Elements for a political ecology of river basins development: The case of the Chao Phraya river basin, Thailand

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Summary

Like other natural resources, water can be mobilized for wealth generation. The spatial expression of land resources and of the natural water regime, in terms of quantity, quality, timing, variability and availability (or easiness to divert or abstract), coupled with the distribution of power in society, defines and underpins the early development of river basins and the pattern of control over water.

As societies grow and more water is diverted, users located in different parts of a river basin find themselves increasingly in interaction through the hydrological cycle. In addition, this cycle is constantly redefined by interventions and infrastructures (dams, dikes, irrigation and drainage schemes, etc.,) and by the different uses themselves (change in timing, alteration of water quality, change in groundwater flows due to abstraction, etc.,). The water regime is thus increasingly man-made or artificial and the resulting interconnectedness partly amenable to management.

The paper argues that the consumption of space, the control over water, and the way costs and benefits are shifted across scales and social groups can be addressed through a political ecology framework. Water use incurs costs and generates externalities that tend to be imposed on third parties. River Basin Organizations—in all their diversity—are an attempt to manage resulting conflicts and to craft patterns of governance that are more inclusive and conducive to a more equitable and environmentally sustainable share of resources. The Chao Phraya river basin, in Thailand, is used as an example.

1 Introduction

Patterns of land and water resources development are underlain by the spatial distribution of these resources and by their natural regime (hydrological regime in terms of quantity, quality, timing, etc.,) but also by the social and political structure of society: distribution of power and agency at a given point in time strongly governs access to resources, together with the possibility for a given

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actor to transfer costs and externalities to other parts of the basin, or to other users or categories of people. Spatial dynamics cannot be explained without a historical contextualization, which spells out the relationships between the consumption of space and a never-ending process of redefinition of the control over land, labor and capital, as well as decision-making power. A particular landscape, thus, is the dynamic outcome of actors competing with one another who, through their exploitation of resources, alter and reshape the environment (Bryant and Bailey 1997; Crifasi 2002).

Such an approach is in agreement with trends in rural geography which define a landscape as a "piece of territory, visible to the observer, where a combination of events and interactions are inscribed of which only the combined effect is observable at a given point in time" (Deffontaines 1973). Research in the field of political ecology has long been concerned with human-environment interactions. Some strands are more ideological and question the underlying economic, political and philosophical dimensions of a "development" which results in environmental degradation (Atkinson 1991). Other currents focus on the genealogy of environmental discourses, and on the interests, ideologies and worldviews from which they stem (Stott and Sullivan 2000), as well as on the concept of "nature" proper (Escobar 1999). Other researchers analyze the production of physical landscapes as a social artifact which reflects relations of power (material, economic, political, discursive or otherwise) and the interactions generated by the types of exploitation or consummation of nature resulting from these relations, between actors, spatial units, and more generally between humans and nature (Swyngedouw et al.. 2002; Sheridan 1995).

The approach adopted in this paper draws from the latter strand of studies and departs from the classical and technicist vision of river basin development, whereby history is reduced to a linear series of phases which reflect growing levels of capital and technology applied to an ever-increasing control over waters and the forces of nature. Such a vision, centered on the number of hectares of land irrigated and infrastructures (storage or conveyance capacity, etc.,) describes the growing anthropogenization of waterscapes without addressing—or even obscuring—the underlying logics, interests, power relationships as well as ecological transformations. Changes are always presented as an improvement—even if some dysfunctions are identified and must be mitigated—and the spatial and social distribution of benefits and costs is overlooked.

The various water users within a given river basin be they individual or collective, private or public, of groundwater or surface water, agricultural or urban, generate externalities (pollution, inundations, contamination, risk, shortages, etc.,) the impact of which grows with the interconnectedness of users through the hydrological cycle. Critically, this interconnectedness grows with basin “closure,” or in other words with the proportion of the basin renewable resources which is tapped or consumed (Molle et al. 2004). The possibility that uses or interventions at some point generate third-party impacts on other users is increasingly high.

Consequently, water themes, particularly when seen at the level of river basins where this interconnectedness and issues of resource sharing, allocation, and conflict resolution find their relevance, are themes of particular interest for the field of political ecology: not only do they refer to the societal use of a critical natural resource, but they also have to deal with a much higher degree of interactions between users (and also sometimes non-users). The possibility for some actors to impose or shift these externalities to other parts of the basin, or to other basins, is the expression of a power structure which must be made explicit. Rivers basins thus appear as wider arenas where complex interactions between societies and the environment take place and where the definition of a regulation

regime—the sanctioned or challenged pattern of access and control over water resources—takes center stage.

This paper describes the development of the Chao Phraya river basin, the main river in Thailand, and attempts to show how the joint structuring of the landscape and the waterscape is the reflect of a particular historical trajectory, with particular actors and interests at play. The analysis is centered on water and—at first—on the delta: it shows how, in the course of time, the intensity and complexity of anthropogenic modifications generate a growing interdependency among users in the delta, and also, increasingly with the rest of the river basin and beyond.

2. Reclamation of the delta and spatial expansion

Because of its contrasted hydrological regime (too much or too little water), its insalubrity, the lack of communication routes, and its remoteness from main urban centers, the Chao Phraya delta, just like the Mekong or Irrawaddi deltas, long remained underpopulated. Constrained by the lack of labor, Siam would draw its wealth from extractivism and international trade, and the development of the delta during the Ayutthaya period (1350–1767) remained incipient. The conditions allowing its reclamation would only be fulfilled by the end of the nineteenth century.

2.1 The Ayutthaya and Ratanakosin periods, up to 1850

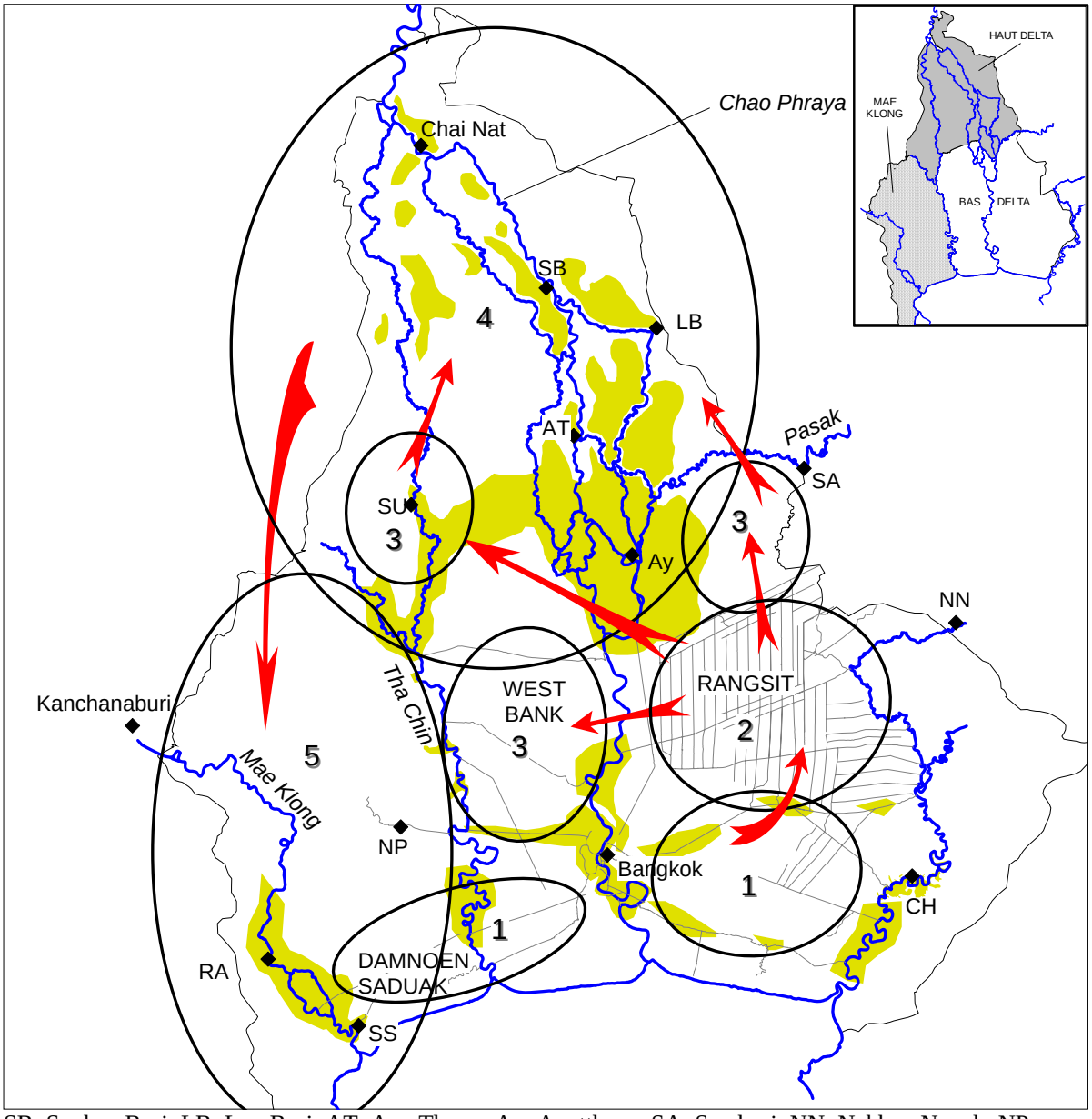
We have only limited information concerning land use during the eighteenth and first half of the nineteenth century. Travelers such as Turpin or De la Loubère joining Ayutthaya or Lop Buri using waterways report the vision of rice fields stretching as far as the eye could see. We know that most of these paddy fields correspond to the areas which, even in present time, are cultivated with deep-water and floating rice varieties. The use of the flood, which gradually fills up the low-lying areas of the floodplain, appears as an optimal cultivation technique in a context of limited labor and technology (Hanks 1972). Sown in dry conditions during the first rains of April, these rice varieties—duly selected according to the local flood regime (starting date, duration and maximum depth)—benefit from the silt brought each year by the flood and provide low yields but with very limited labor requirements (principally harvest). Nevertheless, we know that the floodplain was not fully used since the surroundings of Ang Thong, for example, were "largely uncultivated" in 1835 (Terwiel 1989).

Around 1830–1840, the delta and most particularly its lower part was an essentially virgin as well as inhospitable area: a mix of malarial swamps, dense bushes, bamboo groves, and high savannah-like vegetation, home to elephants and other wild animals (Johnston 1975). Agricultural production was limited to river levees where small settlements could be found: sugarcane (south of Bangkok, Nakhon Chaisi, Chachoengsao, Chai Nat and surroundings of Kanchanaburi), fruits and vegetables (west of Bangkok, vicinity of Samut Songkram and Chachoengsao) and rice (Terwiel 1989). Paddy fields were usually located close to dwellings, e.g., along the Bang Yai canal, near Potharam (irrigation from the Mae Klong river), or along the Tha Chin river. Larger fields could be found north and south of Bangkok, along Saen Saep canal, between Ayutthaya and Tha Rua, and in the region located between Nakhon Nayok and Chachoengsao (figure 1, greyed areas).

Rivers and canals were, thus, axes of colonization and agricultural expansion. Although their primary function was to allow transportation of people, goods, and armies in case of war, their embankments also served to establish homesteads (stilt houses) and, in some instances, to ease irrigation or drainage of adjoining land. These canals were nevertheless the manifestation of state power, which resorted to corvée labor due to the king for their excavation. Around the middle of the

nineteenth century, the Chao Phraya delta was still sparsely populated (410,000 in 1840 according to Terwiel, 1989), despite the establishment of its capital, Bangkok, near the river estuary. Settlements were linear and stretched along rivers and canals, or were confined to highlands in the upper delta. Agriculture was also limited to the most accessible and hospitable portions of the landscape, with the exception of the floodplains where floating rice was grown.

Figure 1. The Chao Phraya delta and successive phases of land reclamation.



SB: Suphan Buri; LB: Lop Buri; AT: Ang Thong; Ay: Ayutthaya; SA: Saraburi; NN: Nakhon Nayok; NP: Nakhon Pathom; RA: Ratburi; CH: Chachoengsao.

Zone 1: 1825–1880; Zone 2: 1885–1905; Zone 3: 1900–1940; Zone 4: 1955–1970; Zone 5: 1970–1990. These dates roughly indicate the period in which land was developed on a large-scale but some canals nevertheless date back to earlier periods (18th century). Greyed areas provide a crude indication ("artist impression") of the land cultivated in the middle of the nineteenth century.

2.2 Expansion of the agricultural frontier

The history of the development of rice cultivation in the delta has been addressed by many studies and will not be developed here (see for example Ingram 1971; Feeny 1982; Manarungsan 1989; Ishi 1975). The reclamation of the lower delta has been boosted by the transfer of the capital to Thonburi-Bangkok in 1767, fiscal incentives granted by Rama III[2] to those who would develop land for cultivation, the ban on export and the reduction of tariffs by king Monkhut in 1851, and by the signature of the Bowring treaty with the British in 1855 (soon followed by other treaties with other western powers): the treaties herald the transition of the rice economy from subsistence to integration into world markets. Trade with Europe also benefited from the opening of the Suez Canal in 1869 (van der Heide 1903).

The development of the delta between 1860 and 1930 can be seen as the result of a struggle between the king, the nobility and a gradually emancipating peasantry around the transformation of the modes of control of land, capital, and labor (Pasuk and Baker 2000). The consumption of space will directly reflect this struggle, but also the ecological diversity of the delta.

In the history of Siam until the middle of the twentieth century, labor appears as the main constraining factor of economic growth (Feeny 1982, 1989; Molle and Thippawal 2000). In a country with limited population and uneasy communications, the control of the labor force and of its military potential are the fundamentals of the political system of the kingdom. Many laws reveal the determination of the king to restrain the possible accumulation of such control in the hands of the kingdom's nobility. The success of a war is often gauged by the number of prisoners who can be taken back home to augment the local labor force under various types of bondage. In short, land only has a subsidiary value and extracting a surplus out of it is predicated upon controlling labor, either in kind or through taxes on products.

During the nineteenth century, the mobilization of labor through the traditional *corvée* system becomes less and less effective (escape of indentured laborers, transfer of the slaves attached to the king to the nobility, low labor productivity, etc.,) and the use of Chinese labor, fuelled by a growing influx of migrants, becomes the rule. From 1830 onwards, most of the works under state initiative employ Chinese laborers, while the corvée system is replaced by an exemption tax.

During the reigns of Rama III and Rama IV, until the 1880s, newly reclaimed land would have been under royal ownership (or under the ownership of nobles who would have undertaken a particular project, such as the Damnoen Saduak canal) and were partially distributed to the nobility. Plots were cultivated under the corvée regime, by slaves (*that*), or rented out to other persons (Tanabe 1978). The nobility was able to extract limited benefit from a land which exceeded the capacity of the labor force under its control. Rama IV's care to curtail speculation and wealth accumulation by aristocrats led him to enact measures which would limit the power of the nobility: land left uncultivated during 5 years would return to the Crown and any canal excavation project would have to set apart land for peasants. In the 1890s, a private company (partly endowed with capital coming from the king), developed the Rangsit area (see figure 1) and served as a model for a series of similar projects launched by aristocrats (e.g., in the West Bank, see figure 1), before eliciting a ban by Rama

[2] Rama III wished "that more jungles be opened up for rice cultivation with a view to increasing the quantity of rice and lowering the price thereof, without prejudice to the interests of peasants and merchants" (cited by Ingram, 1971).

IV, who in 1902 entrusted the reclamation of the delta to the Department of Canals (which was to become the Royal Irrigation Department in 1914).

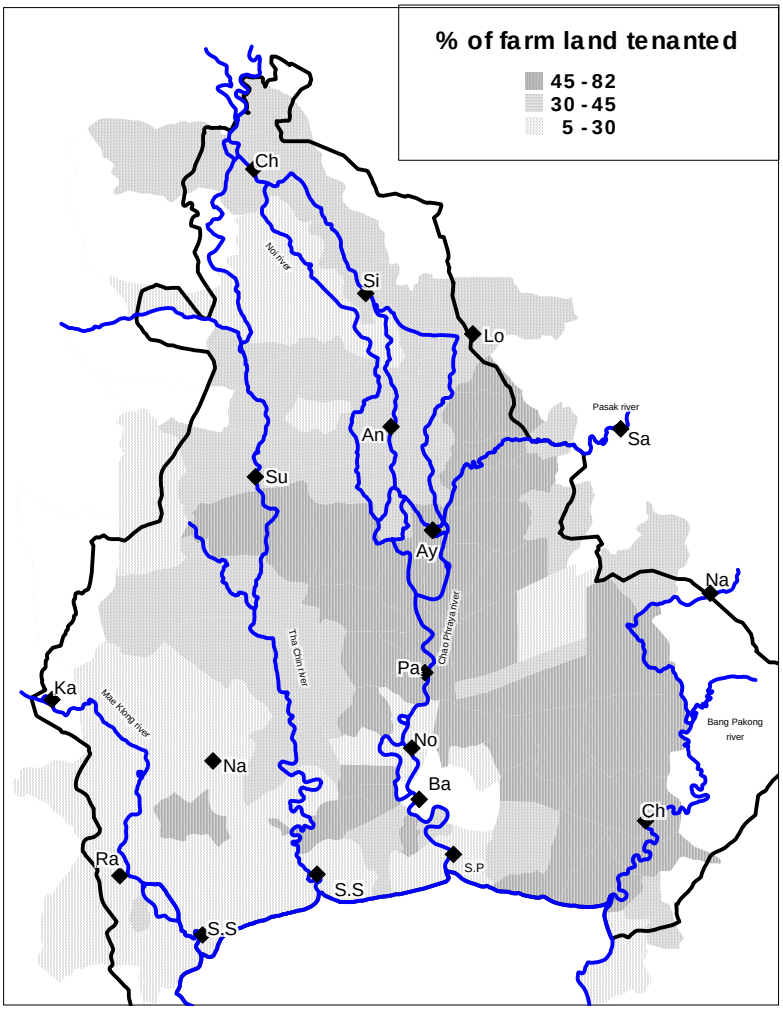
From the 1870s onward, the reforms of King Rama IV would definitively abolish the feudal system and free a growing labor force who, in turn, would invest itself feverishly in rice cultivation. While it formerly relied on bounded labor attached to their position, in the 1980s the nobility finds itself looking for tenants to cultivate its land. Faced with climatic vagaries and unstable rice markets, these tenants soon found themselves indebted to their landlords or to merchants. The agricultural frontier thus became a refuge for farmers fleeing from debts, threats or extortion. This further fuelled the expansion of a smallholder agriculture, mainly aimed at subsistence and largely out of reach of the administration and urban landlords. Landlordism as well as the issuance of land deeds remained confined to the projects developed in the vicinity of Bangkok, preventing merchants and investors to accumulate land: the choice to develop the railways rather than irrigation limited the capital available for the latter and—for some time—the penetration of the state into the delta hinterland (Feeny 1982). The agricultural frontier, partly linked to markets by an army of Chinese peddlers, absorbed a growing mass of peasants who had turned made independent. The rice frontier would soon reach the frontiers of the delta.

The development of the lower part of the delta was, thus, the product of a number of factors; physical, economic and political, which contributed to its reclamation: Rama IV's political reforms, Chinese immigration substituting the Siamese peasant, the provision of capital by the state and by private interests, the incentives provided by the international demand for rice. This development inscribed itself in the landscape through the progressive penetration and ramification of the canal systems, from the main river streams into the hinterland, allowing transportation and a gradual regulation of the water regime with regard to irrigation and drainage: this transformation pitted against each other different categories of population (Chinese peddlers, peasants, landlords, foreign merchants, aristocrats, etc.,) who all attempted to maximize their private benefits through the use of the power and agency at their disposal.

This struggle is still perceptible in today's agrarian landscape. The proximity of Bangkok and the mild hydrological regime of the lower delta (delta flats) conditioned the early development of extensive rice cultivation, with a corresponding pattern of tenure still very salient in present times. Mapping of tenancy and average farm size in the delta (see Molle and Thippawal 2003 and figure 2), shows that the large properties granted to or acquired by the king and Bangkok elites are still visible: Rangsit, but also the areas located along main canals, belong to urban absentee landlords in their great majority, and tenancy is therefore highest.[3]

[3] This is also the case for most of the floodplain but this is due to recent acquisition of land by urban investors.

Figure2. Percentage of land cultivated by tenants.



This particular historical trajectory also influenced social patterns. Adopting approaches developed by cultural ecologists in the 1970s (Wood 1977; Hutterer et al. 1985), some researchers have shown how the reclamation of the delta and agrarian/technical change were attuned to both the ecological characteristics of the delta and to demographic changes, as well as to wider economic circumstances (Hanks 1972). A debate emerged on what could be the implications of such a mode of frontier or pioneer colonization on the social structures that emerged thereof. Early on, anthropologists had contrasted east-Asian social structures with those—deemed loosely structured—of South-East Asia (Embree 1950). Without entering into details, one can both recognize the absence of a strong community structure (in particular, as compared to northern or north-eastern Thailand) and the emergence of a collective action when circumstances allow it, for example, with regard to the organization of funerals, or to the more mundane field of irrigation management (Shigetomi 2002; Molle et al. 2001b).

2.3. Development of the upper delta

The world demand for grains after World War II led Food and Agriculture Organization (FAO) to investigate and recommend the development of irrigation in the upper part of the delta, through a diversion dam (at Chai Nat) which had already been envisioned at the beginning of the century. The Greater Chao Phraya Project, o**r** GCPP, was initiated in the 1950s and included a scheme which had

been developed in the 1930s on the Tha Chin river as well as another scheme located north of Rangist. It allows the irrigation by gravity of the higher land of the upper delta (Takaya 1987). The floodplains are also equipped with canals built on top of the river levees, which can not only supply additional water in deficit rainy seasons but also during the dry season, although this option was not envisaged at the time. Investments were also made in the west bank: the network of canals was expanded, some outlets to the Tha Chin and Chao Phraya rivers or to the sea were gated, and the area came to receive additional water from Chai Nat dam and thus started the practice of double-cropping in the late 1970s. In parallel to this irrigation infrastructure, two large storage dams were constructed on two of the four main tributaries of the Chao Phraya: the Bhumipol dam, on the Ping river (1964), and the Sirikit dam on the Nan river (1974). Although first designed for hydropower generation and flood control, these dams will soon prove paramount in meeting growing water needs in the dry season.

The last nonirrigated part of the delta was the alluvial fan of the Mae Klong river, to the west of the delta. Through a device identical to that of the GCPP, the river was derived at the apex of the fan towards a network of gravity canals which were gradually extended between 1980 and 1994 (figure 1). In this basin too, two large storage dams were constructed on upstream main tributaries (Sri Nakarin (1980) and Khao Laem (1984)).

2.4. The upland boom

The implementation of the GCPP occurred at a time of agrarian crisis, characterized by demographic pressure and land saturation, drastic taxation of rice cultivation through the rice premium, and the domination of landlords and moneylenders. Before ushering in the crisis of the 1970s, the agrarian situation was momentarily relieved by the development of the margins of the delta and of more remote uplands. This new agricultural frontier and the corresponding “upland boom” was supported by the promotion of agro-industry by the Thai state and relatively high market prices for crops such as maize, cotton, cassava, sugarcane, and pineapple, and by the construction of a network of strategic roads by the American, in their fight against communist insurrection (Delang 2002; Pasuk and Baker 2000). Many farmers migrated to this new frontier, some permanently, others for a season or for the harvest period only (Molle and Thippawal 2003). And some others, in smaller numbers, tried their luck in the industrial sector or in the capital.

This injection of urban and foreign capital in a new—largely capitalistic—type of agriculture gave some breathing space to the delta, at least in the short term. This period (1950–1970) thus signals the end of the inner expansion of the delta and a densification of the landscape, with emerging and growing interactions with its periphery as well as with its urbanized heart, Bangkok. If, at that time, these interdependencies manifest themselves in terms of labor and capital flows, it is the water factor which was to take center stage and become a decisive element of coming changes.

3. The closure of the delta and internal interactions

3.1. Intensification and diversification

After the agrarian crisis of the 1970–1976 period, the delta entered a phase of intensification or "vertical growth," despite the completion in 1962 of the irrigated system in the upper delta and of the first storage dam in 1964, it is only in the 1970s that rice cultivation was intensified. It is only after the emergence of dry-season cropping (facilitated by the construction of the Sirikit dam, which regulates supply in the dry season), the increase of rice prices in 1973, and the drop in the costs of fertilizers,

that farmers adopted, gradually but massively, the high-yielding varieties of the Green Revolution, which eventually became attractive. Farmers invested substantial outlays in on-farm infrastructures, tractors and individual axial pumps. Double and even triple cropping developed and was only constrained by the insufficient available stocks in the dry season.

Dwindling average farm sizes and the long-term decline in real rice prices also contributed to fuelling a process of diversification towards cash crops (for the whole delta, the area cultivated with non-rice crops moved from 19% in 1978 to 26% in 1993), and also a massive transfer of labor out of agriculture to other sectors (more than one million between 1987 and 1997), resulting in the stabilization of the population working in agriculture (Molle and Thippawal 2003). The most spectacular increase in cash crops was observed in the area of Damnoen Saduak, in the west of Bangkok, where the production on raised beds (mostly vegetables and fruits) increased from 50,000 to 100,000 ha (gross area) between 1963 and 1995.

3.2. Water as the major production factor: The upper delta

By the end of the twentieth century, the Chao Phraya delta has become a region fully innerved, traversed by multiple canals and rivers, ramified and diverted, and supplied by several reservoirs. Agriculture as well as cities depend on the proper functioning and supply of this network. While the different parts of the delta had hitherto followed relatively independent trajectories, in accordance with their respective comparative advantages and the investments they had benefited, they now find themselves in interaction through their competition for water. A modification of water fluxes converging to the delta, a change in their allocation or timing, reshuffles benefits as well as the costs. Competition between geographic sectors is mostly apparent during the dry season (January to June), when available supply is on average slightly above half the potential demand. Accessing water becomes a vital objective for economic sustainability of agriculture.

While the spatial expression of the continuous "development" of the delta remained marked by ecological variations, the growing anthropogenic remodeling of the region led to a water regime which has become highly "manipulable" and "manageable" by the state. The water regime can be defined by a manipulation of the hydrological cycle with specific, yet dynamic, impacts in terms of equity, economic efficiency and environmental degradation/conservation. The following subregions can be distinguished:

The western part of the delta is supplied by the Mae Klong river. This river basin, with a storage capacity of 11 Bm^3 and a limited population, is still significantly an excess basin and allows in principle double-cropping over 300,000 ha. Agriculture is nevertheless in competition with the hydropower sector since water releases for electricity generation are not always made with enough attention to inter-seasonal regulation, which as resulted in occasional shortages in the past.. In such instance, the orchards of Damnoen Saduak get water on a priority basis because of the magnitude and vulnerability of the capital sunk in these plantations. It is interesting to note that the expansion of this area to the north, mostly through the reinvestment of local capital (mainly Sino-Thai), prompts by itself a reallocation of water: capital "attracts" water. The impact on other water users is still little sensible because water is available in adequate quantity. This privileged situation has nevertheless been used by Bangkok to justify a diversion of water for its own supply, which is planned to reach 45 m^3/s. This transfer triggered some protest from residents and from the provincial administration of Kanchanaburi and Samut Songkram, who consider that the transfer constrains their future

development and will have negative impacts on the ecosystems of the lower Mae Klong (Thitinan 1994).

The upper delta is irrigated by five main canals branching off the Chao Phraya river at the Chai Nat diversion dam. The partition of the flow of the river at Chai Nat is thus a crucial question when one considers that only half of the potential users will be served in the dry season. Ensuring an equitable distribution is first faced with technical difficulties: the water level upstream of Chai Nat fluctuates and this reverberates on the discharge of the different canals.[4] Allocation is also problematic. In the 1990s, a rotation system which contemplated serving half of each irrigation unit on a 2-year basis was experimented with but failed.[5] The analysis of water allocation over a period of 20 years (Molle et al.. 2001a) revealed an uneven repartition. The west of the delta received more substantial supply and could in some places develop a thriving triple cropping, while other subareas were served only exceptionally. The official justification is that the western part has been provided with good on-farm infrastructures and, as a result has a better control of water and a better economic productivity. Part of the difference may also be explained by direct pumping in the Tha Chin river. These explanations are somewhat circumstantial and it is notorious that the province concerned (Suphan Buri) owes much of its preferential treatment to the influence of its governor, a former prime minister (Bangkok Post, May 6, 2005, and May 7, 2005).

Here too, farmers get organized to "attract" water. Beyond the traditional resort to political representatives, notably MPs, several strategies have emerged. The first is to develop aquaculture (e.g., Don Chedi area), which requires a frequent renewal of water and justifies a priority supply because of the investments made and of its economic profitability. For the higher parts of the floodplains, up to now confined to traditional deep-water rice varieties, the objective is to develop on-farm infrastructures (leveling, bunding, digging of small farm level canals and drains) in order to be able to grow dry-season rice crops and to lay claims for a share of water. Others chose to start dry season cropping before the beginning of the official season by using wells or residual waters in drains or ponds, thus forcing Royal Irrigation Department to later allocate water to them in order to avoid crop losses which would make the news and would trigger political interventions. Others, still, organize themselves in Water User Groups to strengthen their claim for water (Molle et al. 2001b).

3.3. The lower delta

The lower delta is partly dependent on the upper delta since part of the water it receives from Chai Nat is conveyed by the main canals of the upper delta. On the eastern side of the river, Bangkok acts as a guarantee: the necessity to maintain the water level in the dense network of canals in order to ensure navigation[6] and a relative dilution of pollution guarantee priority in allocation. Local water demand is also "protected" by the fact that the main feeder canal reaching the area, Rapiphat canal, needs a discharge of 40 m^3/s to avoid the collapse of its banks.

Intensive cash-crops (mostly fruit trees) in the lower delta principally expand in areas: a) protected from floods; b) which have a regular access to good quality water; c) and, have good access

[4] These canals do not have the same sill level and, therefore, are not impacted uniformly.

[5] In dry years, "on" areas would have to be rationed and they did not accept to "pass their turn;" in an excess year, pressure to allocate extra water to "off" areas would rise.

[6] The number of persons commuting daily and using boats is estimated at 80,000.

roads. The Damnoen Saduak area, in the lower Mae Klong basin, has already been mentioned. Rangsit area, north-east of Bangkok, is located at the upstream part of the lower delta and benefits from a better access to water: citrus have developed there on a large scale (Saha 1993).

Agricultural diversification on the west bank, between the Chao Phraya and Tha Chin rivers, is more recent. The area is well watered from the north (supply from Chai Nat), from the east (the Chao Phraya), and from the west (water from the Mae Klong river is diverted to the Tha Chin and pumped onto the west bank in the dry season), but it is also flood-prone. During the last decade some farmers have invested in the dyking of their land and, by pumping from adjacent canals, have developed a triple cropping of rice, orchards, or even fish and shrimp farming (Szuster et al.. 2003; Szuster 2003).

3.4. Bangkok

With a population over seven million, the highest concentration of industries and political power in the country, Bangkok appears as the main actor in the delta. The city first developed at the end of the nineteenth century owing to rice exports as the heart of a "mercantile delta" (Kaida 2003), thriving on maritime commerce. During the cold war, Bangkok was a strategic center of American policy in Asia and benefited from the American presence and financial aid, as well as from the investments of the Sino-Thai community and, more recently, from foreign capital investments (notably Japanese). The growth of the city has shifted the city water demand from 0.46 millions m^3/day (Mm^3/d) in 1978 to 7.5 millions m^3/d (Mm^3/d) in 2000, that is, a multiplication by 16 over a period of 22 years (Molle et al. 2001a). This demand is principally met by a diversion of 45 m^3/s from the Chao Phraya and also by groundwater: 95 percent of the water used by the 20,000 industries of the metropolitan area comes from the aquifers and the volume abstracted daily is close to 3 Mm^3 (equivalent to 36 m^3/s), as compared with an aquifer recharge estimated at 1 Mm^3/day only (TDRI 1990; Christensen and Boon-Long 1994). Irrespective of the degree of success one can expect from the measures recently taken by the government to force industries to resort to tap water, a shift away from wells is not possible without a corresponding increase in the amount of water diverted from the Chao Phraya and, thus, without causing increased stress on other existing users. The preference of industries for groundwater also comes from the fact that it is cheaper, of better quality and reliable, showing that the desired substitution will not go without difficulties.

The federation of Thai industries has hitherto always succeeded in limiting the increase in the taxation of wells, with which it has been recurrently threatened (Bangkok Post 2000). The over-exploitation of aquifers continues and translates into dramatic land subsidence, a third of the capital being presently under mean sea level. Externalities in terms of increased sensitivity to floods, costs of raising and strengthening dykes, cost of pumping stations, and instability of buildings are enormous and distributed over the whole society.

Through the priority granted to it and its diversions from the Mae Klong river, Bangkok enters in competition with the rest of the delta and with neighboring river basins (see §4). By raising its protections and embankments it raises the magnitude of floods and shifts the risk onto neighboring areas. The lower delta is morphologically a water-spreading area and the gradual shrinking of the unprotected area increases the risk and the damages that the latter is to undergo. Dyking by farmers who diversify their production adds to this shrinking and therefore further increases the risk faced by

those who do not want, or cannot afford, to protect their plot, generating a typical shift of externalities. In 1995, the west bank has undergone dramatic flooding with major damage to roads and housing.[7]

Bangkok is also the source of different types of pollution which impact on other sectors and users, and more generally on the environment.

3.5. Water quality and shifting of environmental externalities

Interactions within the delta do not limit themselves to water quantity. The degradation of water quality by certain types of users is transmitted to other users through the water cycle. The numerous canals which criss-cross the lower delta and radiate from the city have been transformed into open sewers. Since the coastal line of the delta is now closed,[8] polluted water tends to stagnate in and around urban areas. This situation not only has a direct impact on public health in a traditionally aquatic urban environment but also impacts on peri-urban agricultural production. The reuse of huge borrow pits as garbage dumps in the vicinity of Bangkok to stockpile —without any control—all types of urban waste has a predictable (yet, so far, little studied) impact on the contamination of aquifers.

The city and agriculture find themselves in competition with the environment since the control of saline intrusion demands a constant minimum discharge of 50 m^3/s in the river estuary (and of 45 m^3/s in the estuary of the Tha Chin river)—(Ruangdej 1994). A decrease of the river flow under this threshold, as observed in some critical years (e.g., 1999), entails a destruction of orchards (citrus, *durian* etc.,) located along the river and a concentration of pollution. The estuary is also heavily contaminated and the river contributes to the pollution of the sea by discharging heavy metals, organic matter, BOD load, and nitrates and potassium originating from agriculture (Wijarn 2000 et al.; Pornsook and Ekachai 2003). The position of estuarine and coastal ecosystems as the most downstream part of the basin, and also as the weakest area in political terms, makes them highly vulnerable. A large part of the flux, which controls saline water intrusion, is now generated by wastewater released by the city…

The hydraulic connectivity of the delta also has an impact at a smaller scale: intensive shrimp farming, which developed in the east and the west of the lower delta, uses the canals/drains also used by rice cultivation and the return flows from rice plots are often loaded with pesticide residues which can trigger a high mortality in shrimp populations. Inland brackish water shrimp farming requires addition of sea water shipped by tankers and has, in return, an impact on surrounding agriculture, as well as on soil quality. The spatial dynamics of this very lucrative –but risky- activity are conditioned by ecological factors (water quality) and by the promotion of this activity by large transnational **agrobusiness** groups like Charoen Prokphand (CP), but also by state regulations, which tend to concentrate their action on the areas symbolically valued by environmentalists (mangrove) or the public at large (the delta, symbol of a rice-based nation) (Vandergeest et al. 1999). However farming techniques operating at low salinity levels have recently been developed (Szuster 2003), thus weakening the arguments of opponent groups. Abandoned farms in scarified landscapes, remnants of the viruses which undermined shrimp farming in the past (including on the coastal area of the delta in

[7] Floods being nevertheless part of life of the local population, damage to agricultural production has been limited to the foregoing of the second rice crop.

[8] The different streams which connect the delta to the sea are controlled by regulators or dikes which allow the conservation of freshwater inland, avoiding its flow to the sea, together with the intrusion of saline water at high tide.

the early 90s), do not bode well for the future of this activity that brings fortune but also bankruptcy, and is based on a short term mining logic.

The area of Damnoen Saduak provides a telling example of power struggles around water management. The filling up of the Sri Nakarin dam on the upper Mae Klong provoked a drop in the discharge reaching the estuary which justified the construction of control structures at the outlet of various canals. The creation of a zone of freshwater in the lower part of the basin prompted the expansion of vegetable farming, orchards, and aquaculture on a considerable area (totaling almost 20,000 ha), generating an unmatched agricultural wealth in the country. With the boom of brackish shrimp farming (*black tiger prawn*), some landowners (in particular those who had opted for extensive fish farming) are challenging the water regime that gives priority to freshwater (for orchards) and militate for an opening of the regulators and a mixture of sea water and freshwater. They support their claim by borrowing from environmentalist discourse and by stressing the need to "restore the ecology of the river" (Bangkok Post 2004). A modification of the prevailing regime would only shift benefits from one area to the other, and from some landowners to others.

The canal system which serves both for supply and drainage is remarkable in terms of efficiency, since all drained volumes can be reused downstream but this canal connectivity also contributes to diffuse pollution generated in one point to a much wider area. Environmental externalities of the cities onto human health, agriculture, and coastal/marine ecosystems are considerable but the object of few measures.

4. Upstream connections: the delta and its water sources

The increase in the interactions between users in the delta described earlier was gradually paralleled by an increased interaction between the delta and its sources of water, upstream. This is a typical feature of "basin closure", whereby the augmentation of water diversions generates a growing interaction between upstream and downstream parts of the basin, between surface and groundwater, and between different categories of users. The impact of hydrologic variability increases with the rate of commitment of resources and increasingly generates critical allocation conflicts (Molden et al. 2001; Molle et al. 2004).

Despite the dams constructed on its tributaries, and because of the unchecked growth of its needs (or potential demand) beyond the amount of water available in the dry season, the delta has created a situation of potential conflict with the other water users in the basin. Due to the anteriority of the massive development of its irrigation infrastructures and to the *de facto* priority granted to Bangkok, the delta claims the lion's share of the basin surface and groundwater and stands as a direct competitor of the current and future development of upstream areas.

The monopolizing of the basin water resources by the delta does not go without contestation from other regions and provinces. The middle part of the basin, between the two dams and the apex of the delta, also benefited from irrigation projects in the 1980s. Claiming a part of these waters that they also consider 'theirs", since they traverse their land, these provinces have obtained irrigation infrastructures first aimed at securing rice cultivation in the wet season. It is interesting to note that the first feasibility studies admitted that, owing to preexisting irrigation development in the delta, only a very limited area could be irrigated in the dry season. Fifteen year later, however, these irrigated areas have de facto conquered the implicit right to divert a substantial part of the dry season flow and now exhibit cropping intensities comparable to those observed in the delta. In the case of the lower Ping,

some sizeable areas with triple-cropping have even been observed, showing the limit of Bangkok's centralized control on actual water allocation within the basin.

Other actors have also challenged the sharing of water privileging the delta. Owing to the intervention of the Department of Energy Development and Promotion (DEDP), groups of farmers have gained access to pumping stations with a 250 l/s capacity which have soon dotted the course of the river and of its tributaries. The combined abstraction of all these users (small and large irrigation systems) has totaled 38 percent of the amount of water released by the two dams during the dry season of 1998 (Molle et al. 2001a), which gives a measure of the radical process of spatial reappropriation of water that is under way.

The politics of regional development are anchored in a rhetoric of equity between regions, which leads poorer regions to claim state investments similar to those received by the regions with better comparative advantages. Regions which support the party in power also expect retribution in the form of preferential investments. The supply-driven logic of international development banks also goes against serious screening of projects. Therefore the logic of water resource development goes beyond mere economic rationality and frequently leads to overcommitment of water resources and to thereby artificially generating effective water scarcity. In an internal report, the World Bank, which funded both the projects in the delta and the subsequent projects in the middle basin, acknowledged that the basin was now "overbuilt".

In the absence of strict rules presiding over the sharing of resources, the legitimization of priorities in allocation is established through debates, representations and dominant discourses, that is, in a symbolic and discursive arena where the stakes are nonetheless paramount. The hegemony of the official discourse on the causes of water shortages is created through the press and television, official declarations, and a certain academic literature. Salinity creeping into the Chao Phraya river or restrictions threatening the capital are due to farmers' squandering of water and insistence in growing rice rather than less water-demanding crops, to El-Niño or to an exceptional drought, and to deforestation of the upper basin: common wisdom strongly associates water shortages with the disappearing of forests, these natural "sponges" which retain water, alleviating floods and sustaining flows in the dry season.

Although the causal link between deforestation and runoff at the basin level has been scientifically largely discredited (Alford 1992 Walker 2002, 2003), its ubiquity in the media (Bangkok Post May 2001; Bangkok Post August 2001) and the discourse of Bangkok urbanites reveals a propensity to blame ethnic minorities (Delang 2002; Hirsch and Lohmann 1989). It also echoes an urban ecologic ideology for which northern Thailand, and the countryside in general, must be conserved in order to – in parallel with an idealization of a pre-modern past- be consumed by an eco-tourism in full development (Rigg and Ritchie 2002). This ideology is, ironically, also strengthened by the popular concept of integrated soil and water management, which enjoins us to take into consideration the interactions between upstream and downstream parts of a river basin (Bangkok Post April 2004). This ideology is effective: it elicited and legitimized programs of reforestation on a large scale and the design of new "state enclosures" such as national parks and sanctuaries (Delang 2002; Sato 2003). These projects have often been, and are still, carried out to the direct detriment of populations whose livelihoods are dependent on these resources. The discourse depicting slash-and-burn agriculture as nefarious and backward lends support to the eviction of local communities (often Hmong people in the north) to the benefit of afforestation which is presented as modern and

productive, thus sanctioning a transfer of benefits to the timber industry (or to tourists, in case of reservations).

These programs have been faced with some opposition: NGOs proposed a *Community forest bill* which would recognize the right of communities to manage their own resources. Access to information on legal issues, the support of NGOs and activists, and the Thai citizenship of some ethnic groups have been found to be the main determinant of success in the recognition of community rights on the ground (Johnson and Forsyth 2002). Access to upland resources by local populations is gained through a political struggle pitting against each other agro-industrial interests, activists, rural communities and the state, through its line agencies and local administrative representations. "Weapons" are money, but also information on rights and laws, media, international NGOs, ethnic stereotypes and mainstream discourses on the causes of the water crises.

Another fascinating example of the power of the dominant discourse is the ban on logging which followed a heated debate on concessions granted by the government (Lohmann 1995) and the catastrophic inundations of 1988 (Lang 2002). Here again, despite the lack of scientific evidence of a causal link between deforestation and flooding on a large scale (CIFOR 2004), the relative success of this ban (followed by a ban in China in 1998 issued for the same reasons) and the vitality of the illicit logging business have shifted tree felling to other countries with weaker state control such as Laos, Cambodia, Myanmar and Indonesia : this situation provides a striking example of the power of an urban discourse which *de facto* links the increased vulnerability of investments in floodplains to the looting of natural resources in poorer neighboring countries.

Popular discourse on the lack of water is also efficient in justifying the development of more water resources. In this version, farmers are mobilized in a positive fashion and their "needs", stigmatized by dry and parched fields in the dry season, are emphasized in order to legitimize the construction of new dams or interbasin transfers. Supplying water to farmers becomes an endless mission, where benefits are obvious but whose costs are hardly mentioned.[9]

In contrast with the view of economists, for whom reallocation of water between sectors should simply follow the gradient of economic productivity, the spatial redistribution of a finite resource, or the grabbing of the resources from neighboring basins, is a process which is highly political and which proceeds along the "path of least resistance" (Molle and Berkoff 2005). The solutions found by cities to meet their growing needs generally minimize political costs and maximize gains to decision-makers. It is tempting to impose the environmental and economic costs of a water transfer to regions or categories of population with a lower bargaining power, and the financial costs to the country as a whole, while benefits tend to accrue to elites and urban investors whose profits are linked to the continuous growth of urban metabolism. The weakest parties are in general the next generations (affected by the exhaustion and contamination of aquifers, and the loss of biodiversity) and the environment (basin closure almost invariably provokes severe environmental stress, at least at the beginning).

[9] Refer to this declaration of an official at the Royal Irrigation Department: “water distribution doesn’t completely cover those irrigation areas; we’ve lost a balance between storage and distribution”, comments a high-level officer …We know the problem… if water can’t be distributed to people, maximum benefits will not be attained” (Bangkok Post, 28 December 2003).

In the present case it is interesting to note that a reduction of the allocation to agriculture is not formally considered[10] and that conventional engineering supply-augmentation options are still favored. Bangkok has first imposed a transfer from the Mae Klong basin, which constituted the less stressing option. In 1999, a new dam with a capacity of 750 Mm3 was built on the Pasak river, which joins the delta on its eastern side, at the request and under the patronage of His Majesty the King, with the main objective to protect Bangkok from the floods. By way of compensation to the provinces affected by the impoundment, an irrigation scheme of 25,000 ha has been added downstream of the dam, instead of earmarking the new water stock for alleviating the situation in the lower delta in general and in Bangkok in particular.[11] Each new reservoir comes with a new irrigation area and recurring shortages justify the mobilization of more distant or costly water. The last project under consideration contemplates pumping water from the Salween river[12] to increase the inflow to Bhumipol dam via a tunnel which is to be excavated through the mountain range.

5. Conclusions

This retrospective on the development of the Chao Phraya delta distinguished three phases. The first phase corresponded to the gradual reclamation of the delta. The spatial distribution of populations and the differentiation into varied types of agricultural systems appeared as the combined result of contrasting ecological conditions and of a struggle for the control of labor and land between the king, the nobility, and an emancipating peasantry. The reclamation of the delta is tightly linked to King Rama IV's political reforms as well as to the development of the international rice market.

After a quasi-total occupation of the delta, the last highland and the terraces of the Mae Klong were included in large-scale irrigation systems supplied by the diversion of the Chao Phraya and Mae Klong rivers. These infrastructures, combined with the construction of major storage dams and, later, with o the Green Revolution, allowed the intensification of rice cultivation, double/triple cropping, and agricultural diversification. Water supply, however, remained limited and could not meet the potential demand in the dry season. This deficit resulted in a tension on water resources, and in a competition between sub-regions and economic sectors, which pushed the various users to look for options and strategies aimed at maximizing their access to water. Water quality became a major aspect of conflicts within a delta that is endowed with very high hydraulic connectivity.

Water allocation becomes a central issue but it is readily apparent that the pressure generated by a fully irrigated delta and by a capital whose needs can grow up to 10 percent a year is shifted onto the upper basin and onto other basins as well. The search for more resources results in conflict with sub-regional development strategies and with the overall growth of water abstraction in the basin. The struggle for water is best fought through projects imposed by the state or urban interest groups, but also through symbolic and discursive means. The construction and control of a mainstream discourse, which defines the causes of (and the remedies to) water scarcity allows to further particular agendas and projects.

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[10] Much to the contrary, Thailand is considering multiplying its irrigated area by a factor two or three through the « Water Grid » project of the Thaksin administration (see Molle 2005).

[11] The same situation was observed with regard to the on-going construction of a dam on the Nakon Nayok river, which also contributes to the delta.

[12] This river defines part of the frontier between Myanmar and Thailand. It is planned to divert a total annual volume of 3.8 Bm^3.

This paper emphasizes that the evolution of the delta is not merely a linear process, whereby technical change would allow ever-increasing control of nature and social benefits. In reality, the consumption of space, the modes of exploitation, the process of intensification and diversification, migrations, etc. are all linked to a manipulation of the hydrological cycle (in terms of quantity, quality and timing) which cannot merely be reduced to issues of technical or economic efficiency. The spatial expression of these changes defines the way in which costs and benefits are distributed among sub-regions and among various categories of actors.

A political ecological approach emphasizes how power relationships inscribe themselves in the landscape, and how the resulting environmental changes, in return, impact on society or segments of it. This paper revealed how the organic development of the delta was staged through the competition of actors as varied as the farmers of the various sub-regions, urban and industrial interest groups, provinces in the basin as well as neighboring ones, the hydro-power and agrobusiness sectors, politicians, line agencies, green NGOs, the media and the academia. Interactions are also spatially hierarchized: Bangkok tends to dominate the delta, the delta tends to maintain (with some difficulties) its privileged access to water in the basin and to impose its logic to ethnic minorities in the north, and the basin tends to expand its grasp on the resources of neighboring basins and countries. Access to water resources is constantly challenged and redefined and the challenge is now to design governance mechanisms at the basin level which can regulate this access in a more open, equitable and sustainable manner.

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