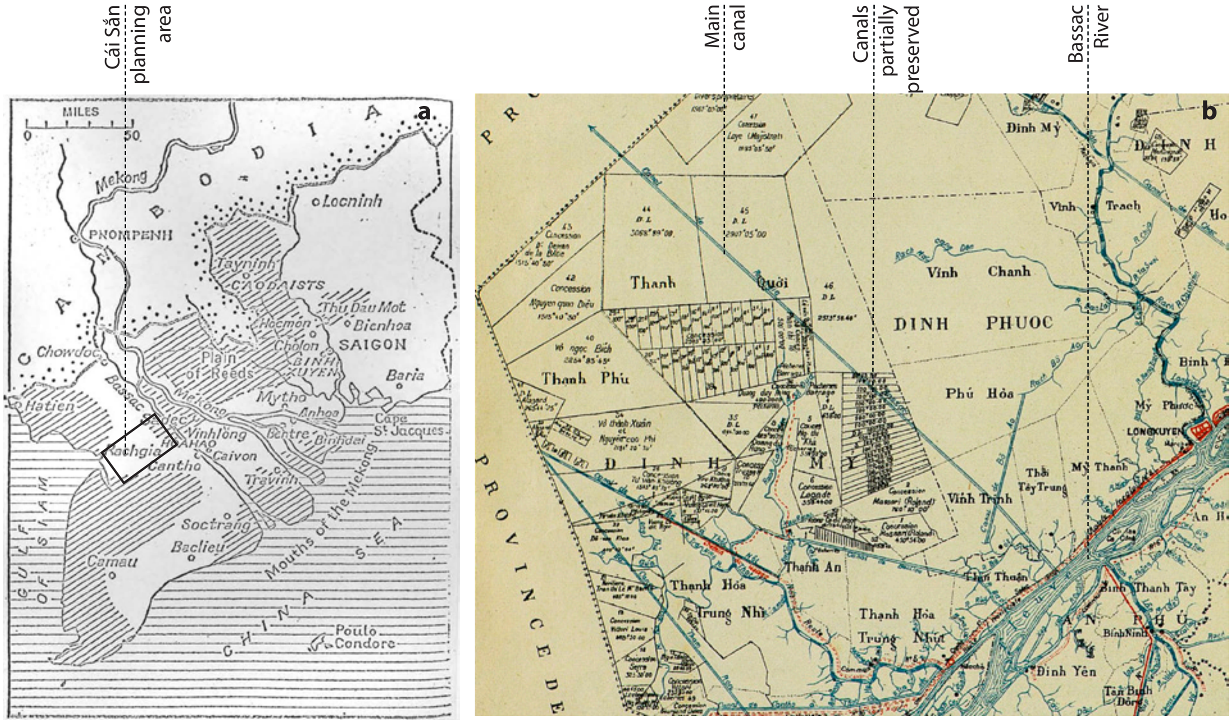

Fig 6.13 Cái Sắn agroville location Shaded areas on the map to the left denote areas that were not controlled by the colonial government in1949. On the right, the main canal which later bisected the Cái Sắn planned area (diagonal blue line). Land lot configuration appears to have almost no relationship with the depicted waterways.
Pentagon Papers Project (1972), *Cochinchina in 1949. The Pentagon paper. Volume IV A, Evolution of the War,* CA: Pentagon Papers Peace Project; Victor Duvernoy (1924), *Monographie de la province de Longauyên (Cochinchine)*, Hanoi: Gouvernment de Cochinchine.

In the Mekong's lowlands, what exactly "hinged" around these "cities" is suggested by the planning of Cái Sắn and the subsequent design of *agrovilles* and *strategic hamlets*. Inaugurated in 1956 – a year before the Dinh Điền were announced as policy – the planned settlement at Cái Sắn was situated along either side of a colonial-era canal, in a part of the delta that only a few years earlier had been under the control of the Hoa Hao sect.[49] According to the information leaflet published by the South Vietnam administration, the rectangular geographic area encompassed by the plan covered about 1,000 km^2.[50] This area was visible from the air "as clearly as on the map" and bounded by the river to the north, the Gulf of Siam to the south and existing waterways - only partially manmade - running between the river and the sea to the east and west.[51] Maps denoting the geographic space under the control of anti-government militia during the last years of French rule, point out that the canal bisecting the site and the land around it, was probably one of the few 'secure' routes from the Bassac River to the coast [**Fig 6.13a**]. Yet if the sea and river were geographic edges and the main canal a

45 *"...to create Agricultural Centers and find land that is agreeable, to organize their own defense, to clear the land by means they already possess, and to erect houses so that gradually their families may join them."* President Ngo Diem quoted in Joseph Zasloff (1962/3), p. 1.

46 Biggs, p. 114.

47 Roger Teulières (1962), *Les paysans vietnamiens et la réforme rurale au Sud Viêt-Nam*. Cahiers d'outre-mer, n. 57 - 15e année, pp. 47-84

48 Zasloff (1962/3), p. 2.

49 Miller (2013), p. 166.

50 Republic of Viet-Nam (1956), *The Dramatic Story of Resettlement and Land Reform in the "Rice Bowl" of the Republic of Viet-Nam.* Saigon: Secretariat of State for Information, Republic of Viet-Nam, p. 23.

51 *ibid*, p. 6.

clear central axis, the choice of existing waterways for the planning area's east and west boundaries did not reflect the limits of an existing ground condition. A different map from 1926 shows that to the northeast of the planned area, land had already been subdivided into plots of various sizes: from lots of one hectare to 30 hectares for large plantations [**Fig 6.13b**]. Assuming that the property subdivisions were made around the same period as the main canal opened to circulation in 1923, the diagonal alignment of lots to the canal would have required individual landowners to make their own connections to the waterway network.[52] Although some canals used as references for the lot arrangement may be absent from the map and not all lot lines would necessarily correspond to waterways, the configuration of the manmade terrain only very rarely appears related to existing streams or even other canals. In this sense, apart for the strategic link from river to coast, a significant part of the areal extent on which Cái Sắn was to be planned did not display any specific organizational principle except perhaps for the rationale dictating the surface area of private lots.

Framed in terms of an areal extent requiring overall planning, organizing the configuration of the ground was addressed by what Edward Miller reports as "colossal earthworks".[53] Construction of Cái Sắn entailed excavation of 200 kilometres of new waterways, with the 180 thousand cubic metres of excavated soil deposited alongside the canals.[54] And although parts of the colonial plot subdivisions were preserved, new waterways were designed to be almost

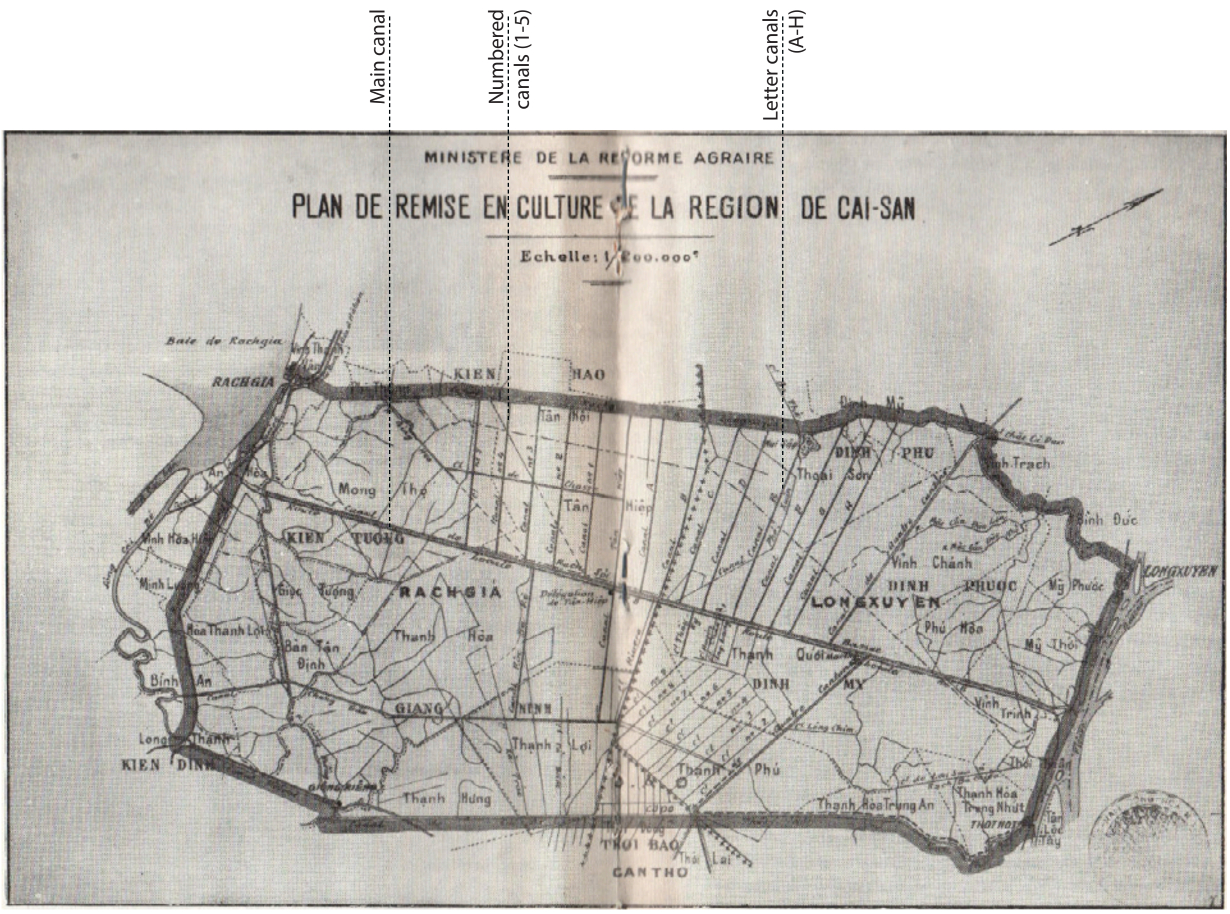

Fig 6.14 Resettlement plan in Cái Sắn area Encompassing about 1,000 km^2, the planning area is bisected by the Rach Gia (Rachsoi)-Bassac canal. Note the new canals and subdivisions to the west of the canal (top) that do not appear on the 1924 map (Fig 6.13b) and are named by letter (A-H) or by number (1-5). Note the cluster of canals east of the main canal which appear on the older map as plot subdivisions and are partially preserved in the new plan.
Republic of Viet-Nam (1956), pp. 14-15.

perpendicular or parallel to the main canal, creating a hierarchical organization within the extents of the planning area [**Fig 6.14**]. On the plan, many of these new waterways were named alphabetically or numerically, structuring a sequence of routes that could be understood in relation to each other.[55] Planned for 120,000 future inhabitants, 20,000 existing residents were relocated along the primary canal, sometimes too far from their existing farms, while 50,000 refugees were given three hectare plots along the secondary waterways.[56] Built on the 20 metre wide platforms along the canals, houses were grouped into villages and served by clustered amenities such as churches and schools dispersed at waterway intersections. With every new canal considered a dike because of the masses of earth piled alongside, the differentiation of the planned area from adjacent areas was not through an outer perimeter of flood defences but rather the regular intersection of these waterways, which together indicated the 'rationalised' extent of geographic space.[57] Thus rather than an isolated 'point' of concentration within a context of diffused building clusters, Cái Sắn was less a "city", and more a dispersed settlement such as those which the writer Sơn Nam had grown up in. If only metaphorical, references to a "hinge city" indicated the defence of a critical junction within a wider strategic terrain. Distinguished from the adjacent marshland by the regularised recurrence of its constituent parts rather than outer edge or the condition of the ground, the Cái Sắn's planning area was not the equivalent of an existing region definable by soil types, vegetation or the behaviour of water. Yet by being 'legible' on a map, from the air or even from a boat, the organization of new waterways in direct relation to the main canal was a necessary step to transform an undifferentiated part of the sedimented lowlands into a specific geographic space.

Despite being considered an economic and political success, the model of regional settlement demonstrated at Cái Sắn was substantially adapted in subsequent plans for *agrovilles*.[58] Government propaganda portraying happy peasants benefitting from modern facilities and affordable land however, did not reflect the realities of a bare, treeless terrain which needed to be made arable. By the end of the 1950s, state-initiated land reform had yielded only a marginal decrease in the proportion of landless households, and by 1959 the security threat perceived by the government had amplified.[59] *Agrovilles* would thereafter intentionally "create densely populated settlement areas" in a countryside where people lived in "such a spread out manner" that it would be impossible for them to avoid the influence

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52 Victor Duvernoy (1924), *Monographie de la province de Longauyên (Cochinchine)*. Hanoi: Moniteur de l'Indochine, p. 79.

53 Miller (2013), p. 182.

54 Republic of Viet-Nam (1956), p. 8.

55 This is also pointed out by David Biggs who uses a different plan from 1956 to indicate the extent of new waterways on the east side of the main canal that if ever implemented, no longer appear on satellite maps. Biggs (2012), p. 165.

56 Zasloff (1962/3), p.9. At 120 people/ km^2 the anticipated residential density would have been considered relatively high in relation to Gourou's map (see Fig 6.8).

57 David Biggs mentions Cái Sắn's design included an encircling dike such as those in the *casiers* of the Red River Delta (*op. cit.*, p. 162). The government's information leaflet mentions that to the north of the site, farmers cultivated "floating rice" on floodwater which would be contradictory to the idea of an outer perimeter of flood protection. In addition, considering an outer flood barrier would have been an important achievement for the government's engineers, it is surprisingly not mentioned in the leaflet.

58 *ibid*, p. 168.

59 Trần & Nguyễn (2016), p. 68.

of the enemy.[60] If the stated objectives of the *agrovilles* was to "improve the life of the rural population", the historical record is full of accounts of the conflicts that occurred between government forces and the thousands violently forced to abandon their homes and farms, often working without pay to build houses and infrastructure.[61] The reasoning cited for adopting such an aggressive strategy in the first place revolved around the social and military benefits of *agglomeration*. In that part of the Mekong's lowlands administered by South Vietnam, the strategic deployment of "agglomeration zones" was fundamentally different to the planning of Cái Sắn. Where Cái Sắn's clusters of public facilities were dispersed to serve people living along canals up to 6 km away, the new *agrovilles* would relocate distant households within relatively close distance from modern schools and medical facilities.[62] Within the new settlements, residents would be theoretically protected by security forces although in reality farmers would still need to travel far outside the settlement's perimeter to work on their old farms.

These contradictions were not just problems arising from planning the configuration of individual settlements. Beginning with the new *agroville* at Vi Thanh, subsequent planned settlement such as those at Duc Hue and Tan Luoc were arranged within a roughly one square kilometre area subdivided by a grid of canals or roads, with each 'block' apportioned into several household plots.[63] Despite spatial characteristics which may have appeared odd for the setting, Vi Thanh was considered the model for subsequent *agrovilles*.[64] Situated along the main waterway from the strategically vulnerable region of Ca Mau to the town of Can Tho, Vi Thanh's location had been selected primarily to control movement along the canal rather than for the qualities of its soils. Maps from 1960 appear to show the site of the *agroville* before and after the plan [**Fig 6.15**]. They depict

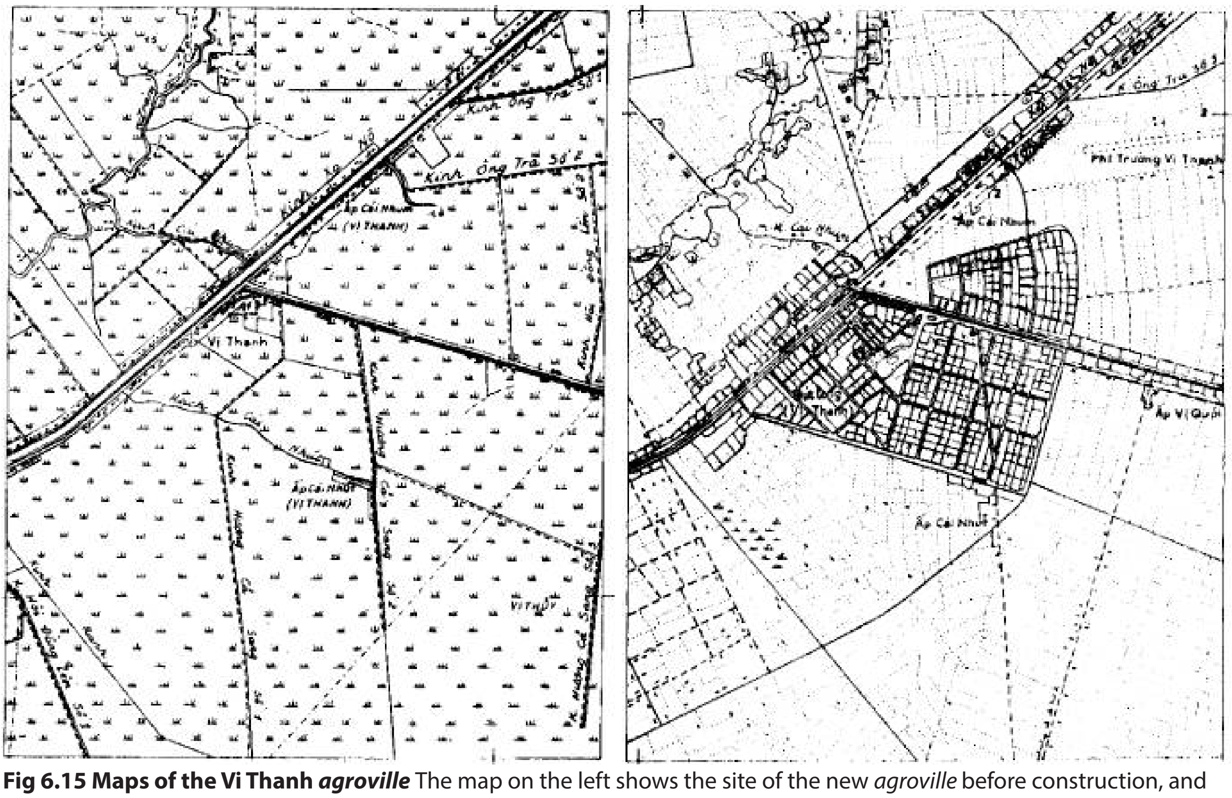

Fig 6.15 Maps of the Vi Thanh *agroville* The map on the left shows the site of the new *agroville* before construction, and the plan on the right shows the configuration of the *agroville*'s infrastucture. Note that the marshland on the map has disappeared on the plan into the outlines of farm subdivisions along with some canals.
http://viethocjournal.com/2018/10/chinh-sach-nong-thon-thoi-vnch-lap-chuc-nguyen-huy/

the new settlement underpinned by a grid, with the main built area encompassing one side of the main canal and new infrastructure (probably a highway) running parallel to the waterway.[65] Existing canals – which appear prominently in the depiction of the previous condition – appear visually subdued or integrated into the outline of roads and plot-lines composing the built area. A new canal extends from the town grid, delineating the land adjacent to the main waterway. Significantly, with the *agroville* in place, the terrain surrounding the built area is no longer depicted as marshland. The regularised subdivision of fields replacing the swamp, continues beyond the frame of the map, implying that the new ground condition is a result of the planned settlement and not necessarily confined to a specific area. Considering that less than one third of the perhaps 20,000 peasants recruited to construct Vi Thanh's infrastructure could initially be accommodated within the *agroville*, suggests that the purpose of agglomeration was not solely the spatial concentration of the rural population.[66] And while examination of these two maps alone does not allow more specific conclusions to be drawn about the design of settlement itself, what is apparent is the aspiration to transform the ground conditions of an area far larger than where buildings are clustered. If to some degree Cái Sắn's plan exemplified the rationalisation of the marshland with new waterways, Vi Thanh's appeared to impose order over the adjacent terrain by making the agglomeration zone the point of reference for a vast geographic space.

Seeding settlement

Recorded in newspaper articles by Vietnamese politicians as well as reports by American researchers, the failures of *agrovilles* not only to improve economic conditions but also to halt the spread of counter-insurgency, initiated the transition to a new model of fortified settlements. Instead of dealing with the conflict arising from forced resettlement, unpaid labour and the suitability of the terrain to accommodate cultivation, "tactical hamlets" in "areas of strategic importance" started to replace *agrovilles*.[67] Named *strategic hamlets* (*ấp chiến lược*), these settlements were intended to articulate the government's vision for a modern country through the grouping of rural inhabitants.[68] Praised by President Diem as the archetype of a cohesive and self-sufficient social unit, the idealised

60 Zasloff (1962/3), pp. 1-2.

61 *ibid*.

62 *ibid*, p. 30.

63 *ibid*.

64 Vi Thanh was designed as a showcase for similar projects, with the central facilities and shopping area planned by the prominent architect Ngô Việt Thu who would later design Saigon's Independence Palace. It was nonetheless described by American officials as akin to a suburban mall, with the significant distance between the centre and the closest houses seen as equivalent to the mall's asphalted parking lots.

65 These two maps are published on the website of the journal of the Institute of Vietnamese Studies. On its website it states that the Institute is a private, non-profit interdisciplinary research institution. The maps are displayed in an article with photographs from 1960 but are not directly attached to a source or a specific date. They appear to use cartographic conventions (eg the depiction of marshland) common in military maps of the 1960s and are therefore most likely from that period. Lạp Chúc Nguyễn Huy, *Chính sách nông thôn thời Việt Nam Cộng Hòa (Rural Policy. Republic of Vietnam period).* Institute of Vietnamese Studies [online edition], accessed 19 February 2022, http://viethocjournal.com/2018/10/chinh-sach-nong-thon-thoi-vnch-lap-chuc-nguyen-huy/

66 Milton Osborne (1965/ 2002), *Strategic Hamlets in South Viet-Nam.* Ithaca, NY: Cornell Southeast Asia Program Publications, p. 24, note 21.

67 *ibid*, p. 25.

68 Teulières (1962), p. 64.

Fig 6.16 Tactical encampments The photograph on the left shows an unspecified strategic hamlet in South Vietnam. Surrounded by a moat, bamboo barrier and raised on an earthen mound, a model village would include a radio station, dispensary, arms storage, school and market place. To the right the American Special Forces (Delta Force) camp at Plei Me, in Vietnam's Central Highlands. Measuring around 150m per side, the triangular camp was established to gain support of the local residents for South Vietnam's war effort.
L.R. (Dusty) Rhodes (unknown date), *Aerial view of strategic hamlet in South Vietnam*; Unknown photographer (1965/66), *Special Forces Camp Plei Me*.

Vietnamese village was considered the appropriate model to initiate change.[69] Derived from appreciation of Central and North Vietnam where the peasant village was considered emblematic of the cultivated landscape, the 'model' commune (*xã*) was formed by a "group of inter-dependent hamlets coordinating their efforts along a common scheme."[70] In practice, this vision was to be implemented by fortifying existing settlements rather than constructing new ones, while at the same time separating government sympathisers from people suspected as having contact with the enemy.

Apart from the implicit references to older Vietnamese modes of colonizing hostile terrains epitomized by the *đồn điền*,[71] British colonial policy in Malaya was also cited as the source of the newer model. To prevent the resupply of communist guerrillas following the end of the second world war, the British administration had moved dispersed landholders into identical houses clustered in groups, where their movements could be monitored.[72] In South Vietnam, the goal of disrupting communication with the enemy materialised in the construction of physical barriers [**Fig 6.16**]. Peripheral fortifications made of barb-wire, bamboo posts and trenches controlled inhabitants' movements through guarded openings, and restricted access to the settlements' supplies by insurgents. A technique

69 *"The Commune, made up of one or several hamlets (Ap) was conceived in itself to be a moral being with the right to the full exercise of civil rights, with the powers of purchase and with free access to justice."* Republic of Viet-Nam (1963), p.22. Catton makes the argument that South Vietnam's ruling family (President Ngo Dinh Diem and his brother Ngo Dinh Nhu), that had grown up in Central Vietnam, idealised the Vietnamese village as symbolic of a "native" type of government organization that preceded colonization. Philip E. Catton (1999), *Counter-Insurgency and Nation Building: The Strategic Hamlet Programme in South Vietnam, 1961-1963.* The International History Review, v. 21, n. 4, p. 936.

70 Republic of Viet-Nam (1963), *Viet Nam's Strategic Hamlets.* Saigon: Directorate General of Information, p.6.

71 Adapted from the Chinese military agricultural settlement *tuntian* (屯田), "garrisoned plantations" known as *đồn điền*, had preceded the establishment of new civilian villages (*dinh điền*) by Vietnamese migrants during the pre-colonial period. These outposts of imperial power were manned by soldiers or civilians trained to serve as soldiers, and were organized for farming and defence. The *đồn điền* were among the various types of settlement recorded in the pre-colonial census of the southern region, which along with communal rice fields (*công diên*), placed up to 15% of cultivatable surface areas of Nam Bộ under direct ownership of the state. Nguyen (1993), p. 283.

72 James Scott (1999), *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed.* New Haven, CT: Yale University Press, p. 188.

suitable for protecting buildings clustered on land rather than along a waterway's embankments, these fences were the subject of communist propaganda that cast the hamlets as incarceration or concentration camps.[73] Especially for those used to living along the region's waterways, the fenced perimeter of an individual hamlet ruptured the relationship between farmers and cultivated land, while the forced resettlement into the enclosure also removed people from proximity to ancestral graves and ceremonial centres. Referring to the strategic hamlets, James Scott has described how these fences produced "concentrated state spaces", where direct control and discipline over people was more important than appropriation of the geographic extent which the boundary enclosed.[74] From the perspective of the thousands displaced in the name of national security, this conclusion would reflect the armed surveillance experienced within these settlements. The areal disposition of these 'points' of concentration however suggests a different way to perceive what geographic space *agglomeration* appropriated.

How individual hamlets were perceived to form groups with other settlements as well as their adjacent terrain, was critical to their spatial arrangement. Published in 1963, the same year the programme was terminated, the government's official brochure on strategic hamlets declared that the benefits of the "rural revolution" instigated by the hamlets would strengthen solidarity between the region's dispersed inhabitants and the state. To achieve this, individual settlements were transformed into "hamlets" and, along with new hamlets wherever required, collectively formed a village with elected leadership.[75] What conditions triggered the requirement for a new hamlet to be erected is suggested by another goal of the programme. The widespread infiltration of existing villages by an enemy hiding "in the forest or among the population", required a "frontline" to be produced.[76] To this end the hamlets would become a "human wall" along the country's vulnerable frontiers, where the inhabitants would theoretically benefit by accessing "untapped" resources.[77] The disposition of new in relation to 'existing' hamlets would therefore need to simultaneously contribute to two groupings of settlement: one collectively forming a "village" and another forming a visible, if not necessarily linear, frontier. However with more than 4,000 hamlets housing a third of the region's population planned for the areas encompassed by the Mekong's lowlands, this "frontline" would not only form the limit of a controlled terrain.[78] If the pattern of model villages further north was defined by the geographic proximity between distinct settlements, the hamlets would need to be positioned at relatively regular intervals throughout terrain. Considering most homes in the Mekong's "countryside" were dispersed along a waterway's embankments rather than clustered around a centre or confined to a peripheral barrier, the distribution of hamlets would have to contend with conditions that challenged the proposed concentration of settlement.

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73 Communist propaganda frequently reported the length of barrier destroyed in local conflicts. Osborne (1965/ 2002), p. 49.

74 Scott (1999), p.188.

75 Osborne (1965/ 2002), p. 26.

76 Catton (1999), p. 920 and Republic of Viet-Nam (1963), p.5. References to the creation of a "frontline" are mentioned numerous times in the government brochure.

77 Miller (2013), p. 163.

78 Republic of Viet-Nam (1963), p.22. 11 of the region's 13 administrative provinces are cumulatively listed as having a resident population of 5,031,401 of which 2,089,435 are listed as residents of strategic hamlets. Moreover, nearly half of Saigon's 1,275,000 residents also appear to be resident in these settlements.

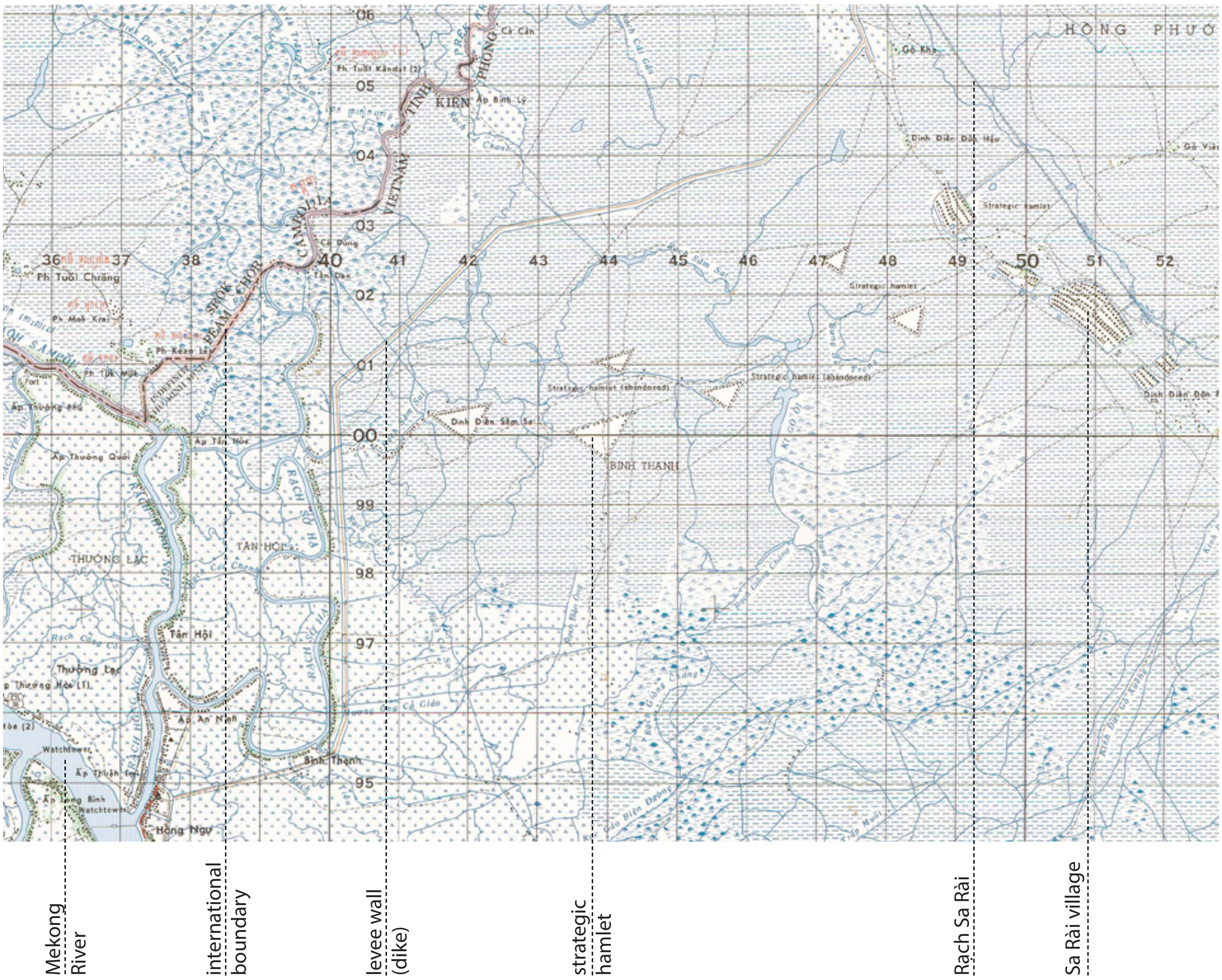

Fig 6.17 Strategic hamlets An excerpt from a larger map of the region around the town of Hong Nu, the drawing shows a number of strategic hamlets and *dinh điền* arranged across 10km of marshland. The largest of the triangular hamlets stretches about a 800 metres on its longest side. A levee wall appears to stretch from the Mekong River across the entire map. Constructed on mounds typical of this part of the marshes (*xứ gò*), Sa Rài village is located a few hundred metres from the canalised Rạch Sa Rài and is not typical of the region's waterway settlements which are visible closer to the River (left). Defense Mapping Agency (1966), *Hong Ngu Vietnam; Cambodia,* (Sheet 6030 I), Series L7014, Washington, D.C.: Defense Mapping Agency, Hydrographic/Topographic Center, 1965-1971.

A 1965 US Army map presenting the topography of South Vietnam's delta region, illustrates how the contradiction between ideas of agglomeration and local settlement organization may have collided [**Fig 6.17**]. Although by no means typical of the programme's implementation elsewhere, the map appears to present six strategic hamlets and *dinh điền* situated in the marshes close to the boundary with Cambodia.[79] Rather than reinforcing an existing settlement, these consistently adopt the triangular planimetric form of the Plei Me Special Forces camp [**Fig 6.16**]. Separated rather than joined with each other by waterways, these are arranged along a 10km notional line roughly parallel to a dike. The "levee wall" which is also several kilometres long would have presumably contained the floodwater flowing overland across the border, as well as block

79 From available maps of this series, it has not been possible to identify other settlements annotated "strategic hamlets". Few other maps show sites for an *agroville* or built *khu tru mat*. Since the maps depicting the terrain were published between 1965 - 1969, it is possible that existing fortified settlements were either not identified, not mapped or had been abandoned.

movement across a terrain where “travel by small boat is unrestricted and concealment easy” for several months of the year.[80] With some hamlets labelled “abandoned” and others presumably still inhabited, their reference to a military base and the insistence on a continuous state presence *across* this particular stretch of uninhabited marshland, suggests that these would collectively form a third "wall" behind the geopolitical boundary and the dike. Prepared by the US military and shared with their Vietnamese allies, such topographic maps at 1 to 50,000 were more useful for providing an overview over a particular area rather than for navigating the nuances of the local topography.[81] If recent remote imagery shows no trace of these hamlets, revealing the position of these tactical bases on a map would have been inconsistent with their strategic value as a defensible“frontline” along a sensitive frontier. Thus even if it is not possible to confirm if these hamlets were ever constructed, much less abandoned, their appearance on the map was arguably deliberate, and served a different purpose than merely depicting an existing condition. Considering the dike – if ever planned – was never built, to conclude that these possibly 'phantom' hamlets and infrastructure were drawn to intentionally show these frontiers as secure, would also imply that such a distant and inaccessible border area first needed to become 'visible' in order for it to become controlled. For an audience of military and government officials, the cartographic figures of hamlets suggested the geographic limit of a 'state space' constructed by settlements and dikes rather than adherence to geopolitical boundaries.

Cited as one of the more important reasons leading to the hamlet programme’s failure, the “traditional settlement pattern in the Delta region” was regarded as antithetical to policies of population concentration.[82] Existing settlement patterns were too “spread out” to oversee effectively, and overly concentrated along existing waterways to monitor movement across the interstitial inundated plains. Planning the configuration of settlement would act as an 'antidote' to a ground condition considered favourable to concealment and infiltration, but also – by providing modern social facilities - to the destitution and isolation of the rural population. Among the many things they can be interpreted as representing, the planning of Cái Sắn, *agrovilles* such as Vi Thanh, and strategic hamlets also presented three different approaches to establish what constituted a particular settlement unit. Although impossible to separate from the threat of violence which underpinned the choice of approach, what Scott calls the “radical simplification” of planned settlement patterns was considered necessary to deliver services, and the enforced “villagization” a way to reorganize social units “in order to make them better objects of political control”.[83] Yet if all three aimed to make the inhabited terrain legible to agents of the state, the construction of legibility under each approach was notably different. The choice of dispersal along a new sequence of waterways, concentration within a grid of infrastructure or isolation inside a fence, was not just a matter of reducing the project’s scale to increase the

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80 Osborne (1965/ 2002), p. 5.

81 The army’s topographic maps are annotated in Vietnamese, French as well as English, indicating the audience was not just American. Although army maps printed at 1: 25000 were also available, their coverage of the same extents as the 1:50000 maps is not certain. However, since the 1:50000 maps do not indicate bathymetry along any waterway, it is not unreasonable to assume that maps at other scales would also have been available for consultation.

82 Osborne (1965/ 2002), p. 5.

83 Scott (1999), p. 224.

speed at which it could be completed.[84] At Cái Sắn and Vi Thanh, new and existing waterways were pivotal in circumscribing the extent and the location of building clusters constituting villages, establishing these waterways as references for a wider geographic extent that also encompassed farms, uncultivated land and uninhabited ground. The fencing of settlements into hamlets, and the grouping of hamlets into villages on the other hand, sought to replace the dispersed clusters of homes along waterways with delineated social units that adhered to the spatial order of the idealised commune further north. And while it is not possible to characterise these agglomerations as 'urban', the programmes confirmed that what could be considered 'rural' in the context of the Mekong's delta, encompassed a geographic area whose extents could be designed by the planning of settlement.

Conclusion

From different perspectives, Vidal's geographic theories underpinned Gourou's analysis of the delta's villages, and President Ngo's subsequent approach to 'resettlement'. On the one hand, Gourou's conviction that "rural density" was the result of a group of people's "perfect" adaptation to the *milieu*,[85] allowed the colonial geographer to assume that the areal form of villages in Cochinchina reflected the limits of the various terrains constituting the delta. On the other, President Ngo's belief that concentrating the population of dispersed, canal-side settlements of the delta into 'hinge cities' would enable a new social order to emerge, was equally an implicit reference to Vidal's observations regarding the benefits of "centralizing on chosen points the exploitation of the soil",[86] as well as driven by the need to create safe routes between government-controlled parts of the terrain. Both approaches developed their theses by idealising aspects of the traditional, northern Vietnamese village into models applicable to settlement on the Mekong's lowlands. Deduced from maps, for Gourou the relationship between cultivated land and Tonkin's village population provided the baseline to assess conditions in Cochinchina's Delta. From this remote perspective he could conclude that the areal form of groups of villages defined sub-regions which cumulatively composed the delta. Even if Gourou appreciated that the ground influenced settlement, on a map on which building clusters were drawn only in relationship to perennial waterways, the flood-prone, unproductive soils characterising the "underpopulated" parts of the Mekong's lowlands were simply extents of geographic space available for human inhabitation. Recognizing the strategic value of these 'available' locations, South Vietnam's resettlement of refugees in *agrovilles* positioned along navigable canals, and the arrangement of *strategic hamlets*, structured a defensible 'state space' on the Mekong's sediment deposits. Conceivably, the frontier formed by President Ngo's "human wall" could have been imagined in other ways. On the US Army topographic map, it manifested in

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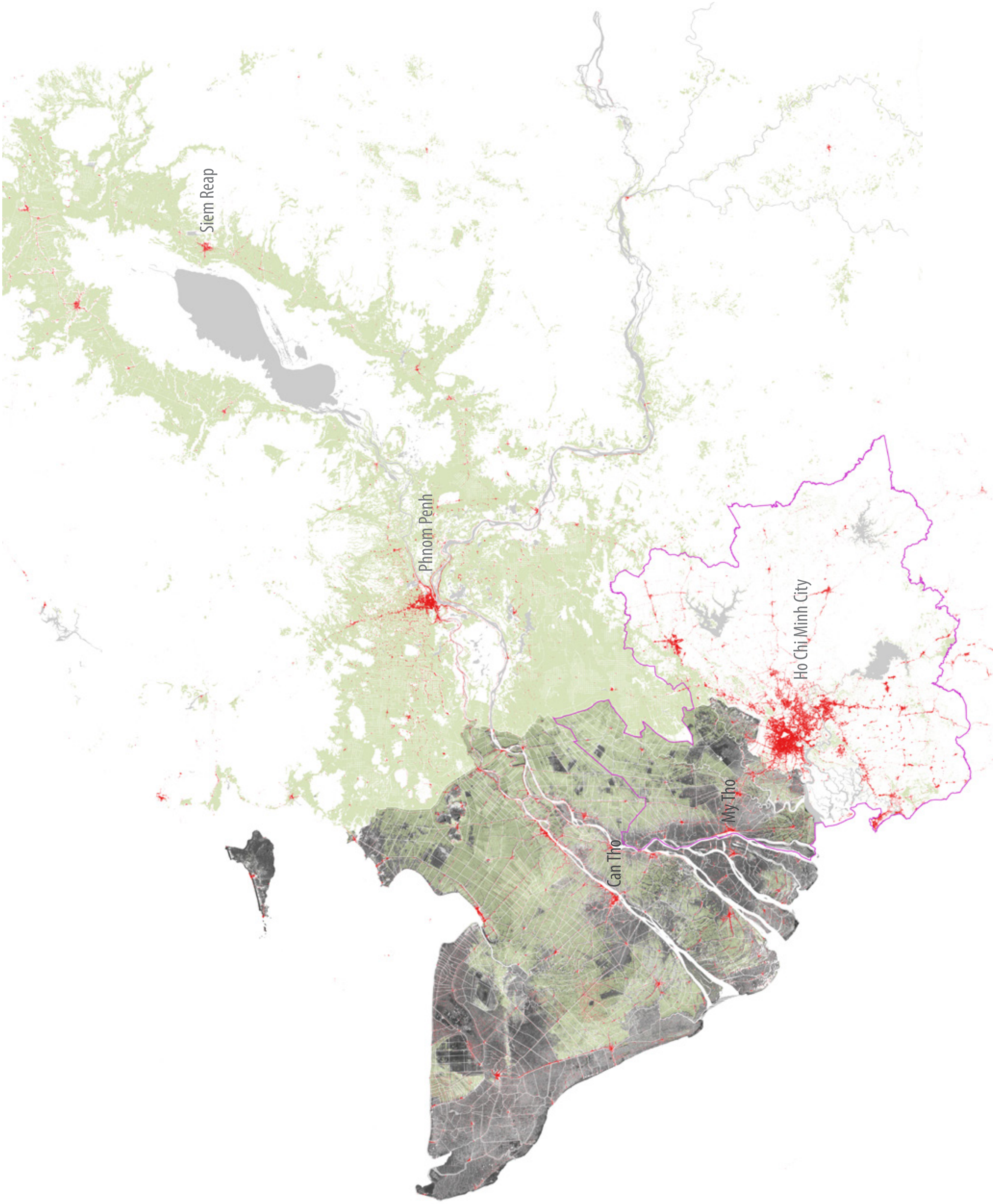
84 Even if the provision of modern facilities was a consistent objective of all these projects, conceivably these could have been provided where inhabitants were already concentrated rather than relocating entire settlements.

85 *"Une telle densité rurale est déjà le résultat une adaptation perfectionnée de homme au milieu une utilisation habile de toutes les ressources."* Gourou (1942), p. 16.

86 *"Une coopération réglant les dates des actes de la vie agricole, fixant certains procédés d'exploitation, s'impose comme avantageuse à tous. La nécessité de s'unir pour l'aménagement des eaux, la construction de puits, l'entretien de certains travaux, l'accommodation d'un milieu favorable aux cultures, resserre la cohabitation. Le village est un organisme bien défini, distinct, ayant sa vie propre et une personnalité qui s'exprime dans le paysage."* Vidal de la Blache (2015), *Principes de géographie humaine, Publiés d'après les manuscrits de l'auteur par Emmanuel de Martonne.* Paris: ENS Éditions, p. 186.

distinct military settlements arranged adjacent to each other and parallel to the boundary with Cambodia, their presence *on the map* reinforcing the government's projection of authority within the 4th tactical military zone (see Fig 6.11). On maps, settlements were not simply layers of information on top of a 'stable' delta describing *how* the terrain was inhabited. The cartographic arrangement of villages proposed particular ways to either *see* the relationship of human activity with the condition of the ground or, to project a specific 'reality' onto that ground. These propositions were instrumental in decisions of which terrain would be the site for resettlement and how – in the form of agglomerations – settlement would be implemented. As well as an outcome of the way human activity was made legible on maps through the areal form of villages, the *delta* described in relation to settlement conditions was also the cause for a particular set of responses that set out to regulate human activity as a function of the delta as a 'whole'. What prescribed that 'whole' was not the hydrological catchment, nor the reference created by the boundary with Cambodia but rather the presence or absence of settlement on the map.



Map F Areas of rice agriculture (green shade) are shown against an aerial image of the Mekong Delta's terrain, settlement clusters (red) and the metropolitan area of Ho Chi Minh City (purple outline). The rice value chain sees significant quantities of the high-quality paddy harvested in Cambodia's southern provinces sold to Vietnamese traders every year. Wholesalers that import, process and package Cambodian rice are mostly situated in HCMC, helping to meet demand for speciality products. See Dao The Anh & Thai Van Tinh (2020), *The Cross-Border Trade in Rice from Cambodia to Vietnam*. In Rob Cramb (ed.) *White Gold: The Commercialisation of Rice Farming in the Lower Mekong Basin*, Singapore: Palgrave MacMillan.
Author (2022). Spatial data sources: *Irrigation canals* (MRC, 2008); *gadm36_Vietnam_1* (GADM, 2022); World Water Bodies (ESRI, 2016); Urban footprint (DLR, 2016); Land cover (JAXA, 2019); Cropland in Cambodia (WFPGeoNode, 2019).

CHAPTER 7 The metropolis' hinterland

… the Mekong Delta and Ho Chi Minh City accounts for more than 60% of the national GDP. However, the role of the Mekong Delta, Ho Chi Minh City and Ho Chi Minh City region in the whole country is not simply reflected in the proportion of that contribution […] investment and support for the Mekong Delta means investment in Ho Chi Minh City itself. This is an interactive and interrelated relationship.

Closing speech by the Prime Minister, Prime Minister Nguyễn Xuân Phúc, 2019

Denoting boundaries, infrastructure and settlements, the cartographic lines which reinforced a state-centric conceptualisation of the delta on the Mekong River also presented the deltaic terrain in relation to the city of Saigon. Conspicuous for its presence on nearly all maps of the Mekong Delta, Saigon's importance as the centre of South Vietnam's political, military and administrative power was equalled only by its significance to the national economy.[1] Inexorably linked to the production of rice, the economic system of South Vietnam was described as equivalent to a "Mekong Delta economy" centred on Saigon.[2] Renamed Ho Chi Minh City (HCMC) following Vietnam's unification, the spatial and economic relationship between the city and the rice-producing delta initially unfolded in '5-year plans' framed through the state ideology of "deurbanization" and the practical need to feed a growing population. The subject of separate planning efforts since the early 1990s, the articulation of an 'urban' agglomeration and a 'rural' countryside pivoted on distribution of water for cultivation has set the scope for state investment in water and transportation infrastructure as well as the construction of new urban areas (NUAs) by private developers. If, as Eric Harms argues, the notions of city and countryside are conceptually distinct in Vietnamese culture, today, the geographic space encompassed by HCMC's metropolitan area extends over 30,000 km^2, almost a quarter of which overlaps with the contemporary delineation of the Mekong Delta.[3] Their conceptualisation as either two parts of the same economic region, adjoining planning entities or intersecting areas of state administration points to a changing geographic relationship between city and delta. Alternating the focus of the cartographic frame between the two, this chapter examines the geographic definition of the Mekong Delta in relation to the delineation of the urban agglomeration to its northeast. Taking into consideration recent plans that show the Delta in terms of

1 See for example Joint Development Group (1969), T*he Postwar Development of the Republic of Vietnam: Policies and Programs, Volume One.* Saigon & New York: Postwar Planning Group & Development And Resources Corporation.

2 Elliott's definition of the Mekong Delta encompasses more or less the geographic extent of colonial Cochinchina but also parts of Cambodia where transplant rice was grown. The study for the US overseas aid agency presented the economic system of this region from rice paddy to retailer in detail. V.L. Elliott (1973), *Development Problems in Viet Nam; A Discussion and Definition of the South Viet Nam (Mekong Delta) Economic Region.* Washington D.C.: USAID, p. 4.

3 Socialist Republic of Vietnam (2008), *Decision No. 589/QD-TTg dated May 20, 2008 of the Prime Minister approving the master plan on construction of the Ho Chi Minh city region up to 2020, with a vision toward 2050.* Hanoi: Government of Vietnam. pp. 1-4.

a hierarchy of densely populated centres, the chapter argues that the catchment area referred to by the alignment of the term delta with a particular geographic space no longer refers to the river's flows but rather to the deliberate realignment of activities to resemble an urban region.

The area of agglomeration

The most extensive agglomeration in post-colonial South Vietnam by far, Saigon's population increased dramatically with the arrival of refugees from the north, as well as migration from the deltaic settlements further south.[4] With infrastructure considered inadequate for the people it was intended to serve, planning emerged as a necessity to organize the new country's capital city. The determination of the city's geographic extent, relied on projections of future population. The 1958 plan *Du Grande Saigon* by the Ministry of Reconstruction and Urban Planning, encompassed an area of 675 km^2 and was designed for a population of three million, partially situated in a "ring of satellite centers" surrounding the existing core.[5] Similarly, subsequent plans for the city prepared by Doxiadis Associates, "blocked out" areas on the map in anticipation of a projected 9 million residents by the year 2000.[6] The same approach incorporating demographic prognosis was also adopted in the 'post-conflict' planning of South Vietnam's economy by the Joint Development Group (JDG) headed by Vietnamese economist Vũ Quốc Thúc and the TVA's former chairman David Lilienthal. Confronted with Saigon's deteriorating transportation infrastructure, housing conditions, and utility supplies that required immediate resolution, the JDG eschewed the type of comprehensive planning which frequently led "to paralysis of action."[7] Instead, recommendations focused on geographically redistributing services such as healthcare and education that were considered overconcentrated in the city.[8] Geographical dispersion would be accommodated in "outlying areas" where satellite cities and dormitory towns would be established to accommodate a projected 30,000 migrant and refugee families from poorer areas of South Vietnam. The report nonetheless noted the challenges of any planned expansion surrounding the urban centre [**Fig 7.1**]. Not only did the deep clay of the deltaic soils, especially to the south and west (in the direction of the Mekong Delta), make construction technically and financially challenging, but the "disconnection" between Saigon and surrounding areas was further augmented by the military infrastructure controlling access to the urban centre.[9] From the perspective of the JDG, a meaningful relationship with the city's "rural hinterlands" did not already exist and would need to be defined by the state before the entire geographic space encompassed by surrounding provinces could eventually constitute a "unified region".[10]

4 The built area identified as Saigon was the home of around a million residents by the end of WW2, to which around 700,000 people were added during the Indochina War. Du Huynh (2015), *The misuse of urban planning in Ho Chi Minh City.* Habitat International, n. 48, p. 12

5 J. E. Bogle, Republic of Vietnam, Daniel, Mann, Johnson & Mendenhall (DMJM) & William C. Rasmussen & Associates (1972), *Dialectics of urban proposals for the Saigon Metropolitan Area.* Washington, D.C. : United States Agency for International Development (USAID), p. 49.

6 *ibid,* p. 50

7 Joint Development Group (1969), p. 505.

8 *ibid,* p. 502.

9 *ibid*, p. 499.

10 *ibid*.

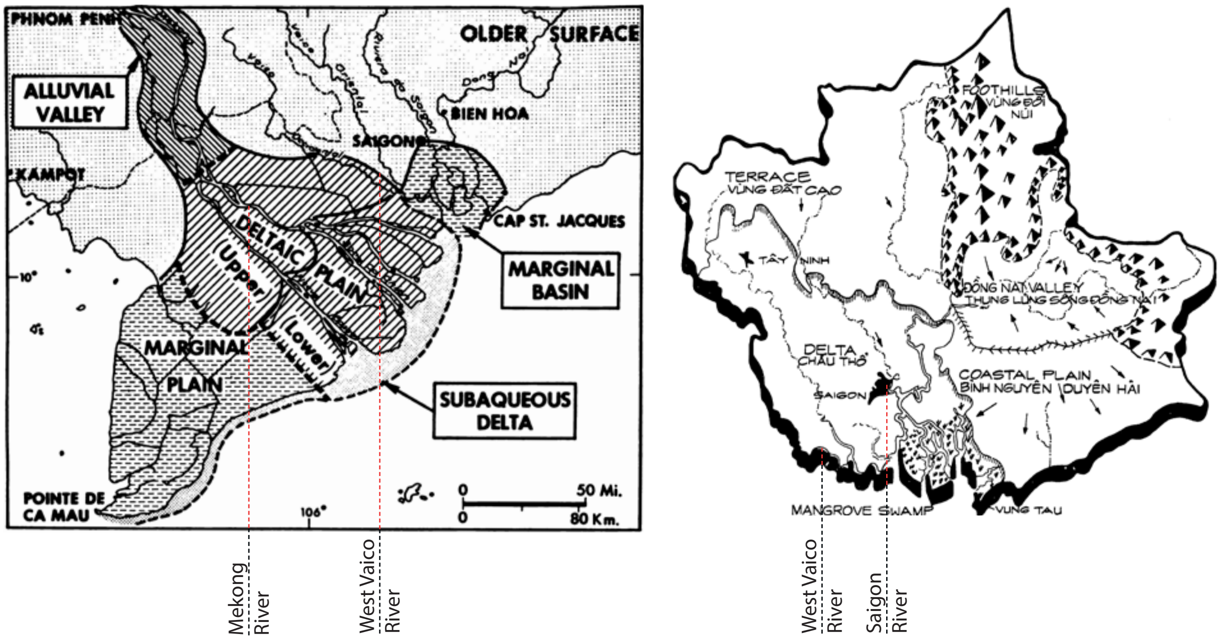


Fig 7.1 Topography of Saigon's surrounding provinces The map to the left shows the Deltaic Plain, which is distinguished from the southern Marginal Plain, and the Marginal Basin south of Saigon. Considering the hydrology of the Saigon River's basin extends further north, the diagrammatic (rather than topographic) delineation of the Marginal Basin is unusual. Confined to one part of the lowlands north of the West Vaico River and south of the city, the map's Basin appears to identify a specific hydrological extent that does not correspond with the catchment areas of existing waterways. On the right, the map presents the topographic diversity of the provinces encircling Saigon, an area equivalent to the 3rd Corps (see Fig 6.11) and delineated by the West Vaico River to the southwest.
Coastal Studies Institute (1968), *Major Physiographic Units of the Mekong River Delta*; Joint Development Group (1969), *Saigon and the surrounding provinces*, Figure 12-9.

The difficulty of constituting a region for the city of Saigon was briefly considered in a new "Metropolitan Plan" proposed in the early 1970s. Presented in a report by American urban planner James Bogle,[11] Metropolitan Saigon would spread over 830 km^2, an areal magnitude suitable to house the existing 2 million residents of the densely populated urban areas as well as more than a million people already living in surrounding administrative districts.[12] In American planning discourse, questions regarding the extent of a metropolitan area, had already been raised a decade earlier by Jean Gottman's analysis of settlement patterns on the US East Coast. For Gottman, the admittedly "loose urbanization" beyond urban centres was less important than the administrative subdivisions (counties) displaying an "economy of metropolitan type", and enough to suggest the presence of a contiguous geographic space identifiable as the distinct settlement unit he called *megalopolis*.[13] Clearly associated with a statistically observable set of economic relationships between distinct agglomerations, a metropolitan area's cartographic outline was formulated by the US Census Bureau. New census categories introduced in 1950 to measure the geographic dispersal of population, recorded

11 Bogle's earlier planning work in Southeast Asia had seen him involved in the *Jengka Triangle* for the Federal Land Development Authority in peninsular Malaysia. In regional plans which included the resettlement of farmers in relation to vast new palm tree plantations, the Jengka Triangle included 23 new settlement centres dispersed over 400 km^2.

12 J. E. Bogle *et al* (1972), p. 22.

13 Jean Gottmann (1964), *Megalopolis: The Urbanized Northeastern Seaboard of the United States.* Cambridge, MA: The MIT Press, p. 21

information within specific areal units. Among them the “standard metropolitan areas” included “urban centers together with all adjoining territory that has been demonstrated to be closely linked with the central cities”.[14] For influential planners such as Jane Jacobs, Metropolitan Areas indicated the observable, physical expansion of distinct cities beyond their formal, political boundaries, to coalesce “with other, formerly separate, cities.”[15]

In the American setting, the Metropolitan Area could therefore delimit the extent of economic, social or physical relationships. The cartographic outline of Saigon’s metropolitan area (SMA) however was not configured to reflect a set of existing conditions. Almost entirely situated on the flat lowlands formed by the sediments of the Saigon and Vaico Rivers, the population and economic activity in Saigon’s rural hinterlands was unevenly distributed [**Fig 7.2**]. Agriculture and undeveloped land occupied almost three quarters of the SMA’s total surface area, with any 'urban' characteristics limited to the 'compact' settlement adjacent to the Saigon River where most residents were concentrated. If the metropolitan boundary did not represent the limits of any specific natural or manmade phenomenon, from Bogle’s perspective, a “natural metropolitan area for the city” could be constituted by combining the extents of separate administrative subdivisions closer to the urban centre.[16] The denoted area would be suitable to “contain” projected future residents and prescribe the location of infrastructure for urban services. And since district units were used for data collection by the South Vietnamese government, the area’s ‘content’ of resources and people could be directly scrutinized using existing statistical categories.Within the limits of SMA, the geographic space surrounding the most densely populated city districts would be intentionally urbanized, with new transport infrastructure, regional parks and generic settlement units constructed according to growing population requirements [**Fig 7.3**]. Unlike the JDG’s assumption that Saigon could potentially extend to the boundary of the country’s tactical Corps, to the south, Bogle’s SMA terminated at Long An Province which straddled the interstitial space between

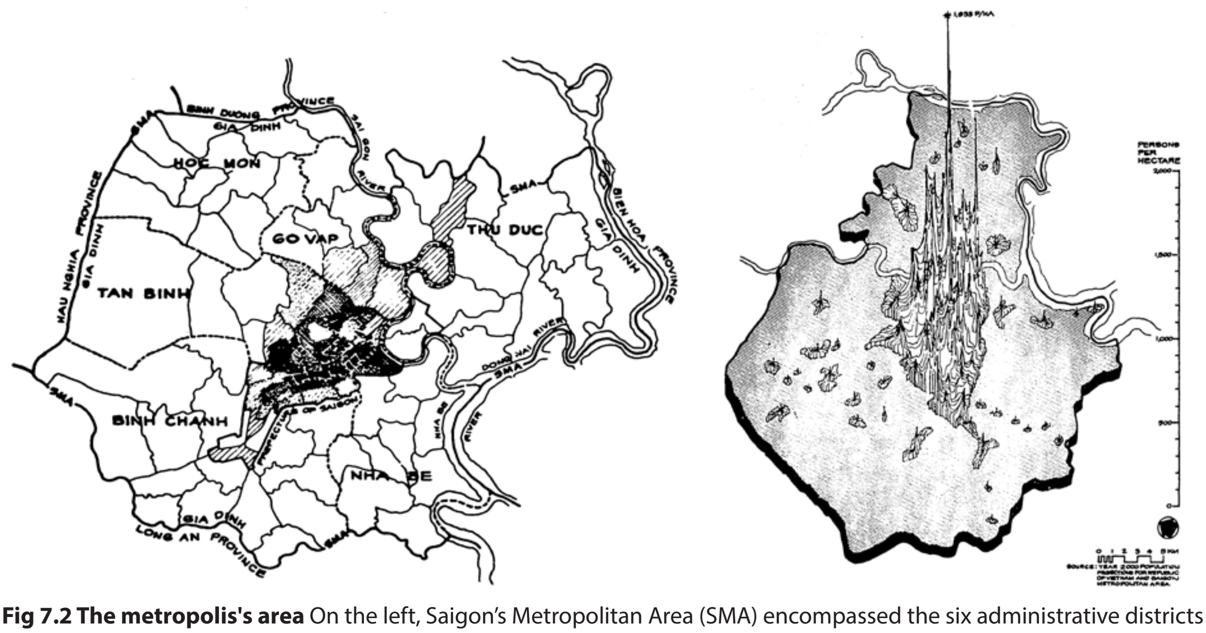


Fig 7.2 The metropolis's area On the left, Saigon’s Metropolitan Area (SMA) encompassed the six administrative districts surrounding the most densely inhabited areas. The black shade and hatch lines illustrate areas with the highest residential densities. The map on the right shows the population density of the SMA where, except for a few existing villages, the vast majority is concentrated in the urban centre.
Bogle *et al* (1972), p. 26, Figure 9 and p.25, Figure 8.

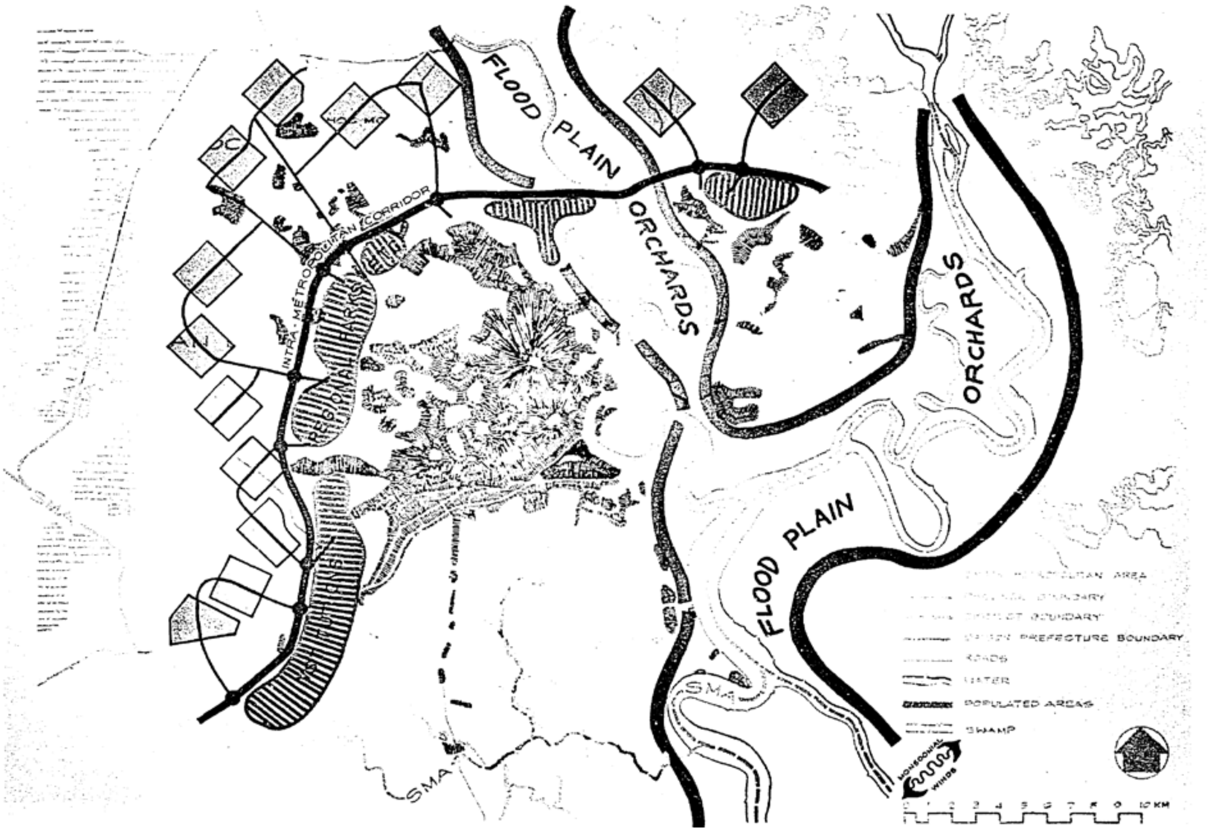


Fig 7.3 Proposed metropolitan form One of the development options for Saigon's metropolitan area, the map shows plans for the generic settlement units (rectangular forms) located to the west and north of the existing urban centre. These units are connected via a proposed transportation corridor complemented by "regional parks" (hatched areas) that appear to form a "green belt" on the city's periphery
Bogle *et al* (1972), p. 125, Figure 31.

the two Vaico rivers. If the social, economic or geographic relationships necessary to distinguish a specific city's region were not apparent in the existing context, the cartographic construction of the SMA suggested that such as region could be created by determining where the future city 'ended' and therefore where the Mekong's 'rural hinterlands' began.

The dimensions of the *rural*

While plans for a metropolitan Saigon were formulated only to remain on paper, concurrent focus was given to the planning of the "so-called, […] Delta of the Mekong River."[17] Published in 1967, the Joint Development Group's *Program for Mekong Delta Development* defined its planning area as "the sixteen southern provinces, lying south of the West Vaico River."[18] Following the cartographic delineation of the country's 4th tactical Corps, this Mekong Delta excluded the

14 Bureau of the Census (1950), *Population of Standard Metropolitan Areas: April 1, 1950.* Census of Population, Preliminary Counts. Series PC-3, n. 3, Washington, DC.: US Department of Commerce, p. 1.

15 *"Metropolitan Area-Economically, it means the same as 'city'. Politically, it means a city that has physically expanded beyond its formal boundaries, in the process engulfing former towns and, in some instances, coalescing with other, formerly separate, cities."* Jane Jacobs (1969), *The Economy of Cities.* New York: Random House, p. 258, quoted in Bogle (1972), p. 22.

16 *ibid.*

17 Quote attributed to David Lilienthal on his return from a field visit to South Vietnam in 1967. Franklin Huddle (1972), *The Mekong Project: Opportunities and Problems of Regionalism*. Science, technology, and American diplomacy. Washington D.C.: U.S. Government Printing Office, p. 47.

18 Joint Development Group (1969), p. 505.

sedimented lowlands within Long An Province which were considered part of the 'fragmented' region centred on Saigon. Instead, development focused on "the long-term future of that area which is producing enormous amounts of rice".[19]
A significant part of the economic system that had emerged since independence began with the Delta's farmers and revolved around Saigon's rice brokers.
The sequence of processes involving paddy producers, agents, processors and intermediaries before rice – either as grain or flour - finally reached consumers, was described in detail by USAID analyst V.L. Elliott.[20] According to Elliott, the entire process was effectively controlled by 10-12 firms based in Saigon that also owned the majority of mills located in the Delta provinces, processing and then shipping rice to Saigon via the system of waterways.[21] Leveraging the value of rice production, these brokers could raise large amounts of capital to finance the import of consumer goods, thus regulating access to foreign exchange as well as the market information critical for setting the price of crops. For paddy farmers selling exclusively to agents within "specific, protected buying areas", this situation amounted to local monopolists setting unfavourable prices for their crops which in turn reduced the incentive to produce surpluses large enough for trade.[22] To the extent that the cultivation, processing and distribution of rice was seen as part of a single system, Elliott's reference to a "Saigon-centered Mekong Delta economy" did not just indicate the dependence of farmers on the decisions of brokers in the city. It also defined an agricultural region that included the Mekong's sedimented lowlands, parts of Cambodia, as well as cities much further north where other agricultural goods were produced [**Fig 7.4**].[23]

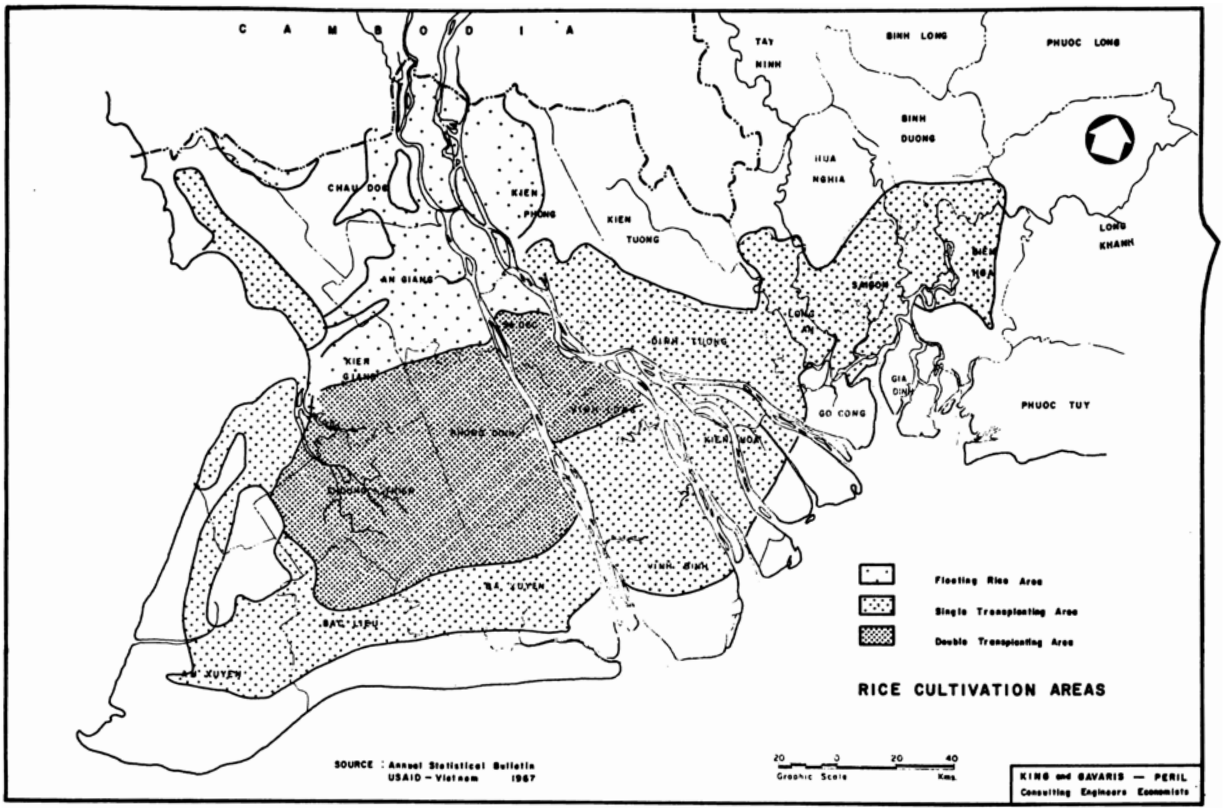


Fig 7.4 Rice cultivation in South Vietnam Rice cultivation in the mid 1960s covered an extent that included Saigon (middle right), with areas of intensive cultivation (double annual crops) in darker grey mostly situated south of the Bassac River. Whereas these cultivation areas were not distinct regions in themselves, their economic interdependence with rice brokers in the city, suggested these constituted parts of a Saigon-centred Mekong Delta economic region.
King & Gavaris (1968), Rice Cultivation Areas, in Mekong River Crossings : Engineering & Economic Feasibility Study, New York: Authors.

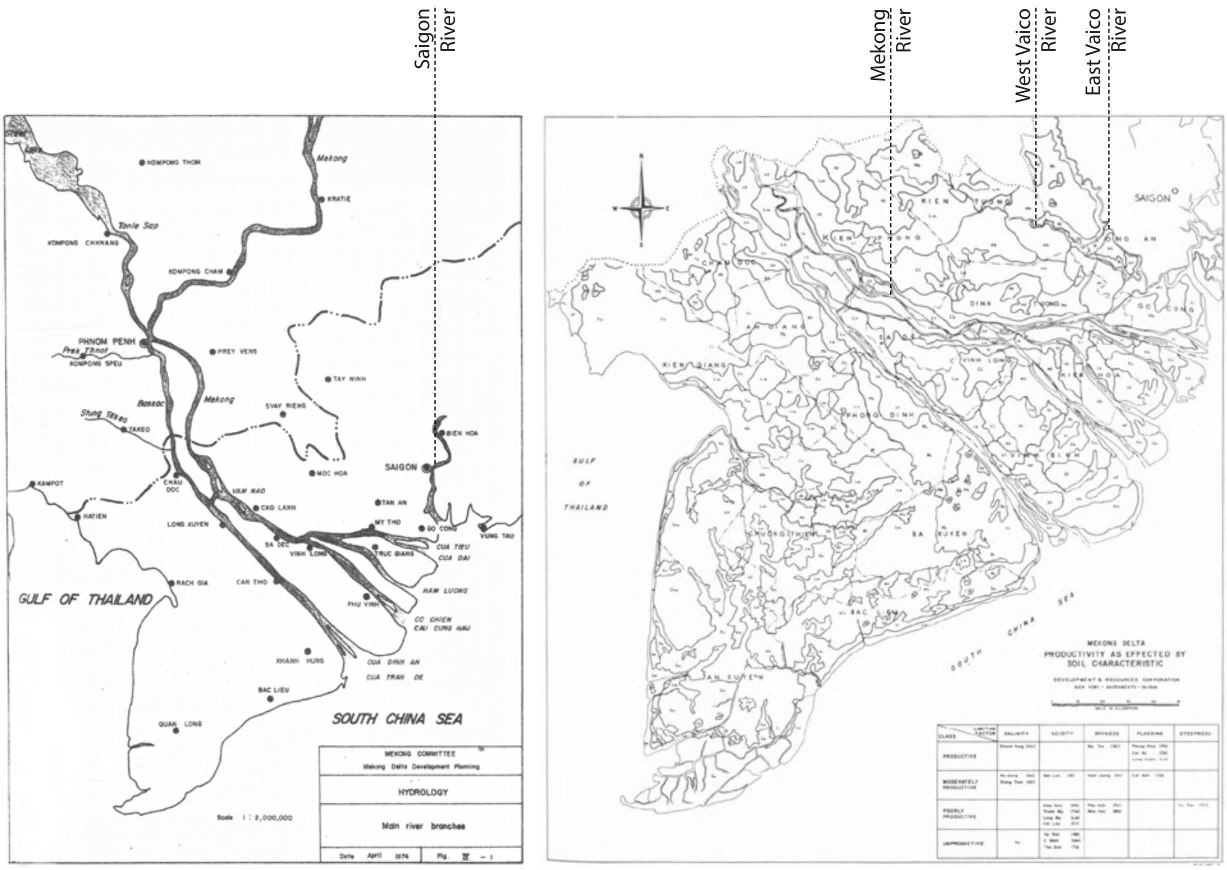


Fig 7.5 Agricultural productivity in relation to soil characteristics Although only incidental to hydraulic modelling, the map to the left is conspicuous for including the Saigon River within the rivers considered relevant for the Delta's hydrology in the 1974 Dutch study. To the right, the map subdivides the Delta according to the areal outline of different soil types. Using an evaluation of productivity in relation to soil, particular areas with particular soils appear more or less productive. Local Development Associations would be delineated to exploit the more productive soils. Note that soils are shown up to the East Vaico River, extending past the Delta's administrative delineation.
Development and Resources Corporation (1968), *Mekong Delta Development Program (Working Paper MD-6) Soils of the Mekong Delta and their Characteristics Relative to Crop Production*, New York.

Confronted with levels of rice cultivation considered to be below the optimal production capacity of existing agricultural land, the JDG proposed extending farming into geographic spaces where surveys indicated suitable soil types to expand agriculture. In an environment in which farmers had to deal with either "too much or too little rainfall during critical periods of growth", hydrology and rainfall were considered the two major factors affecting exploitation of these soils [**Fig 7.5**].[24] Capital-intensive drainage and flood control infrastructure would therefore be needed to extend the growing season to two crops per year (double transplant), and to allow the intensive cultivation of new rice varieties. To achieve this ambitious goal, a Mekong Delta Development Authority (MDDA) would be established. Much like the TVA, within its area of operations the MDDA would investigate, plan and construct projects and programmes related to the

19 Quote attributed to David Lilienthal. Huddle (1972), p. 47.

20 Elliott (1973), p. 4.

21 *ibid*, p. 8.

22 Elliott makes the point that another disincentive for farmers to produce surpluses was Viet Minh "taxation" in areas not controlled by government forces.

23 Elliott mentions the highland towns of Dalat and Bao Loc where vegetables and tea were the main products.*ibid*, p. 1.

24 Joint Development Group (1969), p. 520.

control of water resources for the purposes of agriculture and transportation.[25] Responsibility for implementation of these projects however would not be delegated to existing local government units such as provinces and municipalities. 770 Local Development Associations conceived as organizations of farmers would be created, each encompassing between 2,000 to 5,000 hectares and with populations ranging from 5,000 to 15,000 people. Envisioned as groupings of existing villages, individual Associations would construct, operate and maintain the infrastructure needed to drain "excess" rainfall and irrigate individual farms within their area of responsibility.[26] The idea of groups of settlements collectively responsible for the management of their own infrastructure within a broader framework provided by the state, strongly suggests an organization reminiscent of Powell's self-regulating, hydrologically-determined *irrigation districts*. Nonetheless, where individual *irrigation districts* in America's West were - at least imagined as - natural subdivisions of a larger river basin, the larger catchment area of the Delta would arguably be modified in relation to each individual Association's control of water.

The geographic space that individual Associations constituted collectively is demonstrated in the conceptualisation of the Delta's flood protection system. For the Mekong Committee's engineers, the delta's irrigation and flood control requirements could only be met with local dikes and canals as well as "substantial upstream storage and regulation provided by Pa Mong and Stung Treng projects".[27] Within the context of the Lower Mekong Basin, cost-benefit assessments made these distant projects in Thailand and Cambodia appear advantageous to users in South Vietnam.[28] Using computer modelling to investigate "complete protection" from flooding, the JDG's hydrologists tested various scenarios including the impact of upstream storage.[29] Although water from the proposed upstream reservoirs would eventually be necessary for dry season irrigation in South Vietnam's Delta, these projects were concluded to have negligible impact on floods.[30] Construction of levees and by-pass canals undertaken within the geographic area encompassed by the Delta were considered sufficient for controlling inundation from the Mekong's overflow as well as the heavy monsoon rains. Taking into account the magnitude of the area requiring control – and without considering the ongoing conflict - such a system of public works would take decades to construct and organize. Once completed however, the state could potentially regulate water within the extent of its sovereignty, if not independently from conditions further upstream, then at least by assuming that those conditions would remain stable over the foreseeable future. Thus while not an autonomous hydrological entity, the technical capacity to direct surface water flows, effectively allowed the

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25 *ibid*, p. 526.

26 *ibid*, p. 525.

27 Committee for Coordination of Investigations of the Lower Mekong Basin (1970), *Report on Indicative Basin Plan: A Proposed Framework for the Development of Water and Related Resources of The Lower Mekong Basin, (E/CN.ll/WRD/MKG/L.340)*, Bangkok: United Nations, p. I -15.

28 Cost benefit calculations for individual projects were included in the Committee's Basin Plan. As regards to the benefits of flood protection, these were calculated on the basis that increased agricultural production would offset the damage caused. *ibid*, p. IV-63.

29 Joint Development Group (1969), p. 521.

30 *"The analyses revealed that none of the assumed upstream reservoir capacities will result in full control of flooding in the Delta, although the larger amounts would theoretically permit a reduction in the magnitude of Delta flood protection works. These larger amounts, however, are probably at the upper limits of possible development at the two sites." ibid.*

Delta's water control network to be considered as a catchment separate from the larger Basin.[31] From the point of view that control of these flows was intended to stimulate the production of agricultural goods, the proposed configuration of water infrastructure suggested that the Delta would be organized as a 'rural' region, calibrated to serve the country's Saigon-centred economy.[32]

Nonetheless, the northeast limit of the Delta did not indicate the southwest edge of a future 'urban' Saigon. Even though nominally adjacent to each other, the correlation between the areal extents of the 'rural' Delta and 'metropolitan' Saigon in these early planning efforts, appears weak. The attempts to articulate a 'natural' extent for the city or to organize the Delta into an agricultural region using water control infrastructure, were the results of different studies that did not place emphasis on the distinction between 'urban' and 'rural'. As evidenced by the use of administrative subdivisions but also the adoption of either the East or West Vaico rivers to indicate the city's region or the Delta's geographic area, references to a 'natural' extent cannot be attributed to observable geophysical relationships such a soil or hydrology. Certainly, given the vast extents of land they encompassed, for the cartographic outlines of the Delta or Saigon to have any immediate relevance to the majority of existing inhabitants, would require many years. And without policies and infrastructure investment consistent with these geographic units, the idea that their areal magnitude could be driven by any single set of identifiable relationships would have had little value. From an economic perspective however, the land considered part of the Delta had an additional significance. The mapped Delta articulated which portion of all the sedimented lowlands would need to become productive over subsequent decades to satisfy rice consumption for the Delta's as well as Saigon's projected population. In this sense, the relationship between 'rural' and 'urban' was one in which the former would be developed to feed the latter's prospective growth. If for the JDG but also Bogle, Saigon's 'natural' extent included the geographic space peripheral to the existing urban centre, by considering the Mekong's cultivated lowlands as essential to the city's future, the 'rural' Delta outlined on the map represented the city's agricultural *hinterland*.

The hinterland's metropolis

If none of these plans were systematically implemented, the differentiation between 'urban' and 'rural' gained new significance after the victory of North Vietnam over the South in 1975. Beginning with Vietnam's unification in 1976, new principles of regional and urban planning were introduced by the state. Already by the mid-1950s, North Vietnam's regime had adopted the "scientific" economic and urban planning principles more common in the USSR, China and Eastern European countries. Controlling development with consecutive policy documents called "Five-Year Plans", administrative and political power became concentrated in the capital city of Hanoi which was promoted as an example of "true Vietnamese values".[33] In comparison, southern cities such as HCMC

31 The divergence in the different plans for water was partially reconciled in a new study commissioned by the Committee from a team of Dutch engineers which upheld the JDG's conclusions on the value of upstream dams for flooding.

32 Compared to 1960, the number of residents living in South Vietnam's "urban" areas had doubled to around 6.3 million by 1970. Of the 10 largest urban areas in the country, 3 were situated in the Mekong Delta. Nonetheless their combined population totalled to around 5% of the Delta area's estimated 6 million residents. See Bogle (1972), p. 68 and Joint Development Group (1969), p. 508.

33 William Logan (2009), *Hanoi, Vietnam.* City, v.13, n.1, p. 88.

were identified with overcrowded living conditions and a "distorted, pattern of development" reflecting Western "consumer-society".[34] As explained by the economist and Vice Chairman of the Vietnam Social Science Committee Dao Van Tap, the degree of population concentration in southern cities was "entirely irrational" since it was not related to the production of material wealth.[35] In the belief that a rational distribution of population was possible without the extreme measures employed by the Khmer Rouge in Cambodia, the socialist government sought to "deurbanize" towns and cities.[36] This would be achieved by moving residents to new agricultural settlements as well as industrial towns positioned to complement food production. With plans to ensure food self-sufficiency as well as reduce HCMC's "congested" population by around 2 million residents within the period of the Second Five-Year Plan (1976-1980), new "green belts" peripheral to the urban centre were designated priority resettlement areas.[37] Nonetheless, conditions in the countryside forced many former residents to eventually return to the city or migrate abroad, and by 1979 HCMC's residents had been reduced to 3.4 million from an estimated peak of 4 million in 1974.[38]

Confronted with a significant reduction in the Delta's rice production in the years following unification, the redistribution of population in new villages and industrial centres was aimed at instituting communal farming according to the same model practiced in the North.[39] For the country's fertile delta regions, the socialist government's "agro-industrial" strategy was planned on the basis of new geographic units called New Economic Zones (NEZ). Organized in "districts" each encompassing up to 12,000 ha with around 100,000 to 150,000 residents, NEZs were located on both virgin and fallow land in marginal parts of the Mekong Delta.[40] Despite government programmes to collectivise agricultural production, these met with limited success among farmers who, unlike those in the country's north, persisted in "individual production and private ownership."[41] The failure of these programmes and persistent food shortages led to a new attempt to revitalise rural resettlement with the third Five-Year Plan (1981-1985). The isolated irrigation and flood management projects implemented by the state in the Delta however, were not sufficient to improve agricultural production and to control

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34 Dao Van Tap (1980), *On the transformation and new distribution of population centres in the socialist republic of Vietnam*. International Journal of Urban and Regional Research, v.4, p. 504.

35 In Hanoi, North Vietnam's planners aimed to annually resettle to the countryside a number of people equivalent to the estimated natural increase in the city's population. *ibid*, p. 505.

36 *"In Kampuchea, under the pretext of 'cleaning up' the towns, the inhabitants of the capital were mercilessly driven out into rural areas, where they had to live and work in what were disguised labour camps." ibid*, p. 506.

37 Jacqueline Desbarats (1987), *Population Redistribution in the Socialist Republic of Vietnam.* Population and Development Review, v.13, n. 1, pp. 51 and 54.

38 Those sent to cultivate land in the border areas closer to Cambodia were especially prone to return to HCMC, especially as the conflict between Vietnam and the Khmer Rouge intensified in the late 1970s. *ibid*, p. 71.

39 According to information collected by Desbarats, agricultural production in Vietnam's South declined by nearly 20%, from 7.2 million tons of paddy in 1974 to 6 million tons in 1980.

40 Within these administrative units, existing hamlets would be regrouped into agricultural communities of up to 20,000 inhabitants, while new villages would be constructed for every 5,000 persons resettled from urban areas. Desbarats (1987), p.54.

41 The differences between villages in the North and the South have been examined by Tran & Nguyen, identifying the former with a 'corporate' and the latter with an 'open' structure. Following unification, party leaders strongly criticised villagers in the South for 'individual farming', 'fragmented landholding', 'unequal development' and the influence of capitalism. See Trung Dang (2018), *Vietnam's Post-1975 Agrarian Reforms: How local politics derailed socialist agriculture in southern Vietnam.* ANU Press, pp. 32-43. See also Tran & Nguyen (2016), p. 68.

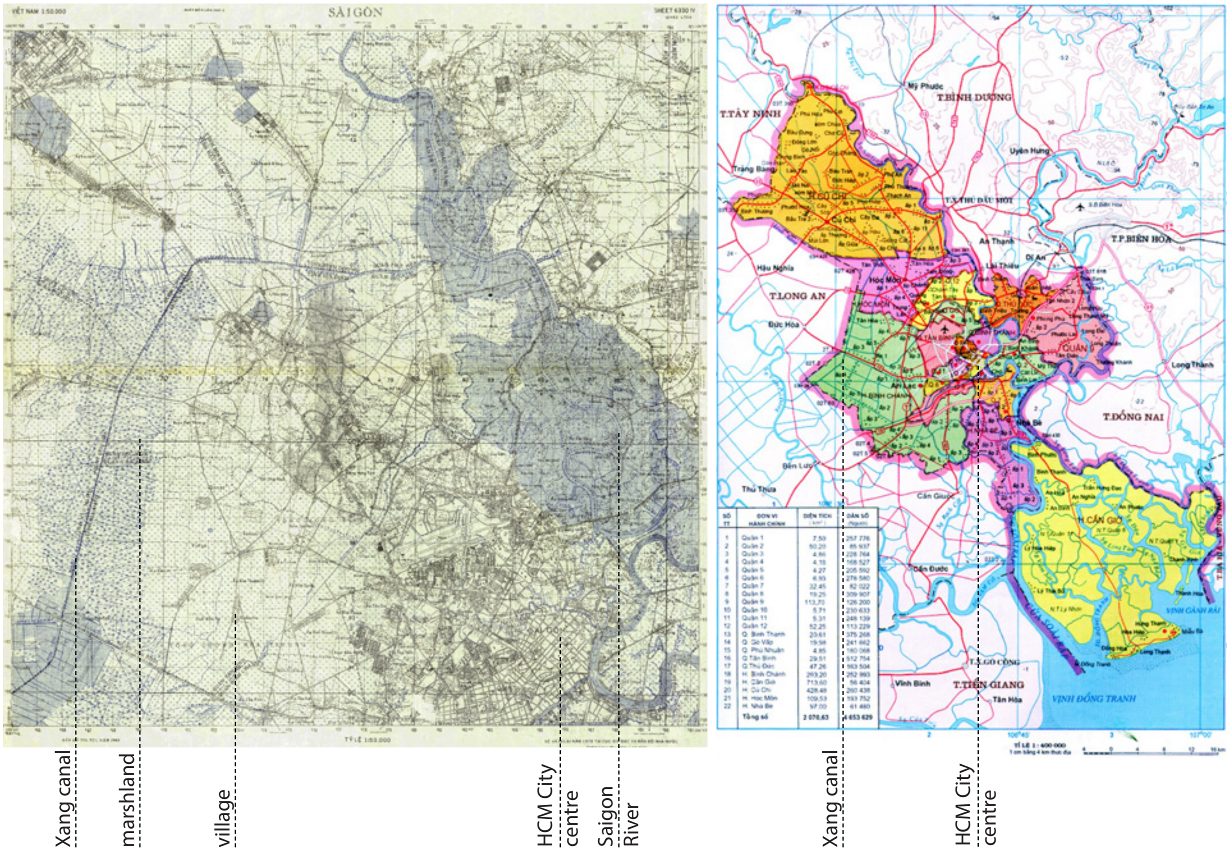

Fig 7.6 The periphery of Ho Chi Minh City Reprinted in 1978 from a 1965 American topographic survey, the map to the left shows the conditions to the north, east and west of the city centre. The flooded plain around the Saigon River (blue shade) and the marshland around the Xang Canal (blue hatch) frame the geographic space where the city is situated. On the right, the administrative map of HCMC circa 1985 showing inner and outer-city districts such as Huyện Binh Chanh (green-coloured area).
Gov. of Vietnam (1978) *Saigon, 6330-4*. Vietnam Center and Sam Johnson Vietnam Archive. Vietnam Archive Map Collection, Texas Tech University; Gov. of Vietnam (1985) *Thành phố Hồ Chí Minh 85,* Virtual Saigon. *https://virtual-saigon.net/Maps/Collection?ID=1131*

inundation.[42] Faced with an economic downturn, the introduction of market-oriented economic policies in 1986 brought to an end the relatively short period of socialist planning in the country's south.

A consequence of these economic reforms, HCMC's industrial output, overseas trade and foreign investment accelerated, attracting increasing numbers of migrants from villages and hamlets. Classified as 'urban' within the limits of 'inner-city' districts (*quận*) rather than the 'outer city' districts (*huyện*), enumerating the city's urban population was not a clear cut process [**Fig 7.6**]. Despite having been resettled there by the state to cultivate food for the city's population, the 1989 census for example, appeared to exclude residents of HCMC's green belts – situated in the *huyện* - from the city's population.[43] The frequent reorganization of administrative districts including the municipal boundaries of Vietnam's cities, made the characterisation of land as'urban' an exercise conducted on maps. As Terry McGee has pointed out, reshaping the geographic extent of Vietnamese cities by the state was intended to reflect demographic

42 Martijn van Staveren, Jan van Tatenhove & Jeroen Warner (2018), T*he tenth dragon: controlled seasonal flooding in long-term policy plans for the Vietnamese Mekong delta,* Environmental Policy & Planning, v. 20, n. 3, p. 274.

43 Banister (1993), pp. 40 and 54.

changes as, presumably rural areas, assumed “more urban characteristics”.[44] Yet with 'urban' environments specified by population thresholds in relation to the state-delineated geographic area, a Vietnamese city’s cartographic limits did not necessarily ‘enclose’ one specific condition that could be uniformly characterised as urban, nor extend far enough to include all the interrelated activities that supported a city’s economy [**Fig 7.7**]. Moreover, the differentiation between urban and rural was not permanent and subsequent changes to the delineation of city regions soon rendered existing spatial divisions obsolete. Thus, even on the surface of maps, the differentiation between urban and rural was not a distinction between opposites. Woven together within the outlines of the city, densely clustered housing, dispersed households, agricultural land, public services and infrastructure formed geographic entities that deliberately staked out a projected condition that was yet to manifest.

From this perspective, the 1993 spatial “master plans” for the country’s two largest cities should be seen as attempts to consolidate the ‘content’ encompassed within the fluid outlines of administrative subdivisions. For the capital Hanoi, the master plan was prepared by architects and engineers as an “urban design”

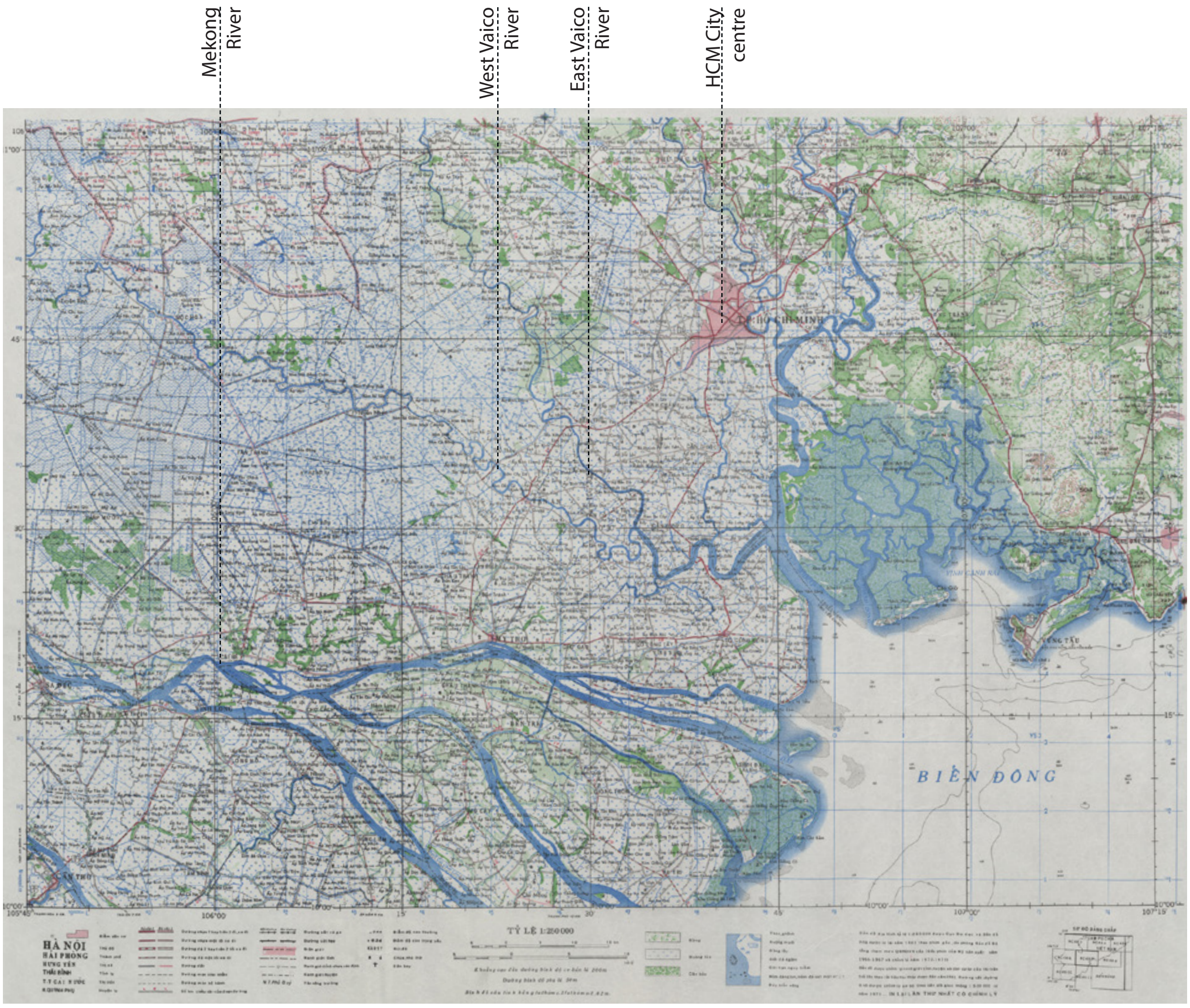

Fig 7.7 Ho Chi Minh City's southern periphery Published in 1982, the map shows the topography south and east of HCMC's urban areas (red shade). Only based on the differentiation between the colours indicating the condition of the ground, the area extending immediatelty south of the city to the Mekong's mainstream appears to be distinguished from the floodplain further west (blue shade), agricultural areas to the north and the forested areas to the east (green shades). Gov. Vietnam (1982), *NC 48-7*. Virtual Saigon. https://virtual-saigon.net/Maps/Collection?ID=1131

based on centralised decision-making.[45] For HCMC on the other hand, the plan granted the city's government the right to allocate land for export processing zones and the development of New Urban Areas (NUAs) by private developers. HCMC's master plan was nonetheless considered ineffective, not least because the population projections its planners adopted were soon superseded.[46] Especially beyond the boundaries of designated Urban Areas, the state's limited appetite to enforce planning regulations coupled with the widespread practice for self-organized housing, structured a disorderly settlement pattern of concern.[47]

Although nominally classified as 'rural', the area surrounding HCMC was not exclusively agricultural. Clustered along transportation corridors heading north to Bien Hoa and south towards the major settlements in the Mekong Delta, commercial as well as small-scale manufacturing activities were located alongside houses, orchards and rice paddy. But the apparent 'sprawl'-like unplanned development in these zones was not only a result of spontaneous bottom-up processes. Used as a tool by the state to control development, 'satellite' NUAs planned on the periphery of HCMC established new residential neighbourhoods within driving distance of the existing urban centre.[48] Moreover, in the early 2000s new privately-operated manufacturing clusters began to be constructed within the marshland drained by the Xang Canal, west of the centre. Located along the administrative boundary between HCMC and Long An Province, these industrial areas benefited from their proximity to the city while remaining within the planning jurisdiction of Long An's provincial government.[49] Spatially separated from the city's built areas by flooded agricultural lands, the relatively new industrial zones appeared to reinforce the model of a geographically-distributed regional economy, with a spatially distinct HCMC in the centre.

Even as the new master plan for HCMC was approved by the city's government, the first regional plan for the Delta under conditions of national economic growth was prepared in 1993. With the opportunity for Vietnam's government to access international funding for water infrastructure from the UN and World Bank, a Dutch consortium - that included Vietnamese engineers and planners – formulated the "first multi-purpose and multi-sector planning document for the delta".[50] Adopting a geographic perspective, the plan reframed the Mekong Delta

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44 Terry McGee (2009), *Interrogating the production of urban space in China and Vietnam under market socialism.* Asia Pacific Viewpoint, v. 50, n. 2, p. 238.

45 Logan (2009), p. 88.

46 According to Du, the 1993 plan's was intended to serve 5 million people until the year 2010 – a number that would avoid high population density and cater for security and defense concerns. However, even by the end of 1990s population estimates were already higher and by 2010 had reached around 7.4 million or 9.6 million if the 'floating' migrant population was included. Du (2015), p. 14.

47 Estimates bring the proportion of houses built by individuals without building permits to around 70% of total houses constructed nationally. See Anh Hoai Tran (2019), *From Socialist Modernism To Market Modernism? Master-planned developments in post-reform Vietnam*, p. 253. In Rita Padawangi (ed.), *Routledge handbook of urbanization in Southeast Asia*. Abingdon, Oxon & New York, NY: Routledge.

48 *ibid.*

49 World Bank data from 2011 shows that between 1999-2009, 22 new industrial zones were created in Long An Province, by far the highest number nationally. World Bank (2011), *Vietnam Urbanization Review. Technical Assistance Report.* Hanoi: World Bank, p. 49.

50 Although the rate of annual increase in rice production accelerated after economic liberalization, planning of water resources in the Delta remained under the purview of what Simon Benedikter describes as self-serving "elite networks" of engineers from North Vietnam. As such, the engagement of Dutch consultants to plan the Delta broke from an established planning system, most likely due to the funds available through multilateral institutions. (...)

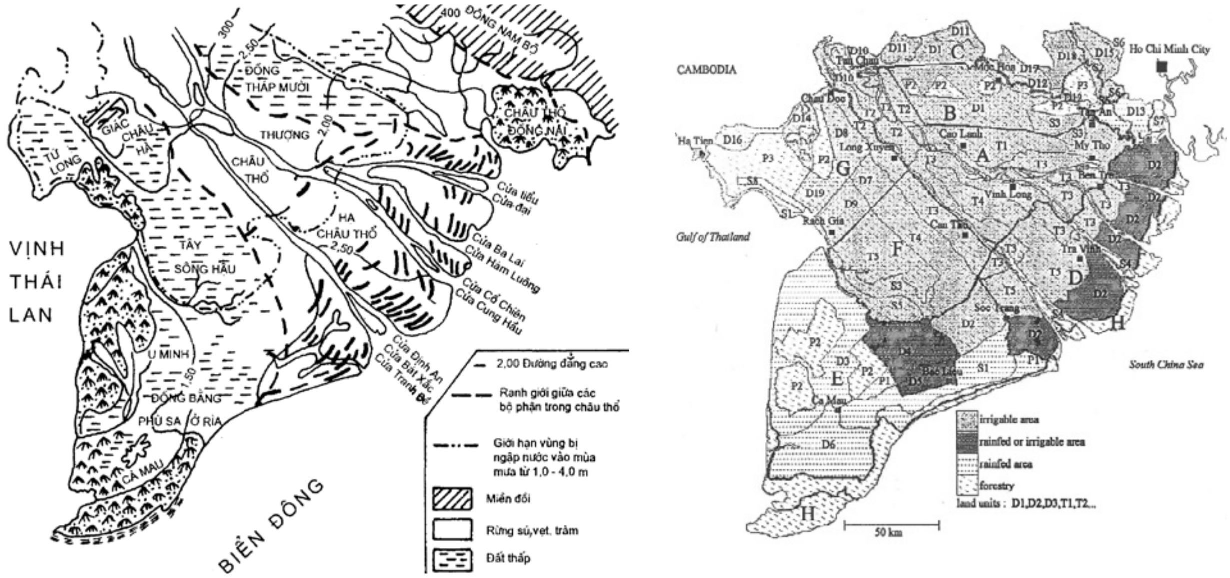


Fig 7.8 Geographic deltas Included in geographer Lê Bá Thảo's description of the Mekong Delta region, the map to the left shows the classification of different terrains, with dashed lines indicating "boundaries between parts in the delta" (*Ranh giới giữa các bộ phận trong châu thổ*). From the 1993 Dutch plan, the map to the right displays the extent of subregions according to agricultural potential. Even if the Dutch map defines subregions according to different criteria, these do not appear to correlate in almost any way with the lines on Lê's map.
Bá Thảo Lê (1998), *Dồng bằng trung và tây nam bộ (Central and southwestern delta),* in *Việt Nam lãnh thổ và các vùng địa lý (Vietnam territories and geographical regions)*. Hanoi: Nhà xuất bản thế giới, p. 526; NEDECO (1993), *Land use and regions*, in *Master plan for the Mekong delta in Vietnam. A perspective for sustainable development of land and water resources*. Arnhem.

within the basin-wide hydrological regime, arguing that full flood protection which had been proposed in the JDG's Delta Program and examined in a 1974 Dutch study for the Mekong Commission, was inadvisable due to the upstream impact on Cambodia's lowlands. Concern for the environmental impact of projects funded through multilateral organizations had been carefully outlined six years earlier in a UN report prepared by the Brundtland Commission. Entitled *Our Common Future*, the report introduced the new notion of "sustainable development" in the management of shared resources in the "global commons", becoming an important point of reference for the Dutch Mekong Delta plan.[51] Thus, apart from proposals for water infrastructure and agricultural production, the plan also introduced principles of environmental management and conservation that were novel concepts in Vietnam's typically goal-oriented planning discussions. As some of the plan's proposals were gradually financed and constructed over the following decade, a precedent was established for transferring a specific type of technical knowledge to Vietnam.[52] If the magnitude of geographic space encompassed by the Delta changed little from previous iterations, the coordinated planning of water resources in the administrative provinces included in the *Mekong Delta* was arguably perceived to produce greater value than the separate planning of the same area's individual parts. Divided into distinct types of sedimented ground each requiring a different approach in their planning [**Fig 7.8**], the idea that these terrains could be controlled collectively,

50 (...) See Simon Benedikter (2014), *Extending the Hydraulic Paradigm: Reunification, State Consolidation, and Water Control in the Vietnamese Mekong Delta after 1975.* Southeast Asian Studies, v. 3, n. 3, p. 580.

51 Van Staveren *et al* (2018), p. 274.

52 By some estimates from 1990 onwards, 15,000km of main canals, 77,000km of secondary canals and tertiary canals were constructed. However, it is very unlikely that these were all directly a result of the 1993 Delta Plan. See Marcel Marchand *et al* (2014), *Mekong Delta: Living with Water, But for How Long?* Built Environment, v. 40, n.2, p. 235.

allowed the Delta to be perceived as a single geographic unit with a specific surface area, positioned immediately south of HCMC.

While the state's ability to produce and implement master plans for an entire region proved effective in attracting foreign investment and meeting development targets, the situation on the ground was far from regulated. Following the Dutch plan, the construction of flood-protected irrigation and drainage schemes in the Delta had unforeseen and increasingly observable impacts on biodiversity, the distribution of floodwater and river bank erosion. Simultaneously, the commodification of land accelerated by economic reforms and foreign investment required that planning institutions formulate strict land use controls.[53] In response, the first Law on Urban Planning approved by the Vietnamese Parliament in 2009, laid out a hierarchy of planning scales, each with specific technical requirements to the design of urban masterplans.[54] Moreover, following the paradigm of Chinese state planning, major cities were given special status and directly administered by the central government.[55] The dominance of urban centres in the national planning hierarchy is best illustrated in the adoption of metropolitan designations for areas considered part of the immediate economic networks of Hanoi and HCMC. Approved in government decrees after 2008, the metropolitan conceptualisation of these cities was a shift from 1998 when national policy emphasised the containment of growth and the development of smaller, designated urban settlements.[56] For HCMC, the metropolitan area encompassed the city's inner and outer-city districts as well as the surrounding 7 provinces, delineating an area more than 30 km^2, coterminous with the Eastern Southern Region (*Đông Nam Bộ*), one of Vietnam's 9 new Economic Zones [**Fig 7.9**]. In the proposed areal configuration, around 20km^2 of predominantly agricultural land in adjacent provinces would effectively be 'recentred' on the tree-shaded boulevards of colonial Saigon. In this new geographic area, the metropolitan population would reach around 16.5 million, almost equivalent to the 17 million residents in the Mekong Delta's Economic Zone. Redefining the hierarchy between existing settlements, the metropolitan plan called for urban and industrial development to be consolidated within a 30km-radius "central area", "counter-balanced" by existing "urban" centres in adjacent provinces.[57] Even though these centres have been described as "little more than district administrative centres or provincial crossroad towns", in the plan these are imagined as critical components of a regional spatial structure, which extends radially outwards from the centre along specific transportation routes.[58] Allocated with specific spatial targets for the conversion of "rural" land into other land uses, the geographic space classified as "urban" equates to the sum of the city's projected economic needs.[59]

53 Benedikter (2014), p. 579.

54 T.H.L. Pham (2010), T*he Legislative Framework for Urban Design and Planning in Vietnam.* In K. Shannon, B. De Meulder, D. Derden, T.H.L Pham. & D. T. Pho. (eds.), *Urban Planning & Design in an Era of Dynamic Development Innovative and Relevant Practices for Vietnam.* Hanoi: Ministry of Construction, pp. 19-21.

55 McGee (2009), p. 238.

56 World Bank (2011), p.3.

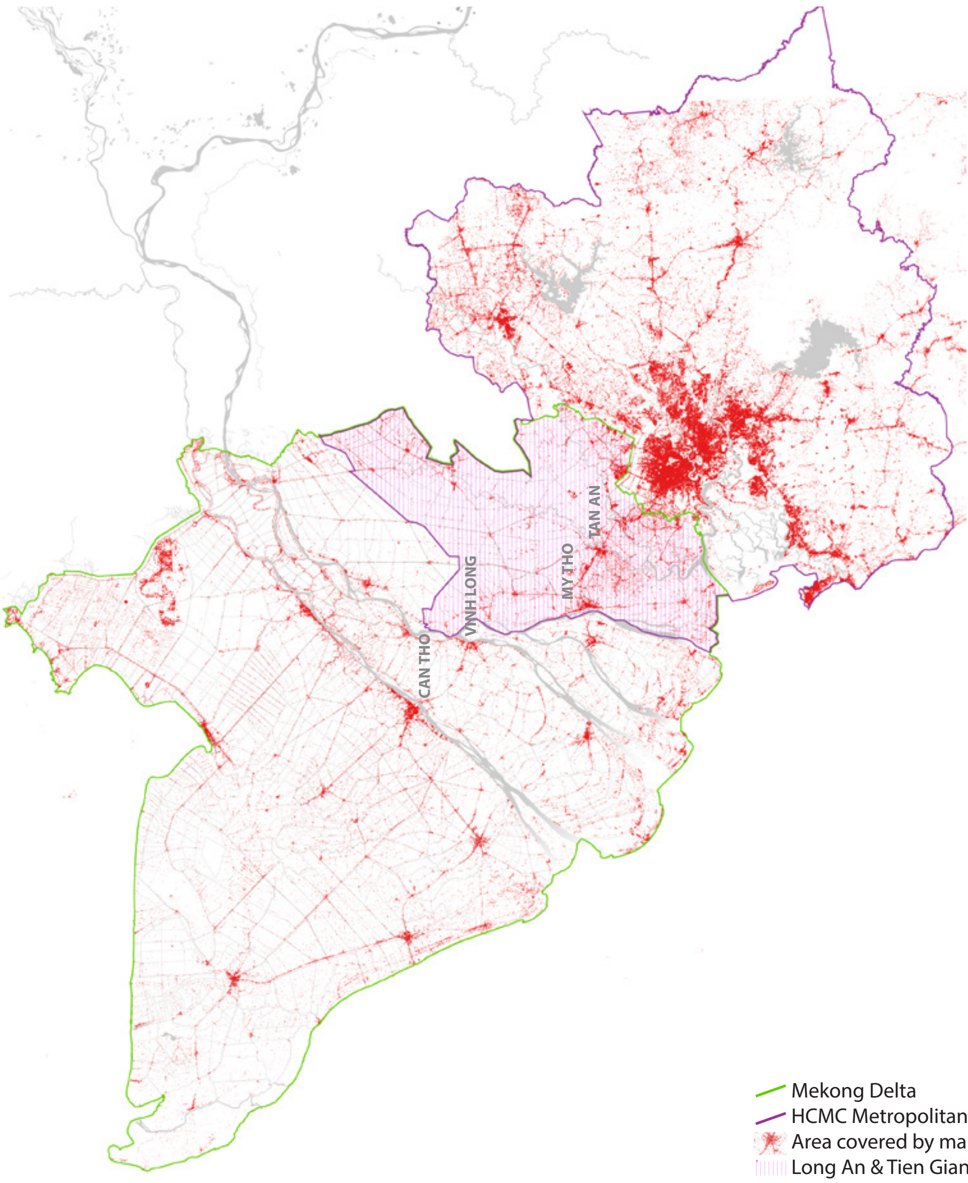
57 Socialist Republic of Vietnam (2008), p. 1.

58 Erik Harms (2019), *Megalopolitan megalomania: Ho Chi Minh City, Vietnam's Southeastern region and the speculative growth machine.* International Planning Studies, v. 24, n. 1, p. 60.

59 With a 2050 horizon, projected areas for the city's key economic land uses total 340,000ha (240,000ha for urban construction and 70,000ha for industrial uses). In the updated decree from 2017, the same quota for "urban" construction is expected to fulfilled by 2030. Socialist Republic of Vietnam (2008), p. 2.

Fig 7.9 HCMC metropolitan region On the left the map of HCMC's metropolitan area also defines the Eastern Southern Region - one of Vietnam's 9 Economic Zones. Below, the map depicts the land covered by manmade structures such as infrastructure and buildings (red) in relation to the metropolitan boundary and Mekong Delta region. From the land cover arrangement it is possible to discern the location of concentrated building clusters as well as buildings arranged along the linear routes of roads and waterways. The two maps correlate where existing population centres are identified as "urban nodes". However, the majority of land included within the provincial outlines used to delineate the metropolitan area is primarily agricultural.

Southern Sub-Institute of Urban and Regional Planning (2008), *HCMC metropolitan regional planning*. Accessed 4th April 2022 from https://www.mlit.go.jp/kokudokeikaku/international/spw/general/vietnam/index_e.html; Author (2022) - spatial data layers: *HRLULC 10m resolution map of the southern region of Vietnam* (Japanese Space Agency, 2017); *administrative boundaries* (https://gadm.org/).



As with other planning endeavours on this scale however, the metropolitan plan does not appear to propose a new spatial configuration. Instead, it consolidates multiple existing plans produced at different scales and administrative hierarchies such as provinces and districts which produce their own 5-year plans. In the discourse of Southeast Asia's urbanization, the geographic area reconfigured by the imposition of this hierarchy has sometimes been understood as a *Mega Urban Region* (MUR). MURs have been used as spatial frames for economic analysis as well as an explanation for the various phenomena related to the city-centric process of "urban expansion" around the largest of Southeast Asia's cities.[60] Seen through the MUR model, various activities and land uses that can be found as far away as 200km from the city core are conceived to be part of the same system of economic, if not social, relationships.[61] In the context of HCMC however, the MUR model is more confusing than helpful in explicating the various phenomena classified as "urban". Certainly the location of industrial parks and satellite NUAs as well as the non-agricultural activities clustered along highways are an outcome of their proximity and access to the city's densely populated centre. Yet this relationship holds true only for a relatively confined distance around the centre served by transport infrastructure. If the lower density rice-growing areas in the floodplain are included in HCMC's metropolitan area, their cohesion into a MUR is not because these particular farms contribute more than other rice-growing areas to the city's economy but because they are located within Long An Province which has been designated part of this "urban" region. As Erik Harms argues, for even the most densely populated province in HCMC's metropolis, their association with the "city" is not because they possesses an inherently city-like environment or a definable "urban" centre. Moreover, given that historically HCMC has been the only major city in Vietnam's south, the densely populated urban core has had "no real metropolitan counterpart in the region with which to 'fuse.'"[62] If an MUR can therefore be identified, it is not observable in the phenomenon of "formerly separate, cities" merging into a singular metropolis, but rather in the geographical imagination of policy-makers that relates distance from the city centre with the control of economic activity.

Planning the Mekong's delta

In relation to the Mekong Delta, what metropolis is being constructed on the map is especially important. With an envisioned "influential radius" of 150-200 km that would reach the Gulf of Thailand to the south,[63] the metropolitan structure incorporates the two Mekong Delta provinces of Long An and Tien Giang. For Long An's spatial configuration, inclusion in this spatial structure entails planning the province's eastern portion "to reduce the load on Ho Chi Minh City".[64] Framed

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60 For HCMC in particular see D.N. Anh (2008), *The Mega-Urban Transformations of HCMC in the era of Doi Moi Renovation*, pp. 196-197. In G.W.Jones & M. Douglas (eds.), *Mega-urban Regions in Pacific Asia: Urban Dynamics in a Global Era.* Singapore: National University of Singapore Press.

61 See for example the diagram entitled "Zonal Model of Southeast Asian Mega-Urban Region C2000", which places the urban core as the conceptual "centre" of a collection of different land uses including a peripheral 'desakota' zone 150km wide in T. McGee & I. Shaharudin (2016), *Reimagining the "Peri-Urban" in the Mega-Urban Regions of Southeast Asia*, pp. 502-503. In B. Maheshwari, B. Thoradeniya & V.P. Singh, (eds), *Balanced Urban Development: Options and Strategies for Liveable Cities.* Water Science and Technology Library, v.72. Springer, Cham.

62 Harms (2019), p. 55.

63 *ibid*.

64 Socialist Republic of Vietnam (2017), *Decision 2076/QĐ-TTg: Decision On The Approval Of The Adjustment Of The Ho Chi Minh City Construction Planning To 2030 And Vision To 2050.* Hanoi: Govt. of Vietnam, p. 3.

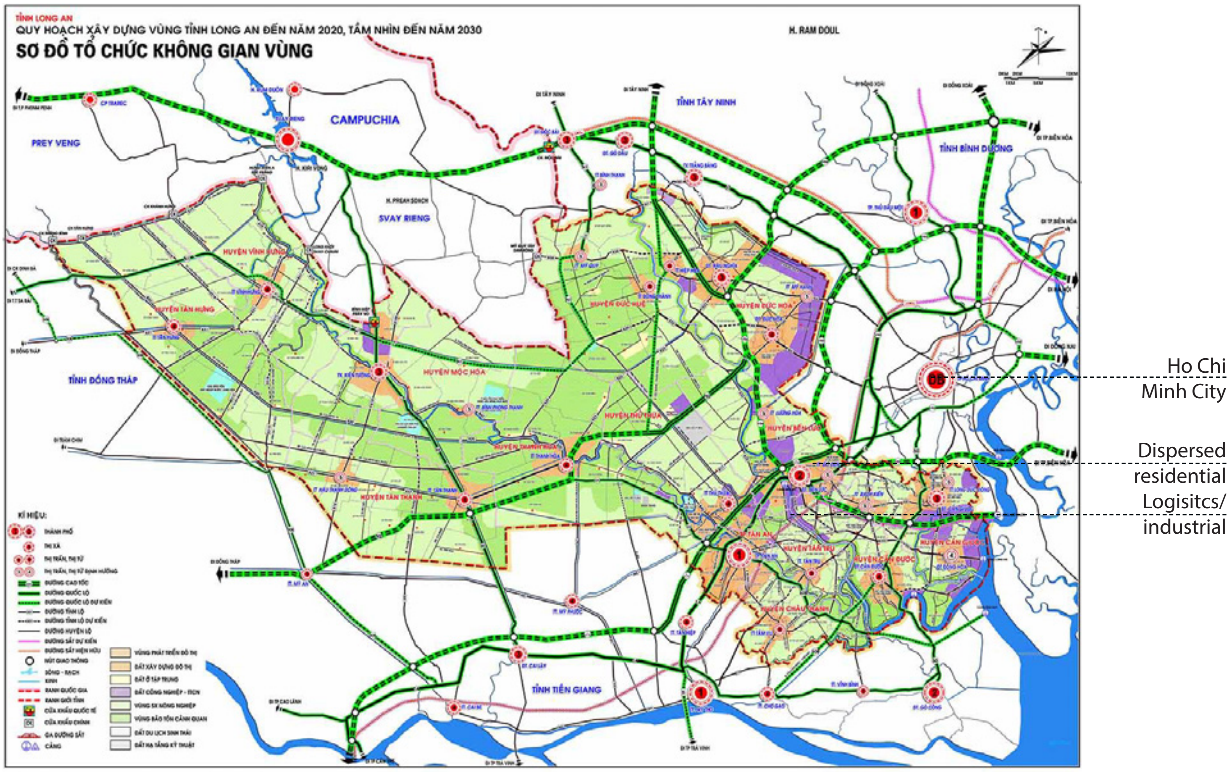

Fig 7.10 Spatial master plan of Long An Province Located to the south and west of HCMC, Long An Province is planned in relation to the Mekong Delta, except for those areas to the east of the province where land uses such as industrial land (purple) are arranged in relation to the metropolitan area.
Government of Vietnam (2017), *Regional construction plan of Long An province with a vision to 2030 (Quy hoạch xây dựng vùng. Tinh Long An, an đến năm 2020 tâm ninh đến năm 2030).*

in terms of logistics and agricultural processing, this "load" is not just related to economic activity. Along with promoting east Long An as the location for vaguely determined "climate-sensitive" industrial activities, the same geographic space is also described as the drainage catchment for HCMC.[65] The province's remaining extent, which includes a significant portion of the Mekong River's floodplain, will continue on the route of agricultural production.[66] On a recent province-level plan (2017), the differentiation of the east from the annually-submerged areas further west is evident in the proposed configuration of land uses [**Fig 7.10**]. In the areas south and west of HCMC, the existing - mostly unplanned - residential, industrial and commercial activities, become the focus for converting rural land into land for industry and logistics activities and thus, potentially fuelling real-estate speculation.[67] Even if understood more as vehicles for economic policy

65 *"The Eastern region of Long An province [...] to develop ecological urban areas, light industry and urban agriculture to adapt to climate change, playing the role of protecting ecological landscapes and draining floods for the urban sub-region. Strengthen the development of ancillary industries [...] to reduce the load on Ho Chi Minh City." (Khu vực phía Đông tỉnh Long An [...] phát triển đô thị sinh thái, công nghiệp nhẹ và nông nghiệp đô thị thích ứng với biến đổi khí hậu, có vai trò bảo vệ cảnh quan sinh thái và thoát lũ cho tiểu vùng đô thị trung tâm. Tăng cường phát triển công nghiệp phụ trợ [...] hóa nhằm giảm tải cho Thành phố Hồ Chí Minh.) ibid*, p. 3

66 *"The area of the remaining districts of Long An province [...] has the role of a water storage area, preserving the ecological landscape of Dong Thap Muoi, regulating water and reducing saltwater intrusion for the Mekong Delta; develop agriculture specializing in rice cultivation, aquaculture, eco-tourism, seafood processing industry." (Khu vực các huyện còn lại của tỉnh Long An [...] có vai trò là vùng trữ nước, bảo tồn cảnh quan sinh thái Đồng Tháp Mười, điều tiết nước và giảm xâm nhập mặn cho vùng đồng bằng sông Cửu Long; phát triển về nông nghiệp chuyên canh trồng lúa, nuôi trồng thủy sản, du lịch sinh thái, công nghiệp chế biến thủy sản.) ibid*, p. 5.

67 Harms notes that the process of "land conversion" around HCMC also amounts to capital creation by real-estate speculators "without actually engaging in any productive activity".

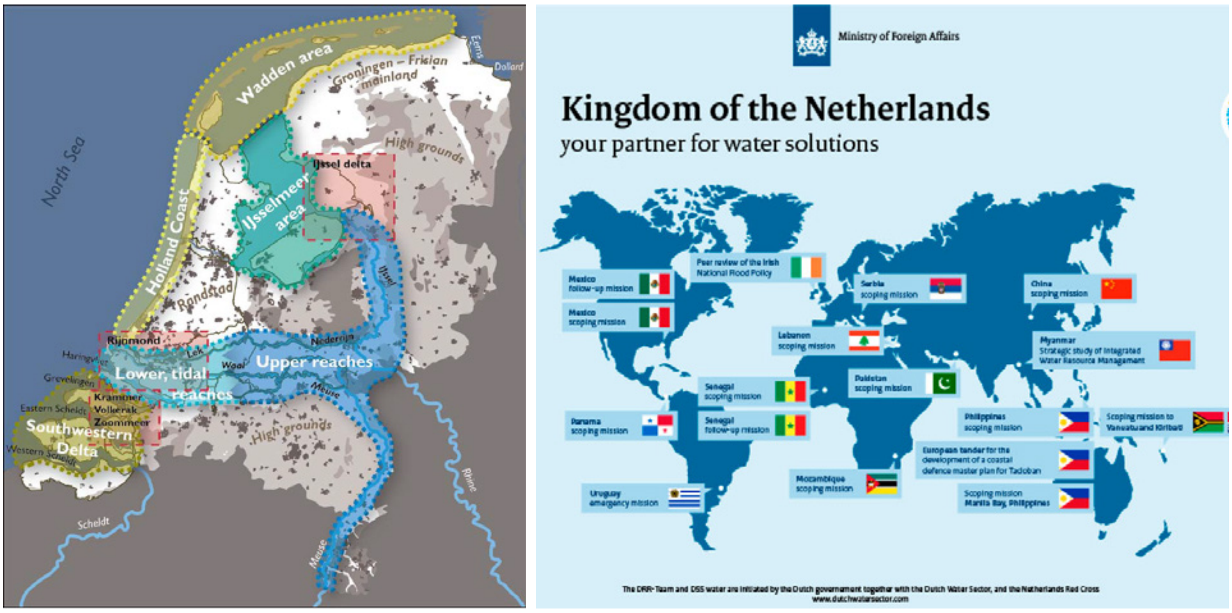

Fig 7.11 Dutch Delta planning To the left, the map that accompanies the findings of the Dutch Delta Commission showing the "regional divisions" on which the Delta programme would focus in subsequent years. To the right, the communication factsheet published by the Netherlands' Ministry of Foreign Affairs identifying "vulnerable" global deltas where the "export" of Dutch expertise can support the formulation of "water solutions".
Deltacommissie (2008), p. 16; Laeni *et al* (2020), Figure 2, p. 9.

and infrastructure planning rather than exercises in environmental and spatial management, such strategic plans are therefore important since they inform where future land conversion is most likely to occur.

The most recently completed 'strategic' planning effort for the Mekong Delta appears to eschew the regional centrality of HCMC. Prepared in 2013 by a team led by the Dutch engineer consultancy Royal Haskonnig , the *Mekong Delta Plan* (MDP) was the result of a concerted effort by the Netherlands' government to package Dutch water management as a global water solution.[68] Promoting the Dutch Delta Programme as the paradigm of best-practices in water management, for the Dutch government, the MDP was an opportunity to "export" the cumulative technical knowledge and engineering expertise from decades of water infrastructure planning to Vietnam.[69] With the Netherlands presented as a "safe and liveable delta",[70] the 2008 Dutch Delta Programme framed flood management on the scale of the entire country including the riparian lands along the upper reaches of the Maas River which were not formed by the accretion of sediment deposits [**Fig 7.11**].[71] Along with "delta technology" (infrastructure

68 N. Laeni, M. A. van den Brink, E. M. Trell & E.J.M.M. Arts (2021), *Going Dutch in the Mekong Delta: a framing perspective on water policy translation.* Journal of Environmental Policy & Planning, v.23, n.1, p. 17. For Dutch Delta practices as an "international brand" see Ellen Minkman & Arwin van Buuren (2019), *Branding in policy translation: How the Dutch Delta approach became an international brand.* Environmental Science and Policy, n. 96.

69 Shahnoor Hasan, Jaap Evers, Arjen Zegwaard & Margreet Zwarteveen (2019), *Making waves in the Mekong Delta: recognizing the work and the actors behind the transfer of Dutch delta planning expertise.* Journal of Environmental Planning and Management, v. 62, n.9, p. 1584.

70 *ibid*.

71 The particular areas of concern for the Dutch Delta Programme are laid out in a map on p. 16 (Fig 7.11). These include the riparian lands of the Maas River until the international boundary which has little to do with the sedimented lowlands indicated by the geographic term "delta". The Delta Commission (2008), *Working together with water, Findings of the Deltacommissie 2008.* p. 16.

for flood protection, water treatment and agriculture), the Programme also brought together institutional governance and scenario-based assessments of environmental and socioeconomic conditions called Adaptive Delta Management. Closely associated to the Netherlands' national-level spatial planning, the tripartite Dutch Delta approach was considered particularly relevant for the Mekong Delta whose extent at 40,000 km^2 almost equals that of the Netherlands. Convincing Vietnamese officials of the relevance of Dutch planning was achieved by an alarming report by the engineering consultancy Deltares.[72] Presenting the significant socioeconomic impact from rising sea levels and inundation for the Mekong Delta's agricultural economy, the report noted that the 1993 Dutch scheme would be ineffective in meeting the challenges of climate change. The report's implication that a new plan was now necessary, also suggested that Dutch delta planning approaches conceived in the European legal setting and underpinned by decades of public consultation in the context of the Netherelands, would the most appropriate model for future development in south Vietnam's monsoonal environment.[73]

The argument that deltas, viewed from a hydrological perspective, are globally comparable systems, allowed Dutch planners to bring climate change and the long-term impact of decision-making to the forefront of planning discussions. The plan aimed to develop the Delta into a "safe, prosperous and sustainable region", by deploying the Adaptive Management practices for the Dutch Delta in the Vietnamese setting. Presenting Vietnamese planners with scenarios - particular development choices along with their economic and environmental impacts - the planning process sought to shift focus from enumerated economic objectives to building consensus among Vietnamese decision-makers around 'no-regret' measures involving new infrastructure and diversifying agricultural crops.[74] The

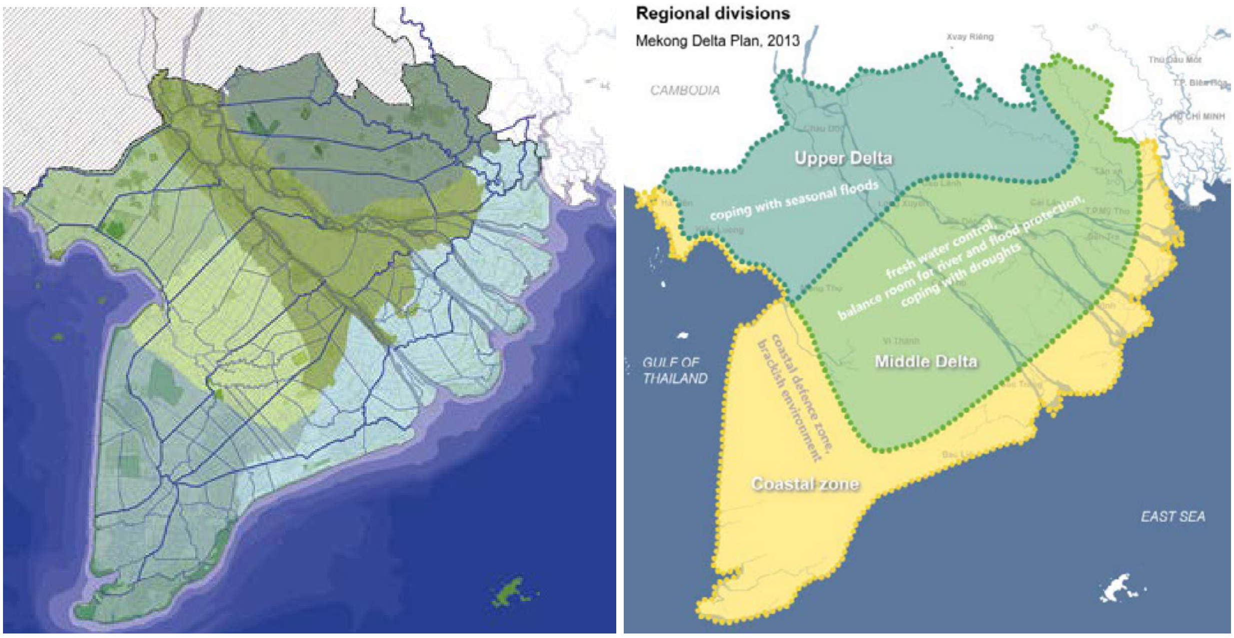

Fig 7.12 Hydrological and Agro-ecological planning zones The map on the left shows the six *agro-ecological zones* identified through a landscape-driven approach to the morphology of the Mekong Delta's terrain. These constrast significantly with the MDP's three *hydrological zones* on the right which are united by generalised problems (coping with flooding or coastal defense) rather than the condition of the ground. The *Middle Delta*'s delineation (green shade) corresponds with the 'industrial' corridor from Can Tho to HCMC (Fig 7.9).
RUA (2016), *Agro-ecological regions of Vietnam's Mekong Delta*. In Bruno DeMeulder & Kelly Shannon (2019), *The Mekong Delta: A Coastal Quagmire,* in Elizabeth Mossop (ed.), *Sustainable Coastal Design and Planning,* Boca Raton, FL : Taylor & Francis, p. 301; MDP (2013), p. 14.

construction of scenarios was accompanied by the internal subdivision of the Delta into 3 hydrological zones [**Fig 7.12**]. Grouping the entire floodplain within Vietnam into the "Upper Delta" as well as coastal areas into the "Coastal Delta", Dutch planners identified a new "Middle Delta". Encompassing the industrial periphery of HCMC, and following the densely populated 'corridor' of unplanned activities situated along the highway leading to Can Tho - the most populated city of Vietnam's Mekong Delta - the Middle Delta 'united' the distinct hydrological regimes south of HCMC, along the Mekong's mainstream and the inundated rice-growing agricultural areas further south, into one zone.

The significance of the Middle Delta's dubious hydrological distinction, surfaced in the MDP's scenarios. According to one of the four scenarios, the continuation of the current concentration of industrial activities along the north-south highway was anticipated to create "an industrialised metropolis in a highly fertile and flood-prone area and a rural hinterland struggling to keep up pace."[75] Conflating a broadly conceived urban 'metropolis' with the Delta's hydrology, maps illustrating the course of action proposed by different scenarios drew attention to existing urban centres and the Mekong Delta's different ground conditions. Presented with the choice, Vietnamese decision-makers showed their preference for the more geographically distributed "agro-industrial" scenario from which the Delta's largest city Can Tho, would eventually emerge as a complementary second "node" to HCMC [**Fig 7.13**]. Given the city's special status within Vietnam's hierarchical structure of centrally-administered cities, Can Tho would therefore function as the 'capital' of the Mekong Delta region, becoming the centre for a network of smaller urban areas connected by road infrastructure. On the MDPs maps, the extent occupied by the Delta's urban network is deliberately differentiated from HCMC.[76] However, with emphasis given to creating an "agro-business", water-related planning – the key reason Dutch rather than any other experts were awarded the consultancy - was given far less attention than state-driven socioeconomic "adaptation".[77] As a result of the focus on agriculture, the more general problems of fresh water supply, subsidence and salinization are seen through the lens of cultivation, and therefore problems of policy.[78] Delivered as a reference document for revising spatial planning rather than as a set technical recommendations surrounding water management, the Delta presented in the MDP was geographically if not functionally distinct from HCMC.

Since the MDP's publication, the planning principles which emerged from the process have been incorporated into legislation and the World Bank-financed project initiated in 2016. The 3 "hydrological zones" expressed by the MDP became 4 zones in World Bank documents and the basis for considering planning interventions. In government Resolution 120 (2017) and Decision 68 (2018)

72 Hasan *et al* (2019), p. 1590.

73 *ibid.*

74 Mekong Delta Plan (2013), p. 46.

75 *ibid*, p. 39. Except for generalised warnings that particular scenarios would lead to unnecessarily high costs to achieve adequate water supply, the issue of water appears to be considered as the background for economic planning.

76 Maps and government decrees present the Mekong Delta as equivalent to the limits of provincial administrative units. On the MDPs maps, the boundary of the Delta with HCMC does not follow the outline of Long An Province, and shows the city extending to the interstitial area between the two Vaico rivers.

77 Hasan *et al* (2019), p. 1595.

78 Laeni *et al* (2021), p. 10

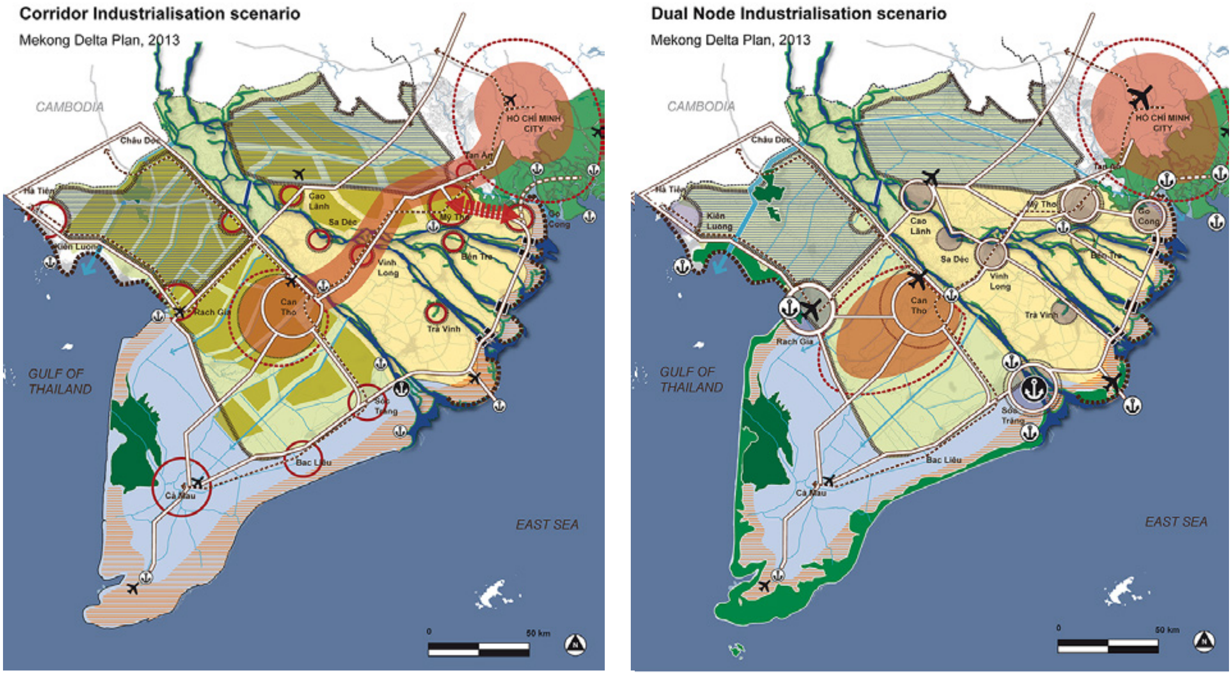

Fig 7.13 Development scenarios of the Mekong Delta Plan The two plans show different development trajectories for the Delta. The "corridor" scenario to the left, presents a condition described as undesirable. The"dual-node" scenario to the right shows the preferred planning direction, where Can Tho is presented as a separate urban core to HCMC. At the geographic centre of the Mekong Delta, Can Tho dominates the hierarchy of smaller centres, the area surrounding the Delta's "capital" city appearing as an agricultural "hinterland", distinct from adjacent ground conditions.
Mekong Delta Plan (2013)

on the development trajectory of the Mekong Delta region, Vietnam presented its vision for "climate-resilient and sustainable development". In legislation, the four hydrological zones became six "agroecological zones" similar to those already pointed out in the JDG's plan from the 1960s, the Resolutions setting out these zones as the new geographic references for agricultural development and industrial investment.[79] These have been accompanied by policy statements to "develop the morphology of rural residential space" according to the characteristics of each sub-region.[80] Either raised on stilts, on the soil or floating above the tidal plain depending on the sub-region,[81] encouraging local people to live on water or to move to higher elevation during the flood season recalls older government policies for "living with the flood" initiated in the 1990s. Reflecting the state's inability to control floods with infrastructure, the hands-off approach to "living with the flood" was substantially revised to "protect urban areas".[82]

79 Socialist Republic of Vietnam (2018), p.3.

80 *"Develop the morphology of rural residential space according to the characteristics of each sub-region: In the deeply flooded sub-region, form concentrated population clusters with the form of houses on piles; in the sub-region in the middle of the delta, to develop concentrated residential areas towards modernization and increase in density; In the coastal sub-region, concentrated residential areas will be formed in the form of clusters of floating projects associated with the mangrove landscape and aquaculture space." (Phát triển hình thái không gian dân cư nông thôn theo đặc trưng của từng tiểu vùng: Tại tiểu vùng ngập sâu, hình thành các cụm dân cư tập trung với hình thái nhà trên cọc; tại tiểu vùng giữa đồng bằng phát triển các khu dân cư tập trung theo hướng hiện đại hóa và tăng mật độ; tại tiểu vùng ven biển hình thành các khu dân cư tập trung theo hình thức các cụm công trình nổi gắn kết với cảnh quan rừng ngập mặn và không gian nuôi trồng thủy hải sản.) ibid*, p. 7.

81 *ibid.*

82 Chu Thai Hoanh, Diana Suhardiman & Le Tuan Anh (2014), *Irrigation development in the Vietnamese Mekong Delta: Towards polycentric water governance?*, International Journal of Water Governance, v. 2, p. 74.

In the new policy documents, the reorganization of settlement patterns will aim for "compact" population clusters and eliminate "continuous urbanization in deep floodplains" as well as "between deltaic and coastal" areas.[83] Without specifying the conditions for continuity, calls to limit construction "in areas adjacent to rivers, canals and high-risk areas"[84] appear to draw inspiration from the regulatory context of the Netherlands where certain land uses can be excluded from riparian zones to make "room for the river".[85] In the context of the delta's settlement however, such policies appear contradictory. Although residents' preference for waterfront housing is diminishing especially closer to larger towns, many of the Delta's inhabitants continue to reside in close proximity to the continuous network of waterways.[86] With legislation supporting the vision proposed by the MDP, the 'sustainable' Delta emerging from these planning endeavours does not so much ignore the context, as seek to transform current conditions to conform to a 'sustainable' model of population concentration.

Arguably, government Resolutions only define the broad policy direction rather provide a plan for physical change. However, the discrepancy between the government's approach and the conditions where millions of people live, suggests an almost abstract preoccupation with settlement morphology framed on the scale of the entire region. In this conceptualisation, what constitutes the 'urban' is equally as important as what constitutes the region. The view that urbanisation is a major component of economic development has been embraced by Vietnam's government, that has attempted to frame economic regions (such as the Eastern Southern Region and the Mekong Delta) as competitive 'global spaces' geared towards attracting investment.[87] According to the most recent World Bank-funded plan for the Mekong Delta also prepared by Royal Haskoning, the government will "further develop the system of existing urban areas."[88] But with their expansion deliberately constrained, urban areas will be "developed with support from new integrated agro-industrial hubs".[89] Restrictions on building outside a designated "urban area" will concentrate high-value economic production inside these controlled development zones, thus reinforcing their differentiation with the surrounding countryside.

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83 *"...limiting large-scale concentrated urban development and expansion; do not form urbanized areas, continuous urbanization bands in deeply flooded areas, between plains and coastal areas." (...hạn chế mở rộng, phát triển đô thị tập trung quy mô lớn và trên diện rộng; không hình thành các vùng đô thị hóa, các dải đô thị hóa liên tục tại các khu vực ngập sâu, giữa đồng bằng và ven biển.) ibid,* p. 3.

84 *"...review and finalize the land use planning, rearrange the population in which to control and limit the construction of concentrated residential areas in areas close to riverbanks, canals and canals with high risk of subsidence" (...rà soát, hoàn thiện quy hoạch sử dụng đất, bố trí lại dân cư trong đó kiểm soát và hạn chế việc xây dựng các điểm dân cư tập trung tại các vùng sát bờ sông, kênh, rạch có nguy cơ sạt lở cao nhằm tránh rủi ro.) ibid,* p. 5.

85 Initiated in 2007 by the Government of the Netherlands , Room for the River (Ruimte voor de Rivie) was an infrastucture programme to increase the capacity of the country's floodplains to retain water. As a result, further development in certain areas would be limited. A proposed Room for the River concept in relation to the Mekong Delta was presented by Deltares researcher Marcel Marchand using the interstitial area between the Mekong and Bassac Rivers to retain floodwater. See Marchand *et al* (2014).

86 Thi Hong Hanh Vu & Viet Duong (2018), *Morphology of water-based housing in Mekong delta, Vietnam.* MATEC Web of Conferences, n. 193, 04005, p. 2.

87 Terry McGee (2009), pp. 236 & 242.

88 Commissioned by Vietnam's Ministry of Planning and Investment MPI), the text of the consultancy report (*Development of Vietnam Mekong Delta Master Plan to 2030 with an outlook towards to 2050*) appears to imitate the language in government decrees. Royal Haskoning & Deutsche Gesellschaft fur Inter-nationale Zusammenarbeit (GIZ) (2020), *Mekong Delta Integrated Regional Plan MDIRP-RHD-D4-XX-RP-Z-0007*. p. 153.

89 *ibid.*

If this strategy recalls the failed proposals for agro-industrial centres in New Economic Zones (NEZ), the motivations and contexts when these principles were historically deployed are not the same as today's situation. In recent Resolutions, the idea of compact settlements is cast as supporting "sustainability" - an answer to the impending impact of climate-change and resource depletion – rather than the military threat to national security from the 1960s. In its current iteration, population concentration would conceivably allow planners to focus flood-protection infrastructure on particular settlements rather than the entire network of waterway houses. Applied to the Delta, a strategy of 'compactness' would also potentially protect unused - or undeveloped - lands and more generally reduce energy consumption for transport by shortening the distance between destinations.[90] To imagine such operations affecting the entire region however should take into account that market forces have been far more influential than planning in shaping the urban environment of a major city such as HCMC, let alone the multiple urban and rural areas encompassed by the Mekong Delta.[91] Evaluated in relation to the resettlement of thousands of people into compact urban areas, such an endeavour would take decades to achieve, and its impact on flood risk reduction or agricultural production would most likely require a critical mass to be implemented before the benefits could be validated in the context of Vietnam. These policies are therefore more aspirational than realistic, in that they seek to project an idealised "climate-resilient and sustainable" Delta through the overlap of "best-practice" regulations within one specified extent of geographic space.

Conclusion

Outlining the conceptual contradictions of defining a particular area as 'urban' in relation to Southeast Asia's rice-growing regions, Stephen Cairns has framed the explanation of this unplanned configuration of diverse activities by suggesting the agency of a "pre-existing rurality".[92] Yet while this would imply that a 'rural rationality' would be a better way to understand the pattern of land uses observable on maps and aerial imagery, the cartographic differentiation of land as either "urban" or "rural" is not always intended to represent an existing condition. From the perspective of the state, land classified as urban has a higher value for the region's economy than agricultural areas. Although in many ways speculative, the controlled conversion of rural into urban land uses signals that, despite the difficulty of articulating the difference between urban and rural in areas where farms adjoin industrial parks or the residents of agricultural settlements receive an income from non-farming activities, non-city settlement conditions are, in the end, "urban in intent or destiny".[93] The inclusion of parts of the Mekong Delta into HCMC's metropolitan designation, but also the identification of the urbanized Middle Delta in Dutch plans, are therefore part of a deliberate effort to delineate such an urban condition, even as the majority of residents continue to be involved

90 Stephen Cairns (2018), *Debilitating City-Centricity*, p. 120. In Rita Padawangi (ed.), *Routledge handbook of urbanization in Southeast Asia.* Abingdon, Oxon & New York, NY: Routledge, p. 117.

91 Du (2018), p. 18.

92 Cairns (2018), p. 120.

93 *ibid*, p. 116. Cairns argues for the fallacy of assuming Southeast Asia's high-density rice-growing areas as a rural condition whose inevitable outcome is to become "urban". Based on observation of the mix of land uses in areas far outside HCMC's densely populated centre, it is indeed difficult to imagine such a transition, if the designation "urban" is intended to indicate a city-like environment rather than just sporadic clusters of non-agricultural activities.

in the cultivation of rice or other crops.[94] Evident in the MDP, the geographic space of the Delta formed on the planners' maps is organized according to the presence of distinct urban centres of various magnitudes. The amplification of the importance of existing urban areas and their collective organization into a network of agro-industrial production centres suggests that the Delta's urbanisation is not just a process that arises through unplanned activities but also a purposeful strategy to redefine the Delta's relationship with the country's economy. In this equation the management of water continues to be critical for the state as well as local people. But it is clear that even though the total surface area has remained the same, what the delineation of the Mekong Delta denotes today is fundamentally different from a hydrological catchment within the extents of Vietnam's sovereignty. The Delta's significance as the geographic unit for resolving problems through planning, now equally aligns with social and economic considerations as much as a group of the river's flows. As such, it is tempting to think of the Mekong Delta presented on maps as the anthropocentric manifestation of a pre-existing hydrological condition, modified by calibrating the extent of the 'rural' with the proposed hierarchy of flood-protected urban centres that collectively form a regional economy to complement HCMC's. From an extent created by sediment deposits to the projected area of control over land, the delineation of the Delta on maps suggests the construction of a new geography based equally on the configuration of settlement, as on the river's surface flows.

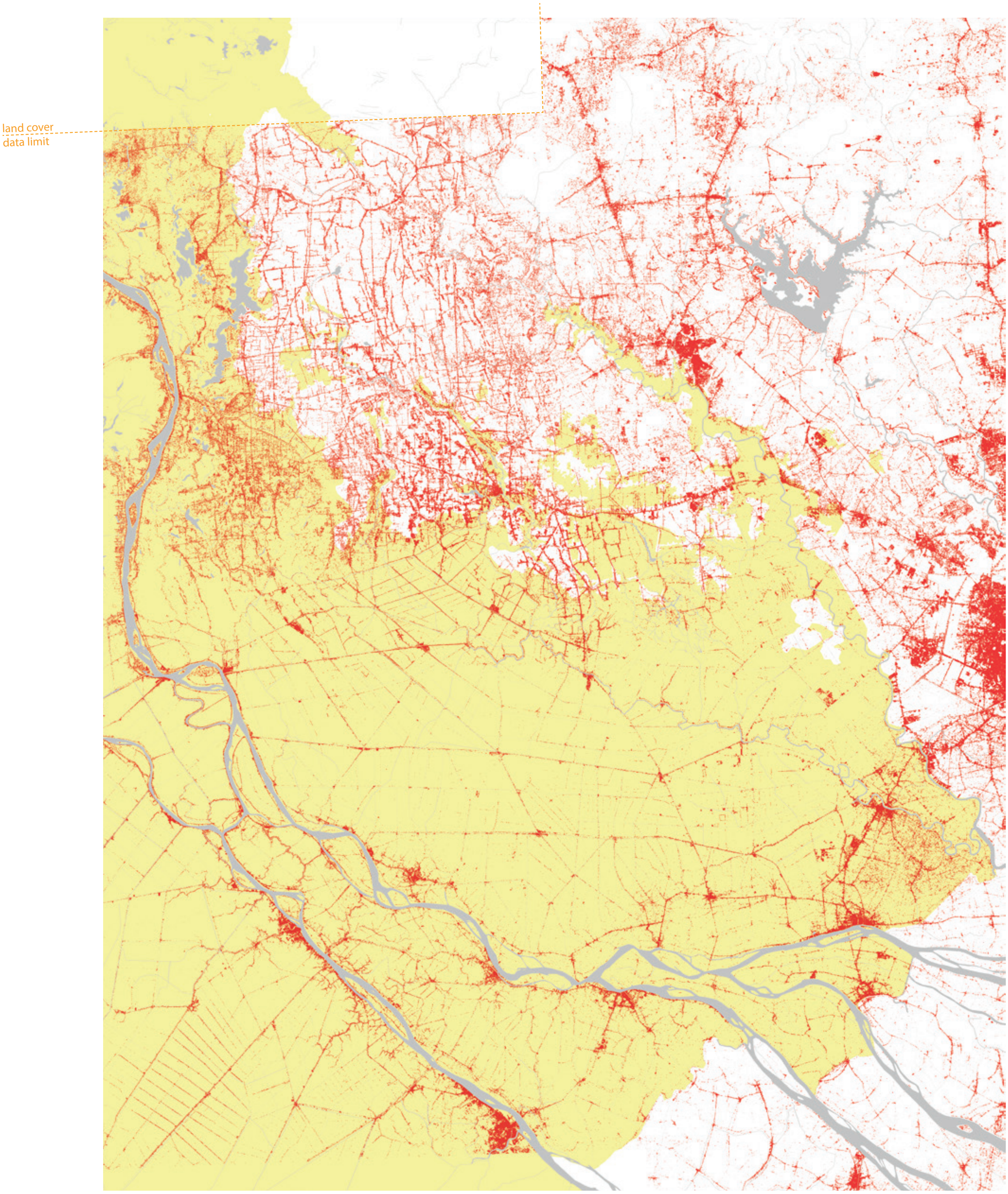
94 Based on the results of the 2019 census, 1,417,050 people out of Long An's 1,688,547 total population continue to be classified as residents of "rural" areas. See General Statistics Office (2020), *Completed results of the 2019 Viet Nam population and housing census.* Hanoi: Statistical Publishing House, p. 36.

PART THREE

FLOODPLAIN

Divided into seasons of heavy rainfall (wet) and intense sunshine (dry), the tropical year in Southeast Asia alternates between periods of abundant water and drought. When the accumulated wet season rains cause rivers to overflow beyond their cartographically prescribed limits, a particular extent of ground can be submerged for weeks or even months. Referred to as *floodplains*, the geographic spaces where water briefly erases most terrestrial landmarks, can be technically understood as any "land area susceptible to being inundated by water from any source".[1] In the Mekong's lowlands, floods are not only the result of the river's annual "pulse" but also the outcome of floodwaters distributed by manmade waterways, extreme local precipitation events and, closer to the coast, by high tides during storms.[2] If a single flood occurrence cannot be assigned to only one of these factors, when drawn on a map, this seasonal process occupies an area that suggests a specific geographic space. Cartographically delineated, the allusion to a 'stable' geographic area onto which water periodically invades, not only contradicts the interannual variability of inundated zones but also the succession of ground conditions which range from waterlogged to patches of dryness. The ambiguity inherent to the conceptualisation of the flood as a specific space as well as an event, is reflected in the way the extent of inundation is recorded. In a phenomenon unique to the Mekong's geography, a proportion of the wet season river water reaching Cambodia is detained in a topographic 'bowl' centred on the Tonle Sap, increasing the lake's surface area sixfold.[3] Of the vast volumes of floodwater that continue flowing southwards along the mainstream, those overflowing south and west of the river can reach the coast of the Gulf of Thailand. To the mainstream's east and north however they are retained within a shallow geological depression where they merge with the flows of the Vaico River - west of Ho Chi Minh City - submerging a terrestrial surface nearly 10,000 km^2 that belongs to different river basins. In some places a perennial marsh and in others a productive agricultural ground, the area known today as *Đồng Tháp Mười* by the Vietnamese has been historically associated with the different dangers that stem from the impact of inundation. Also known as the *Plaine des Joncs* (Plain of Reeds) by Europeans and Americans, the cartographic delineation of this specific section of the entire floodplain has been the subject of maps and plans seeking to define where water is absent or present. If today infrastructure has significantly altered the way floodwater is diverted in comparison to the 1970s, the question of what the outline of the floodplain represents remains relevant, especially as the total volume of floodwater reaching the Plain of Reeds becomes increasingly harder to predict.

1 Federal Emergency Management Agency (FEMA), *National Flood Insurance Program Terminology Index*. Retrieved October 10, 2020, from https://www.fema.gov/flood-insurance/terminology-index



Map G Settlement (red) is presented in relation to the extent of geographic space submerged during the devastating year 2000 wet season (yellow shade). Within the floodplain, areas of settlement concentration are organized along the river's mainstream, alongside waterways and at the intersections of navigable canals. Note that due to the method of data collection and processing, red areas sometimes exaggerate the extent and spatial cohesion of built areas, showing sizeable population concentrations that do not exist.

Author (2022). Spatial data sources: *HRLULC 10m resolution map of the southern region of Vietnam [2017] (ver.18.09)* (Japanese Space Agency, 2019); *World Water Map* (ESRI, 2014); mrc_SDE_INUNDATE_b_ex_mj (MRC, 2008).

CHAPTER 8 A section in water

These are immense quagmires on which grow rushes, aquatic plants and forests of a thorny tree, with white bark, with rare foliage which is called the Tram. These unproductive plains are designated under the generic name of Plains of rushes.

Les Premières années de la Cochinchine, Colonie française, Pauline Vial, 1875

Formed by the sediment deposits that also define a delta, the floodplain is scientifically considered more a riverine process rather than a specific landform.[4] Determined either through the observation of an existing condition, by records of historical high-water events or the qualities of a specific topography, the extent of the floodplain has a different significance for a farmer benefitting from the waterborne nutrients and for the inhabitant of an urban settlement threatened by invading water. Described as a *territory of risk* by Nathalie Pottier, the delineation of the floodplain's limits are not only related to the determination of the threat posed by the seasonal action of water on property and people's livelihoods.[5] One part of the 50,000 km^2 floodplain stretching to Cambodia, in the Plain of Reeds, the temporary 'disappearance' of political boundaries or the stagnant pools of water left behind as the floodwaters drain, have associated the areas where land is periodically submerged with the dangers of disease or with the lack of military control by the state. Identifying what 'risks' the floodplain is drawn to denote, can therefore also suggest a way to perceive what on a map would otherwise be considered as the representation of a temporary shoreline. Based on colonial-era maps, this chapter argues that a specific region was constructed from a section of the floodplain's catchment area to denote an uninhabitable and uncivilizable terrain, far from the control of the colonial state.

Pathologies of an empty map

The notion that part of the geographic space encompassed by the Mekong's flows could also be described by a relationship with inundation was perhaps first suggested in Tang-dynasty Chinese annals. Sent as ambassadors to Angkor, 7th century Chinese chroniclers described the kingdom of *Water Chenla*, which contemporary scholars situate within the flood-prone, south part of Cambodia.[6] Studying the historical record, O.W. Wolters has argued that the division of Chenla

2 Claudia Kuenzer, Huadong Guo, Juliane Huth, Patrick Leinenkugel, Xinwu Li & Stefan Dech (2013), *Flood Mapping and Flood Dynamics of the Mekong Delta: ENVISAT-ASAR-WSM Based Time Series Analyses.* Remote Sensing, n. 5, pp. 691-692.

3 Avijit Gupta (2009), *Geology and Landforms of the Mekong Basin*, in Ian Campbell (ed.), *The Mekong: biophysical environment of an international river basin*. New York, NY: Academic Press, p. 44-45.

4 William D Thornbury (1968), Principles of geomorphology (2nd edition). New York: Wiley, p. 165.

5 Nathalie Pottier(2000), *Risque d'inondation, réglementation et territoires*, Hommes et Terres du Nord, Hydrosystèmes, paysages et territoires, pp. 94-95.

6 Vickery (1994), p. 16.

into separate polities of *Land* and *Water* was geographic, and most likely related to the ambassadors' observations of local floods rather than reflect a specific extent of political authority.[7] A name the Vietnamese later associated with the Khmer kingdom, Chenla and its kings' hereditary jurisdiction over the Mekong's lowlands, were a key reason for the establishment of the Nguyen dynasty's military fortifications in Nam Bộ, the "southern region" of their empire.[8] Annexed by the Vietnamese from Cambodia, Nam Bộ's administrative subdivision into six districts took into the account the movement of troops across particular sections of terrain. Critical to defensive strategy, deploying army units through inundated areas was difficult throughout the year. But while Vietnamese canals created new perennial water routes through impassable wetlands, these water-logged areas were not solely the result of the Mekong's flood. Torrential monsoon rains combined with daily tides made the presence of water on the ground ubiquitous throughout the wet season, and the division of the region according to the extent of the river's overflow relevant only for very few.

Prepared by naval hydrographers, early maps of the colony concentrated on articulating the main branches of the Mekong, which connected existing densely clustered, riparian settlements. Between the main waterways however, depictions of the interstitial, inundated areas were devoid of geographic detail [**Fig 8.1**]. Introduced almost a century earlier by the French cartographer J.B.B. d'Anville, the deployment of pictorial 'voids' on maps was a reaction to the practice of

Fig 8.1 French Cochinchina in 1866 Covering a significant portion of the map and devoid of detail, the inundated plain is labelled as "*grande plaine d'herbes couvert d'eau*" within the colony, and "*vaste plaine inondée*" to the north, in Cambodia.
Jean Rambosson (1868), *Les colonies françaises : géographie, histoire, productions, administration et commerce*, Paris: Impri. Delagrave.

depicting uncharted regions with imaginary creatures or terrains.[9] Thus rather than consider these areas featureless, such blank spaces indicated a lack of verifiable topographic knowledge about the physical geography of the terrain. But in a region where the ground perpetually fluctuated between states of wetness and dryness, mapping the ground was itself a challenge. The use of typical cartographic notations that differentiated land from water such as coast-lines or embankments, only represented a momentary glimpse of a monsoonal region where water was everywhere, in numerous forms, throughout the year.

A local perspective on the relationship between the flood and geographic space was captured by the Vietnamese writer and educator Petrus Ky. Writing in French and without referencing seasonal inundation directly, Ky presented the "action of water" (*l'action de l'eau*) as the critical factor underpinning the colony's geography.[10] With water creating the colony's ground, the triangular delta which Ky located downstream from Vinh Long was only a small part of the total land formed by the river's sediment. References to localised topographic conditions appear common in the regional Vietnamese dialect. In what contemporary scholars call the "language of the river region" (*ngôn ngữ miền sông nước*), the spatial and seasonal differentiation of moisture content on the ground, subsoil and atmosphere has been conveyed in specialised expressions for fresh and saline water. Used to describe the liquid's multiple distinct states (such as still, slow, fast), such expressions implicitly or directly reference the location of such regularly occurring, micro-topographic conditions.[11] Thus rather than the geographic magnitude of periodic inundation, the toponymy of discrete terrains addressed 'permanent' or recurring topographic characteristics such mountains or the water-logged ground.[12]

The contradiction between the seasonal influence of water and the stillness of maps, also surfaced in French accounts of the Mekong's geography. Discussing the emergence of "*real* islands of extraordinary fertility",[13] the naval officer Oswald Taillefer identified these relatively drier areas as most suitable for the location of settlements and intensive rice cultivation. The *reality* he recognised was produced by the replenishment of land by the Mekong's annual sediment deposits, which gave the delta's 'garden lands' (*miệt vườn*) the appearance of permanence and durability. Beyond such naturally-occurring havens from the invading waters however, the perpetually soaked ground of the floodplains was considered part of a separate domain. The wetness of the vast inundated floodplains and brackish

7 Wolters (1974), pp. 369-370.

8 Contemporary articles discussing the Nguyen dynasty military defence in the Mekong, refer to Cambodia as *Chân Lạp* (Vietnamese for Chenla). See Trần & Dương (2016), p. 70.

9 Lucy Chester (2000), *The Mapping of Empire: French and British Cartographies of India in the Late Eighteenth Century.* Portugese Studies, v. 16, p. 257

10 Petrus Trương Vĩnh Ký (1875), p. 12.

11 Pascal Bourdeaux (2014), para. 38. Among the regionally unique phrases recorded by Vietnamese author Son Nam to describe water in the Mekong's delta region : high water, poor water, upwelling water, slump water, shockwaters, crawling water, running water, standing water etc. See also Nguyễn Văn Nở (2014), *Tìm hiểu cách vân dụng thành ngữ, tục ngữ trong tác phẩm Sơn Nam (Study on the use of locutions and proverbs in the work of Son Nam)* in Dao Huu Vinh & Pham Duc Binh, *Ngôn ngữ Miền sông nước (Language of the river region)*, Hanoi:Nxb Chính trị quốc gia, pp. 90-118.

12 Topographic features such as hills (*Bảy Núi* – Seven Mountains) or marshes (*Cà Mau* – Black Swamp) were part of the region's geographic nomenclature prior to colonization.

13 My italics. "*Ces sables se rencontrent partout à des profondeurs variables, et ils atteignent parfois la surface, où ils forment de véritables îlots d'une fertilité extraordinaire*." Taillefer (1865), p. 45.

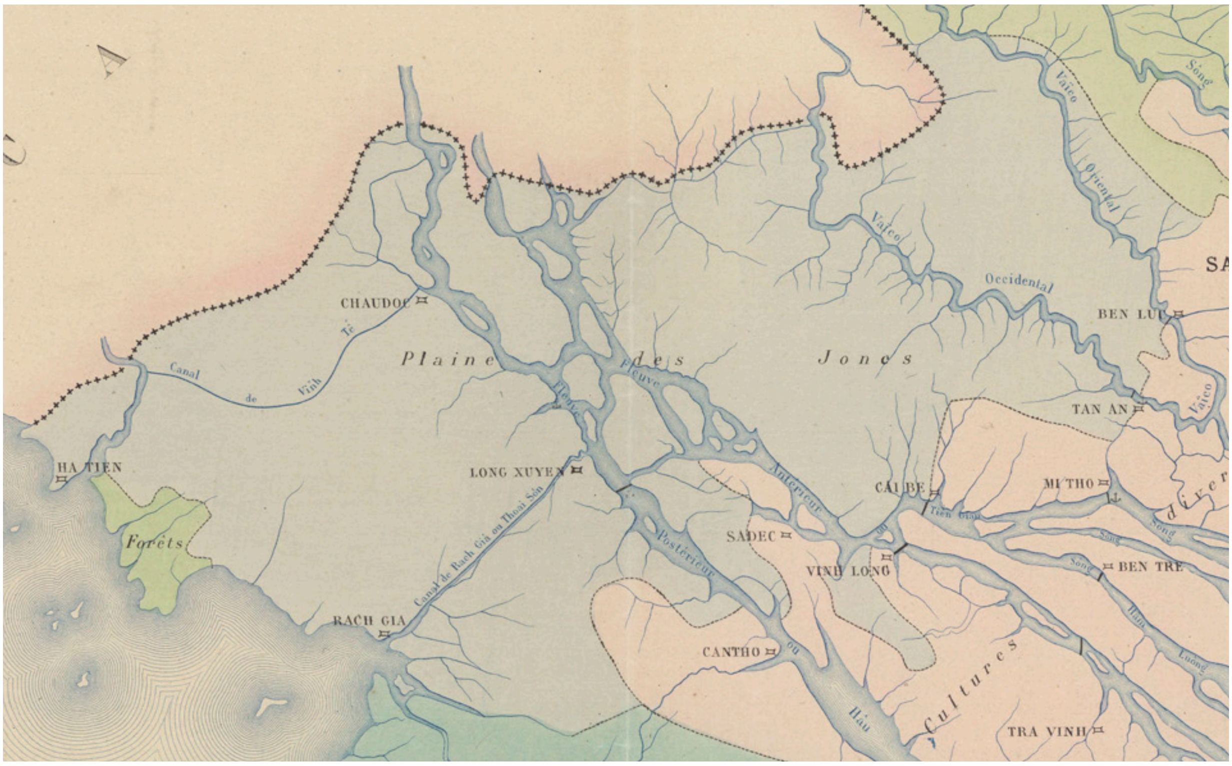


Fig 8.2 Excerpt from map of the colony's four zones Extending on both sides of the Mekong, the light blue coloured area on the map represents a geographic space annotated as Plaine des Joncs. Rather than describing the extent of a grass-covered ground, this zone encompasses the flat, inundated wetlands adjacent to the colony's waterways.
M. Bertaux (1882) (cartographer), *Carte de la Cochinchine française divisée en quatre zones*, Service topographique.

coastal marshes of the Mekong was directly implicated by Dr Jules Harmand as responsible for the spread of tropical infections. Pointing to these nameless places on the map, Harmand's commentary associated the intangible threat of disease with the physical condition of the ground, suggesting that the terrain itself was suffering from the constant presence of water.[14] Siobhan Carroll has called these natural regions which remained blank on colonial maps *atopias* or non-places in the sense that their intangibility, inhospitality, or inaccessibility did not allow them to be converted into spaces of inhabitation.[15] In colonial Cochinchina, these *atopias* manifested around areas of 'excessive' wetness, in which the action (or inaction) of water prevented the formation of firm land.

The pathologies of the maps' empty spaces overlapped on the Mekong's floodplains. Flat, wet and covered in more than a metre of floodwater for months, these areas were in every way the ontological opposite to Taillafer's dry, fertile islands. On early colonial maps, the geographic space annotated as "*plaine inondée couverte d'herbes*" or "*plaine d'herbes couverte d'eau*" extended from Cambodia to the western doorstep of the French administrative capital in Saigon. Cartographic zones of the colony alluding to particular characteristics of the terrain, presented the extent encompassed by the "*Plaine des Joncs*" as equivalent to the water-logged ground on either side of the Mekong [**Fig 8.2**]. However, the chosen name did not

14 *"Si l'on jette les yeux sur une Carte de Cochinchine, on verra des espaces immenses, presque sans nom de villages, et portant la mention: marais incultes, plaine de joncs."* Jules Harmand (1874), *Aperçu pathologique sur la Cochinchine*, Versailles: Impri. Aubert, p. 14.

15 Siobhan Carroll (2015), *An Empire of Air and Water: Uncolonizable Space in the British Imagination, 1750-1850*, University of Pennsylvania Press, p. 6.

describe a grass-covered extent. While today trees are a rare sight, historical botanic research describes a region covered with clusters of *melaleuca* forest with grass limited to only a few areas.[16] Rather, as naval captain Pauline Vial noted, colonial references to vegetated plains indicated a generic 'overgrown' and unproductive region, an *atopia* centred on the deep geological depressions "occupied by marshes".[17] The perceived disorder of these peripheral landscapes was further compounded by the absence of solid ground to pursue those resisting colonial rule. Citing the area known as "*la plaine de joncs*", the colony's official newspaper described the hiding place of "agitators" such as Võ Duy Dương whose stronghold was located in the ruins of *Thap Muoi*, north of the river. Surrounded by swamps, pursuing armies needed to laboriously wade through the stagnant water, making the exercise of military control almost impossible and the wet condition of the ground tantamount to a state of lawlessness. From the viewpoint of the newspaper's journalist, the plain was located as far from colonial authority as if it was beyond the colony's frontiers.[18]

When later these frontiers were finalised along the Vinh Te canal, they delivered a new geographic focus for cartographers and administrators which required depictions of the terrain to adopt new toponyms and subdivisions. On these maps, the annotation *Plaine des Joncs* was used to signify only the inundated land within the boundaries of French Cochinchina and north of the Mekong.[19] Yet in relation to the entire extent covered by floodwater, the geographic space that could be identified as constituting the floodplain was not immediately evident. The observable and thus recordable condition of the ground during wet season rains was not a phenomenon limited to a particular type of landscape or a single distinguishable terrain. Drawn by Algerian-born engineer Albert Pouyanne, the limits of inundation appeared to cover the majority of the colony's surface area,[20] differentiating a particular geographic space from what he considered an immense plain with only minor topographic undulations [**Fig 8.3**].[21] The planimetric depiction of the flood's maximum extent however did not just differentiate

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16 Le Cong Kiet (1993), *Dong Thap Muoi: Restoring the Mystery Forest of the Plain of Reeds*, Restoration & Management Notes, v. 11, n. 2, p. 102-103.

17 "*Entre les différents bras des fleuves existent de profondes dépressions du sol occupées par des marais.* [...] *Ce sont d'immenses fondrières sur lesquels poussent des joncs, des plantes aquatiques et des forêts d'un arbre épineux, à l'écorce blanche, au feuillage rare que l'on nomme le Tram. On désigne ces plaines improductives sous le nom générique de Plaines des joncs.*" Paulin Vial (1874), *Les Premières années de la Cochinchine, Colonie française*, Paris: Challamel Ainé, p. 31.

18 "*Quand toutes les préoccupations des habitants se portent vers le commerce et l'industrie, les excitations des agitateurs qui se sont réfugiés dans les bois et la plaine de joncs ou qui se cachent au delà de nos frontières ne sont plus que des menaces vaines et puériles.*" *Partie non officielle (Saigon, 5 novembre 1865)*, Courrier de Saigon, Journal officiel de la Cochinchine Francaise, n. 21, Novemebre 5, 1865, p. 2.

19 In his collection of local folklore, the Vietnamese historian Nguyễn Hữu Hiếu points out that parts of the flat, annually-flooded region north of the Mekong, were known by different names prior to French colonization. Nguyễn Hữu Hiếu (2018), *Văn hóa dân gian vùng Đồng Tháp Mười (Folklore in the Dong Thap Muoi region)*, Nhà xuất bản: Văn hóa - Văn nghệ, http://nxbvanhoavannghe.org.vn/van-hoa-dan-gian-vung-dong-thap-muoi.html

20 In his 1911 *Atlas Cochinchine*, Pouyanne does not mention the delta as the site of the hydrological phenomena which his maps and plans depict. While it is certain that the future Inspector of Public Works would have been aware of the term, the absence of any mention of the river's delta in the context of Cochinchina suggests this was either not an important hydrological factor or that, at the time of writing, this was not a widely used reference for parts of the colony. See Albert Pouyanne (1911), *Voies d'eau de la Cochinchine*. Saigon: Impri. nouvelle.

21 "*Toute la basse Cochinchine, don't la superficie attaint environ 4 million d'hectares, constitue une immense plaine qui presente de tres faibles ondulations*" Albert Armand Pouyanne (1926), *Inspection générale des travaux publics*, Impri. d'Extrême-Orient, p. 98.

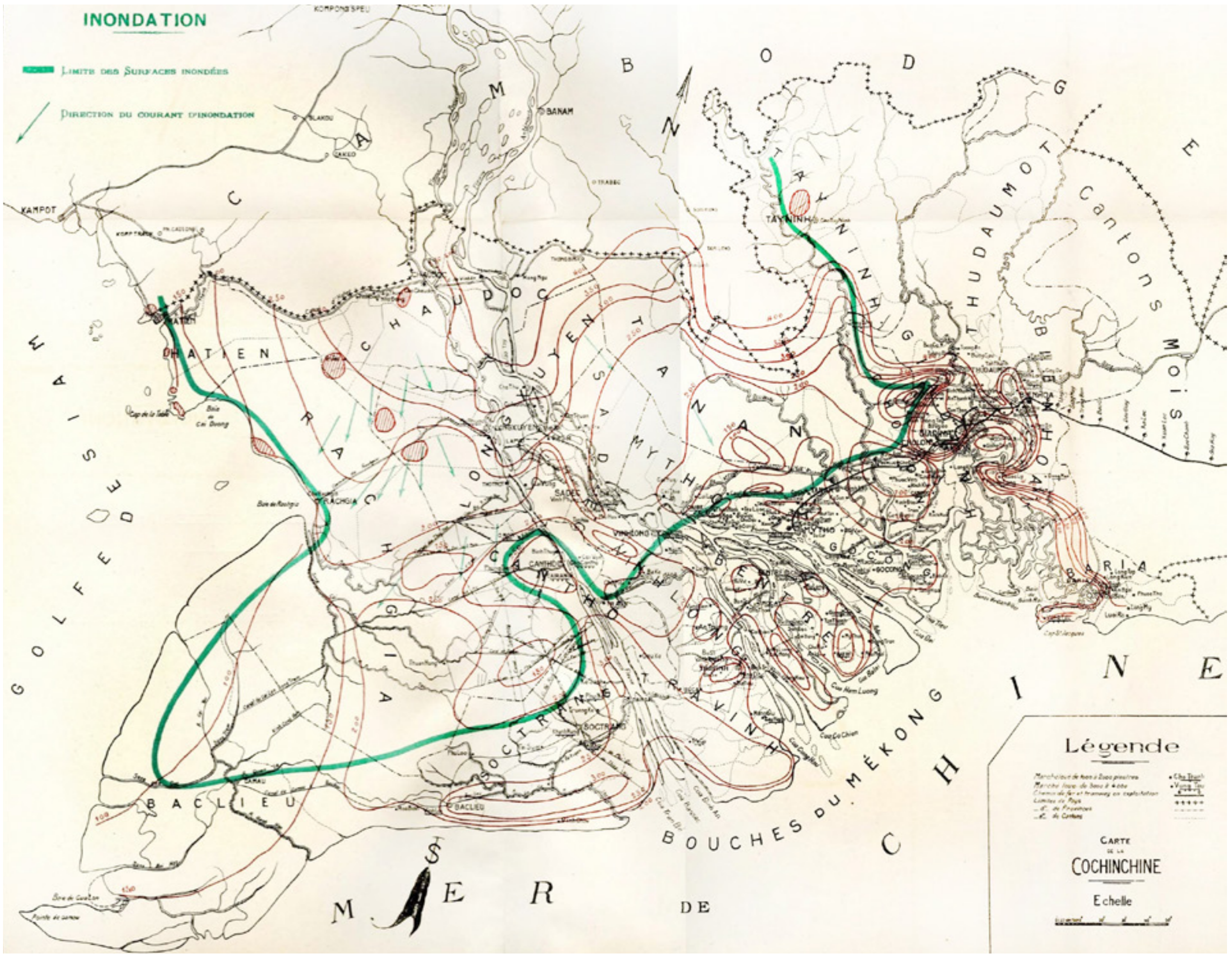

Fig 8.3 Inundation in French Cochinchina Encompassing a significant proportion of the entire colony, the green line displays the limits of the geographic space covered by floodwater during the wet season.
Pouyanne (1911), *Inondation.*

between areas of seasonal wetness and dryness. Within the cartographic limits of inundation, regions with notable topographic, historical or cultural differences were all presented as unified by the impact of a single phenomenon.This apparent unity however was only temporary, and contradicted the different rates at which particular areas became inundated or drained. For an engineer like Pouyanne the delineated area experiencing inundation was not just the record of a particular condition. Later appointed colonial Inspector of Public Works for all Indochina, he identified the problems related to flooding in the Red River Delta as the focus of the colony's public works projects. Referencing the dangers to agriculture and villagers' lives from floods, the mapped outline of inundated land clarified the colonial engineer's primary *area of operations*.[22] On Pouyanne's maps of Cochinchina's hydrology, the entire collection of waterways within the colony were presented as part of a single system that could be designed concurrently. New canals such as the Duperré or Lagrange which allowed uninterrupted navigation between the Mekong and Vaico rivers, were therefore connections within the same hydraulic network as well as waterways linking two different river basins.

22 "*La question des inondations et des crues du Fleuve Rouge et celle des travaux de défense contre les inondations sont d'une importance primordiale pour le pays". ibid,* p. 130. Pouyanne noted the disasters caused by breaches in the casier flood defences of Tonkin and the importance of inundation for agriculture.

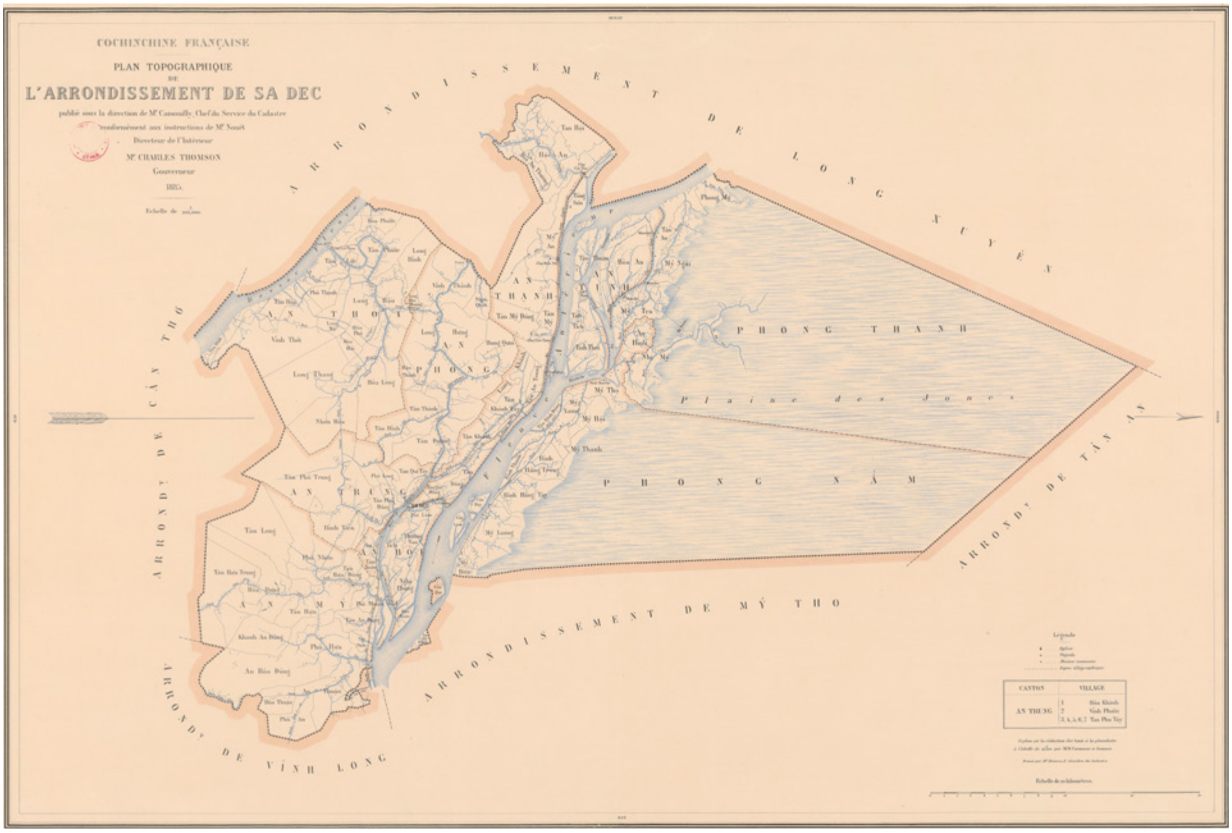

Fig 8.4 Province of Sa Dec Depicted as neither dry land nor as the same water flowing through rivers, the Plaine des Joncs is shown as a homogeneous surface permanently covered by inundation.
Camouilly & Boisson (eds.) (1885), *Plan topographique de l'arrondissement de Sa Dec,* Paris: Impri. Lemercier.

If areal depictions of the flood alluded to a single terrain confronted with similar problems, new administrative subdivisions appeared to fragment the floodplain [**Fig 8.4**]. As the French consolidated power in Cochinchina, districts (*arrondissments*) used to qualify the extent of subregional governance, subsumed control of the Plaine des Joncs' amorphous ground within a regional hierarchy that privileged the drier, higher landforms around rivers. With the notional centre of the map focused on the banks of the Mekong where settlements were overwhelmingly located, on maps, the Plain appeared as a permanently submerged hinterland on the margins of civilization. By the first decade of the 20th century however, the area's peripheral relationship to the colony's social and economic life had begun to change. Hundreds of kilometres of canals had been excavated around the southern and eastern edges of the swamp, enabling army gunboats to patrol throughout the year and new agricultural land to be farmed.[23] To construct the canals, slow mechanical dredgers sliced through the compact clay soils in continuous straight lines that paid little attention to topographic nuances. These public works became a key feature of colonial maps, on which their colossal scale seemed to rival the length and importance of many natural waterways. Crossing the empty spaces of the map, the solid blue lines representing the canals, filled the void with the man-made geometry of water [**Fig 8.5f**]. And, by appearing to restrict the presence of water in the landscape only to the canals and rivers,

23 David Biggs (2008), *Breaking from the Colonial Mold: Water Engineering and the Failure of Nation-Building in the Plain of Reeds, Vietnam,* Technology and Culture, Vol. 49, No. 3, Water.

later maps also suggested that the ground around these manmade waterways was, if not totally dry, then at least in some way modified to manage wetness.

The archaeology of limits

As new routes were cut through the swamps to permanently change the floodplain's hydrology, the production of geographic but also historical knowledge of the region was promoted in new colonial institutions. While geography had been part of the *Academie*'s epistemic disciplines since 1730, in France, the first university department was created in 1873 and Vidal de la Blache appointed as Chair.[24] Pierre Singaravelou has described how the study of the geography of France's colonies (*colonial geography*) accelerated towards the end of the 1800s, with Vidal and his students playing a key role in shaping the curriculum taught at universities as well as Paris' *École coloniale*.[25] Characterised by the rejection of political boundaries as the spatial extent of geographic study, Vidal's 'regionalist' approach became increasingly influential in the way colonies such as Indochina became known to European audiences. Founded in Hanoi at the turn of the century, the French School of the Far East (*École française d'Extrême-Orient*; EFEO) concentrated its researchers' attention on knowledge of "oriental" cultures. Especially after 1930, colonial scholars at the EFEO addressed Indochina's growing social and economic problems which included the movement of thousands of migrants to Cochinchina, by examining these problems in

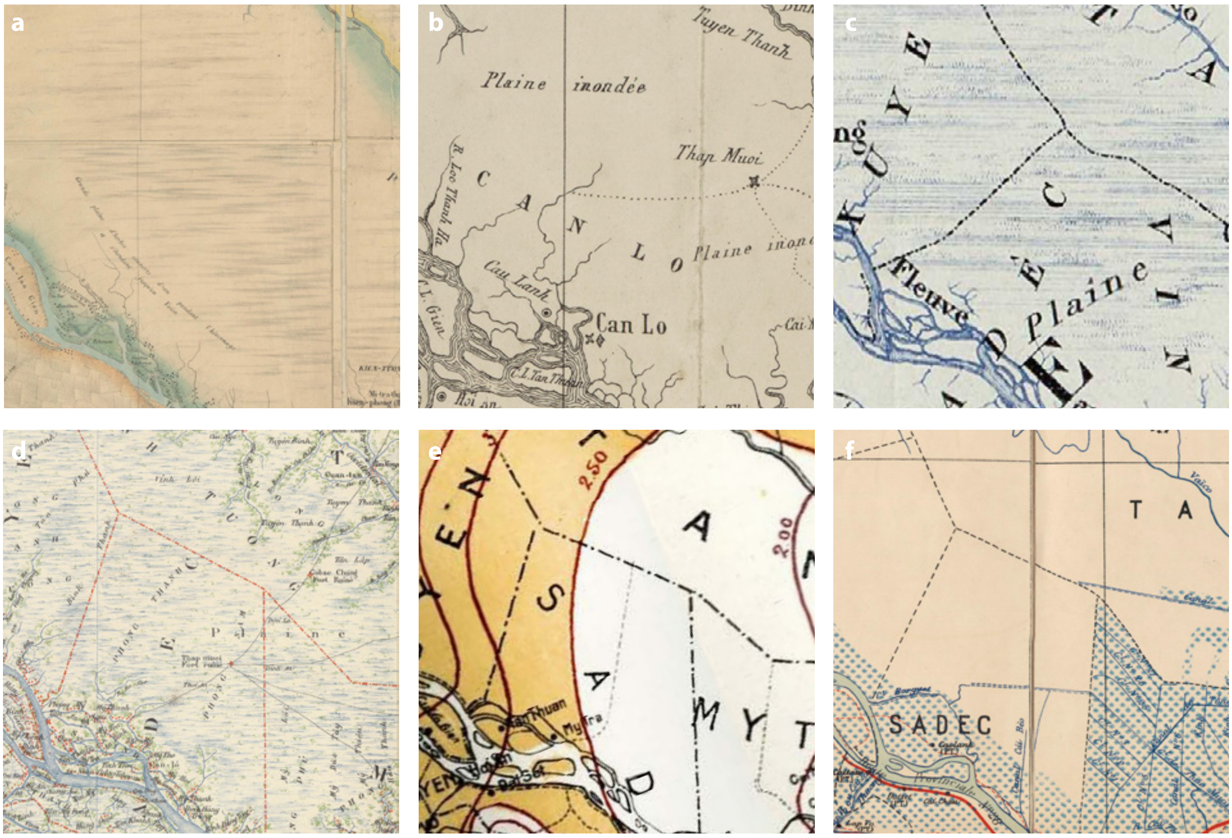

Fig 8.5 Excerpts of maps showing the Mekong's north floodplain What was considered relevant to include in a map of the Plain of Reeds was not necessarily consistent with the collection of new geographic information. Major landmarks such as Thap Muoi (5b) do not appear in all subsequent depictions (5c, 5e and 5f), while the configuration of rivers connecting to the Mekong (bottom left) or the Vaico (top right) also change from map to map.
(a) Manen & Heraud (1863), *Basse Cochinchine*; (b) Challemel (ed.) (1868), *Cochinchine, Possessions Françaises*; (c) Challemel (ed.) (1878), *Carte générale, Cochinchine Française*; (d) Challemel (ed.) (1901), *Carte de la Cochinchine Française*; (e) Pouyanne (1910); (f) Service de Travaux Publics (1926), *Carte routiere de la Cochinchine.*

relation to the natural setting in which they appeared.[26] Part of the EFEO's scope, historical studies presented the colony's distant past as a function of Southeast Asia's mutual influence from India and China. Facilitated by the inclusion of both Cambodia and Cochinchina within French Indochina, cross-border historical research published in the EFEO's bulletin, examined new and available archaeological evidence in relation to the topography of the Mekong's monsoonal lowlands.

Translated by the EFEO's most eminent archaeologist Georges Coedès, an inscribed stela found in the Plaine des Joncs, revealed the royal lineage of a religious "domain conquered on the mud" of the floodplain.[27] The vivid reference to the condition of the ground in relation to a controlled domain, suggested the relative autonomy of the region's *mandala* polities but also the sense that qualities of the topography were critical to understanding the location and perhaps the dimension of that control. Conjectured to be part of the prehistoric "kingdom" of Funan noted in Chinese annals, the archaeological remains of *Thap Muoi* (Prasat Pream Loven in Khmer) where the stela had been discovered, were given a new geographic dimension with the advent of aerial photography. The assemblage of aerial images taken in the late 1920s allowed provincial administrator and amateur archaeologist Pierre Paris to identify older canals connecting distant locations of the Mekong's lowlands [**Fig 8.6**].[28] Although parts of these structures were already known from ground-level observations, the mapped routes of the ancient waterways appeared to converge on the inhabited mounds of Thap Muoi to the north, and the hill of Ba Thê in the Mekong's southern floodplain. Close to the hill, an archaeological expedition funded by the EFEO in the 1940s uncovered the ruins of a major urban settlement. In the eyes of the expedition's leader Louis Malleret, the canals did not only enable communication but by draining floodwater also 'removed' the toxic levels of acid sulphate from the soil that inhibited the cultivation of rice.[29] Drawn in relation to the limits of inundation, archaeological sites on Paris' map appeared to be strategically situated on the edge of the floodplain. And with the canals' location framed within the outline of the seasonal movement of surface water, the map presented a prehistoric domain associated with the flood's coverage.

The significance of these discoveries was pointed out by geographer Pierre Gourou. Writing as France's post-war hold on Indochina was collapsing, a short article published in the *Annales de Géographie* discussed the historical succession of landscapes in Cochinchina. Framing current conditions as a continuity with the distant past, the article pointed out that "today [1950] the sites occupied by these

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24 Yves Lacoste (2012), *Geography, Geopolitics, and Geographical Reasoning*, Hérodote, v. 146-147, n. 3-4, p. V.

25 Pierre Singaravelou (2011), *The institutionalisation of 'colonial geography' in France, 1880-1940*, Journal of Historical Geography n. 37, pp. 150-151.

26 Biggs (2012), p. 105.

27 *"Tout ce que l'on peut tirer du texte, c'est que le roi père de Gunavarman était de la race de Kaundinya, et qu'il avait mis son fils à la tête d'un domaine « conquis sur la boue », c'est-à-dire évidemment récupéré par drainage et assèchement sur les alluvions du Mékong qui constituent l'actuelle Plaine des Joncs."* Georges Coedès (1931), *Etudes cambodgiennes. XXV, Deux inscriptions sanskrites du Fou-nan. XXVI, La date de Kôh Ker. XXVII, La date du Bàphûonm.* Bulletin de l'Ecole française d'Extrême-Orient, v. 31, p. 2.

28 Pierre Paris (1941), *Autres canaux reconnus à l'Est du Mékong par examen d'autres photographies aériennes (provinces de Châudôc et de Long-xuyên).* Bulletin de l'Ecole française d'Extrême-Orient, v. 41.

29 Louis Malleret (1951), *Les fouilles d'Oc-èo. Rapport préliminaire*, Bulletin de l'Ecole française d'Extrême-Orient, v. 45, n. 1, pp.80 & 88.

cities are almost uninhabitable."[30] Based on Malleret's thesis, Gourou claimed that it was the "large hydraulic organization" that had made civilization on such a scale possible in the inundated terrain. In this scenario, the flood's seasonal sediment deposits also required the canals to be regularly maintained and, Gourou conjectured, this lack of regular maintenance - caused by political unrest - was the reason these canals and their associated settlements had been abandoned more than 1000 years ago.[31] For Gourou, the societal value of these ancient structures was therefore comparable with the benefits of the modern program of hydraulic organization inaugurated by the French, implicitly associating the flood with the potential for civil unrest, and the canals with the manmade colonial 'order'. Specified as the context for historical discourse, the floodplain was framed as a

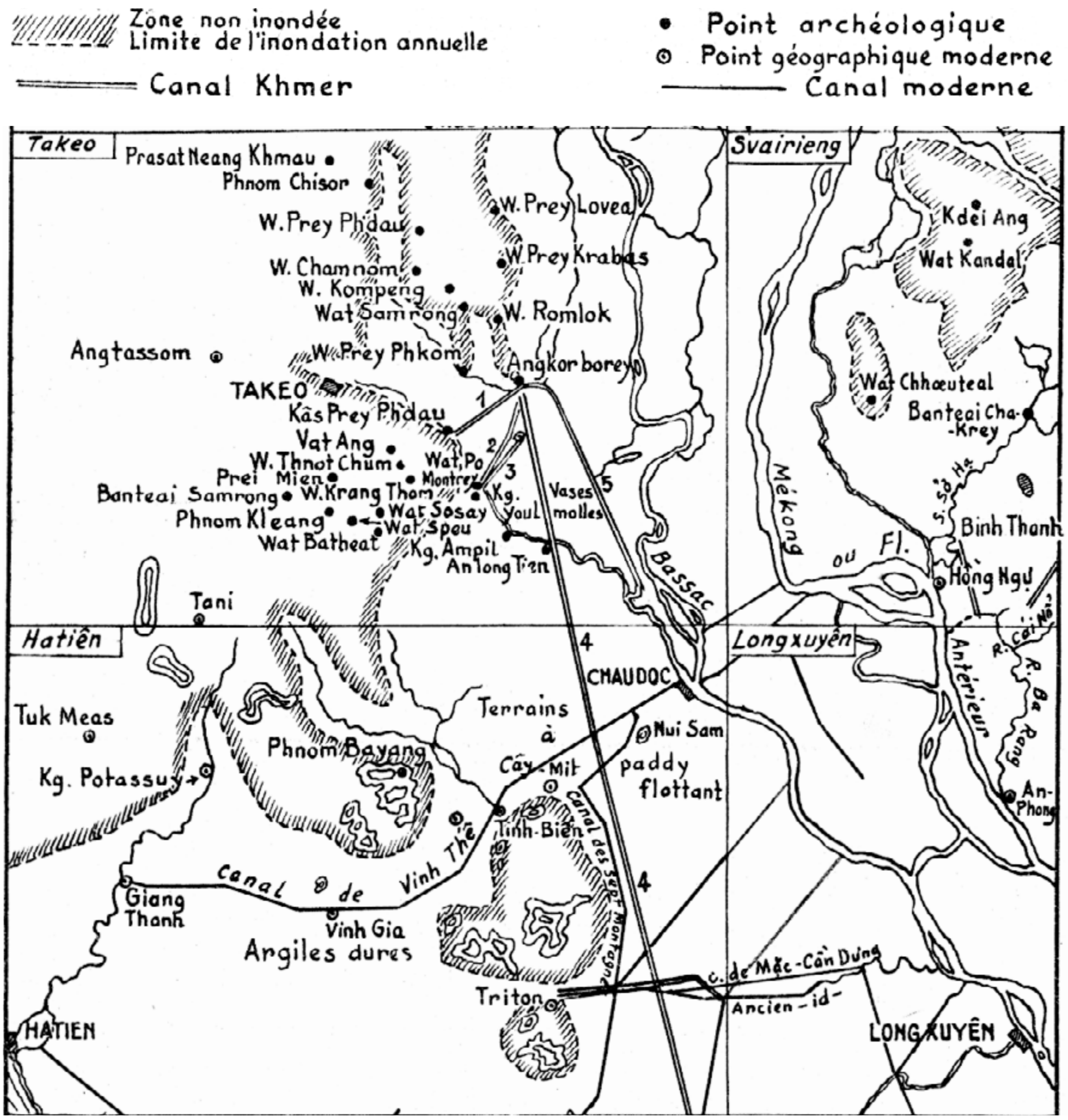

Fig 8.6 Excerpt from a map indicating ancient canals Traced over aerial photographs, the map depcits the location of ancient canals in relation to the limits of the flood. Drawn in relation to the limits of the flood rather than colonial boundaries, these appear to radiate from Angkor Borey in Cambodia to the floodplains of Cochinchina. Note that Thap Muoi and the ancient canals in the vicinity are in the middle right of the map. Note that the majority of the archaeological "points" (black dot) are situated on the edge (but outside) the floodplain.
Pierre Paris (1941), *Traces de canaux Khmers dans les provinces de Treang et Baphnom,* Fig. 5.

distinct landscape in which modern canals were just the latest iteration of a long lineage of infrastructure works considered necessary for inhabiting the inundated lowlands.

Yet the experience on the ground was quite different. Excavation of the canals in the Plaine des Joncs had indeed accelerated the rate at which the floodplain drained. However the patchwork of new dry zones that appeared in the upstream areas was not uniformly distributed.[32] And although *alum* (acid sulphate) was indeed the result of the naturally-occurring ferrous soils, the oxidization producing toxic level of the substance was exacerbated by the canals' construction, exposing the excavated subsoils to the atmosphere during the dry season before being carried away by the rising water. Thus rather than 'repairing' a natural condition threatening the stability of the colony, the impact of modern canal building on the floodplain was far from uniformly beneficial for local farmers, and only incidentally comparable with the transformation of the inundated *atopia* of the past into a habitable terrain. From this perspective, the areal extent constituted by the limits of the flood was not just the context on which prehistoric settlers and migrant farmers struggled to grow crops. It also encompassed a geography associated with the threat of armed conflict and political unrest and which colonial governance theoretically prevented rather than generated.

Conclusion

Referencing Anne Spirn's *Language of Landscape*, historian David Biggs argues that certain landscape forms such as floodplains symbolize meanings "depending upon the applicable political ideology".[33] This may be true where a lack of topographical knowledge could have indicated the inhospitability of flood-prone areas or a refuge for "rebels". Yet it would also not be enough to imagine a basic hydrological concept onto which social, technical and political ideas were imposed. As a part of the entirety of flooded areas encompassed in an archaeological landscape or an engineer's area of operations, the Plaine des Joncs supported claims regarding a singular terrain threatened by impending danger. Positioned as the Mekong's north floodplain on the other hand, the uninhabitable swamp or the distant hinterland of riverine settlement, was presented as a separate domain. Unlike the "sublime" wasteland which David Cronon has identified with the unexplored American wilderness however, the plain's pathologies were not considered immediately redeemable.[34] And while 'amputation' would be an exaggerated way to describe the notional separation between the Plain and the rest of the colony, the marginalization of this *atopia* was consequential in supporting different ideas referring to the same geographic extent. As it appeared on a map, the planar surface area covered by water could be visually equated with the floodplain's extent. The succession of ground conditions

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30 Pierre Gourou (1950), *La succession des paysages humains en Cochinchine occidentale*, Annales de Géographie,v. 59, n. 313, p. 79.

31 "*Des troubles politiques — qui ont peut-être coïncidé avec la fin du Fou Nan — ont dû provoquer l'abandon des travaux d'entretien ; les hommes ont été chasses par l'inondation croissante.*" *ibid*, p. 80.

32 Olivier Husson (1998), *Spatio-Temporal Variability of Acid Sulphate Soils in the Plain Of Reeds, Vietnam: Impact of soil properties, water management and crop husbandry on the growth and yield of rice in relation to microtopography*, Unpublished PhD thesis, Delft University of Technology, pp. 80-81.

33 David Biggs (2008), p. 603.

34 William Cronon (1996), *The Trouble with Wilderness: Or, Getting Back to the Wrong Nature*, Environmental History, v. 1, n. 1, p. 9.

that followed inundation however ranged from water-logged to relatively dry, until the next rainy season restarted the process. In this sense the delineation of the floodplain's magnitude was fundamentally different to the inclined ground defining the basin or the accretion of sediment describing the delta which changed according to the rhythms of earth's geology. The mapped limit of both a specific space and an annual phenomenon, the floodplain's outline referred to the temporary accumulation of water rather than an extent of land. This accumulation could be understood in terms of the annual sequence of human activities such as agriculture, that were contingent on the changeable condition of the ground. From the perspective of the immense human labour involved in cultivating, inhabiting or domesticating any part of the inundated areas, the floodplain's delineation therefore reflected an intimately anthropocentric conceptualization of the Mekong's riparian areas. The improbability of ever defining an indisputable limit to the floodplain, made the 'accuracy' of the mapped outline secondary to the conviction of the arguments which made its visual presence on the map necessary in the first place.

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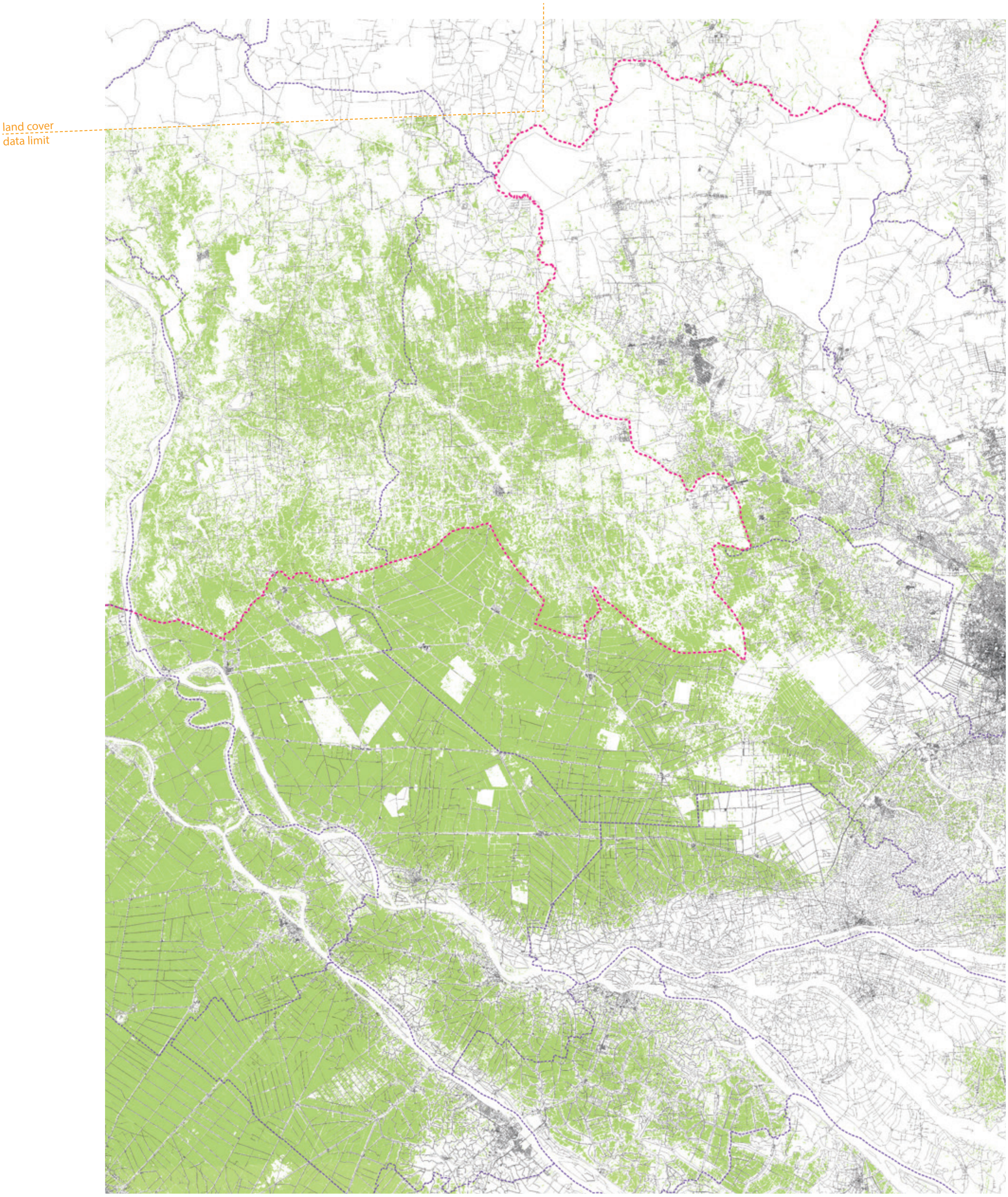

Map H Shaded green, rice agriculture is presented in relation to the national boundary (purple dotted line), province-level administrative units (blue dotted lines) and roads (black lines). Roads often follow the edge of waterways in the Vietnamese section of the floodplain and the relatively higher ground on the Cambodian section. The apparent differences in the concentration of rice paddy on either side of the border are partially a result of the topography, settlement practices and the network of water control.

Author (2022). Spatial data sources: *Openstreet map (OSM, 2021)*; *HRLULC 10m resolution map of the southern region of Vietnam [2017] (ver.18.09)* (Japanese Space Agency (2019); *mrc.SDE.WATER_b_lmbbnd50* (MRC, 2008); *gadm36_Vietnam_0*, *gadm36_Vietnam_1*, *gadm36_ Cambodia_1* (GADM, 2022).

CHAPTER 9 Articulating inundation

A United Nations report of 1959 makes reference to a preliminary plan already existing in 1947 for the opening of 500,000 hectares of land to cultivation in the Plain of Reeds. This was to be accomplished by the erection of a dike to separate the Plain from the Mekong River so as to control flooding, and by the digging of a number of canals to facilitate drainage.

The development of the Plain of Reeds: Some politico-military implications, Victor Croizat, 1968

Although the risks associated with the Mekong's floodplain pervaded colonial references to the phenomenon of wet-season inundation, floods were not considered a problem everywhere. Differentiated from the *mùa lũ* (flood season) associated with natural disaster in the Red River Delta, *mùa nước nổi* (the water-rising season) in the Mekong Delta typically heralds the arrival of fertile sediment deposits critical for agriculture.[1] As colonial atlases from the turn of the century show however, topographic conditions and the annual variability of floodwater volumes, meant that some areas were affected more often and for longer than others [**Fig 9.1**]. Yet even in those geological depressions where floodwaters receded more slowly, conditions varied. The floodwaters which appeared to extend Tonle Sap's size during the wet season also created the conditions for fish to spawn, supplying local residents with food for the entire year. In the Plaine des Joncs on the other hand, wet season inundation sustained expansive marshlands which were widely considered inhospitable for human habitation. Thus if the mapped limits of floodwater defined the extent of geographic space subject to the threat of inundation, they also suggested the delineation of particular regions which could presumably also be characterised by the activities of a group of people taking place within the floodplain. In the Plain of Reeds however, submerged surfaces did not necessarily equate with one single type of terrain or a particular group of people. Not only did Vietnamese and Khmer residents of the Plain live on both sides of Cambodia's border with Cochinchina. Melaleuca forests, stagnant pools of giant lotus, mounds of accumulated sediment and concentrations of toxic acid sulphate soils created diverse ground conditions that enabled or constrained human activities. For French as well as American cartographers, mapping these characteristics was not just a matter of recording their location and extent. Underpinned by maps that assigned a specific magnitude to the floodplain's catchment area, the answer to the question of where flood phenomena occurred was critical to establish the 'site' for new development as well as the control of surface water. Taking place 40 years apart, the chapter examines two attempts to delineate the Plain of Reeds that unfolded under significantly different political contexts and that employed different cartographic techniques. Taking into consideration the way the threat of inundation became the plan for a specific course of action to mitigate the perceived risk, the chapter asks whether the articulation of wet and dry areas on the surface of the map was the justification for controlling the flows of people as well as floodwater.

1 Judith Ehlert (2012), *Beautiful Floods: Environmental Knowledge and Agrarian Change in the Mekong Delta.* Vietnam, ZEF Development Studies v. 19, Zurich & Berlin: LIT, p. 69.

Challenging flatness

Having consolidated their colonial empire in Southeast Asia at the end of the 19th century, the work of mapping French Indochina was undertaken by the *Service Geographique d'Indochine*. Beginning with Tonkin and the Red River Delta in the first decade of the 20th century, new surveys expanded the scope of cartographic knowledge southwards, reaching Cochinchina in the early 1920s.[2] For the colonial administration, maps of deltas drawn at the scale of 1: 25000 were considered particularly useful for the planning of water infrastructure and the cadastral operation necessary for tax collection.[3] Yet for many colonial geographers, the Service's cartographic representations were also critical to understanding the qualities of the landscape (*paysage*).[4] The importance of the landscape for the study of social relationships was framed in the geographic discourse of Paul Vidal de la Blache. Influential for the study of geography in France and the colonies during that period,[5] Vidal viewed the landscape as the product of a process of adaptation by a group of people to particular features of their natural surroundings (*milieu*). Using large-scale topographic or geological maps, the science of geography could deduce the "human dimension" of the *milieu* and identify the restrictions imposed by the *milieu* on that group of people.[6] Thus, although Vidal warned that cartography could not fully explain all the facts,[7] for those geographers seeking to define the different relationships between people and the colony's ground, the Service's new maps were important documents that could give insights into existing social conditions.

In this context, the most well-known studies of Indochina's geography began to appear towards the end of the 1920s. Following the principles of 'Vidalian'

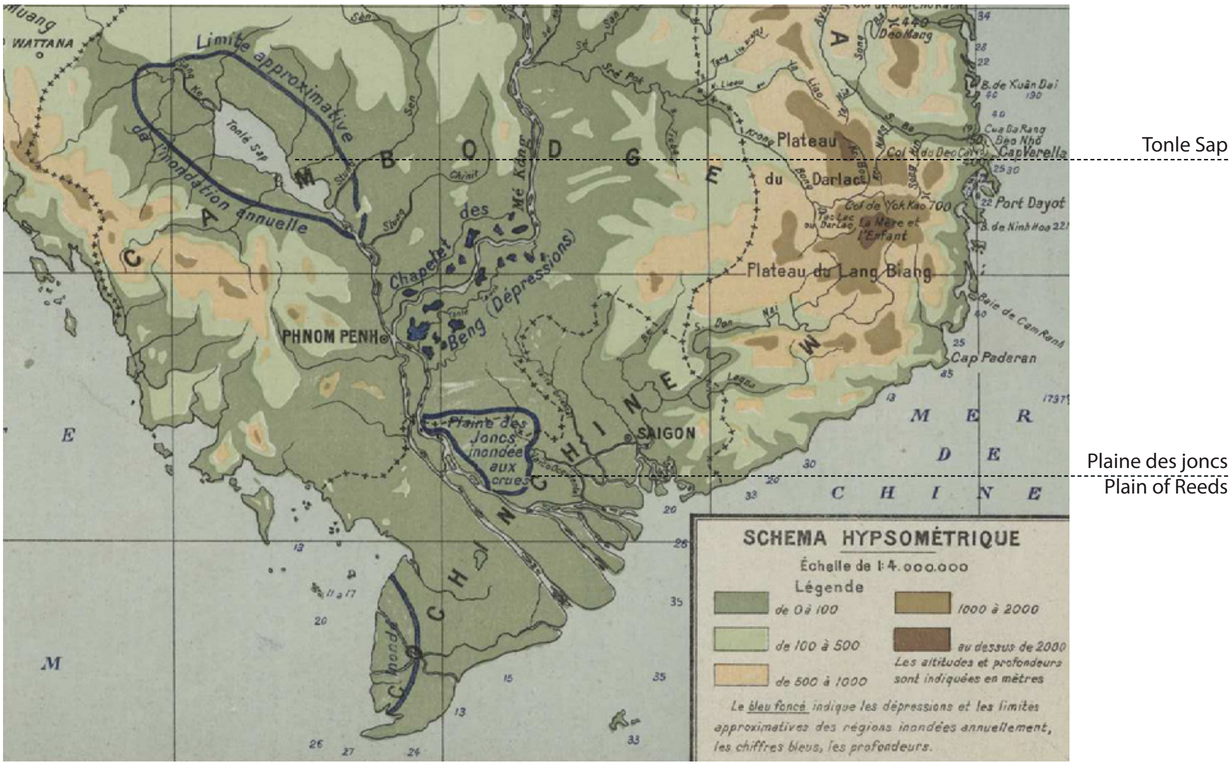

Fig 9.1 Inundated regions Extracted from a colonial atlas published in 1914, the map shows the topography of French Indochina and identifies the geological depressions (dark blue outline) affected annually by inundation. Note that the denotation of the Plaine des Joncs is restricted to the area encompassed by the flood. Also note that inundation in the southwest corner of Cochinchine is caused by tidal fluctations as well as precipitation but not the Mekong's flood.
Gouvernement général de l'Indochine (1914), *Essai D'Atlas Statistique de l'Indochine française* , Hanoi: Impri. d'Extrême-Orient, Carte n.1.

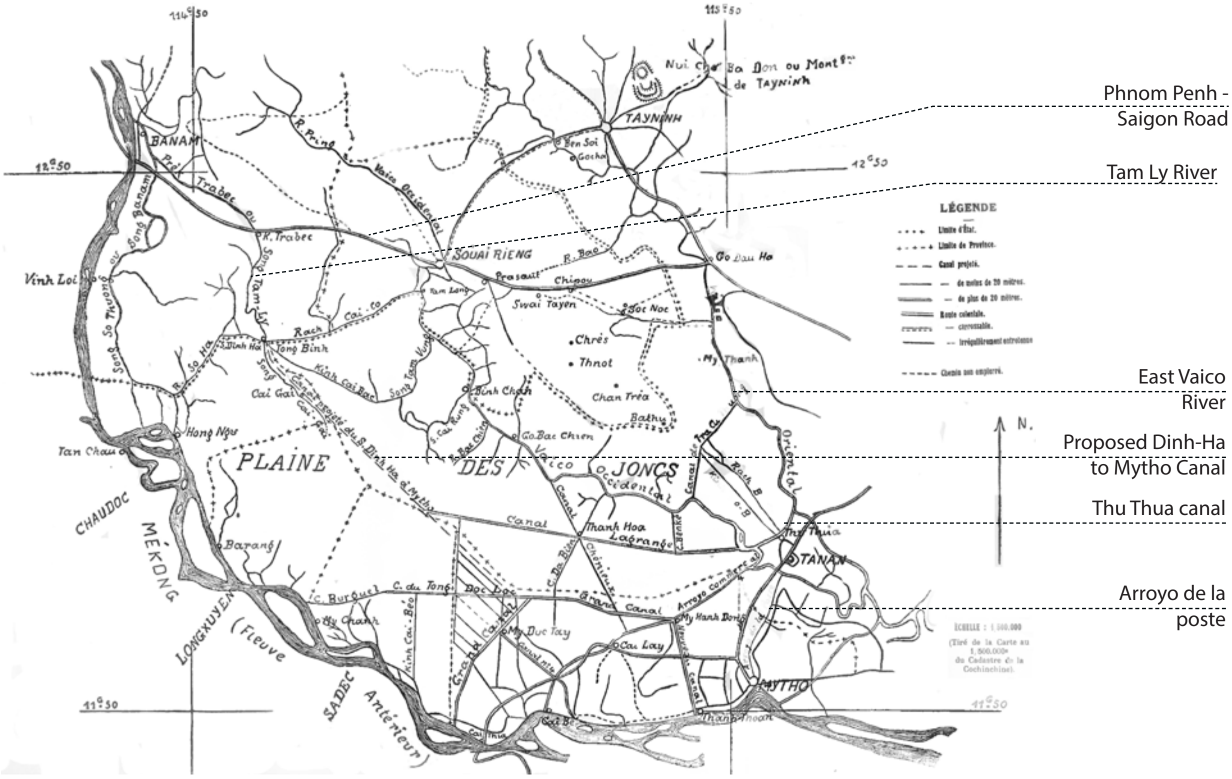

Fig 9.2 Map of the Plaine des Joncs Delahaye's cartographic depiction of the floodplain shows the main natural and manmade waterways, major settlements and roads. The Plaine des Joncs is delimited by the Phnom Penh-Saigon Road to the north, the East Vaico to the east, the Mekong river to the west and to the south the *Thu Thua* canal and the *Arroyo de la Poste*. Note the proposed diagonal canal (Dinh-Ha to Mytho) extending northwest from the Lagrange canal.
Delahaye (1928), Planche 1.

geography, both Charles Robequain's investigation of the Thanh Hoa delta (1929) and Pierre Gourou's research of the peasants in the Red River's delta (1936) were significant for applying a "French science into a landscape hitherto unstudied in France".[8] But while these studies focused on the historically densely-populated deltas in the north of Indochina, the geographic research of Victor Delahaye focused more specifically on the sparsely inhabited ground of the Mekong River's floodplain [**Fig 9.2**]. Entitled *La Plaine des Joncs et sa mise en valeur*, Delahaye's

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2 Gouvernemeni général de l'Indochine (1931), *Service géographique de l'Indochine. Son organisation - Ses methodes - Ses travaux*, Exposition coloniale internationale, Paris 1931, Hanoi: Impri. d'Extrême-Orient, p. 22.

3 *"Dans les deltas, une carte au 25.000°, à l'altimétrie basée sur un nivellement direct, a été reconnue nécessaire, pour préparer les travaux de canalisation, d'irrigation, et faciliter la tâche du cadastre." ibid,* p. 14.

4 See for example Charles Robequain (1926), *Gouvernement général de l'Indochine. Service géographique. Année 1925. Compte-rendu annuel des travaux exécutés par le Service giographique de l'Indochine,* Bulletin de l'École française d'Extrême-Orient, v. 26, p. 388.

5 Regarding Vidal's influence on colonial geography see Pierre Singaravelou (2011), *The institutionalisation of 'colonial geography' in France, 1880-1940,* Journal of Historical Geography, n. 37, p. 154.

6 Guy Mercier (2009), *Vidal de la Blache, P.*, in Rob Kitchin & Nigel Thrif (eds.), *International Encyclopaedia of Human Geography*, v. 12, p. 148.

7 *"... car la cartographie, si variés que soient ou que puissent devenir ses moyens d'expression, ne saurait suffire à l'explication des faits. Ces noms assemblés, ces lignes de demarcation tracées sur une feuille de papier recouvrent*(...) *parfois des différences tells qu'une interprétation attentive des faits qu'ils expriment est seule capable d'introduire la clarté."* Paul Vidal de la Blache (1898), *La Géographie politique, à propos des écrits de M. Frédéric Ratzel*, Annales de Géographie, v. 7, n.32, p. 111.

8 John Kleinen (2005), *Tropicality and Topicality: Pierre Gourou and the Genealogy of French Colonial Scholarship on rural Vietnam.* Singapore Journal of Tropical Geography, v. 26, n.3, p. 341.

doctoral thesis was published in 1928, and was one of the few on colonial geography conducted by a French military officer.[9] Stationed in the Plaine des Joncs, his examination of this "very distinct and original small region", was based on personal observations and first-hand experience of the annual flood. Similar to Robequain and Gourou, the study of the region was accompanied by photographs, planimetric sketches and the classification of local villages into types. Yet unlike those other studies, Delahaye's goal was not merely to describe an existing condition. Narrating his experience during the flood of 1923, he noted how farmers remained in their homes until finally, overwhelmed by the force of the current, they were forced to flee in despair. Proposing specific interventions that would drain floodwaters and ultimately allow cultivation on the Plaine des Joncs, Delahaye chose to focus his research on the cartography of the floodplain in order to formulate and verify the technical feasibility of his proposals.

Imagining the view from an airplane, Delahaye's introductory description noted the flat "reed-covered" lowlands, the "silver ribbons" of waterways, the plantations and the clusters of melaleuca forest that characterised the topography of the "particularly depressed and very humid zone, which the floods of the Mekong inundate every year."[10] To explain the flood regime he had witnessed, Delahaye turned to a study by the colony's Chief Engineer L.M.J. Bénabenq. Less than a decade earlier, Bénabenq had noted that the rise of floodwaters along the Mekong corresponded with an equal rise along the Vaico two days later, while the waters receded almost simultaneously across the same area.[11] He had also noticed that particularly in east-west canals, flotsam on the surface and the sediment below water would accumulate, rendering many waterways almost unnavigable. Conceptualising the floodplain's catchment area lying between the Mekong and West Vaico rivers and stretching to the border with Cambodia [**Fig 9.3**], Bénabenq hypothesised the existence of an 'outer' tidal zone where nearly all agriculture

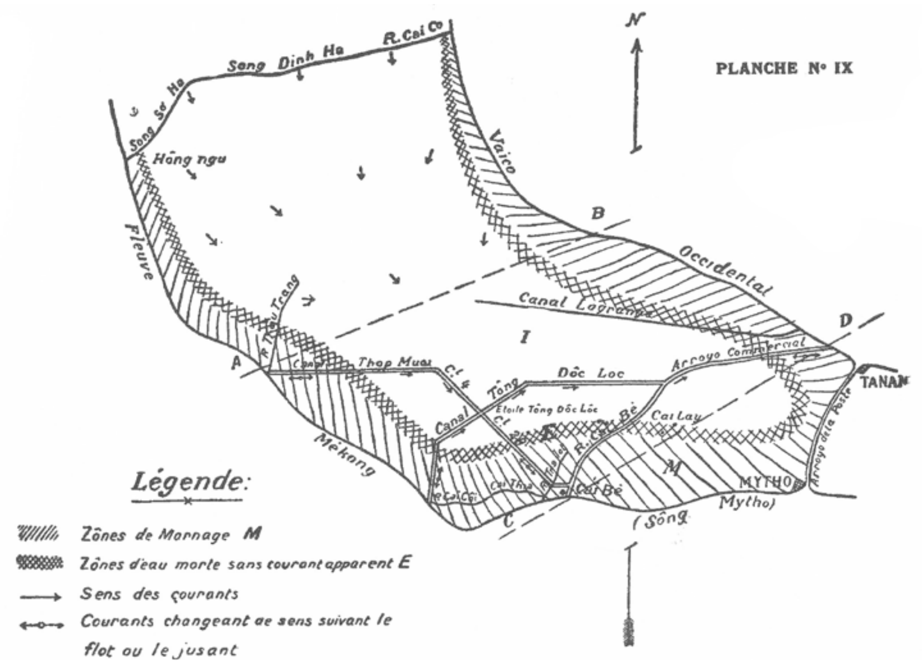

Fig 9.3 The floodplain's catchment Drawn by the engineer Bénabenq, the map presents the catchment area of the Plaine delimited by the Mekong and West Vaico rivers, the waterways along the boundary with Cambodia (north) and the *Arroyo de la Poste* (southeast). The tidal zone (hatch) is bounded by a dead-water zone (crosshatch). Further inland, arrows representing the direction of water flows, shows the flood draining towards the middle of the catchment.
J. Bénabenq (1920), *Crues et inondations*, Bulletin agricole de l'Institute scientifique de Saigon, n. 7. In Delahaye (1928), p. 91.

was located, and an ‘inner’ flooded area that gradually drained towards the middle of the floodplain. On a terrain that was generally perceived as “absolutely flat” and marshy, the subtle changes in elevation that explained the extent of these zones also determined the effectiveness of canals to drain floodwater or to act as transport routes. Knowledge of the floodplain’s gradient was therefore important in understanding the way floodwater moved (or remained still) over the terrestrial surface but also critical if Delahaye’s proposals were to accomplish the goal of draining the Plaine des Joncs and removing the threat of periodic flooding.[12]

The distant perspective which allowed Delahaye to compare the vegetated floodplain with a “billiard table cloth”, contrasted with his experience mapping the ground. A captain in the colonial army, Delahaye’s posting in Cochinchina had taken him on cartographic missions throughout the colony where he had participated in the process of surveying the Mekong’s deltaic lowlands. To challenge the perceived flatness of the floodplain, Delahaye highlighted the significance of *levelling* (*nivellement*). He argued that knowledge of the height of the ground above a notional datum was more valuable than topographic features to understand the flood regime, and therefore essential for the region’s future development.[13] Acknowledging the efforts of surveying officers to map almost half of the Plaine’s 7,000km^2, he was nonetheless highly critical of the *Service géographique*’s attempts to record elevations. He pointed out that the pylons used to triangulate location were sometimes invisible from other surveying stations, and were also moved after monsoonal storms. Individually minor, the cumulative impact of these errors compromised the accuracy of maps, suggesting these were unreliable tools for planning infrastructure on the floodplain. Responding to his own critique, a new map referenced existing elevation measurements taken nearly 20 years earlier at particular points along the region’s few navigable rivers, canals and road [**Fig 9.4a**]. These formed the basis from which to extrapolate the configuration of height contours in the marshy terrain between the two rivers [**Fig 9.4b**]. Considering that in the cartographic ‘gaps’ between transport routes, elevation information was either absent or of dubious quality, Delahaye’s pursuit of levelling suggests that this was not just a matter of accurately representing the ground on the map.[14] Symbolised by the distance between individual one metre contours, the terrain’s gradient indicated a relationship between water and ground that appeared to unfold across more than one hundred kilometres of geographic space. Stretching from the Arroyo de la Poste near My Tho to the

9 Although he fails to mention Delahaye, Singaravelou’s research indicates that between 1909-1942, three colonial officers defended theses on colonial geography at French universities. *ibid,* p. 149.

10 Victor Delahaye (1928), *La Plaine des Joncs (Indochine Française) et sa mise en valeur : etude géographique*. Doctoral thesis, the Faculty of Letters, University of Rennes, Rennes : Impri. de L’Ouest-Éclair, p. 36.

11 *“La montée se propage presque intégralement, c’est-à-dire, qu’à une montée de cinq centimètres de l’origine, côté Mékong, correspond, quarante-huit heures après une montée identique à l’extrétmité côté Vaïco. Par contre la décrue s’effectue Presque simultanément ,sur toute la longueur de la voie considérée. Les differences relevées sont si peu importantes qu’elles ne permettent pas de noter de zones particulières d’écoulement.” ibid*, p. 90.

12 *“Pour que la Plaine des Joncs puisse être mise en valeur, il est évident qu’il faut l’assécher, et, pour cela, éviter les inconvénients de l’inondation périodique, ou mieux, supprimer celle-ci.” ibid*, p. 219.

13 *“Cependant, il faut reconnaître que ce n’est pas tant le travail topographique [...] qui interviendra pour la mise en valeur de la Plaine des Joncs, mais bien plutôt le nivellement dont tout découlera, au vrai sens du mot.” ibid*, p. 17.

14 As Delahaye admitted, between the primary levelling points, the terrain had not been mapped. *“La pente générale ainsi déterminée, reste à considérer les cotes fournies par 1e nivellement général pour toutes les parties qui n’,ont pas encore été levées topographiquement, c’est-à-dire tout l’Ouest de la Plaine.” ibid*, p. 221.

a b

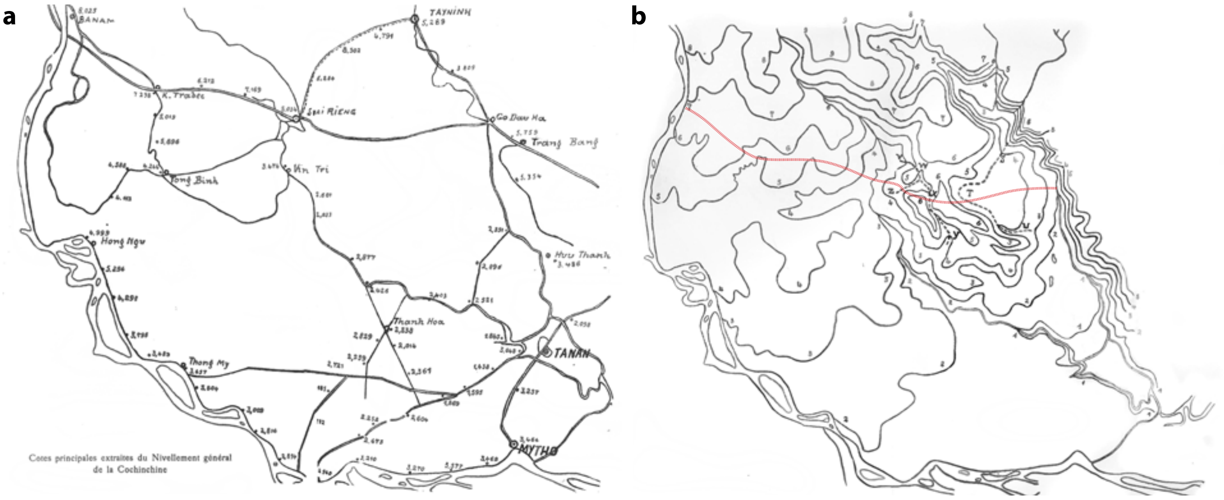

Fig 9.4 Levelling the terrestrial surface To the left, Delahaye's map of the elevations (spot heights) along waterways and canals. To the right, the height contours extrapolated from the elevations. Although the elevation map has signficant gaps between measurements, the contours span the breadth of the region, suggesting knowledge of the entire floodplain. Note that the red line in (b) representing the Mandarin Road is drawn by the author.
Delahaye (1928)

causeway of the so-called Mandarin Road linking Saigon and Phnom Penh in one direction, and from the Mekong to the East Vaico River in the other, the extent of hydrological phenomena rendered visible by these new maps equated with the 'site' of Delahaye's proposals.[15] From this perspective, the topographic elevations presented on Delahaye's map were not merely descriptive of the condition of the ground. Rather, the gradient defined the geographic magnitude of the *inaction* of stagnant water which had perpetuated the widely accepted idea of an 'uncivilisable' *atopia*. In this sense Delahaye's thesis did not so much identify the observable 'human dimension' of the floodplain espoused by Vidalian geography as calibrate the configuration of water infrastructure in relation to the floodplain's catchment.

In a period in which the length of waterways constructed by the colony's Public Works department increased every year, Delahaye's proposed water infrastructure did not just aim to 'dry' the floodplain. During the time he had spent on surveys, Delahaye had observed that the arrangement of small canals excavated by Vietnamese farmers in some parts of the Plain had washed away the toxic acid sulphate soils which prevented cultivation of nearly four fifths of this flood-prone region.[16] Adopting the idea that new canals could eventually allow cultivation of the entire floodplain Delahaye's plan aimed to 'arrest' the primordial flows of the flood at the "origin of evil", and divert them through the floodplain.[17] Referring to the canals as the *absorption system* and their earthen embankments

15 It is worth mentioning that the East Vaico was not consistently seen as the limit of the floodplain's catchment area. Writing a few years after Delahaye's thesis was published, Vietnamese hydrographer Nguyễn Hiến Lê pointed out that from a hydrological perspective the West and East Vaico should be considered separately since the land between them (which at the time included an extensive melaleuca forest) was of a different character than the rest of the floodplain. *"Nhiều nhà địa lí cho Đồng Tháp Mười gồm cả khu ở phía Đông sông Vàm Cỏ Tây vào tới tận bờ Vàm Cỏ Đông, nhưng đứng về phương diện thủy học khu sau đó có tính cách khác hẳn Đồng Tháp, tách riêng nó ra thì phải hơn."* Nguyễn Hiến Lê (2002), *Bảy Ngày Trong Đồng Tháp Mười (Seven Days in Dong Thap Muoi).* Nhà xuất bản văn hóa thông. Online book, retrieved 20 October, 2020.

16 *"Mais celui-ci n'en existe pas moins et son abondance rend, actuellement, nous le répétons, toute culture impossible sur les 4/5 de la région envisage [...] Pourtant le mal n'est pas sans remède. DéJà certains «nhà-qués» [Cultivateurs* (...)

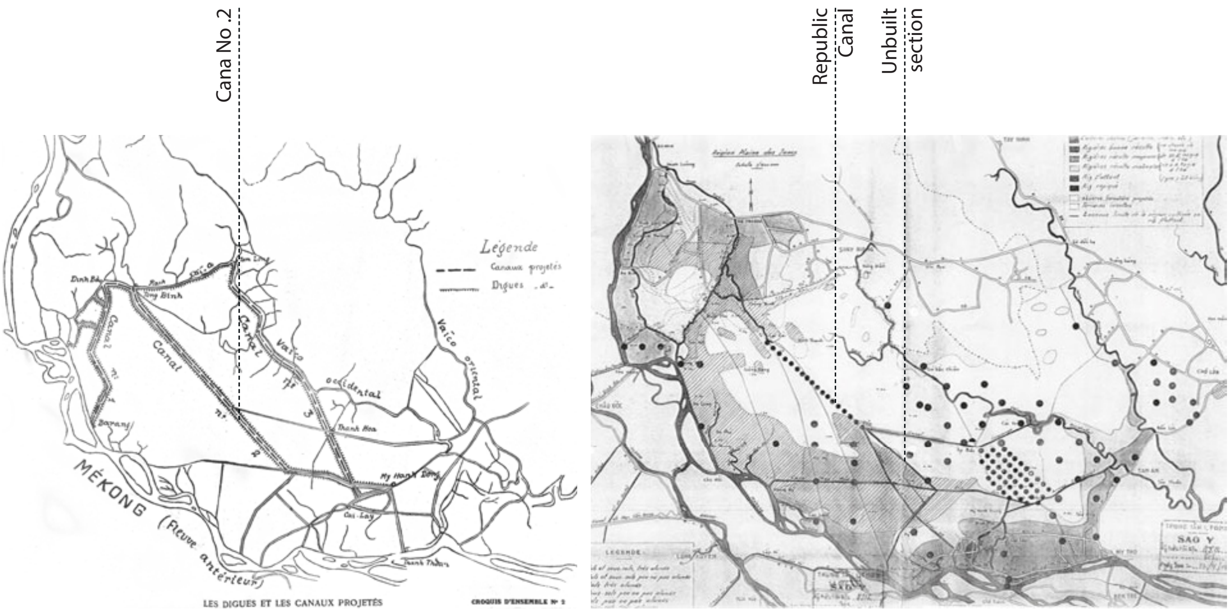

Fig 9.5 Draining the floodplain To the left, Delahaye's 1928 map showing the canals that would "dry" the floodplain. On the right, the map "shows major canals and different areas of cultivation circa 1943, with the dots representing soil surveys conducted after 1955". The line of soil surveys corresponds with Canal No. 2. Construction was completed in 1958 as the Republic Canal (*Kinh Cộng Hòa*), providing a route for troops to access the vulnerable border area with Cambodia.
Delahaye (1928), *Croquis d'ensemble*; Biggs (2012), Figure 28, p. 182, credited as *Aménagement de la Plaine des Joncs: Carte des cultures, Annexe no. II jointe au rapport de l'ingenieur des P. C. Jammé*, file 312, Bộ Giáo Thông Công Chánh, Trung Tâm Lưu Trữ Quốc Gia II, Hồ Chí Minh City.

as the *protection system*, his proposals were carefully crafted to follow the nuances of the ground's mapped undulations. Deploying a flood barrier (*digue*) along the natural waterways forming the boundary with Cambodia, all three canals in his development plan extended southwards from the meanders of natural waterways. Reinforced with high embankments, these waterways would be converted into monumental drainage channels that collectively evacuated all the floodwater to the sea [**Fig 9.5**]. Where excavation was required, new waterways would follow the slope of the terrain and, with the information provided by levelling, maximize the height difference between the canal's two ends. Adherence to the 'reality' presented by the gradient was particularly emphasised for Canal No. 2. A proposed waterway that had originally appeared on a 1: 500,000 cadastral map of Cochinchina, the route of the *Dinh-Ha to Mytho Canal* was incorporated in the plan after meeting all the conditions with regard to gradient which Delahaye had set for his own proposals.[18] Extending southeast in the same direction as a natural drainage channel, No. 2 joined the flows of the Tam-Ly River at the boundary with Cambodia with the Lagrange and Grand canals. Positioned in the middle of the floodplain - approximately where Bénabenq had previously hypothesised that floodwaters converged - the embankments of the canal were designed to prevent the diverted floodwaters from overflowing into adjacent areas. Considering that

16 *(...) annamites] sont arrivés à laver leurs terres au moyen de petits canaux recevant les eaux pluviales, chargées de sels après un court séjour à la surface du sol, et les évacuant par la suite dans les «rachs» ou les fleuves voisins." ibid,* p. 40.

17 *"Rappelons d'abord la démonstration - faite au chapitre sur l'hydrograpihie - dans laquelle nous avons montré que l'inondation, venant pour la plus grosse partie du Fleuve antérieur - ou plutôt de ses effluents [...] c'est à l'origine même du mal, de Tong Binh à Hong-Ngu, qu'il y a lieu d'intervenir en premier lieu." ibid,* p. 220.

18 *"Il figure sur la carte au 1 : 500.000- du cadastre de la Cochinchine et porte le nom de "canal projete du song Dinh-Ha à Mytho" bien qu'il u'aboutisse pas à cette ville..." ibid,* p. 223.

No. 2 bisected the geographic space between the Mekong and West Vaico rivers, the new water infrastructure would also divide the floodplain into discrete segments and maintain the relative dryness that would follow.

Haven from threat

If only conceptual, Delahaye's thesis prefigured discussions on the settlement of the floodplain that would culminate in the next two decades. Increasing pressure to resolve the problem of overpopulation in Tonkin presented the French administration with an incentive to examine the planned resettlement of peasants from the north to the sparsely populated areas of the Mekong's floodplain. Historian David Biggs distinguishes between two approaches favoured by colonial engineers.[19] On the one hand, the monumental infrastructure works that would remove floodwater across the entirety of the catchment. And on the other, the construction of dikes to protect the farms and settlements situated within the floodplain. Spearheaded by the left-wing Popular Front government of France (1936-1938), the latter approach sought to apply water control techniques from the Red River Delta to the Mekong's delta.

Called *casiers* by the French, the dikes encircling an extent of geographic space were a typical feature of Tonkin's countryside. Technically synonymous with the *polders* constructed in the inundated lowlands of the Netherlands, the land enclosed by *casiers* allowed water within the dikes to be controlled independently from the "surrounding hydrological regime".[20] For geographer Pierre Gourou and other colonial scientists and observers, these structures were not only important for their control of hydrological phenomena. With each village - rather than the state - responsible for the construction and maintenance of their own flood-control structures, the unit of geographic space encompassed by dikes was considered emblematic of north Vietnam's agricultural landscape [**Fig 9.6**]. Thus, although dikes altered the hydrological regime by detaining floodwater even after water levels had subsided elsewhere, *casiers* became associated with the 'natural' adaptation of a group of people to local topographic conditions that was characteristic of Vidalian human geography.[21]

Whereas Tonkin's villagers were praised for their "stubborn" subdivision of the Red River Delta into "an infinity of casiers",[22] the apparent order visible in the patterns of dikes and settlements on aerial photographs contrasted sharply with the extensive, uncultivated tracts of land in French Cochinchina's floodplain. For the colonial administrators dealing with the problem of overpopulation, *casiers* were seen as a model for resettlement that could also increase the total land used for agricultural production. The construction of such a structure in the Mekong's delta is described by historian David Biggs. Planned as a grid of canals surrounding an existing manmade waterway, the *casier tonkinois* was dredged by colonial engineers in 1943 and soon became the home for 750 migrant families from the north.[23] To the degree that the movement of water could be controlled in

19 Biggs (2012), p. 184.

20 Due to the separation of hydrological regimes, Segeren comments that this definition of polders would theoretically allow rice paddy or a floodplain to be considered as polders, adding that these are rarely (if ever) considered as such. W.A. Segeren (1982), *Introduction to polders of the world*. Water International, v. 8, n. 2, p. 51.

21 Biggs (2012), p. 107.

22 Y. Claeys, quoted in Biggs (2012), pp. 108-109.

23 Biggs (2012), p. 119.

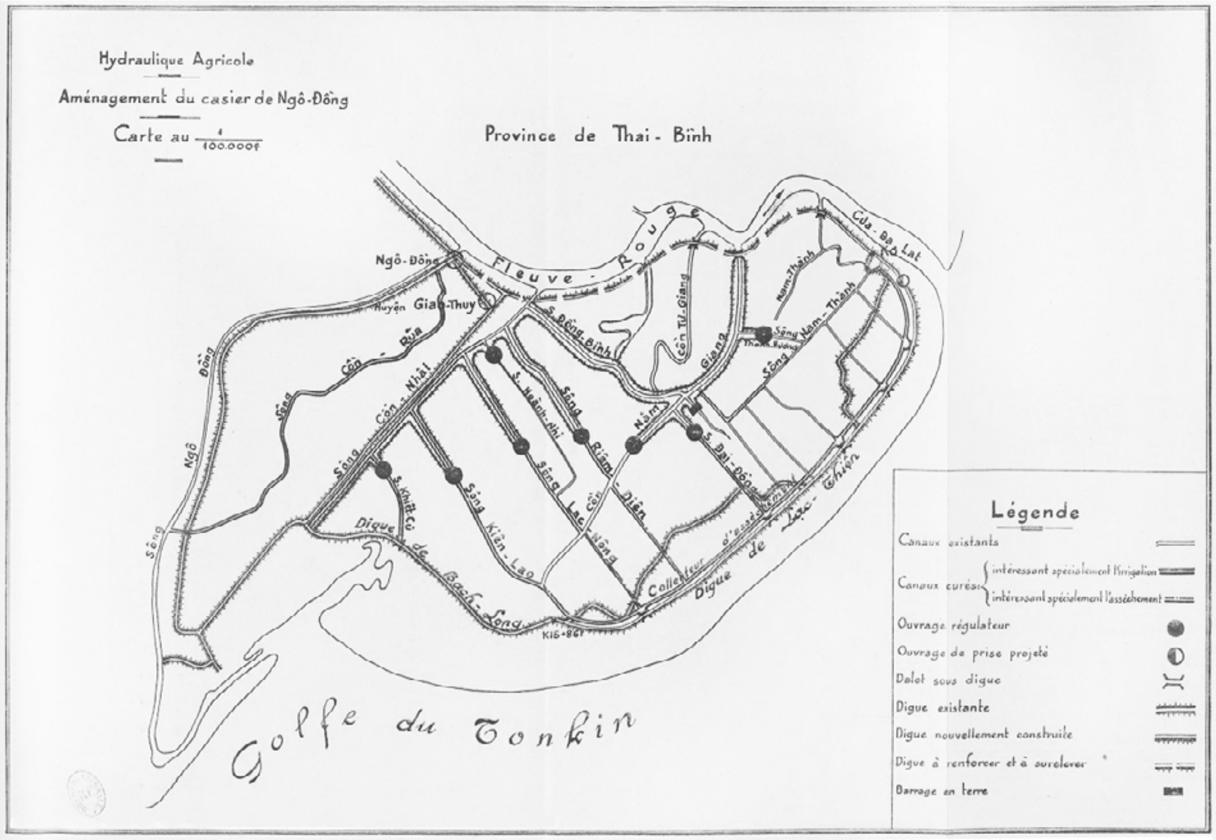

Fig 9.6 A *casier* in the Red River Delta The map shows one of the casiers situated along the coastal lowlands of the Red River Delta. Existing and planned dikes are shown to surround the main waterways with water gates regulating the volume of water entering the 'enclosed' area.
M. Garcin (1943), *Aménagement du casier de Ngo-Dong*. In M. Garcin, *Aménagement des Lais de Mer de Lac-Thien dans le casier De Ngo-Dong (Province De. Namdinh)*, Annales de travaux publics de l'Indochine, 1re année, Hanoi: Impri. d'Extrême-Orient, Planche II.

the Mekong's southern floodplain, the *casier*'s outer perimeter of dikes acted as a barrier to the rising floodwaters, while canals within the perimeter would irrigate (or drain) the agricultural land between them. However, the separate hydrological regime created within the dikes was soon plagued by severe water shortages that undermined the control over floodwater promised by the design, and which had made this part of the floodplain viable for settlement and agriculture in the first place.[24] Despite such apparent failures, the *casier* model continued to be promoted by French agricultural engineers (*Service du génie rural*) as well as the colony's Vietnamese politicians, that saw the paid construction jobs, and potential improvements in crop yields as an antidote to destitution and the rising influence of communist agitators. If only implicitly, the geographic space defined by the dikes suggested a haven from the perpetual threat of inundation, a condition that would not have been apparent in the dispersed waterside settlements elsewhere on the floodplain. Finite and theoretically controllable, the enclosed, protected area of the *casier* was the conceptual opposite to the natural and manmade waterways that disappeared behind the flat horizon of the Mekong's lowlands.

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24 Biggs suggests that settlers unfamiliar with the Mekong's hydrology constructed deep canals that drained water outside the protective dikes. Why the deep canals were required in the first place however is not clear and may have been the result of inadequate planning of the *casier* in the first place. *ibid,* p.20

The only example of a *casier* planned and constructed prior to the collapse of colonial rule, David Biggs argues that the *casier tonkinois* was referenced by the government of South Vietnam in the planning of the Cái Sắn settlement more than a decade later. Located between parts of the floodplain that were still controlled by political and religious groups hostile to the government, Cái Sắn was planned to accommodate mainly Catholic refugees fleeing from communist-controlled Tonkin. Yet where both projects focused on the resettlement of migrants along a group of new waterways, the canals as well as natural rivers forming the edges of Cái Sắn's rectilinear planning area are unlikely to have constituted a single protective flood barrier for the entire 1000 km^2. The separation from the floodplain's hydrological regime occurred along the new canals where "the rich clay soil" excavated during their construction was "piled into dikes along the banks."[25] Thus, even if each of the many dike-defined enclosures could be considered a distinct polder, the absence of an outer perimeter of flood defences suggests the similarity to Tonkin's *casiers* was not in the creation of a cohesive haven from inundation. Framed as the solution to the problem of reclaiming the land abandoned during the conflict of the Indochina War, Cái Sắn's planning was also aimed at installing a permanent government presence on a disputed terrain. As such, although not representing a dike, the visual clarity of Cái Sắn's rectilinear perimeter on maps indicated the limits of a state-controlled 'shelter' in which residents would be defended from "natural and social hazards" by a benevolent government.[26] The association between *casiers* and an extent of protected land, recast the multiple issues related with security - against inundation, hunger, hostility or even long-term tenancy - as an integrated problem resolvable within the manmade boundaries of a group of waterways.

Articulating inundation

As the regional conflict intensified after the mid-1960s, the use of polders to structure the flows of water within vast swathes of the floodplain was described by the Joint Development Group's (JDG) *Program for Mekong Delta Development* in 1967. Plans prepared by the JDG and David Lilienthal's Development and Resources Corporation conceived of polders creating six separate geographic units [**Fig 9.7**]. Outlined in a report for the US Agency for International Development (USAID), the polders aligned with existing and proposed waterways, controlling inundation in order to improve agricultural yields. The escalation of regional military conflict however did not allow these monumental plans to be further elaborated. Especially after North Vietnam's surprise attack during 1968's New Year (*Tết*) celebrations, efforts to reclaim the floodplain's "abandoned land" were severely limited due to the loss of government control over significant extents of the Mekong Delta.[27] Subsequent planning and economic studies were set within an imagined 'post-conflict' condition that allowed planners to focus on the technical rather than political issues surrounding the development of agriculture in the floodplain. Thus rather than account for the Delta's spatial fragmentation into different areas of military control, geographic space was presented as essentially contiguous within the extents of a catchment area that extended from South Vietnam to Cambodia's Tonle Sap. Yet if the Delta's fragmented political

25 *ibid*,p. 115.

26 Republic of Viet-Nam (1956), *The Dramatic Story of Resettlement and Land Reform in the "Rice Bowl" of the Republic of Viet-Nam*, Saigon: Secretariat of State for Information, Republic of Viet-Nam, p. 9.

27 *ibid*, p. 19.

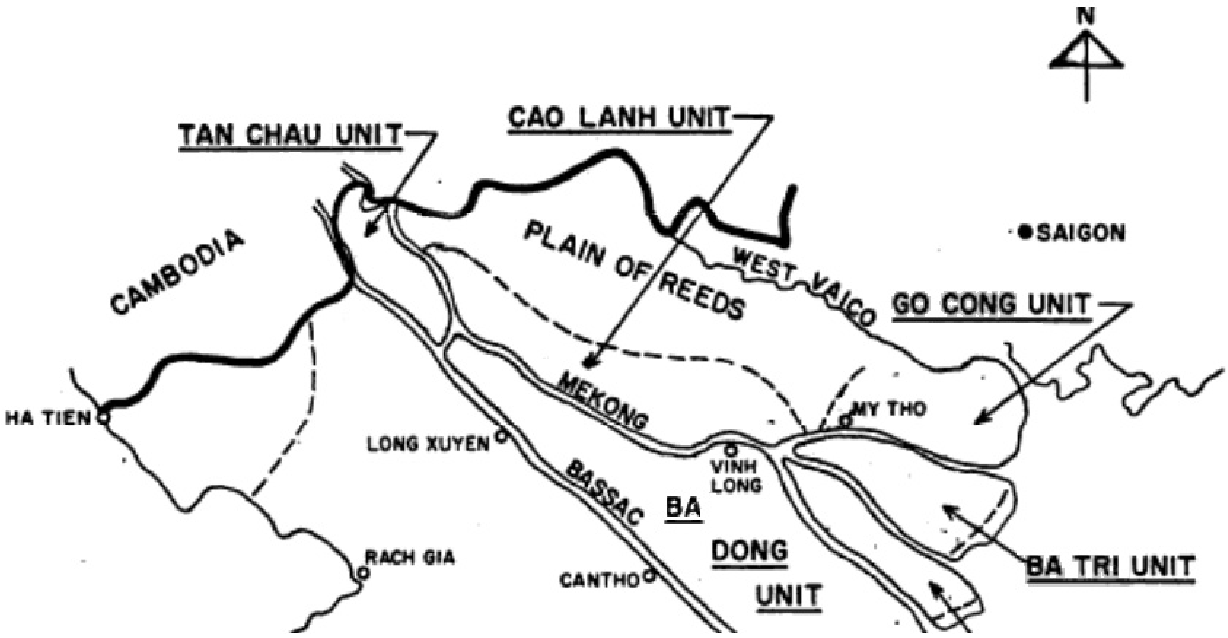

Fig 9.7 Polders as geographic units Extracted from a map showing the proposed location of dikes, the drawing shows the distinct "geographic units" that would be created within the flood barriers.
Joint Development Group (1967), *A Program for Mekong Delta Development*, Saigon: The Group, p. 22.

and military conditions were - to some extent – intentionally ignored, the use of polders for agricultural production introduced a new kind of geographic compartmentalisation that was not limited to the control of water.

Published in 1968 and 1969, two planning reports by the US Army's Engineer Agency of Resources Inventories (EARI) demonstrate the way water infrastructure was conceived in the flood-prone border areas of South Vietnam. Founded in 1963 with the intention of providing the USAID with the technical services of the US Army Corps of Engineers, the EARI was staffed with geographers, geologists, cartographers and engineers.[28] Geographically focused on the Mekong's floodplains, the EARI's studies aimed to resolve the problem of the "uneven distribution of water" which restricted the Mekong Delta's "tremendous economic potential".[29] The suggestion that there was "too much water in the wet season",[30] reflected a particular understanding of the total geographic extent within which such a perceived excess was recorded. Presented as the area where the overland flows from three rivers merged, the defined outline of the Plain of Reeds on hydrological maps appeared in contrast to the "indefinite" extents of drainage

28 James O'Neal (1967), *The Role of The Engineer Agency For Resources Inventories In International Development.* The Professional Geographer, v. 19, p. 34. Also see James O'Neal & James Bwins (1974), *An operational application of ERTS-1 imagery to the environmental inventory process (Conference paper).* Goddard Space Flight Center 3d ERTS-1 Symp., v. 1, Sec. A, p. 579. https://ntrs.nasa.gov/citations/19740022632 accessed on 16th May 2022.

29 Prepared by Charles Schwartz (geographer), Allen Reimer (soil scientist) and Joseph Brewer (hydraulic engineer), the An Giang report (1969) appears to be an elaboration of the earlier planning study for the Plain of Reeds (1968) and shares the same technical contributors. Engineer Department for Resources Inventories (1969), *A program to Attain Maximum Agricultural Production in An Giang Province, Viet-Nam.* Washington DC: Dept of the Army.

30 Engineer Agency for Resources Inventories (1968), *Accelerated Development in the Plain of Reeds.* Washington: US Army. Summary of Report, p. *vii* (Summary).

basins [**Fig 9.8**]. Adopting the boundaries used by Delahaye 40 years earlier, the delineation of the floodplain's catchment enabled engineers to estimate that, constrained by the volume of water flowing through the hydrological catchment in both Cambodia and Vietnam, only a small proportion of the terrain could be exploited for cultivation. Even on this small proportion of the floodplain however, the feasibility of agriculture was uncertain. Considering the geographic magnitude and toxicity of acid sulphate soils had not been previously mapped in sufficient detail, the effectiveness of the extensive drainage infrastructure required to 'flush' the acidic water could not be guaranteed. Thus, despite calls from the Mekong Committee for both Cambodia and South Vietnam to jointly focus on the economic

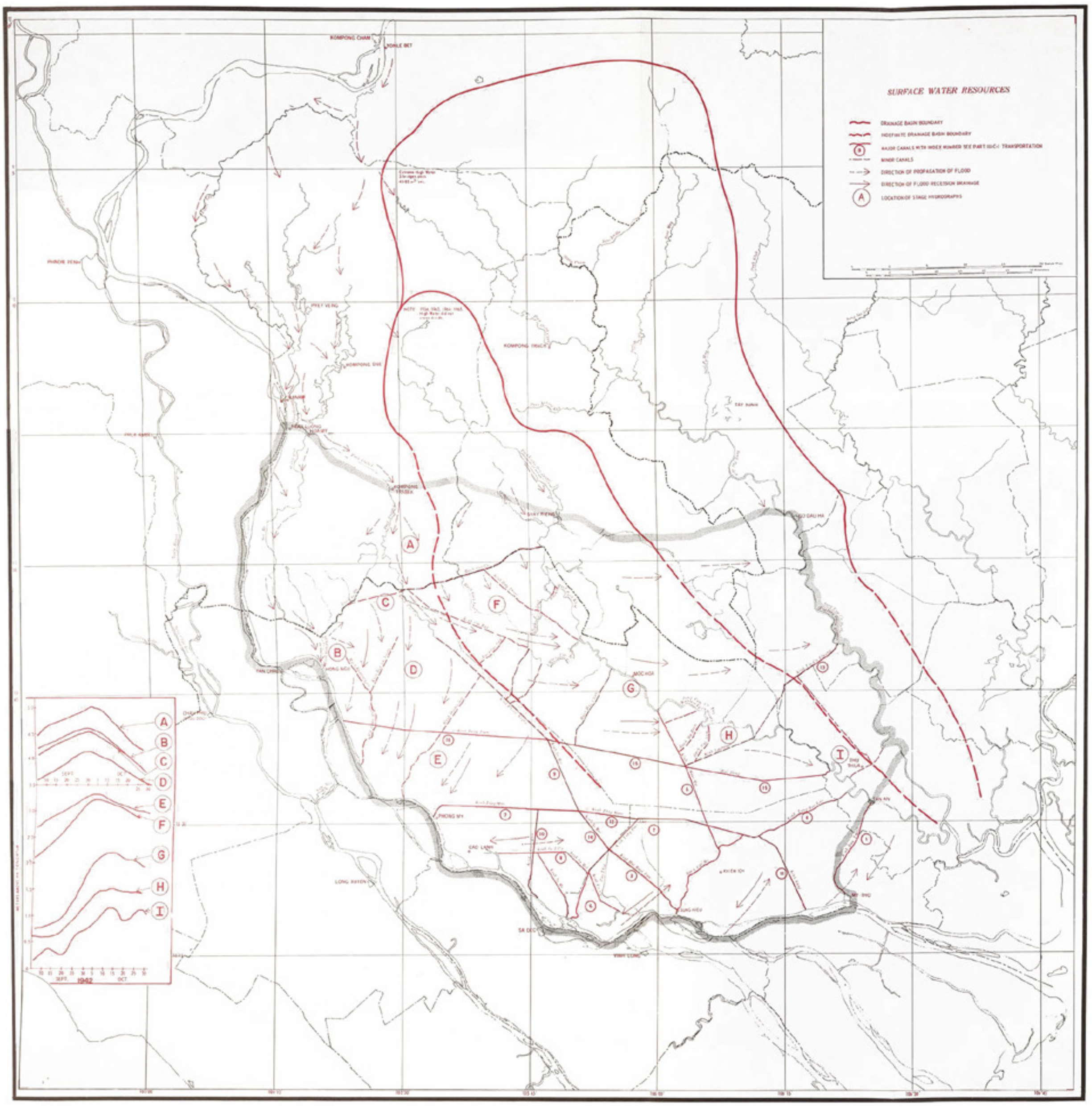

Fig 9.8 Hydrology of the Plain of Reeds On the map, the hydrological extent of the Plain of Reeds (grey outline) is presented against the boundaries of "drainage basins" (red lines). These boundaries become dashed when crossing into the Plain from the north, suggesting an "indefinite" watershed between the Mekong and the East and West Vaico Rivers that contrasts with the "definite" extent of the floodplain's delineated catchment.
EARI (1968), *Surface water resources.*

and social problems of the Plain of Reeds, the costly infrastructure and limited benefits to agriculture meant that development of the floodplain remained a low priority for the state.[31]

However, it was another cartographic feature of the floodplain that became increasingly significant as armed regional conflict escalated. Appearing to straddle the geopolitical jurisdictions of both South Vietnam and Cambodia, the EARI considered the Plain of Reeds a "natural reservoir" without which "flooding would make the Mekong Delta virtually untenable".[32] During the wet season, a significant proportion of the floodwaters covering the Plain flowed southwards from Cambodia. Reaching around 2 metres in depth, the rising flood overtopped the rivers that acted as the dry-season marker for the national boundary with South Vietnam.[33] The border's temporary disappearance under seasonal floodwaters and the perennially wet condition of the ground in the Plain facilitated the illicit movement of people, weapons and supplies between Cambodia and South Vietnam's communist-controlled areas.[34] The absence of settlements in many parts of the Plain exacerbated the perception that the flooded border area was a vulnerable frontier. Thus, from the perspective of the security situation "the high costs of reclamation could conceivably be accepted" if they eliminated a strategic risk that maps portrayed as lying on the western 'doorstep' of Saigon.[35] Conflating the movement of water with the movement of people the EARI's planning report stated that:

> *The establishment of water barriers through the construction of major canals as part of the development program, especially those on an east-west alignment, would provide barriers to infiltration.*[36]

With "infiltration" referring to the penetration of enemy troops rather than the absorption of floodwater into the ground, the perceived threat from inundation was not confined to the damage caused directly by water. Promoted as the answer to these multiple concerns, the planning of "large-scale polder development involving extensive dikes and levees" did not allude to traditional *casiers*.[37] Instead, they referenced the modern techniques and equipment that would overcome the terrain's susceptibility to the inundation which "inhibited growth". Cast as technical solutions, the spatial magnitude of polders was determined by the relationship between available water resources and financial costs [**Fig 9.9**]. According to the EARI's calculations, using the Mekong's average annual flows,

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31 *"We are of course aware that the potential benefit/cost ratio of any such reclamation of the Plaine des Joncs would probably be low. But there are abundant social reasons which might nevertheless mean that the Mekong Committee, and in particular, the governments of Vietnam and Cambodia, might after a detailed feasibility investigation has been carried out, decide to press for such reclamation."* Dr. C. Hart Schaff, Chief executive of the Mekong Committee (1964) quoted in Victor Croizat (1969), *The Development of the Plain of Reeds: Some Politico-Military Implications*, Santa Monica, CA: The Rand Corporation, p. 22.

32 EARI (1968), p. *vii* (Summary).

33 *ibid*, p. 3.

34 Croizat (1969), p. 22.

35 *"Therefore, when considering the national security interests of South Vietnam, it becomes apparent that the penetration of the Plain by government forces and its eventual resettlement could help eliminate one major center of communist infection. For this reason the high costs of reclamation could conceivably be accepted, provided the measures taken in the re-settlement process were carefully related to the security situation." ibid,* p. i (Preface).

36 EARI (1968), p. 84.

37 EARI (1969), p. 4.

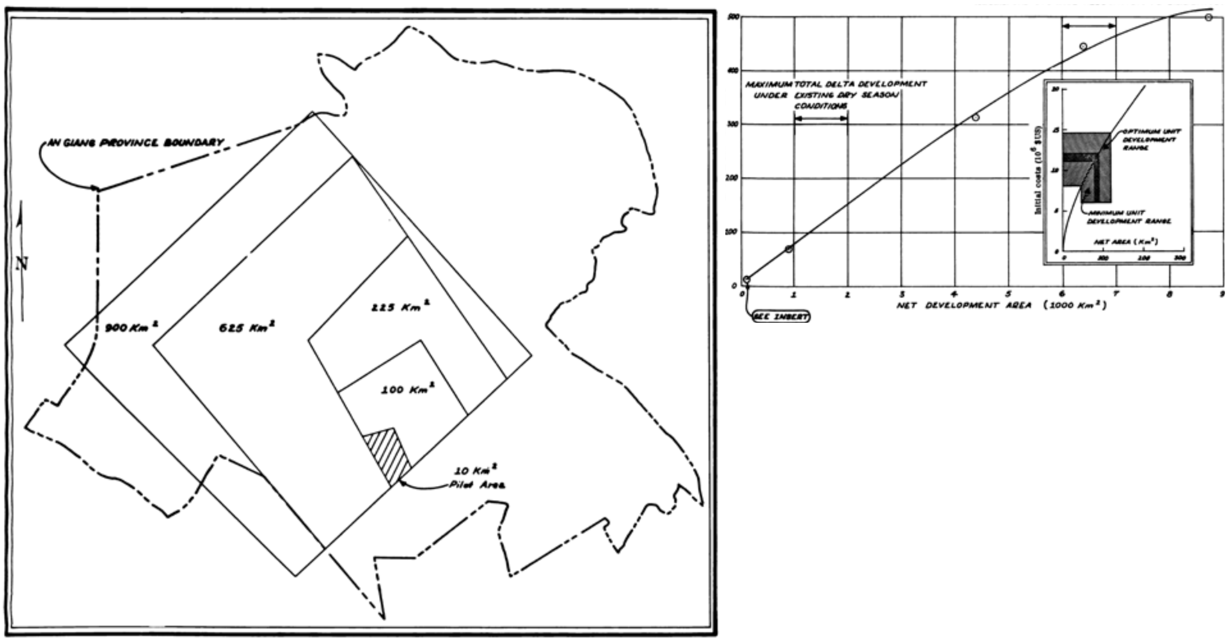

Fig 9.9 Dimensioning polders On the left, the EARI's proposals for polders of different, specific dimensions in An Giang Province. Based on a carefully costed proposal for a 10 km² pilot project (hatched area in the centre), the graph to the right extrapolates costs for various sizes of polder that are considered "optimal" in terms of their estimated returns on investment.
EARI (1969), pp. 17 and 20.

only a small fraction of the Delta's 62,000 km² catchment area could be irrigated and up to 20 optimally sized polders - 100 km² each – would be feasible.[38] However, the possibility that upstream infrastructure could be constructed in the future, allowed far larger sizes to be considered. With individual polders reaching extremes of 8,000 km², the EARI's planners argued that the subdivision of the floodplain into hydrologically autonomous compartments was technically achievable, if not socially acceptable.[39]

Elaborated across more than 40 maps, the EARI's investigation and planning attempted to ground the technical and economic reasoning underpinning the conceptualisation of polders with the actual conditions encountered in the floodplain. New detailed maps based on the latest aerial photographs traced the areas of physical and human resources such as water, soils, demography and land uses. Consistent with the 'layer cake' approach taught and practiced by landscape architect Ian McHarg, separately mapping specific qualities or uses of a terrain could potentially reveal new, or confirm known relationships [**Fig 9.10**]. Elements such as water could be appreciated as particular natural systems but also in terms of their interrelationship with human activities. For Mc Harg:

> *A single drop of water in the uplands of a watershed may appear and reappear as cloud, precipitation, surface water [...] in considerations of climate and microclimate, water supply, flood, drought and erosion control, industry, commerce, agriculture, forestry, recreation, scenic beauty, in cloud,*

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38 The EARI estimated that up to 2,000 km² out of about 62,000 km² could be used for agriculture simply based on the quantity of available water. EARI (1968), p. 22.

39 EARI (1969), p. 13.

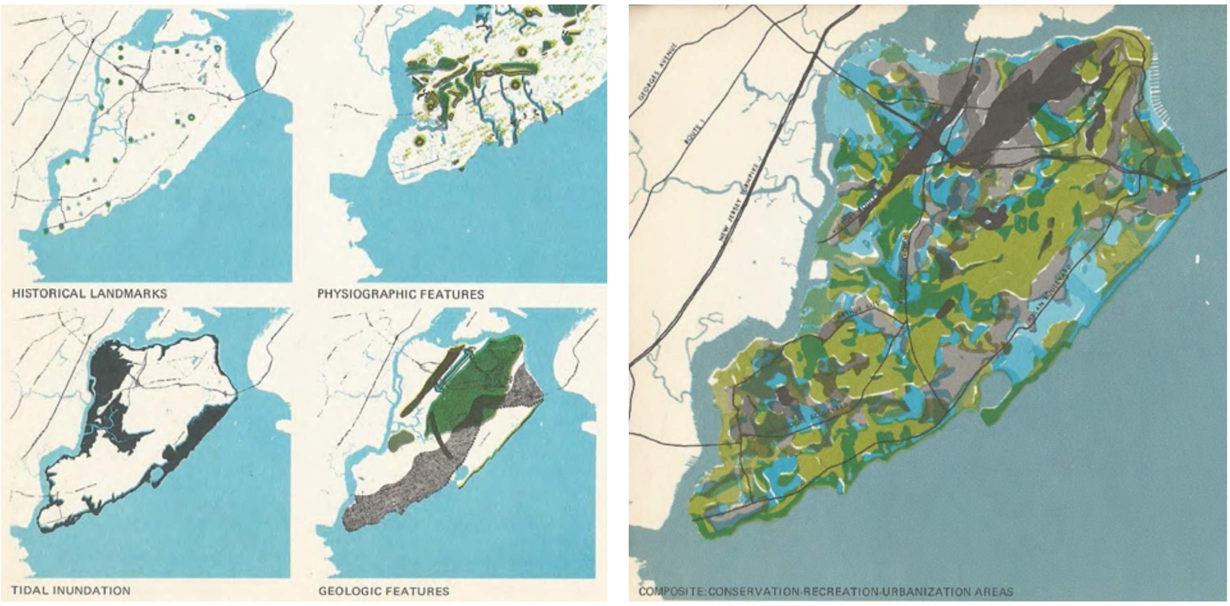


Fig 9.10 Layered knowledge Samples of maps used by McHarg to illustrate the method of identifying "the major physical and biological processes that cause Staten Island to be and that operate there now". After collecting information on individual mapped 'layers' (shown on the left), composite maps would be compiled showing the relationship between those layers and a possible design strategy.
McHarg (1971), pp. 106 and 114.

> *snow, stream, river and sea. We conclude that nature is a single interacting system and that changes to any part will affect the operation of the whole.*[40]

McHarg's suggestion of a natural "whole" contingent on the condition of its different "parts" was not immediately apparent in the Mekong's floodplain. Rather than an homogeneous vegetated *atopia* , the EARI's new maps revealed a terrain replete with specific ground conditions. To the extent that the cartographic articulation of acid soils, land uses or population density indicated important characteristics of the floodplain, when considered separately these did not necessarily compose a single, distinct geographic area.[41] Without reference to the Plain's catchment area, to appreciate these separate layers as parts of specific whole would require this whole to be 'constructed' from the information available on maps. The use of maps to notionally unify parts of the floodplain that would otherwise be considered separate is illustrated in the map of the Plain's physiography [**Fig 9.11**]. This representation of the floodplain's terrain used height contours that varied in places from intervals of one metre to ten centimetres. As a result of these variations, the same number of contours are concentrated on the floodplain's flattest section as on the higher ground in the Cambodian section of the Plain. Thus, while the map is 'accurate' in its portrayal, it also appears to emphasise the straight, manmade landforms produced by existing canals that would otherwise be almost invisible. Deliberately or not, the map's suggestion that the floodplain's gradient could be considered an outcome of human activity, arguably also indicated that there were other ways to imagine

40 Ian McHarg (1971), *Design with Nature*, New York: Doubleday/ Natural History Press, p.56.

41 Doubts as to the geographic integrity of the Plain was expressed in the text: *"The designation "Plain or Reeds" is widely used but general agreement as to the limits of the area encompassed is lacking [...] because of a lack of uniformity it should not be considered as an entity but as separate geographic areas."* EARI (1968), p. 1.

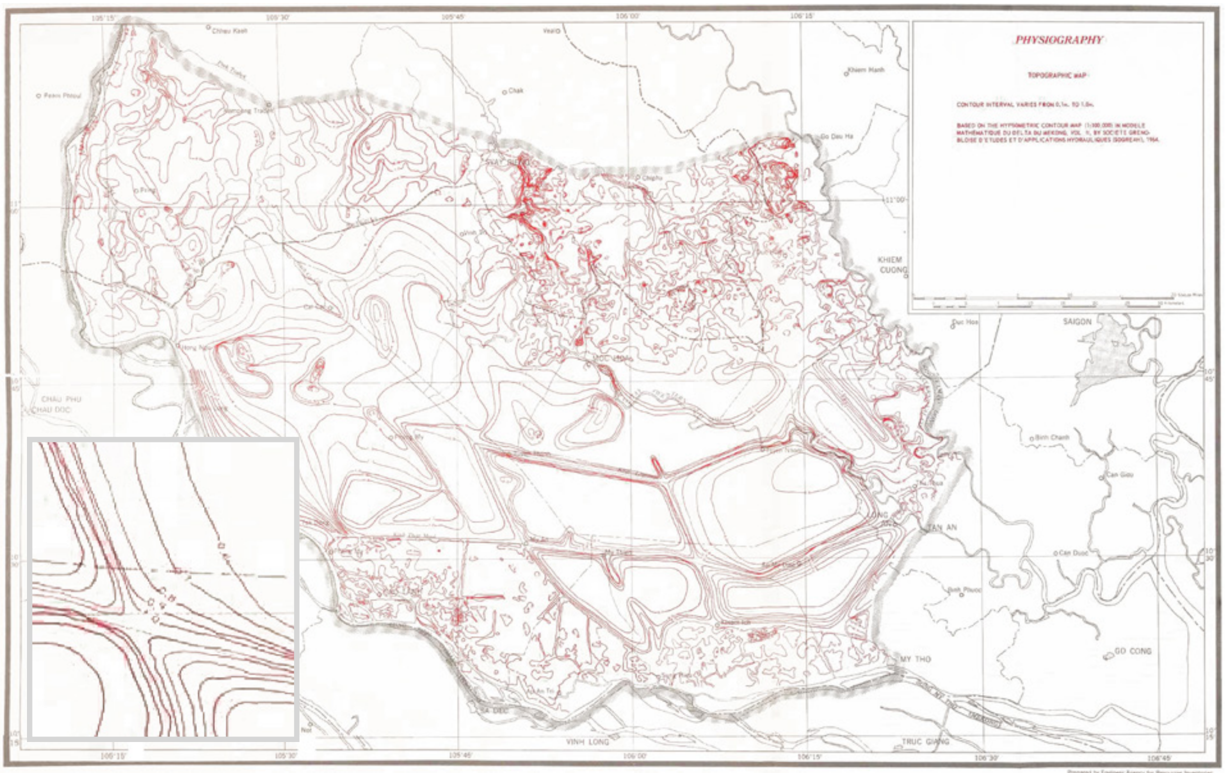


Fig 9.11 Contoured terrain One of the 40 maps prepared by the EARI, the articulation of the Plain's topography used contours at 1 metre and 10 centimetre intervals. Applied to the flattest part of the floodplain, the 10 cm contours reveal the otherwise imperceptible landforms that appear to be 'carved' into the ground's geomorphology.
EARI (1968), *Physiography*,

what physical characteristics constituted a differentiable geographic space. In this sense, the use of contours to describe the terrain was also an argument about that terrain which, if nothing else, presented the possibility of polders as an extension of the floodplain's geomorphology.

Thus, even without displaying a specific proposal, the cartographic articulation of the Plain's characteristics could indicate a particular course of action. If the plan's ambition was to "transform an unstable political base to one of great stability" by the "delineation of the acid sulphate soils, and the construction of water control structures", new soil surveys revealed that only a small part of the Plain could be productively cultivated.[42] This constraint was reflected in the first of six "improvement" plans which - similar to the JDG's Cao Lanh unit - limited dikes to an area that extended in parallel with the river's mainstream (see Fig 9.7). And while the second and third options limited interventions even further without incorporating water infrastructure, extensive polders were proposed in the three subsequent plans. Dimensioned on the assumption that upstream reservoirs would detain part of the annual volume of inundation for dry season use, the 24 polders presented in *Improvement Plan III* (IP3) would range from about 150 to 1000 km^2. Rather than designed to avoid areas dominated by unproductive soil types, the polders were configured to take advantage of the straight edges of existing canals. Levee walls built at a distance from the edges of waterways were envisioned to create *floodways* 1500 metres wide. These would divert floodwaters

42 EARI (1968), p. *ix*.

to drain into the Mekong and Vaico rivers, separating the hydrology of each interstitial sub-area from the seasonal ground conditions but also from each other. Within each compartment, pumps drawing water from the floodways would allow control of the ground's wetness, potentially producing five crops over two years.[43] By confining perennial wetness to the floodways however, the diversion of water for irrigation to a particular farm would require large scale infrastructure that only the state could provide. Thus, although the EARI's report stated that control over irrigation and drainage was designed to operate on a "polder-by-polder basis", the flows of water in each compartment could be regulated according to "military, political or economic necessity."[44] From this perspective, the almost autonomous management of water that each polder theoretically represented, was not conceived purely as a technical operation but also one intimately associated with the potential to control people and activities within the polder's confines.

In the maps introducing the plans, the control of water that underpinned the configuration of polders was not confined to South Vietnam. Speculating that the scheme could encompass the entirety of the areas submerged under floodwater, the floodways in IP3 continued into Cambodia [**Fig 9.13**]. Arguments insisting that development of the Plain should be "contemplated in its entirety" referenced existing institutional mechanisms for international cooperation in water

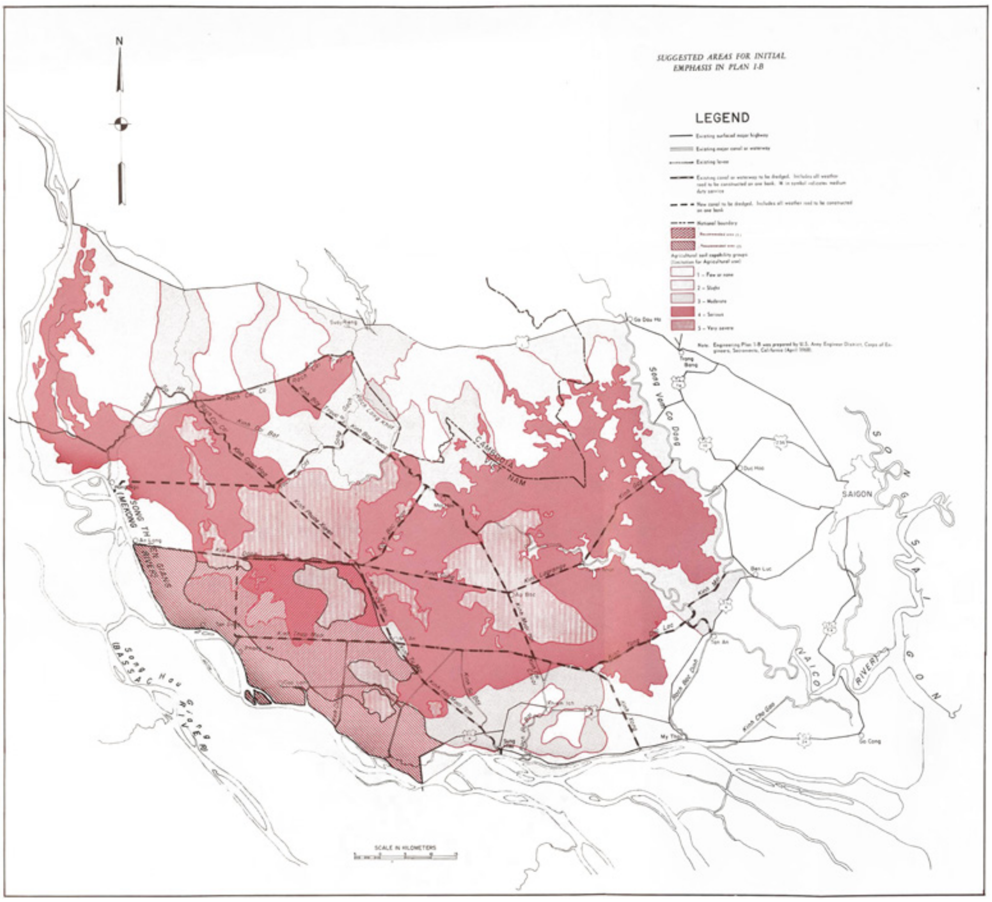


Fig 9.12 Synthesising cartographic knowledge The map is a composite of different layers presented in the EARI's report. These layers include the evaluation of the productive capacity of different soil types (red shades) as well as existing canals (dotted lines). Shown together these layers suggest which areas will be prioritised for development, a specific course of action which is further explicated in subsequent plans for polders.
EARI (1968), *Suggested areas for initial emphasis in Plan 1B.*

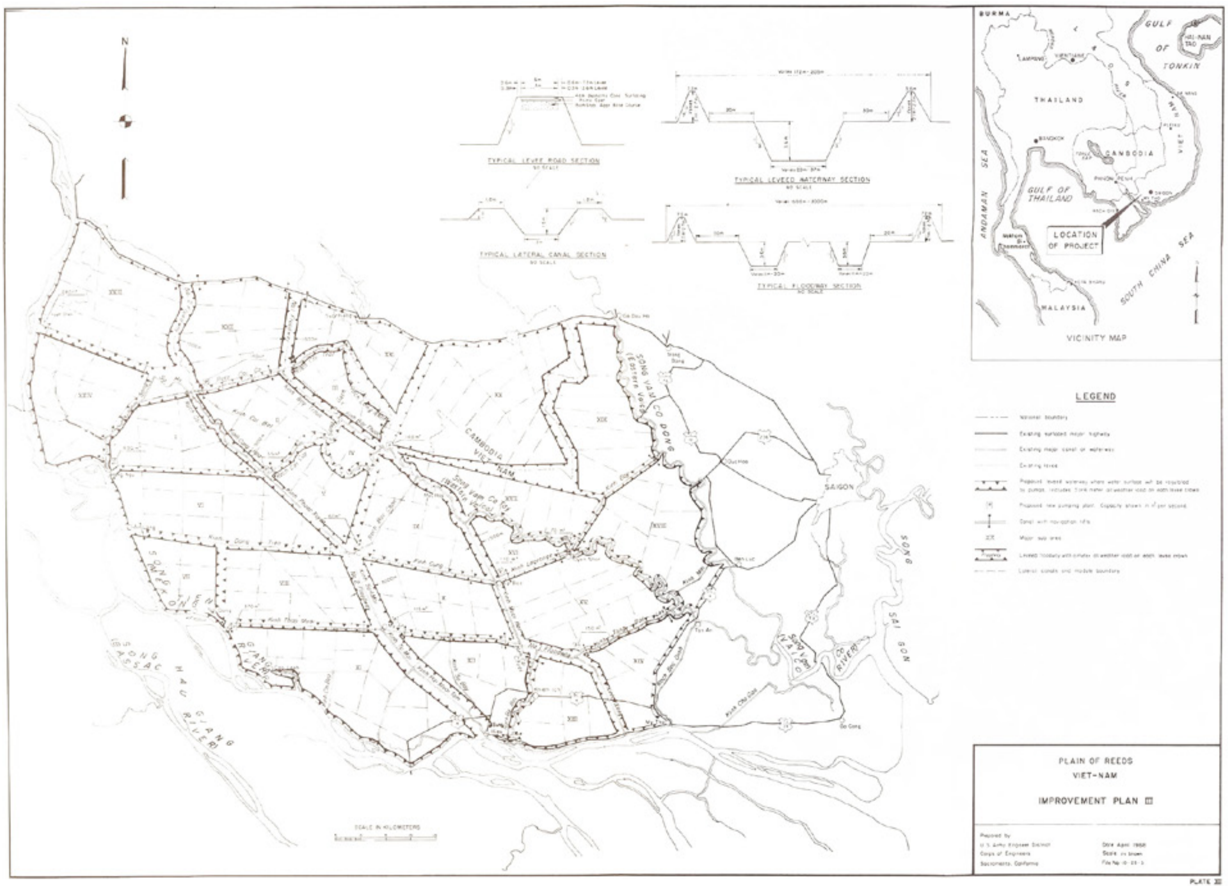


Fig 9.13 Improvement Plan III Illustrating the polder scheme in its full extent, the map shows the entire extent of the Plain of Reeds divided into 24 polders by *floodways* reaching a width up to 1,500 m. Presumably operated by the state, pumping stations on each polder would distribute water from the floodways to the farms.
EARI (1968), *Implementation Plan III.*

resource management.[45] Drawing parallels with the basin-wide international planning of the Mekong Committee, the strategic assessment by the Advanced Research Projects Agency (ARPA) recommended that South Vietnam should invite Cambodia in a joint reclamation project of the Plain of Reeds. As outlined in ARPA's report, the deteriorating security conditions were not confined to one side of the boundary, but existing diplomatic tensions between the two countries required a tactful approach to any potential new settlements in the border areas.[46] Similar to the Mekong Committee, the joint project would therefore serve as a framework for international cooperation between the two countries, with the Plain of Reeds substituting the basin as the geographic area of operations. Seen from this perspective, the continuous parallel lines indicating "proposed leveed waterways" on the plan, visually construct a very specific geographic entity based on the assemblage of individual polders. Thus rather than a singular terrain

43 *ibid.*

44 *"The series of canals and levees recommended in this study results in the type of poldering that allows controlled irrigation and drainage on a polder-by-polder basis as dictated by military, political, or economic necessity. The approach also provides for the orderly transition to flood control whenever circumstances warrant." ibid*, p. *x*.

45 Croizat (1969), p.32.

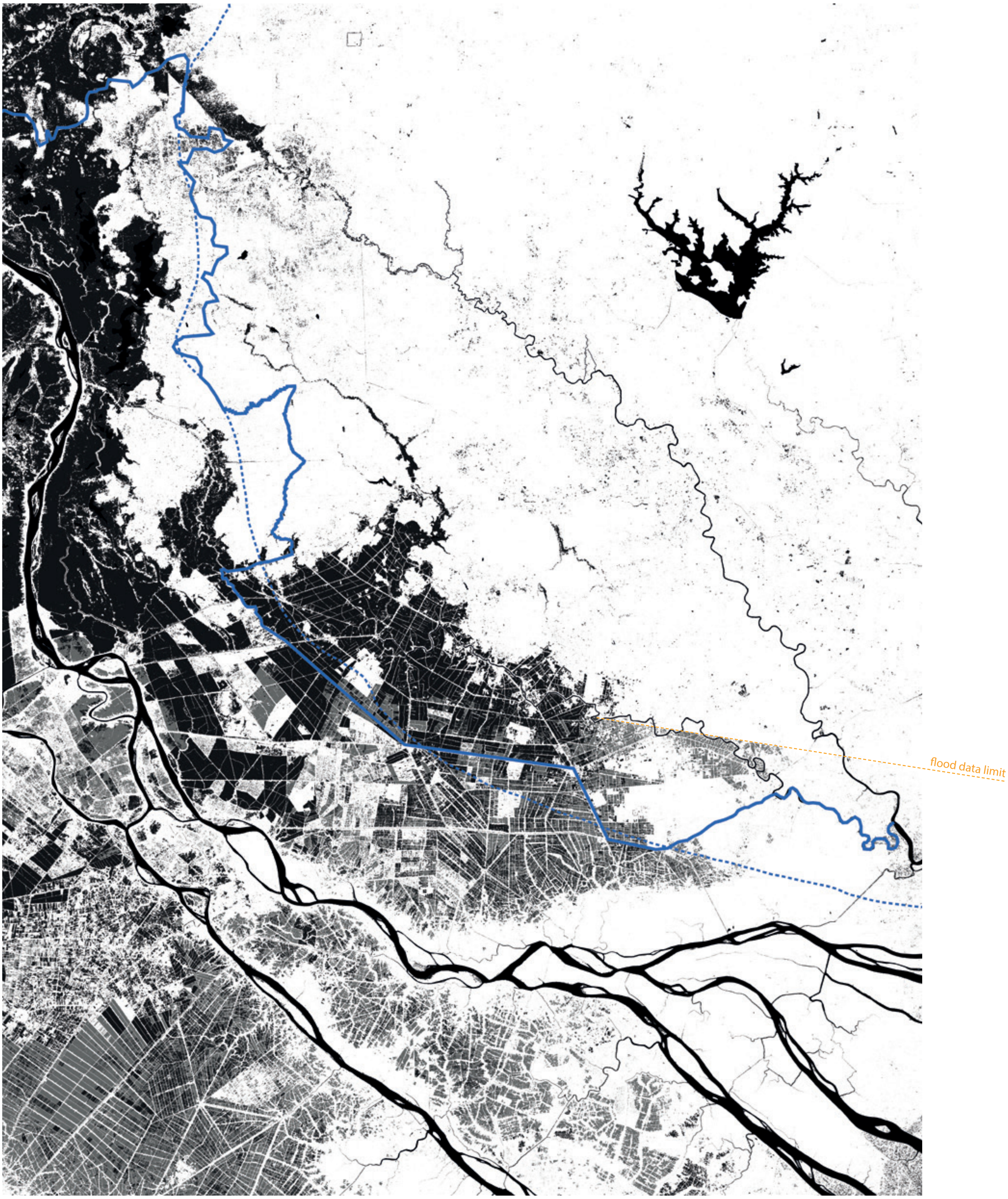
46 *ibid.* Croizat's analysis of the Plain of Reeds highlighted the military and political reasoning for cooperation between Cambodia and South Vietnam, but fails to mention the benefits to farmers on the Cambodian side.

"divided" into 24 separate compartments, the 24 individual polders could be imagined to collectively construct the Plain of Reeds. Within this Plain, water infrastructure would act as the barrier to the flows of water as well as weapons, supplies and people.

Conclusion

Examining diachronic plans for polders, Biggs has asserted that *casiers* represent a "containment strategy" attractive to the different political regimes controlling the Vietnamese section of the Mekong's delta.[47] Even with the perimeter of water surrounding each polder, the idea that floodways could function as 'moats' to confine people to areas within the polder is less convincing than the 'containment' of water itself. Bounded by levees and with water distributed to farms by pumps and gates, the geographic space encircled by dikes would remain safe even in the wet season, increasing agricultural output on an otherwise unproductive terrain. However, the same infrastructure could also withhold water from agricultural use, allowing those with the power to operate the pumps and gates to potentially coerce residents. The risks related to inundation were therefore replaced by the threat that water infrastructure serving individual polders could be used to create conditions of artificial 'dryness' regardless of the hydrological conditions in surrounding areas. Alluding to an imbalance in the hydrological equilibrium, this approach to the use of infrastructure was enabled by the diachronic perception that the Plain had "too much water in the wet season". Quantified with reference to the floodplain's catchment area, the problem of 'excess' water framed the military need to control the border in terms of an environmental anomaly, two problems which rational, scientific planning could mitigate simultaneously. In this sense, adopting the floodplain as the extent of these corrective operations did not only align with the preference of modernist planners to employ 'natural' hydrological scales for water management. Serving as the geographic reference with which to analyse those same phenomena, the pictorial articulation of the floodplain also structured an hypothesis about the way those phenomena related to each other. In this sense, what could be perceived as the Plain of Reeds from the perspective of the map entailed more than imagining the sum of the Plain's cartographically defined 'contents'. The outline of the floodplain's catchment area allowed the varied ground conditions encountered on the Plain to be considered collectively as a distinct geographic unit, differentiated from all others according to the geostrategic military value of the terrain.

47 Biggs (2012), p. 94.



Map J The map shows satellite-detected surface water in the Plain of Reeds during two key moments of annual flood - the middle of the wet season in late August 2018 (black) and the end of the wet season in early November 2017 (grey). The Mekong's basin (blue dashed line) and the catchment area delineated by the units of water managment (blue line) appear to divide the flooded areas in two parts. The majority of the "dry" areas produced by dikes is visibly concentrated south of the catchment/ basin limit.

Author (2022). Spatial data sources: *Satellite Detected Surface Waters Evolution in Southern Provinces of Vietnam* (UNOSAT, 2018); *World Water Map* (ESRI, 2014); *mrc.SDE.WATER_b_lmbbnd50* (MRC, 2008); *catmb_4K* (MRC, 2012); Lower Mekong Basin (MRC, 2008).

CHAPTER 10 The region's immergence

The Plain of Reeds could now be renamed the 'Plain of Rice' since the park is surrounded by a 'sea of rice' and human settlements in six surrounding communes and a district town.

Situation Analysis: Plain of Reeds, Viet Nam, Nguyen Xuan Vinh & Andrew B Wyatt, 2006

In the geographic area through which the Mekong River flows, discussions about water management have usually been framed as critical to rural development, the sharing of increasingly scarcer resources, and more recently the impacts of climate change. Agriculture and its associated irrigation apparatus have been prominent in these conversations. Accounting for nearly 90% of all water abstractions from the Mekong River, the magnitude of land under irrigation command has grown from almost nothing in the 1950s to more than 5 million hectares by 2015.[1] Of this, almost 80% is situated in the Vietnamese part of the Mekong Delta where individual command areas can reach up to 8,000 hectares.[2] Along with the introduction of high-yield varieties of rice (HYV) sparked by the 'green revolution', this has more than doubled the tonnage of rice produced in the south of Vietnam since unification.[3] Especially after the implementation of market-oriented economic policies in the late 1980s, the Delta has been described as Vietnam's 'rice bowl', with the region's rice exports competing for dominance in global markets.

Although credited with bringing widespread socioeconomic benefits across large parts of Southeast Asia, today there is general consensus that the region's irrigation systems have not performed to expectations.[4] Known as *command areas* by agricultural engineers, distinct irrigation systems are only partially cultivated while, designed to accommodate rice paddy, they have proven difficult to adapt for growing other crops. Particularly in the Plain of Reeds, the impact of water infrastructure has unfolded beyond individual command areas. Providing water-borne access to homes and protecting nearby fields, the collection of canals and

1 Mekong River Commission (2019), *State of the Basin Report 2018.* Vientiane: Mekong River Commission, p. 152, Table 6.6.

2 Mekong River Commission (2018), *Irrigation Database Improvement for the Lower Mekong Basin.* Vientiane: Mekong River Commission, p. 11. Data from the MRC indicates that in Vietnam's Mekong Delta 2 million hectares of irrigated land have been created by 120 schemes averaging more 16,000 ha each, compared with the whole of Laos (88 ha/ scheme) or Cambodia (390 ha/ scheme).

3 Jean-Francois Le Coq, Marc Dufumier, & Guy Trébuil (2001), *History of Rice Production in the Mekong Delta*. Paper presented at Third EUROSEAS Conference. London, 6–8 September 2001, p.5, Figure 4.a.

4 Despite the proliferation of irrigation in the Mekong Basin, less than 40% of farmland in the region is irrigated. Chu Thai Hoanh, Thierry Facon, Try Thuon, Ram C. Bastakoti, François Molle & Fongsamuth Phengphaengsy (2009), *Irrigation in the Lower Mekong Basin Countries: The Beginning of a New Era?* pp. 149-150. In F. Molle, T. Foran & M. Kakonen (eds.) *Contested waterscapes in the Mekong region: hydropower, livelihoods and governance.* London: Earthscan.

dikes that constitute irrigation infrastructure have underpinned the location of new settlement, increasing the number of residents in this part of the floodplain from perhaps one million in 1969 to almost 3 million today.[5] However, the irrigation infrastructure used to drain floodwater and to water fields during the dry season has also driven the loss of wetlands and thus reduced the floodplain's capacity to detain inundation.[6] Such rapid changes to the way the hydrological system operates defy the idea of a permanent geographic 'background' in relation to which the history of human actions is recorded and subsequently perceived.[7] As water historians Tvedt and Jacobsson argue, specific water infrastructure projects can have long term, irreversible downstream impacts as people adapt their lives to the new condition of the ground. Contending that distinct infrastructure "events" such as the operation of a new dam or excavation of a canal do not necessarily coincide with the broader economic, cultural or political context, this critique of *la longue durée*, also challenges the notion of a 'fixed' geographic context within which other events or seasonal processes unfold. Examined from this perspective, the construction of the individual canals and dikes that collectively constitute the floodplain's current hydrology are not just historical episodes. How these projects were planned and implemented shapes the context in which they are considered. As such, rather than only asking how the flows of water have materially changed in relation to a previous natural or unmediated state, it is equally important to examine what floodplain was referenced when these projects were conceived and implemented. Focusing on the changes to surface water flows caused by irrigation infrastructure since Vietnam's unification, the chapter examines whether the floodplain's catchment area has been replaced by the surface water diversions used to transform the Plain of Reeds into a Plain of Rice.

Isolating wetness

In plans formulated in the 1960s, "sealing off" the delta and the floodplain from the river's inundation and the intrusion of saline water was considered critical to the maximization of agricultural production.[8] Working from their headquarters in Bangkok, for the Mekong Committee's engineers and planners, the control of water in the floodplain was contingent on dams constructed further upstream. Framing water control from the perspective of the river's hydrological basin, in order to limit wet season destruction and grow crops during the dry season further downstream, it would be necessary to retain and store floodwater in the vast reservoirs planned for Cambodia.[9] Subsequent studies provided alternatives. With access to an early computer and the hydrological model prepared by SOGREAH, a Dutch team commissioned by the Committee in 1974, calculated the impact of dikes on the water levels of shallow flooded areas. Dividing the

5 EARI (1969), p. *x*; Vietnam General Statistic Office (VGSO) (2020), *Completed Results of the 2019 Viet Nam Population and Housing Census (Tổng điều tra dân số và nhà ở năm 2019).* Hanoi: Statistical Publishing House, pp. 36-40.

6 Hoang Huu Nguyen, Paul Dargusch, Patrick Moss & Da Binh Tran (2016), *A review of the drivers of 200 years of wetland degradation in the Mekong Delta of Vietnam*. Regional Environmental Change, v. 16, n. 8, p. 2308.

7 Terje Tvedt and Eva Jacobsson (2006), *Introduction: Water History is World History.* In T. Tvedt & E. Jakobsson (eds.), *A History of Water, Volume 1: Water Control and River Biographies*. London & New York: Tauris, p. *x*.

8 JDG (1969), p. 520.

9 Committee for Coordination of Investigations of the Lower Mekong Basin (1970), *Report on Indicative Basin Plan: A Proposed Framework for the Development of Water and Related Resources of The Lower Mekong Basin, (E/CN.ll/WRD/MKG/L.340).* Bangkok: United Nations, p. III-20.

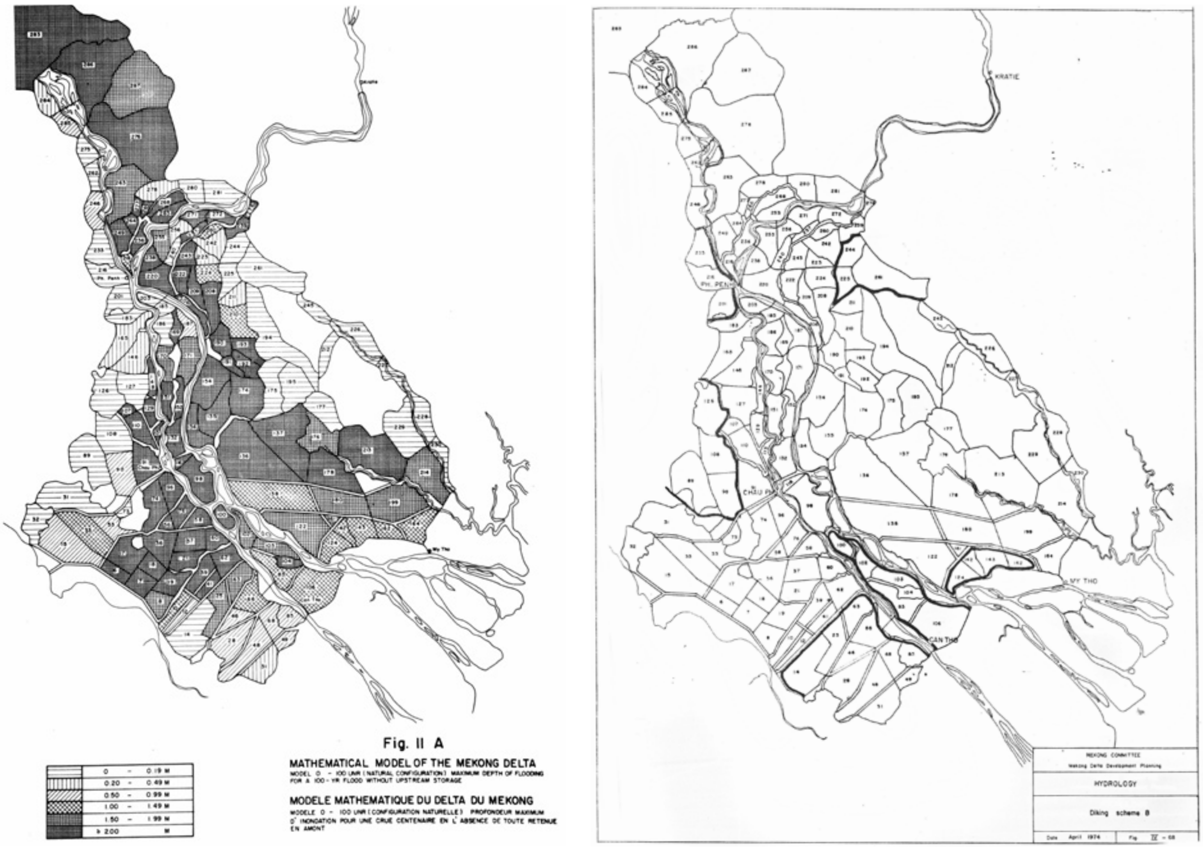


Fig 10.1 Inundated region On the left, the baseline model of flood conditions prepared by the hydrologists of the Mekong Committee shows the depth of inundation for a 100 year flood without upstream storage. Divided into compartments ("meshes"), their edges do not necessarily indicate a specific flood barrier but are used for calculating water depth. On the right the Dutch team's model for "full" protection with the dikes in "shallow flooded areas" represented by the thicker black line. Models showed the impact of dikes would be observed with increased flood levels upstream and in the Plain of Reeds. Mekong Committee (1970), *Mathematical model of the Mekong Delta*; Netherlands Delta Development Team (1974), *Diking Scheme 8*.

flood-affected areas of the delta into notional meshes to compartmentalise the computation of water depth, 11 schemes were tested based on combinations of 7 dikes [**Fig 10.1**]. The study concluded that without dikes in Cambodia, diking within the Vietnamese part of delta alone "would not strongly affect the river stages" at which water might breach manmade barriers.[10] The report highlighted that, to a greater or lesser degree, creating flood barriers to direct waterflows anywhere would cause upstream areas in Cambodia to "suffer increases of floodlevels".[11] The impact would not only be visible upstream. Even in the scenario where all dikes were simultaneously tested for their cumulative impact, the depth of inundation in the Plain of Reeds would rise at least one metre above baseline levels.[12] As such, without careful planning of their location and dimensions, dikes would almost certainly change the impact of annual inundation in Cambodia as well as disparate sections of the Mekong's floodplain.

The political and military situation that saw the American army leave South Vietnam in 1973 however, brought almost all projects to exploit and control the

10 Netherlands Delta Development Team. (1974), *Recommendations concerning agricultural development with improved water control in the Mekong delta, v. 7, Working Paper IV - Hydrology.* Bangkok, p. 36.

11 *ibid*.

12 Referencing the table of flood levels, only in scenarios 4 and 7 do flood levels remain the same. In all other diking schemes – including partially diking the Plain of Reeds – flood levels rise. *ibid*, p. 37.

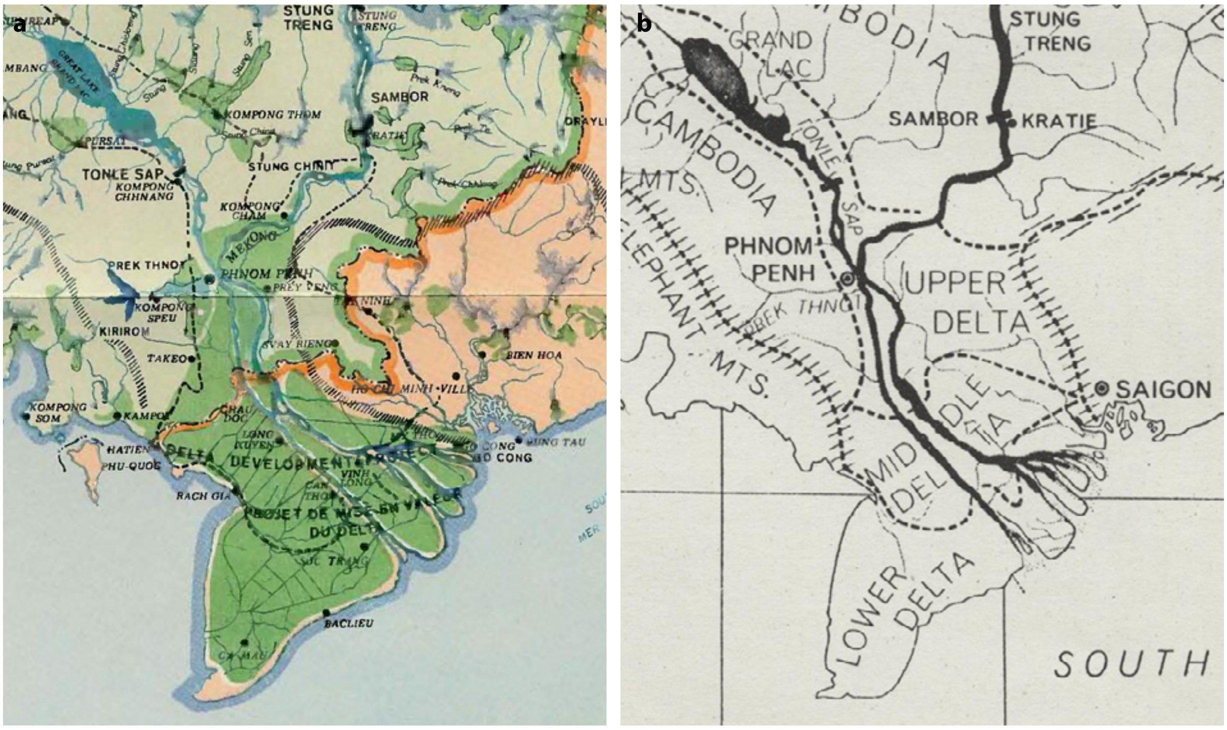


Fig 10.2 The limits of catchments On the left, a detail from the Interim Mekong Committee's map of basin development published in 1978. The basin's *watershed* (hatched line) and *flooded areas* (dashed line) are shown in relation to *potential irrigated areas* (green shade) and the *national border* between Vietnam and Cambodia (orange line). Similar to the Committee's 1970 indicative basin plan, north of the river and within Vietnam, irrigation appears to terminate at the watershed. On the right, part of geographer Gilbert White's map of the Mekong's basin showing possible *water-management regions* (dashed lines) in relation to the *watershed* (hatched/ dashed line). Published 15 years before the map on the left, White deliberately redraws the watershed to correlate with the extent of inundated areas, thus including the entire floodplain within the *middle* and *upper delta* regions.
Mekong Commission (1979), *Annual Report 1978 (ST/ ESCAP/ 79)*, Bangkok: United Nations; Gilbert White (1963), *The Mekong River Plan*, Ekistics, v. 16, n. 96.

Mekong's mainstream to a standstill. Reconstituted in 1978 with the participation of Thailand, Laos, a unified Vietnam but not Cambodia, the *Interim Mekong Committee* helped reopen diplomatic discussions on the development of shared water resources. Nonetheless, civil strife in Cambodia as well as the political isolation of Vietnam and Laos' communist regimes from sources of Western funding and technical knowledge, prevented any concerted effort to implement the Committee's plans for hydroelectric dams and storage reservoirs. Even without the upstream infrastructure however, irrigation in Vietnam's south was considered important. Driven by the need to feed a growing population and to reorganize agricultural settlement in a period of forced "deurbanization", the Vietnamese state's approach to regulating the Mekong River's flows aimed for total water control in the entirety of its domain.[13]

Indicative of a strategic approach rather than a technical plan, the map included in the Committee's 1978 report illustrated the imagined relationship between agriculture and water management [**Fig 10.2a**]. Depicted in relation to the river's surface flows, the map's green shade representing "other possible irrigation areas" appeared to extend from the sea to the north of the Phnom Penh. Rather than confined within the dashed limits of the "flooded area boundary", potential

13 HH Nguyen *et al* (2016), p. 2308.

irrigated areas were also shown to encompass the coastal lowlands where seasonal inundation was an outcome of tides and monsoonal rains rather than the river's overflow. The geographic configuration of planned cultivation in the coastal lowlands suggested that agriculture was possible without the sediment deposits carried by the flood. The cartographic notation that appeared instrumental to the extent of irrigation however was the basin's "watershed". Most possibly a result of the Committee's mandate to focus on the land 'contained' within the basin, the alignment of irrigation with this particular mapped limit served to subdivide the Plain of Reeds. Differentiating the more densely populated areas located closer to the river from the largely uninhabited swamp further away, the watershed would have primarily denoted where a specific behaviour of river water supposedly ended. Observation of the rising floodwater in remote imagery but also of dry season conditions on the Plain, suggest that this particular subdivision does not correspond with a specific behaviour of water. More importantly, the map also indicated where projected irrigated areas would *not* to be located. With visual emphasis given to the national border separating Vietnam from Cambodia, the map reinforced the idea of geopolitical autonomy in water control, while also suggesting the extent of potential international involvement in the development of new water infrastructure. Intentional - or not - of a decision to focus water infrastructure in only part of the floodplain, the map correlated irrigated agriculture with a particular behaviour of water that could only be perceived on the surface of the map.

The absence of irrigation in the north part of the floodplain however cannot be seen only from the perspective of a convenient alignment between the basin's outline and agriculture. Mapped information regarding the status of ground conditions in the Plain of Reeds was either deficient or contradictory.[14] Important for planning the location of irrigation, cartographic records of existing cultivation practices such as floating rice were inconsistent as to their extent and location. The traditional crop of the floodplain's farmers, "floating rice" was sown directly into the sediment deposits left by the flood, growing long stalks that were visible above the high water level. Adapted to the fluctuations of the annual flood and thus requiring almost no infrastructure to control water, this labour-intensive method yielded far lower quantities of rice than the crop grown on paddy.[15] Moreover, given the dependence on annual deposit of sediment which could not be precisely predicted, the method also entailed the risk of a poor harvest. Estimated to encompass up to 500,000 ha in the early 1970s,[16] floating rice was identified as a crop that could be replaced with HYVs.[17] Using transplanting techniques where the plants would first be grown in a nursery and then transferred to the field, HYVs required "full water control and adequate irrigation water" to achieve two annual crops.[18] Drawn together with single-transplanted paddy, a map by the Mekong Committee located floating rice in the Mekong's floodplains where the relatively shallow geological depression detained floodwaters for the

14 Perhaps due to their strategic nature, the detailed maps of acid sulphate soils in the Plain prepared by the Engineer Agency for Resources Inventories (EARI) do not appear to have informed maps from other sources.

15 François Molle & D.T. Tuân (2006), *Water Control and Agricultural Development: Crafting Deltaic Environments in South-East Asia.* In T. Tvedt & E. Jakobsson (eds.), *A History of Water, Volume 1: Water Control and River Biographies*. London and New York: Tauris, p.150.

16 Mekong Committee (1970), Annex V-6, Table 7, p. 91.

17 Molle & Tuân (2006), p. 150.

18 Mekong Committee (1970), V-40.

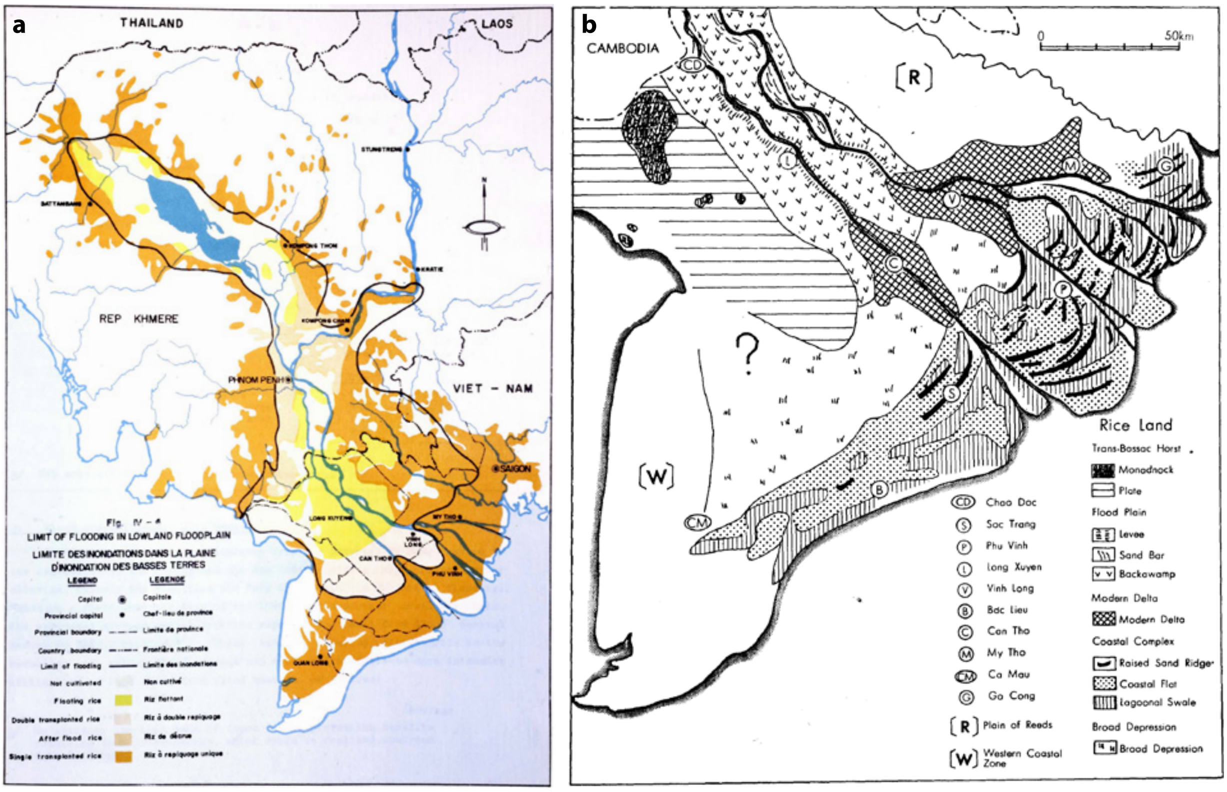


Fig 10.3 Locating rice production To the left, the Committee's map of rice cultivation in the delta. While it is not clear in the report's text if this map represented an existing condition or a projection following the application of water control, it shows that cultivation of floating rice in the Plain of Reeds would be limited to areas closer to the river and the border with Cambodia. To the right, Takayo's map gives similar value to "backswamp" areas within 20km of the Mekong's mainstream. These are differentiated from the [R] (Plain of Reeds) which is shown to have no agricultural potential.
Mekong Committee (1970), Limit of Flooding in Lowland Floodplain, p. V-40; Takaya (1974), *The Physiographic division of the Mekong delta with respect to rice growing condition,* Fig 3.

duration of the growing season [**Fig 10.3a**].[19] In the Plain of Reeds, this technique encompassed a significant portion of the flooded areas closer to the Mekong's mainstream and along the seasonally submerged border with Cambodia. Shown to cover the majority of the Plain, single transplanted rice appeared further inland where conditions were more often described as unsuitable for paddy agriculture. Indeed, as a different map published four years later indicated, only the areas adjacent to the mainstream were actually usable for rice cultivation. Prepared by Japanese agriculture specialists after fieldwork in the region, the map presented the physiographic classification of existing ground conditions and their relationship with cultivation [**Fig 10.3b**]. Diagrammatic rather than technical, the map's depiction of the "backswamp" indicated that agriculture on the Plain of Reeds was possible only in these "marginal parts of the area", where *emplodering* would allow "modification of the original hydrography" and farmers to control water in the early part of wet season.[20] In contrast, the report accompanying the map warned that it was of "no use to drain all the water" in the "great swamp"

19 The report from which the map is extracted does not discuss the map except to mention that it is a "generalized map of flooding". While this suggests it depicts an existing condition, the extent of single transplant rice in the floodplains suggests it may also be a projection of rice agriculture after full flood control has been achieved.

20 Yoshihiro Kaida (1974), *Hydrography of Rice Land in the Vietnamese Part of the Mekong Delta.* Southeast Asian Studies, v. 12, n. 2, p. 153.

located more than 20 km from the mainstream.[21] The perennially wet grounds of the Plain were considered unsuitable for cultivation and depicted without any information about the soil and only an **R** denoting the Plain's toponymy. Due to the depth of floodwaters as well as the presence of acid soils, the infrastructure needed to establish agriculture in these areas was too costly in comparison with other parts of the Mekong Delta and therefore a low overall priority. Either as a "backswamp" or as "floating rice", the differentiation of the Plain's agricultural potential closer to the river is apparent on both maps. Conditions north of those riparian ones however, prevented the establishment of paddy agriculture without drainage and irrigation infrastructure. As such the extent of single transplant rice fields on the Committee's map is dubious. Even if the Committee's map was a projection of future conditions rather than a record of existing ones, the 1978 map [**Fig 10.2a**] placing irrigation where floating rice – a crop requiring minimal water control - would be grown, appears contradictory. Although it is impossible to deduce if this was an error on the part of the cartographer or a contradiction internal to the plan, the map confirmed that conditions closer to the river were different enough to warrant a different treatment from the "great swamp" further inland. By excluding the unsuitable ground conditions of the Plain from consideration, the map argued that a productive, irrigated terrain identified with the delta could be discerned from all other adjacent areas

The geography of irrigation

In the context of the Mekong's lowlands, "irrigation infrastructure" includes control structures such as embankments and water gates as well as water distribution systems such as canals and pump stations.[22] While the limits of distinct irrigated command areas are not always spatially defined by waterways, canals provide the surface water needed for cultivation during the dry season and determine how it is accessed by farmers. Following Vietnam's unification, more than 15,000 km of main canals have been constructed in the Mekong Delta.[23] A significant portion of these canals has been built in the Plain of Reeds, extending the network of waterways constructed by the French and the post-colonial administrations of South Vietnam.[24] Arranged to form an irregular 'grid', the main canals visible on maps and aerial images occupy the entirety of the geographic space between the Mekong's mainstream and the border with Cambodia [**Fig 10.4**]. Constructed incrementally, the arrangement of waterways today is a consequence of multiple plans formulated by the Vietnamese state following the country's unification. The first plan for irrigation in the Delta by the Vietnamese state was articulated in 1976, and intended to counter the unplanned waterways constructed by local farmers that had resulted in the distribution of the toxic water from acid soils further downstream.[25] Based on the water control

21 *ibid.*

22 Mekong River Commission (MRC) (2018), *Irrigation Database Improvement for the Lower Mekong Basin.* Vientiane: MRC, p. 11.

23 Nguyen *et al* (2016), p. 2308. The length of canals constructed since unification is reported differently in various sources. Marchand *et al* (2014) indicate that 15,000 km of main canals, 27,000 km of secondary canals and perhaps 50,000 km of tertiary canals were built after 1990.

24 A current estimation of canals in Dong Thap Muoi by Vietnam's National Agency for Science and Technology Information notes that the rice protection embankment system has a total length of 7,171 km. Although these embankments may not equate with the definition of "canals" in other estimations, the total number is indicative of the attention given to creating irrigation infrastructure.

25 CT Hoanh *et al* (2014), p. 68.

Fig 10.4 Canals in the Plain of Reeds The map shows the location of irrigation canals constructed after unification (orange line) in relation to the waterways recorded on US topographic surveys in the 1960s (black lines). Highlighted canals (thicker black and orange lines) denote the waterways linking the Vaico and Mekong rivers. For reference, Delahaye's proposed Canal No. 2 is shown, of which only the Republic Canal was constructed.
Author (2022). Spatial data sources: *Irrigation canals* (MRC, 2008); *gadm36_Vietnam_0* and *gadm36_Vietnam_1* (GADM, 2022). US Army Map Service (1965-1970), Vietnam Topographic Maps 1:50,000, U.S. Army Map Service, Series L7014.

practices in the Red River Delta, the new plan focused on organizing irrigation, introducing pumping stations on large canals.[26] However, these early attempts faltered. In combination with the lack of petrol and the availability of small pumps useable by individual farmers, pumping stations constructed to irrigate command areas between 1,000 and 8,000 ha, only reached up to 15% of design capacity.[27] Along with the lack of dredging equipment which forced canals to be excavated manually, the production of major irrigation infrastructure in the 1970s was severely constrained.

The failure to plan a distribution system suitable to the actual conditions confronted by farmers led to a change in approach. Adopting the idea that long-term technical plans required scientific knowledge as well as political will, the Vietnamese state initiated studies to understand the actual conditions on the ground.[28] Complemented by hydraulic and salinity models to predict water flows, soil surveys and programmes to understand social conditions, the compiled information was used to formulate a new plan for the period 1986-1990.[29] An

26 *ibid.*
27 MRC (2018), p. 11.
28 Hoanh *et al* (2014), p. 71.
29 *ibid*, p. 70.

important part of the plan, the Delta was subdivided into five irrigation zones, with each zone indicating a different approach to water control based on the identified physical conditions [**Fig 10.5**].[30] The Plain of Reeds was included in the *East Tien River Zone* that spanned between the hydrological regimes of the Mekong, East and West Vaico rivers. Within the zone, new east-west canals were constructed to drain floodwaters towards the Vaico River and to use the Mekong river's flows to wash away the toxic surface water created by immersion of the acid soils. Partially following the route of the Sở Hạ River, the national boundary dividing the Plain of Reeds between Vietnam and Cambodia became the edge of a 'grid', composed of new drainage infrastructure. According to a Vietnamese map of the Plain available in 1968, acid soils were known to be concentrated inland from the river, and already formed the ground through which important manmade waterways such as the Republic Canal and the Lagrange had been routed [**Fig 10.6**]. With reference to the planar configuration of these existing waterways, the new primary canals were excavated through areas where acid soils were predominant. The risks entailed in the redistribution of acid water through the canals became a point of contention. Arguing that waterways such as the Hong Ngu canal would pollute the Mekong's mainstream and the surrounding paddy fields, Vietnamese researchers and international scientists voiced strong objections to the central government's plans.[31] When concerns were also raised by the party Chairman of Dong Thap Province, the central government stopped construction to study the impact more closely, restarting construction after provincial authorities had been convinced. Completed, the canal began to 'push' acid water into the West Vaico river where it flowed downstream to be diluted in

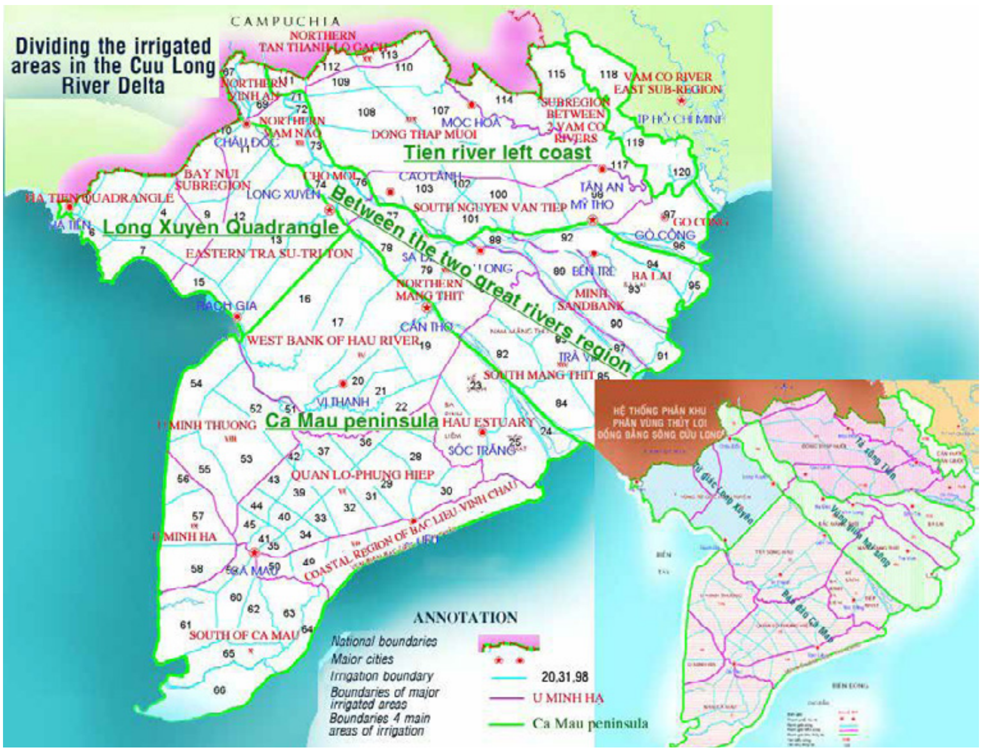


Fig 10.5 Irrigating regions The map shows the Mekong Delta's subdivision into five irrigation zones. The Plain of Reeds is included in the East Tien River zone that stretches from the Mekong's mainstream to the West Vaico River. Note that the internal subdivision of the zones into (enumerated) compartments appears to follow the same logic of spatial subdivision as the hydraulic model used by the Mekong Committee in the 1970s.
MRC (2018), *Irrigation system regions and zones in the Viet Nam Mekong Delta*, p. 44.

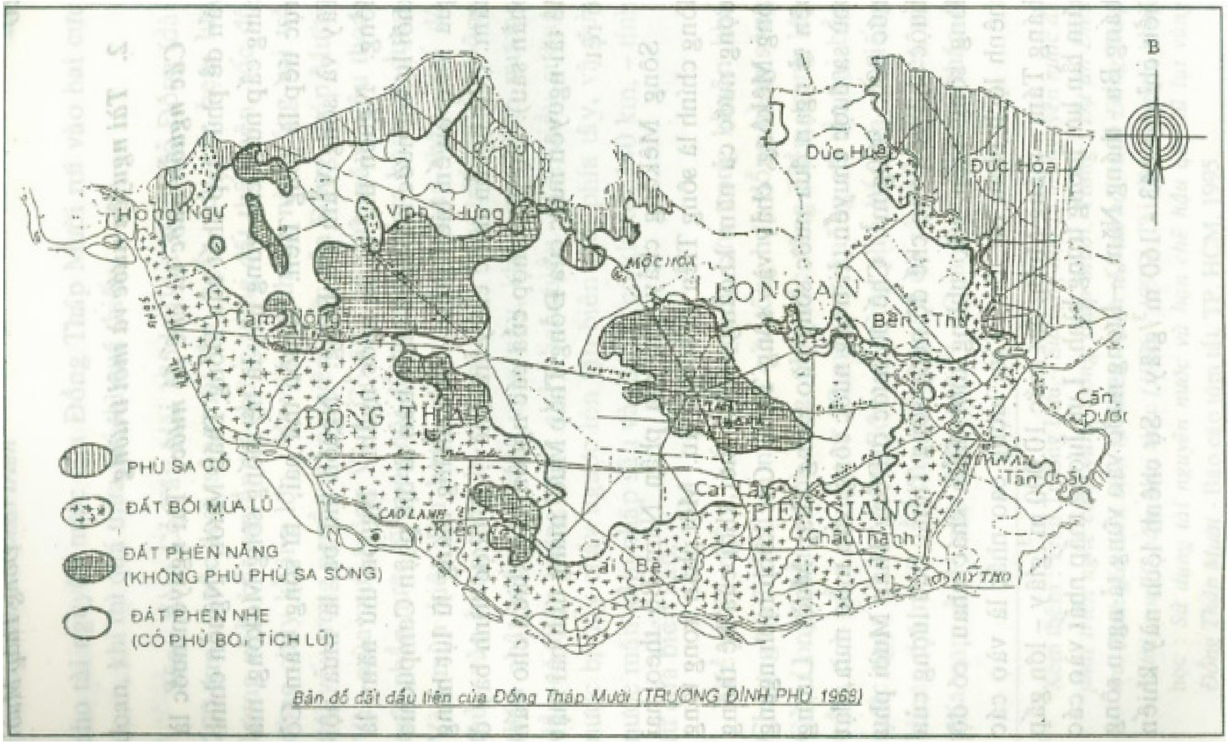


Fig 10.6 Subsoil configurations Republished in 1999 accompanying a description of the geography of Đồng Tháp Mười, this Vietnamese map from 1968 shows the distribution of soils. Canals built prior to unification are shown to traverse through acid (dark hatch), alkaline (blank) and alluvial (cross hatch) soils. The extent, type and location of soils appears to closely correlate with maps prepared in the same year by the Engineer Agency for Resources Inventories. Considering their distribution, new east-west canals would have unavoidably excavated through these areas.
Nguyen & Phan (1999), p. 19.

the estuary.[32] Although the downstream impacts eventually dissipated, the state's drainage infrastructure dispersed conditions that were previously concentrated in one part of the floodplain to the distant part of a different river. If before the new canals, the Vaico and Mekong had been discussed as part of the same hydrological system during the wet season floods, the canals would henceforth unify the flows of the two rivers in the dry season as well.

Joining distant parts of the floodplain into new contiguous geographic areas, the new canals also placed barriers to the movement of water. Raised at a height to direct floodwater in the early part of the *mùa nước nổi* (the water-rising season), earth embankments which allowed the condition of the ground between the canals to be controlled began to be constructed after 1976.[33] Re-built annually by local farmers, low levee walls called *August dikes* (*bao lung*) were used to protect planted fields as the flood levels rose. Timed with the harvest of a second rice crop, the height of the dikes was designed to overflow with the high-water levels in late August. This allowed the nutrient-rich sediment to settle in the fields after the first harvest, with the floodwater detained within the waterworn

30 *ibid*.

31 *ibid*, p. 71.

32 *ibid*.

33 Unlike *casiers* in the Red River's Delta, the construction of dikes was not considered a traditional technique for controlling water by Vietnamese farmers in the Mekong's floodplain. Describing his experience in An Giang (...)

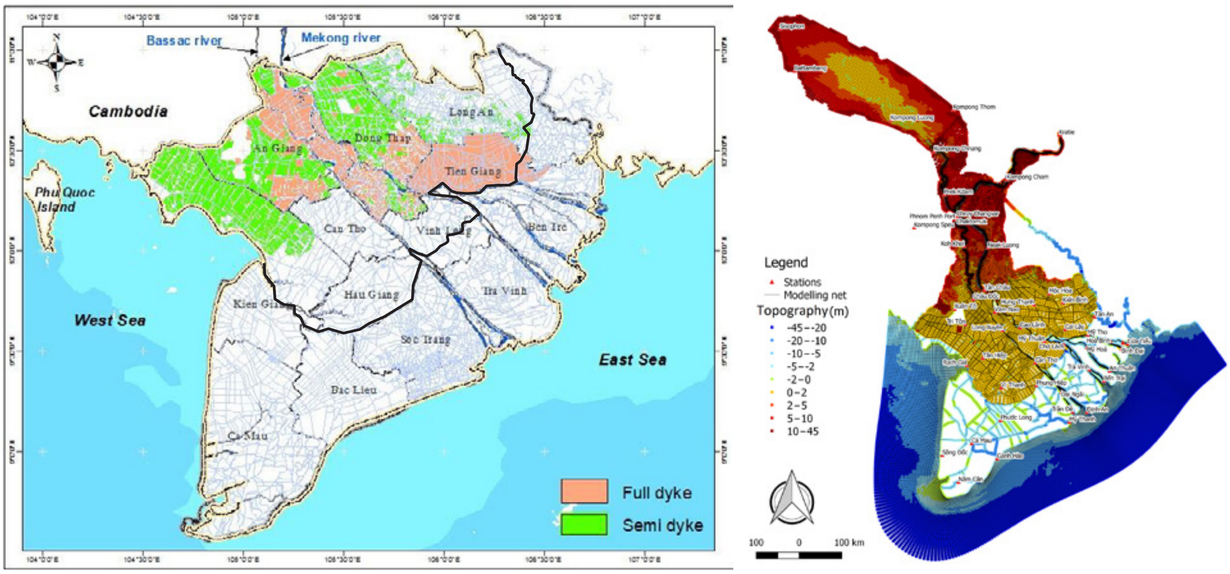


Fig 10.7 Dikes and the hydrological catchment The map on the left is one of the most recent records of the location and extent of 'August' or low dikes (green shade) and high dikes (brown). The map to the right is extracted from the study evaluating the impact of high dikes. It shows the hydraulic model used for evaluation and outlines the floodplain's catchment area (coloured areas showing the flood depth). The black line in the map on the left (by the author) indicates the limit of the catchment area from the hydraulic model on the right.
Duong *et al* (2014), *Dyke system in DTM and TGLX in 2011*; Thanh *et al* (2020), *Mekong Delta modelling grid and river interpolated topography.*

embankments available until the end of the wet season. Individually considered as "adaptations" to the flooded conditions, the state-sanctioned proliferation of low dikes throughout the floodplain signified a change in approach to how floods were managed.[34] Brought into law in 1986, policies to further increase rice production resulted in the government raising the height of existing embankments even further.[35] Encircled by walls, and using gates and canals to divert water into and out of the dikes when needed, the dispersion of floodwater was no longer contingent simply on the rhythms of the monsoonal climate but also on the demand for water. With the ability to fill and drain the paddy encircled by dikes more than once each year, the increased control over what and when to plant allowed farmers to cultivate a third annual rice crop. Following the catastrophic floods of 2000, the construction of high dikes accelerated.[36] Since then, concrete embankments designed at a height to withstand inundation throughout the year have been built throughout the floodplain [**Fig 10.7**]. In the Plain of Reeds, these high dikes are concentrated within the administrative boundaries of Dong Thap and Tien Giang provinces, encompassing the part of Plain's almost flat

33 (...) Province in 1976, the former Chairman of the Provincial People's Committee Nhị Minh Nguyễn, pointed out that the model for low embankments was inspired by observation of Cambodian farmers during the American War. Initially met with resistance from farmers, for the construction of these dikes each household in the village was mobilised to make mud bricks for the new embankments. With the top of the embankments used as roads and the relatively mild flood of 1976 both showing the benefit of these structures, the model of low seasonal dikes was subsequently adopted in the other parts of the Mekong Delta to increase rice harvests. https://laodong.vn/phong-su/di-tim-cha-de-mo-hinh-de-bao-dong-bang-song-cuu-long-525727.ldo Accessed 16th June, 2020.

34 Molle & Tuân (2006), p. 151.

35 Van Staveren *et al* (2016), p. 286.

36 Vo Quoc Thanh, Dano Roelvink, Mick van der Wegen, Johan Reyns, Herman Kernkamp, Giap Van Vinh & Vo Thi Phuong Linh (2020), *Flooding in the Mekong Delta: the impact of dyke systems on downstream hydrodynamics.* Hydrological Earth System Sciences, v. 24, p. 191.

topographical incline where the flood depth is lowest. As a result of the sixfold increase in land dedicated to producing three annual crops, rice yields in the Plain of Reeds have doubled since 1995,[37] allowing some to describe the continuous extent of paddy covering the floodplain as a vast "Plain of Rice" stretching to the flat horizon.[38]

Although the control of water within these floodproof 'cells' has become synonymous with industrial-level triple rice crops, in the Plain of Reeds dikes have also become the site of efforts to recreate an almost extinct natural condition. Since perhaps 700,000 ha of melaleuca swamp forests (*tram*) had been converted into rice farms during the 1980s alone, restoring these forest ecosystems was a key concern of some local officials.[39] Initiated by the chairman of Dong Thap Province, the first attempts to preserve the Plain's indigenous biodiversity focused on a dike between four canals which had been designed to retain floodwater rather than to grow crops.[40] As a result of the lack of agriculture activity which maintained existing melaleuca trees, the rare eastern saurus crane was spotted nesting in the dike and by central government decree, the Tram Chim National Park was established in 1992 to conserve the wildlife and vegetation within the dike. In terms of biodiversity, the forest which has grown within the dike stands in contrast to the rice monocultures in the surrounding fields [**Fig 10.8**]. Nonetheless, the quality and depth of the water on which the acid-tolerant melaleuca grow, is controlled by the opening and closing of six gates timed to follow the seasonal fluctuations of floodwater.[41] The maintenance of water levels at artificial depths have resulted in biological changes for some species of

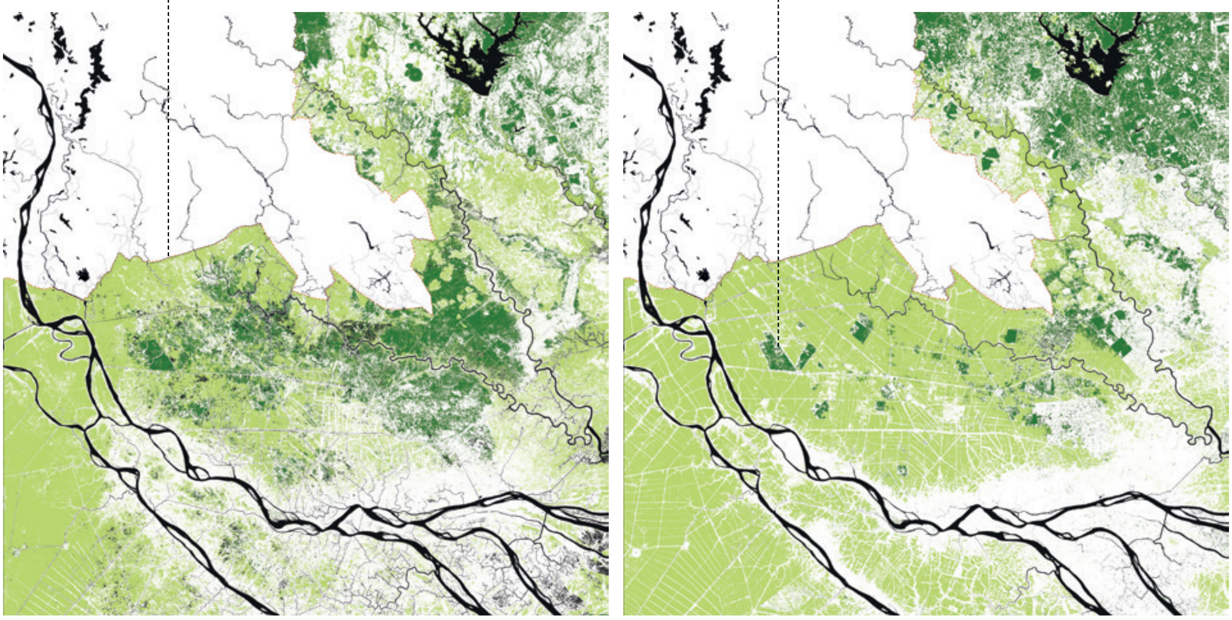


Fig 10.8 Shrinking swamp The two maps show the geographic distribution of land classified as *rice paddy* (light green) and *wetland/ forest* (dark green) in 1990 (left) and 2020 (right). Forest areas are most probably *tràm* (*melaleuca leucadendron*), a type of myrtle tree that grows on perennially wet acidic soils. Over the 30 year period these maps record, the proportion of *paddy* in the Plain of Reeds has increased while the land classified as *wetland/ forest* has decreased significantly. Moreover, what patches of wetland/ forest remain, appear to be confined within the limits of manmade waterways.
Author (2022), Spatial data sources: *HRLULC 10m resolution map of the southern region of Vietnam [2020] (ver.18.09)* (Japanese Space Agency, 2019); *World Water Map* (ESRI, 2014); *khm_rivl_gov* (OCHA, 2008).

vegetation, while also increasing the risk of forest fires during the dry season.[42] From this perspective, Tram Chim's geographically isolated forest ecosystem is not the preserved fragment of a previous, pre-dike condition. Encompassed within one of the hydrologically autonomous units created by the subdivision of the terrain with dikes, Tram Chim's 'nature' is contingent on the same technologies which allow farmers to grow rice on a former swamp.

As floodbarriers in one place affect floodlevels in another, the maintenance of the irrigation system must constantly also account for the changes the system induces both upstream and downstream. In hydrological models, the catchment area used to quantify the volume of water diverted by the embankments of dikes in the Plain of Reeds extends to Tonle Sap [**Fig 10.7**]. Studies based on these models have identified the impact of high dikes on the floodplain's hydrology. While the temporary nature of August dikes does not appear to have had measurable effects, high dikes have been connected with higher flood depths further upstream as well as downstream increases in mean water levels.[43] Considering that land subsidence as well as climate-related changes in tidal levels are also important reasons for these changes, those induced by the construction and use of high dikes to detain water have extended the threats posed by destructive floods, dry season drought and salinity intrusion to downstream areas.[44] While these conclusions describe conditions across the entire floodplain, the propagation of rice agriculture which has resulted from the flood control of both high and August dikes has affected the Plain of Reeds more profoundly. Research has pointed out that the disappearance of perennial wetlands in the Plain of Reeds has been driven by the demand for agricultural land, which the drainage of the floodplain has produced.[45] Coupled with the destruction of the melaleuca swamp forests, the capacity of the Plain to detain floodwater has been significantly reduced. If the cartographic delineation of the floodplain is closely associated with defining the area at risk from inundation, then does the redistribution of these risks imply that a more fundamental relationship between water and geographic space has also changed?

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37 See Duong Vu Hoang Thai, Van Trinh Cong, Franz Nestmann, Peter Oberle & Nam Nguyen Trung (2014), *Land Use Based Flood Hazards Analysis For The Mekong Delta.* Proceedings of the 19th IAHR-APD Congress 2014, Hanoi, Vietnam, Figure 3. Rice production in the three provinces dividing the Plain of Reeds increased from about 3,800 thousand tons in 1995 to around 7,200 in 2019. GVSO (2022), https://www.gso.gov.vn/en/px-web/?pxid=E0615&theme=Agriculture%2C%20Forestry%20and%20Fishing

38 Nguyen Xuan Vinh & Andrew Wyatt (2006), *Situation Analysis: Plain of Reeds, Viet Nam*. Vientiane: Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP), p. 15.

39 Nguyen *et al* (2016), p. 2308.

40 Le Cong Kiet (1993), *Dong Thap Muoi; Restoring the Mystery Forest of the Plain of Reeds.* Restoration and Management Notes, v. 11, n. 2, p. 102.

41 Jill Pacovsky (2001), *Restoration of wetlands in the Tram Chim Nature Reserve (Dong Thap Province, Mekong River Delta, Vietnam).* Student On-Line Journal, v. 7, n. 3. Department of Horticultural science, University of Minnesota.

42 Water levels in the dike have been responsible for reducing the growth rates of the melaleuca trees, and for reducing the main source of food for the saurus cranes which have subsequently impacted the bird population nesting in the Park. Duong Van Ni, Deanne Shulman, Julian Thompson, Tran Triet, Thai Truyen & Martin van der Schans (2006), *Integrated Water and Fire Management Strategy Tram Chim National Park.* UNDP/ IUCN/ MRC/ GEF, p. *ii*.

43 Vo *et al* (2020), p. 189. See also Dung Duc Tran, Gerardo van Halsema, Petra Hellegers, Long Phi Hoang, Tho Quang Tran, Matti Kummu & Fulco Ludwig (2018), *Assessing impacts of dike construction on the flood dynamics of the Mekong Delta*. Hydrological Earth System Sciences, v. 22, p.1875.

44 Van Khanh Triet Nguyen, Viet Dung Nguyen, Hideto Fujii, Matti Kummu, Bruno Merz & Heiko Apel (2017), *Has dyke development in the Vietnamese Mekong Delta shifted flood hazard downstream?* Hydrology and Earth System Sciences, v. 21, p. 3992

45 Nguyen *et al* (2016), p. 2308.

An answer to this question is provided in the delineation of catchment areas published in maps and spatial datasets by the Mekong River Commission (MRC). The organization charged with coordinating exploitation of the river's water across four countries, the MRC is also one of the most important sources of information about the river. Derived digitally by the MRC's cartographers, the outline of the Mekong's tributary basins and catchment areas is obtained by projecting water flows on a digital elevation model [**Fig 10.9**]. In the mapping process, this technique of determining boundaries is utilised for catchment areas between the river's sources in Tibet and the upper part of Vietnam's Mekong Delta.[46] Throughout the remaining Delta however, the topographically derived boundaries are combined with "water resource management areas". Thus, where in the Cambodian part of the Plain of Reeds, the catchment areas appear to follow the irregular features of the terrain, in the Vietnamese part they correspond with the subunits of the East Tien River irrigation zone (see Fig 10.5). To the extent that the map illustrates a plausible spatial relationship between land and the flows of water, the catchment

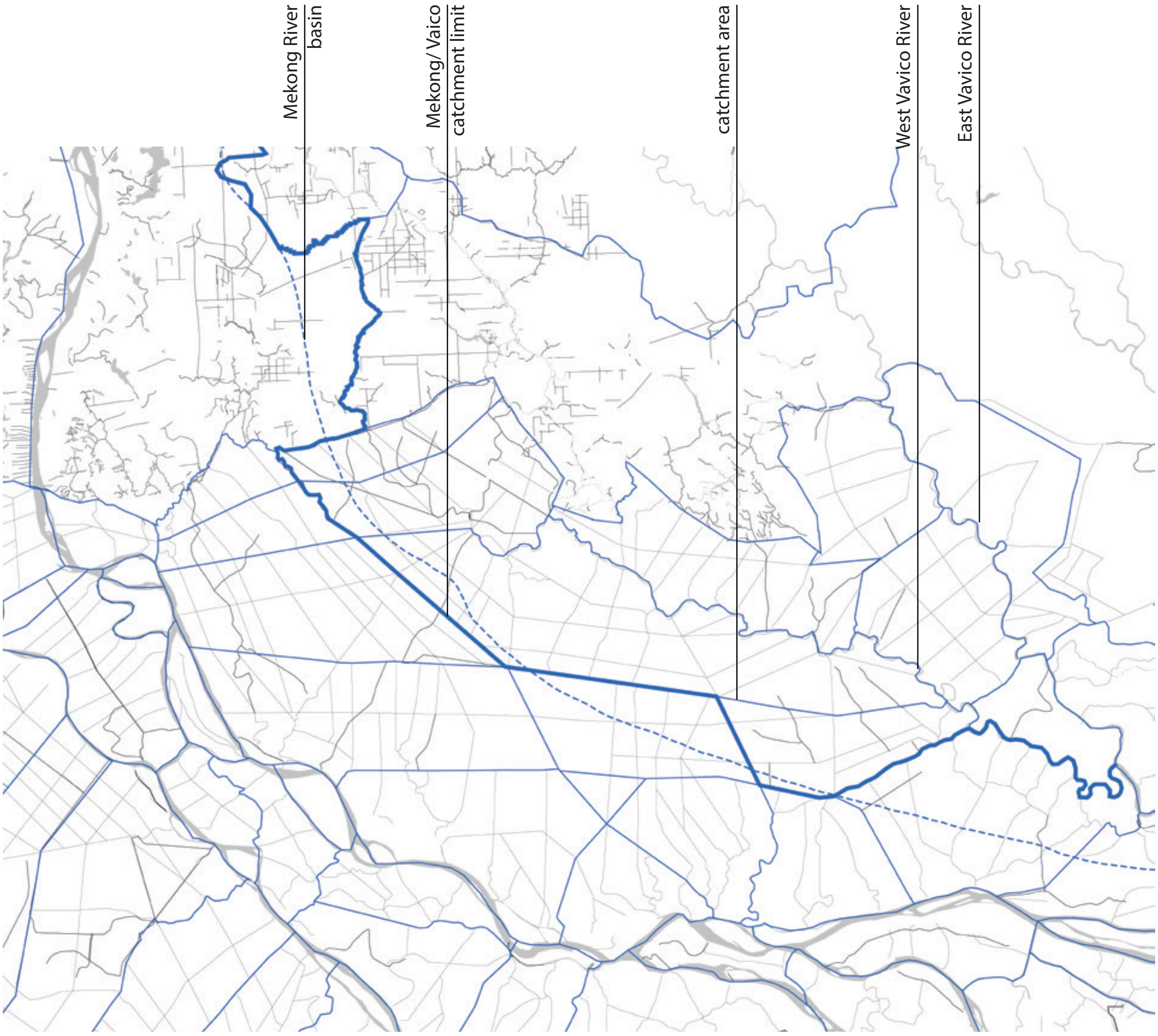

Fig 10.9 The floodplain's catchments Drawn with spatial data from the MRC, the map shows *catchment areas* (blue lines) in relation to the *Mekong River's basin* (blue dotted line) and the differentiation between the Mekong and Vaico catchment area (thick blue line).
Author (2022), Spatial data sources: *catmb_4K* (MRC, 2012); *World Water Map* (ESRI, 2014); *mrc_SDE_IRRIGAT_b_irrcanal01* (MRC, 2012); hotosm_khm_waterways_lines (OSM, 2021).

outlines suggest that for the MRC's cartographers, the most relevant spatial unit for describing the relationship between water and geographic space equates with the configuration and regulation of water for irrigation. Considering that the hypothetical line dividing the flows of the Mekong with the Vaico now aligns with the straight edges of canals, the configuration of the Plain's irrigation system appears to have substituted the 'natural' basin as the reference for water control.

Conclusion

Confronted by such diverse depictions of the catchment's cartographic delineation, it is worth considering what relationship the catchments are used to describe. Even if the MRC's version can be seen as a purely technocratic response to the question of where the watershed between waterways is located, the conceptualisation of catchment areas in terms of an area of water control is consistent with earlier versions published after 1975. Denoting the extent of irrigation in the Mekong Committee's map from 1978, the position of the basin's limit in the Plain of Reeds would have been difficult to reconcile with an observable behaviour of water. Intentionally or not, the watershed's cartographic division of the Plain of Reeds reflected most closely the approximate location of alluvial soils closer to the river that were most favourable for agriculture, leaving 'blank' the space on the map where most of the acid soils were concentrated. Iterations of the outline still used today have refined the watershed's configuration roughly equidistant between the Vaico and Mekong rivers. But, as the catchment of the hydraulic model shows, knowledge of this hypothetical limit has almost no value in the calculation of floodwater volume flowing over the Plain. Even if the Lower Mekong Basin's outline also functions as the MRC's *area of operations*, the line bisecting the Plain of Reeds is perhaps more symbolic of a hydrological concept rather than instrumental to spatial decisions regarding water control. Similarly, given the proliferation of dikes, the outlines of the irrigation units from which the MRC's "catchments" are extracted do not necessarily specify a distinct behaviour of water situated only within their limits. From this perspective, the extents of these catchments can be thought of as imaginary hydrological notations which allude to a particular perception of geographic space that is intimately connected with the control of water for the purposes of irrigation. Cartographic references to the irrigation system are therefore equally symbolic of the process of rice cultivation driving the changes observable in the Plain, as much as they are intended to describe the extent of a particular behaviour of water.

Showing the satellite-detected surface water as the flood season peaks in late August, maps constructed from GIS spatial data reveal the degree of control exercised by water infrastructure in the flat lowlands of the Plain of Reeds [**Map J**]. Prescribing where water flows or stands still, the distribution of the dikes and canals used for irrigating rice, produces a visible patchwork of (relatively) dry land, concentrated mostly to the south of the cartographic line indicating the river basin's boundary. If maps showing the location of surface water are intended to present the 'reality' of an existing condition, understanding what

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46 *"Basinwide catchments (4,000 km2 upstream areas) for the whole Mekong Basin. [The dataset] is derived by burning the classified river dataset into the existing DEM data to update DEM reflecting the patterns of water flow across the landscape and enable upstream area to be calculated to delineate boundary of catchment over the upper part of Vietnam Mekong delta, then combined with projected water resource management area of Vietnam Mekong Delta."* https://portal.mrcmekong.org/data-catalogue?q=catchment&size=n_20_n accessed 22nd June 2022.

environment becomes visible in the cartographic lines of the Plain's catchments is important. Equated with the watersheds of the Mekong's tributary basins, the rectilinear areal forms drawn by the MRC's cartographers suggest that collectively, anthropogenic changes to the flows of water have produced an environment which cannot be described solely through existing hydrological registers like the river's basin, delta or floodplain. What some scholars have called a *second nature* is closely connected with an understanding that natural conditions have been permanently transformed by human activity.[47] As the socially-produced environment of these processes is thought to have "replaced a non-human 'first nature'",[48] the way this transformation is presented on a map is not limited to the individual alterations to the terrain in subsequent depictions of the same geographic area. Calibrated in relation to the practices of rice agriculture, the MRC's hypothetical catchment areas do not so much replace a pre-existing 'natural' environment but rather present that environment as an outcome of the human labour invested in its control and domestication. To therefore conclude that the irrigation system has become the geographic reference for the physical control of water is also to accept that the terrain visible on the map is not the same floodplain which Delahaye and American engineers had examined. Yet this is not just because infrastructure, agriculture and settlement have changed the physical conditions the map purports to depict. If references to catchments are also intended to evoke a permanent geographic 'reality' that could conceivably be restored if human maintenance of the system ceased, the 'second floodplain' produced by human activity suggests that the return to an 'equilibrium' prescribed purely by natural forces is no longer available.

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47 Christian Schmid (2016), *The Urbanization of the Territory: on the Research Approach of ETH Studio Basel.* In Mathias Gunz & Vesna Jovanovic (eds.), *Territory: On the Development of Landscape and City.* Zurich: Park Books, p. 28.

48 Noel Castree (2000), *Marxism and the Production of Nature.* Capital & Class, v. 24, n. 3, p. 25.

Conclusions

We must learn to recognize as causes what have ordinarily been taken to be effects.

The structure of scientific revolutions, Thomas Kuhn, 1962

The research findings are compiled in the table below. They identify the territories that are displayed, maintained and produced by mapping, delineating and planning the Mekong River's catchment areas. In the context of this thesis, *mapping* refers to the process of collecting and displaying information about the condition of the terrain; *delineating* refers to the intentional differentiation of one particular part of the terrain; *planning* refers to the instrumentalization of mapping and delineation to organize land, water and people's activities. This chapter discusses the key findings derived from the research and their implications. These are followed by notes on the limitations of the adopted method and the validity of the results, and concluded with recommendations for further research.

Research findings

The research provides answers to the question of what, except for the physical flows of water, is being mapped, delineated and planned with reference to the basin, delta and floodplain. In relation to the table below, the key findings are compiled vertically, for each catchment area.

Basin The research shows that colonial-era surveys of the mountain topography and the river's mainstream equated the basin with the jurisdiction of the state. In separate hydrographic and topographic mappings, cartographers 'contained' Siam's authority within watersheds or projected the limits of French or Siamese influence on riparian areas. Subsequent surveys by the Mekong Committee supported the

	Basin	Delta	Floodplain
Mapping *What relationships are being mapped?*	**inclination of ground** • geopolitical influence • spatial continuity	**accretion of sediment** • military conduits • settlement patterns	**accumulation of water** • geography of risk • uninhabitable *atopia*
Delineating *What extent is being differentiated?*	**river system** • area of operations • unit of international development	**soil disposition** • defensible terrain • rural hinterland	**inundated area** • reclaimable terrain • units of cultivation
Planning *What course of action is being prescribed?*	**water resources** • downstream dependencies	**hydrological region** • population redistribution	**ground's wetness** • corrective operations

decision to separate the catchment area along national boundaries, with each part corresponding to the influence of rival Cold War powers. Not only did these mappings make a case for excluding China's Lancang River from consideration in shared resource management [**Figs 4.6, 4.7 & 4.8**]. They also argued that the water, land and people within the 'lower' basin occupied a separate geography. By proceeding to map this particular section of the basin, the disparate terrains and distinct groups of people situated across different national jurisdictions were repeatedly portrayed as parts of the Lower Mekong Basin rather than the Mekong Basin [**Fig 4.9**]. These recurring depictions reinforced the idea of a geographic unit that manifested south of where the Mekong crossed into Laos. Collecting and displaying information about only part of the terrain extricated a singularity out of the total of all terrains, to indicate the 'contents' of a particular geopolitical 'whole'. For the cartographic endeavours discussed in the thesis, mapping the terrain of the Mekong's basin articulates and maintains geopolitical authority.

The determination of the catchment's limits illustrates that the spatial dimension of planning water resources converges with political concerns at the definition of the 'common problem'. Fundamental to the articulation of a shared interest between different groups of people is the claim that the river's water supports all human activities. According to these discourses a natural 'unity' exists between water resources and people, an economic and environmental relationship that demanded the simultaneous consideration of all available surface water as well as land. The establishment of autonomous agencies charged with overseeing the design, construction and operation of multiple water infrastructure projects was considered necessary to ensure that the river's exploitation benefitted water users equally across separate jurisdictions [**Fig 3.4 & 3.9**]. In the Cold War context, the operation of the new authority independently of the existing power structure of administrative and governance units, introduced an explicit political dimension to the technical aspects of controlling hydrological and terrestrial resources. The UN promoted multi-functional water projects globally, with the river basin serving as the reference for participation in coordinated international efforts to plan water infrastructure [**Fig 4.2**]. Applied to the Mekong River, the global concept of *integrated river basin planning* qualified the Lower Mekong Basin to indicate a specific region within the larger Mekong's basin. This region's extent was designed to promote collaboration among mainland Southeast Asia's governments and to exclude Cold War adversaries. With metaphorical allusions to the flows of water, the basin delineated by the UN's experts indicates a "common valley", a political unity with the participatory qualities typical of Western democracy. In this sense, the delineation of the basin is underpinned by the intention to specify an area for technical as well as political solutions.

Planning documents show that the technical consideration of the river's entire flows distinguishes basin-level planning from merely situating infrastructure along different waterways of the same river system. The outcome of planning the Mekong's waters as a common valley is the imagined geography of interdependencies produced by the deployment of infrastructure [**Fig 4.10 & 4.14**]. Maps showing the numerous dams and canals planned by the Mekong Committee projected the power of the organization to harness engineering in order to domesticate the entire river. The new geography was composed of different projects operating simultaneously and in relation to each other. With the capacity to store wet season water or to irrigate land during the dry season, these would transform ground conditions over thousands of square kilometres into the appropriate level of wetness suitable for cultivation. More importantly, to sustain the new conditions, the plans intentionally created – or magnified the existing – dependence between upstream diversions and downstream conditions located in different political jurisdictions. The manmade geography produced by referencing the basin would need to be artificially maintained in perpetuity for the outcome to be considered successful. In practice however, the design of individual infrastructure projects was effectively considered separately from the designed relationship between two or more projects. As the Bureau of Reclamation's planning for Pa Mong shows, the envisioned coordination with other projects was not incorporated into the project's parameters due to the uncertainties of constructing downstream projects. In this sense, the basin prescribed a particular way for different projects to work together that was inherently difficult to design and riddled with unresolvable contingencies. Instead of explaining how the river should be planned, the basin's planning visually describes the result of controlling the river. Projected onto a planning map, the basin illustrates – rather than demonstrates - the domestication of the river.

Delta Referencing their authors' intent, the thesis distinguishes between mappings of the terrain formed by the diachronic accretion of the Mekong River's sediment – the delta – and mappings of the Mekong Delta. In early mappings, the objective of cartography was to record information about particular aspects of the terrain rather than explicitly about the terrains collectively forming the geographic delta. Vietnamese and early colonial maps illustrate that mapping rivers and streams denoted knowledge of the strategic conduits that organized troop deployment and the location of centres of military or administrative power [**Fig 5.13**]. These waterways described larger geographic areas that corresponded to the control of military garrisons. Subsequent mappings of the canals built by the French described perennial routes through the dry season low water which were equated with the capacity of the colonial state to control the entirety of its domain as well as the extent of land converted into rice paddy [**Fig 6.1**]. In addition to waterways, detailed mappings highlighted the extent of the individual villages subject to taxation. Projected together onto maps by Gourou, the configuration of settlement clusters was used to deduce the extent of the delta within the French colony, and the uninhabited areas suitable for resettlement [**Fig 6.8 & 6.9**]. In these examples, knowledge of the Mekong's lowlands is described through the social and military significance of waterways and settlement patterns. By assigning different values to the same terrain, mapping displays multiple deltas that correspond with anthropocentric rather than hydrological concerns.

Maps that project the terrain of the Mekong's lowlands, almost never specify the extent of the geographic delta. Instead, differentiation of the delta from adjacent terrains is a result of operations with similar objectives. First, delineation is repeatedly an answer to the question of defensibility. The power exercised by the pre-colonial Vietnamese state through the use of the network of military infrastructure differentiated a specific section of the Mekong's lowlands from areas under Cambodian authority. French army officers recognized that the defensive infrastructure was built on a geographic delta reaching inland to Phnom Penh. By situating the colonial endeavour within the contested limits of the *Delta du Cambodge*, the French juxtaposed a geographic idea with the strategic evaluation of the terrain to justify European involvement beyond the Vietnamese empire's area of authority. As the research shows, the process of maintaining the boundary along the Vinh-Te canal's defensible frontier has arguably produced a material distinction between the geographic delta and the Vietnamese Mekong

Delta [**Fig 5.17**]. Defensive reasons are also visible in post-colonial topographic maps prepared by the US Army [**Fig 6.17**]. Depictions of strategically situated "hamlets" parallel to the boundary with Cambodia presented South Vietnam's Mekong Delta consolidated behind a "human wall". Planned settlements cumulatively defined a 'state space' under government military control. In these cases, delineating the defensible terrain produces and maintains a delta that projects the state's control over land and people.

A second approach to the delta's delimitation is seen in attempts to geographically differentiate the Mekong Delta from the metropolitan area of HCMC. The thesis shows that using the Vaico River as reference, the Delta encompassed the majority of rice-producing areas that underpinned the city's, and arguably South Vietnam's, post-colonial economy [**Fig 7.4**]. Defined in relation to Saigon, the Mekong Delta was distinguished from the urban metropolis, and included within the city's extended agricultural hinterland. Following Vietnam's unification, state policies of de-urbanization and pressure to increase rice production, accentuated the distinction between the rural Delta and the city's urban economy. As urban and industrial activities have become increasingly spatially intertwined with agriculture, maintaining the distinction is expressed in new differentiations. By projecting a hierarchy of urban centres, Dutch-initiated planning endeavours emphasise the autonomy collectively produced by the network of settlements [**Fig 7.13**]. Rather than distinguishing between conditions, here delineation redefines the parameters which maintain the Mekong Delta's internal cohesion as a separate regional entity.

Considered collectively, the administrative provinces included in the Delta are identified as a 'whole' that is equally, if not uniformly, susceptible to the impacts of climate change. Framing the problem of climate change in relation to the entire Delta, provides the incentive to qualify specific parts of different provinces in relation to urbanization patterns. The focus on regulating settlement is underpinned by multiple reasons that emphasise the economic advantages of urban areas, the vulnerability of "continuous urbanisation" and the "sustainability" of concentrated clusters of inhabitation. Urbanization in general – and in the conditions of the Mekong Delta in particular - is framed as the problem rather than a consequence of the closely related but ultimately different problem of water. In a context where enforcement of planning regulations is weak and most new house-building is self-funded and unplanned, these endeavours appear in conflict with local preferences and have only limited chances for implementation. From this perspective, assigning a "hydrological" notation to a delineated region such as the urbanized Middle Delta does not describe an existing geography related to the action of water [**Fig 7.12**]. Instead, references to the delta's 'fragile' hydrology unify administrative units under a single concern, and lend a particular urgency to planning processes that aim to deal with the imminent problems of climate change. By evoking the delta's hydrology, planning prescribes the spatial parameters for redistributing people and activities within the larger Mekong Delta.

Floodplain The process of mapping the floodplain is intended to describe both the maximum surface area of accumulated floodwater as well as the succession of ground conditions sustained by the annual submersion of land. Although the Mekong's overflow was considered beneficial for agriculture in the 'garden lands', from the European perspective the empty, unmapped spaces on early colonial maps which corresponded to the floodplain were viewed as threats. Maps described the stagnant water retained within topographic depressions, the ground's perennial wetness and the prevalence of acidic soils that created the conditions for disease and inhibited the establishment of settlement and agriculture. Represented in maps of the colony's administrative units, the featureless expanse of the Plain of Reeds defined the wet grounds of an uncultivatable and inhospitable *atopia* [**Fig 8.4 & 8.5**]. The same conditions that made the Plain of Reeds uninhabitable in the colonial imagination, made it possible for groups of insurgents to establish bases, and impeded the enforcement of state power. Similarly, for the EARI's cartographers the water that periodically invaded the Plain was also responsible for the disappearance of the land border between Cambodia and South Vietnam, allowing the resupply of insurgents hidden in the swamp. In these cases, mapping the floodplain aligns the temporary extent of inundation with a permanent state of impending danger to health, to inhabitation and to state security.

The Plain of Reeds described in Victor Delahaye's PhD thesis and the EARI's polder study include the same terrains, but take different approaches to determine the floodplain's limits. Delahaye's design-oriented research defined the catchment in relation to the slope that made floodwater a threat to settlement and agriculture [**Fig 9.4**]. The EARI's cartographers on the other hand, determined a fixed dimension for the Plain in contrast to the surrounding "indefinite" catchment areas which encompassed the vulnerable border area with Cambodia [**Fig 9.8**]. By first articulating the entirety of the floodplain, the infrastructure proposed in Delahaye's canals and the EARI's polders subdivided the Plain's 'whole' into discrete sections within which agriculture would be possible. The conjunction of the floodplain's extent with the infrastructure specifying the wetness of the ground denoted the spatial units for cultivation. The situation is reversed in the MRC's subsequent alignment of catchment areas with discrete "water resource management areas". Aligned with the Plain's irrigation units, the MRC's catchment areas cumulatively describe the transformation of the wetlands into a vast agricultural expanse [**Fig 10.9**]. By recovering the capacity of water-logged lands to produce crops, by regaining control of the Plain from the disruption caused by enemy insurgents and by 'rescuing' the colonial *atopia* from the dangers posed by the action of water, the floodplain's extent differentiates the terrain to be 'reclaimed' from various threats. Arguably, delineating the floodplain in these cases is a function of the corrective operations aiming to 'redeem' the Plain from its marginal status. By making the temporary accumulation of water 'visible' on a map, the floodplain's delineation articulates the response to a perceived imbalance in the natural, political and social equilibrium.

Implications of the findings

The cartographic construction of the three catchment areas provides insights into the design of territory. In relation to the table of findings, the implications of the research are compiled horizontally. They constitute answers as to how territory is produced by the operations of mapping, delineating and planning the Mekong's catchment areas.

Mapping context Mapping serves to describe the geographic setting where human activities unfold. The outline of waterways, the colours of the ground and the shape of settlements all provide valuable information about the terrain, situating where people live or where armies are deployed. In the mappings discussed in the thesis, visual descriptions of waterways and topographic inclines are not ends in themselves. Rather than mere depictions of an existing condition, the map presents the available body of information to assess the validity of a proposed differentiation between parts of the terrain or the efficacy of a specified course of action. By correlating state authority, agricultural production or perceived threats with particular geographic phenomena, mapping articulates the *working object* of geography but also of geopolitics, infrastructure planning and military control. Rather than differentiating between terrains, mapping the *working object* serves to define the principles which underpin the selected area's internal coherence. Cartographers classify surveyed phenomena into existing categories to make the terrain 'visible', interpreting information from different oral, visual or numerical sources to articulate a singular visual description. In this sense, the regions qualified on maps by collecting and displaying information about the river constitute hypotheses rather than unequivocal realities. Because they explicate economic, social, political and environmental conditions, hypotheses can be presumably redefined - along with the region they envelop - to convincingly describe conditions which inevitably change at different rates. By intentionally maintaining the validity of the hypothesis when it is no longer descriptive, the *working object* indicates what should be rather than a current or previous condition. Once the *working object* specifies change, what may have begun as a *region* describing the context becomes a *territory* prescribing where transformation will take place. In other words, if the process of mapping is intended to provide 'objective' evidence to support design decisions, the results of mapping the Mekong's catchments conform to the setting of a predetermined course of action. Through allusions to an existing geographic entirety mapping designs territory by constructing the context around human activities.

Delineating site

The rivers, mountains and soils which collectively indicate the presence of the catchment directly affect where and how infrastructure is designed, as well as people's decisions to locate their homes and farms. Mapping water flows, the incline of the ground and the accretion of sediment and then distinguishing a catchment from their configuration, suggests the cartographer first records what is there, and subsequently 'interprets' the visual information in order to 'see' the catchment. The area which is visualised as a catchment is the outcome of the interaction between these geophysical phenomena. Because references to the *hydrological* basin, the delta and the floodplain indicate a measurable extent of the terrestrial surface, the area specified as the catchment is conceived – if not always represented - in terms of an outline. This line describes the location of a process and does not necessarily equate to a difference between existing ground conditions or with a physical boundary. Although the limits of catchments are - in this sense - imaginary, as the research shows, the articulation of their areal 'whole' on the map has a causal influence. By indicating the scientific knowledge of water flows, by placing value on the entirety of the catchment area, and by presenting political choices as the adherence to the spatial qualities of a 'natural' phenomenon, the catchment's boundaries acquire authority. Equated to the surface area they occupy, the projection of catchments on a map affects how water is diverted, who controls geographic space and where people live and work. Thus, unlike the rivers, mountains and soils from which they are derived, catchments trigger physical changes when they are known in terms of the entirety they encompass. Given that knowledge of the 'whole' is only possible when their imaginary limits are delineated, catchments affect human activity only when they are projected on a map. This does not imply that catchments themselves do not exist independently of maps. Rather, that the delineation of catchments transforms the possibilities inherent in mapping the flows, outflows and overflows of the river into the illusory certainty of a specific territory.

Each delineation of each catchment has specific reasons for its preparation. The differentiation between two otherwise equal parts, and the unification of disparate parts into a new 'whole' are the most important objectives of delineation. Just as the Mekong Delta references the Mekong's geographic delta to validate its existence as part of a larger geophysical system, separate delineations of the same catchment are recalled simultaneously to construct arguments that justify a specific course of action. In this sense, the territories specified by differentiating do not erase or replace the territories produced by unifying and vice versa. In each instance, the notions attached to the basin, delta and floodplain conform to the shape of the 'container' provided by delineation to specify a quantity of water, a group of people or an extent of land. Metaphorically similar to the material condition of liquids that possess a definitive volume but no fixed shape, the territories evoked by catchments align specific objectives with different areal extents. Instead of 'inscriptions' overwriting an imaginary 'parchment' of dry land, the imaginary geographies outlined by the catchments' areas coexist, combining to affect the condition of the ground, the location of settlement and the control of resources. The liquid territories formed with reference to catchments *emulsify* to project human activity on the terrain.

Planning catchments

Geographic theories framing the relationship between people and rivers explicate the value of catchment areas. Appeals to the extent of the basin, delta and floodplain expound the naturally-occurring differentiation of ground conditions, and the adaptation of human activities to the specificity of the surface flows they encompass. Denoting catchments therefore situates local activities within a larger context, and simultaneously identifies the extent of particular modifications to the terrain. The relevance of the Mekong's catchments in the production and implementation of a specific course of action does not lie solely with their power to describe the conditions which are subject to change. The research shows that the technical and managerial practices compiled into "export products" for planning international basins, and more recently global deltas, identify the catchment with the source of 'common' problems and paradigmatic solutions. Comparison of 'model' catchments in America and Europe with their counterparts in Southeast Asia exemplify the benefits of the model's coordinated development, to claim all basins and deltas are 'designable'. Regardless of the multiple political, economic as well as hydrological considerations typified by the model, the catchment – of all possible historical, administrative and environmental configurations of geographic space – is framed as the most relevant extent to prescribe solutions for resource management, economic growth, climate change and urbanization. Packaged with reference to the issues, problems and explanations presented by the archetype, technical knowledge for controlling catchments is commodified and primarily transferred from West to East. With knowledge 'objectified' in the shape of the basin or the delta, the catchment becomes symbolic of a supervised geography pivoted on the expert's capacity to distinguish the extents of a 'natural' system. In this sense, catchments illustrate the intention of planners and engineers to coordinate transformation of the terrain as well as human activities. Irrespective of the results of planning, the cartographic projection of basins, deltas and floodplains projects the power to shape geographic relationships.

Validity and limitations of the research

The thesis structure, discussing the basin, delta and floodplain as separate constructs with specific histories - rather than constituent parts of a single body of water - has been helpful in several ways. First, by analysing catchments the thesis can convincingly engage with issues of water in terms of space and vice versa. Second, by analysing catchments individually, the research has identified the multiplicity of notions attached to the same hydrological concept rather than to the river in general. Third, by analysing three catchment areas rather than only one in greater depth, the research is able to address the social, political as well as technical principles that underpin the constitution of an *area of water* rather than the specificity of the terrains encompassed by the basin, delta and floodplain. By focusing the analysis of the three catchments from the perspective of maps, the thesis has productively engaged with aspects of the design of territory and explored the production of territories from their inception and into the present. Centring the discussion on the way maps of the terrain are constructed rather than the descriptions of the physical terrain, has provided a lens to view my own actions and biases that emerge during the process of design. At the same time, the availability of maps limits the articulation of a continuous chronology of events from which definitive conclusions can be derived. In this sense, the current thesis is a history of particular ideas about rivers rather than a historical study that seeks to explain events in the past or the diachronic transformation of a particular geography.

Early plans to include parts of Cambodia in the scope of the study were terminated by the coronavirus lockdown. As a result, the focus of the thesis on the 'lower' basin and the Vietnamese sections of the delta and floodplain limit the conclusions that can be drawn about the entirety of the Mekong's catchment areas. 'Managing' the influence of China in the LMB, shaped the scope of the research about the basin which intentionally does not address the post-1990 period when Chinese planning and financing of projects began to affect areas further downstream. Moreover, the transboundary extents of all three of these catchments present unique geopolitical conditions. The importance of the historic geopolitical contestation of the Mekong's catchment areas was not anticipated at the start of the research. With perhaps few exceptions, the particularities of this history and the current international status of the catchment areas, limits the direct relevance of the findings to other rivers in Southeast Asia and around the world.

Recommendations for further research

Areas for further research suggested by this study highlight the need to critically investigate the impacts of conceptualising and defining the limits of catchment areas. In this respect, examination of the Mekong River still needs to address the Cambodian section of the basin, delta and floodplain as well as the influence of Chinese planning. With regards to knowledge of urbanization in the Mekong Delta, a subject which lacks adequate research is the production of settlements by the post-colonial governments of South Vietnam. The subject of the *agrovilles* and the *strategic hamlets* are only partially covered by English and Vietnamese literature. In Southeast Asia, a shared history of colonization by different European powers and the concurrent introduction of modernist approaches to water management and infrastructure design after the WW2, suggest that the cartography of catchment areas may have played a part in the construction of other geographies which today host major urban centres. In this respect, research into the hydrological cartography of Manila and Jakarta could yield insights into the urbanization of vast regions that are usually only considered from the city-centric perspective. The impact of sharing the transboundary basins, deltas and floodplains of the Indus, Ganges/ Brahmaputra and Uruguay rivers also needs to be elaborated and could form the basis of a similar research that examines the effect of articulating catchments on geopolitical, military and planning decisions. Further research into the relationship between natural and manmade boundaries is also needed. Waterways as well as watersheds form the limits of jurisdictions in many parts of the world. However, the impact of placing and - more importantly - *maintaining* boundaries in these instances is rarely discussed in environmental terms. Finally, the impact of 'integrated' basin planning and the 'redesigning' of deltas according to the nomothetic principles derived from comparison needs to be critically explored. If the process of climate change adaptation privileges the knowledge of catchments compiled by experts in the West, what are the "vulnerable" geographies of Southeast Asia being designed to resist and to sustain? A local condition observable in the specific qualities of the people and terrain? Or the generic problems of *resilience*, *urbanization* and *economic growth* that correspond to already predetermined solutions?

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0. Introduction

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Fig 10.8 Shrinking swamp

• Author (2022), Spatial data sources: *HRLULC 10m resolution map of the southern region of Vietnam [2017] (ver.18.09)* (Japanese Space Agency (2019); *World Water Map* (ESRI, 2014); *khm_rivl_gov* (OCHA, 2008).

Fig 10.9 The floodplain's catchments

• Author (2022), Spatial data sources: *catmb_4K* (MRC, 2012); *World Water Map* (ESRI, 2014); *mrc_SDE_IRRIGAT_b_irrcanal01* (MRC, 2012); hotosm_khm_waterways_lines (OSM, 2021).