land

MDPI

Article

Contested Living with/in the Boeng Chhmar Flooded Forests, Tonle Sap Lake, Cambodia

Vu Thi Phuong Linh, Kelly Shannon * and Bruno De Meulder

OSA Research Group Urbanism & Architecture, Department of Architecture, Faculty of Engineering Science, KU Leuven, 3000 Leuven, Belgium
* Correspondence: kelly.shannon@kuleuven.be

Abstract: The paper is based on empirical research of a territorial transect in Cambodia's Tonle Sap floodplain. The flooded forests of the Tonle Sap Lake are determined by a significant seasonal flood of up to 13 m, where a large gradient of wetness and alluvia flow and dramatically transform the territory. The paper zooms into a case study of the inhabited RAMSAR area of Boeng Chhmar with its five floating villages, which are dispersed along seasonal waterways. Boeng Chhmar is one of the richest symbiotic habitats in the world and its inhabitants completely rely on the flooded forest's natural cycles for settling, subsistence fishing, and forest−gathering activities. From two opposite landscape transformation processes, Khmer indigenous practices and State development procedures, the paper unravels the logics of settling, coexistence, and contestation. On the one hand, local daily practices are embedded in seasonal floods and forest lifecycles, coexisting, and reconfiguring the inhabited wild for subsistence living. On the other hand, State development through history has centered on (de)−(re)forestation and modern landscape construction for commercially exploitative practices. Forest logging and large−scale fishing lots extracted enormous quantities of natural resources and compromised the health and natural regenerative capacity of the ecological system. This also undermined the ago−old legacy of inhabitant's ways of settling in and with the landscape. Today, State operations face challenges from both nature itself and cultural resistance. The findings for the paper are based on multi−scalar interpretive mapping. The tracing of morpho−typologies and landscape transformation processes allows multiple narratives to be translated into spatial terms. The coexistence and contestation in Boeng Chhmar and the Tonle Sap can provide spatial insights into contemporary forest and water urbanisms, especially concerning local material cultural practices and landscape transformation.

Keywords: Khmer floating villages; State development; inhabited wild; contested landscapes; traditional ecological knowledge

Citation: Linh, V.T.P.; Shannon, K.; De Meulder, B. Contested Living with/in the Boeng Chhmar Flooded Forests, Tonle Sap Lake, Cambodia. *Land* **2022**, *11*, 2080. https://doi.org/10.3390/land11112080

Academic Editors: Gunilla Lindholm, Caroline Dahl and Lisa Diedrich

Received: 18 October 2022
Accepted: 7 November 2022
Published: 18 November 2022

1. The Inhabited Boeng Chhmar Flooded Forest

The flooded forests of Cambodia's monumental Tonle Sap Lake are determined by a significant seasonal flood of up to 13 m and a large gradient of wetness and dryness, where water and nutrient−rich alluvia flows dramatically transform the territory. Boeng Chhmar in the Stoung District, Kampong Thom Province, is one of the three core protection zones of the Tonle Sap Biosphere Reserve. Its swamp eco−hydrology is determined by a geological depression where the Stung Staung and Stung Chikreng rivers interact with the lake's great flood−pulse regime (Figure 1). The lake has the unique quality of changing its water−flow direction in the dry and wet seasons. As well, shallow creeks seasonally feather water and sediment in and out of the region. The area is a giant biodiverse quagmire, its mud and dense wood and shrub communities significantly slow down flood and sediment flows and create habitats for a large assemblage of plants, fish, reptiles, mammals, and birds [1]. In 1999, Boeng Chhmar (with its associated rivers and floodplain) was recognized by the UNESCO convention of wetland conservation program and named RAMSAR site

no.997. This highly protected area of 28,000 hectares is one of three core areas of the Tonle Sap Biosphere Reserve, playing a critical role in wetland hydrology and animal refuge. Although the flooded forest remains inhabited, the RAMSAR status has renewed the State's efforts to manage fishing, wood collection and the transformation of forests to grasslands and shrublands [2,3].

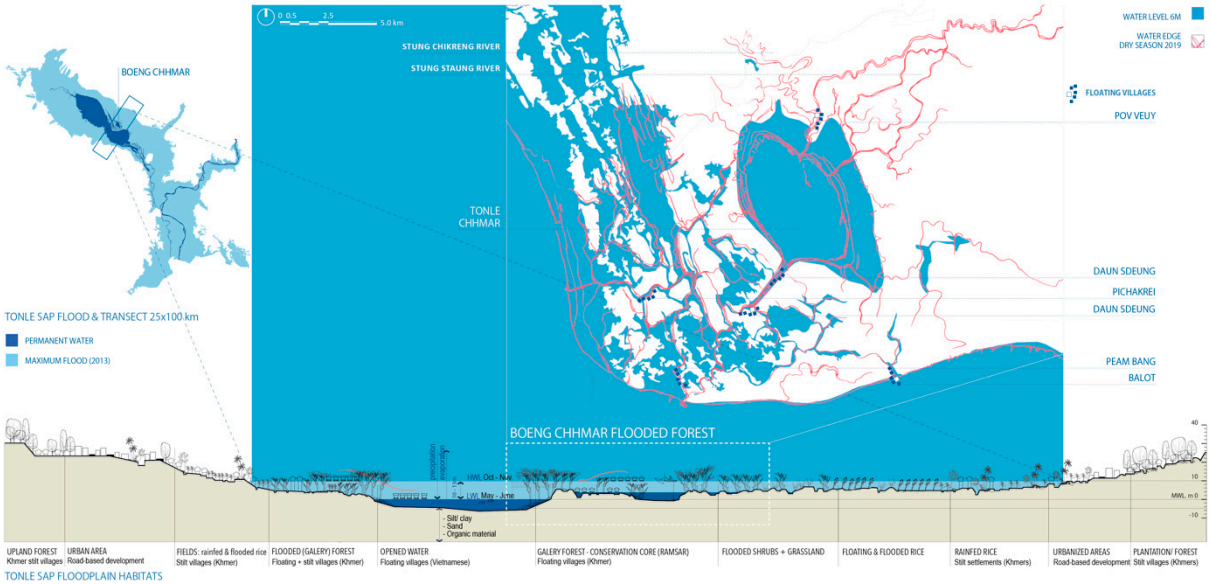


Figure 1. Boeng Chhmar forest and floating villages the Tonle Sap Lake and floodplain. The lake habitats are determined by the great seasonal flood−pulse. The transition of habitats follows the dynamic inundated topography from the floodplain to the opened water. Most of the area in Boeng Chhmar is inundated during the flooding season when only high tree canopies, flood−resilient plants and floating species can be seen. (Linh Vu, 2022, with GIS Cambodia open source, Google Earth, ecological and hydrological studies of the Tonle Sap).

Since the lake's formation 5000–6000 years ago, terrestrial, and aquatic species have found permanent or migrating environments in and around the lake [4,5]. Meanwhile, the history of domestication started with early nomadic ethnic groups and their boats, even before the rise of the mighty Angkor Empire (9th to 15th centuries). In Boeng Chhmar, there was a hunter/gatherer culture, where kinship with nature, a sense of belonging, sharing and an ecologically balanced way of managing resources reigns. Spaces of interaction drive local intervention, construct life, and generate knowledge—all contributing to a strong 'common'. Wet−rice cultivation gave birth to Khmer water civilizations that concentrated in the northeast Tonle Sap. The area of Boeng Chhmar was first occupied in the 6th–8th centuries. The pre−modern era was considered the golden times of flooded forest 'barbarians,' a term and concept adopted from political scientist and anthropologist J.C. Scott, before the lake and the forest became divided by modern States [6,7]. In a bas−relief at Angkor Wat (7th century), the interdependent and interactive environment was visualized by gathering and hunting activities around the flooded forest, celebrating the abundant life in the swamp. The richness of the flooded forest is also part and parcel of ancient Khmer legends. For millennia, the flooded forest has been a vibrant environment for floating communities to coexist, shape, and sustain their livelihoods with various water and forest species. In opposition to the abundant life shown in the Angkor bas−relief, an early 19th century Siam map [8] emphasizes a wild and dangerous Tonle Sap. And through the course of history, inhabitants in the Tonle Sap swamp forests have changed in relation to the giant flood−pulse, State control, and various crises. However, today, no ancient settlements can be found due to their use of highly perishable materials. Nonetheless, there is significant research concerning early inhabitation by archeologists, anthropologists, and ethnographers.

Colonial maps (1914 [9] and 1949 [10]) of ethnic groups show extended appropriation on the lake. Simultaneously, a fishing lot system (that went hand−in−hand with the introduction of new technologies for industrial−scale catches) was allocated along the Tonle Sap lakefront and within the Boeng Chhmar forest [11]. The lots were mainly allocated to Chinese traders. The extractive lot system didn't imply ecological kinship with the wild lake. Non−Chinese maintained an ecological kinship but were, however, seasonally excluded from the lots. Despite these radical changes, the Boeng Chhmar forest remains densely inhabited (Figure 2).

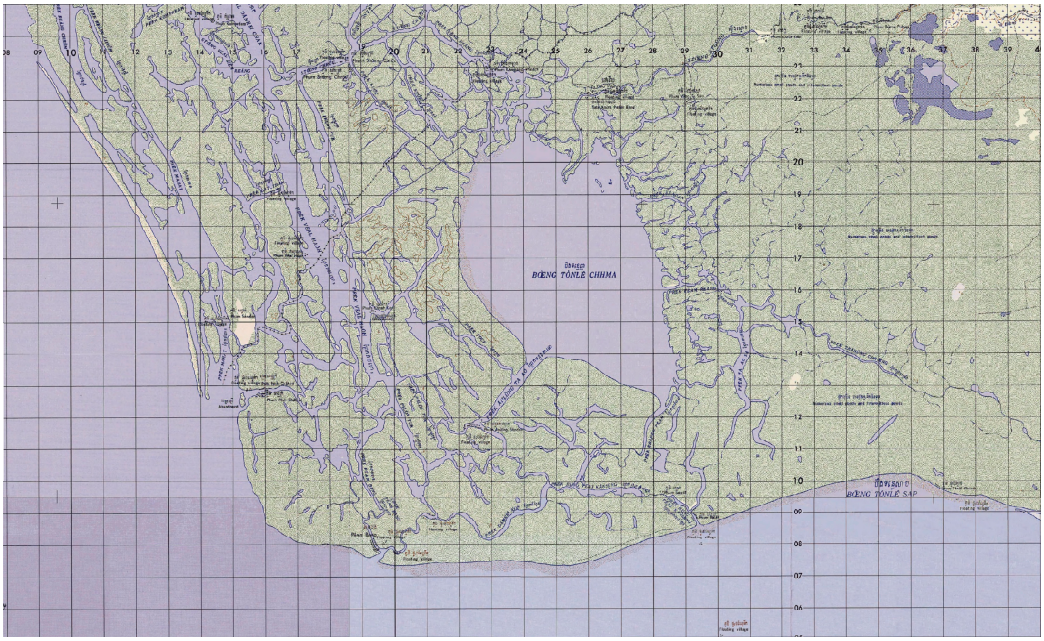


Figure 2. Topographic condition of Boeng Chhmar and its villages in the 1960s. (excerpt from Cambodia National Topographic map of 1:50,000 of US Military 1968-1969. Available online: http://gigapan.com/gigapans/130187, accessed on 6 November 2022).

Starting with UNTAC (United Nations Transitional Authority in Cambodia, 1992–1993) and from 2000s onwards with political support, villages in Boeng Chhmar have been recognized, temples rebuilt or extended, and social and governance systems (including schools and conservation centres) established [12,13][1]. Fieldwork in 2022 confirmed the intense occupation of Boeng Chhmar. Human marks are omnipresent, with abandoned large fishing nets, traps, bamboo sticks, and gillnets. Frequent movement and fishing take place at the land−forest edges. Within, and surrounding the villages (floating houses) and along the waterways, small fish traps, clam catching, gardening, and cultivation activities appear and disappear seasonally. The forests are extensively exploited (for timber, charcoal, medicinal plants, vegetables, and fruit) [14].

However, Cambodia's economic reforms of 1997 and global warming accelerated an ecological crisis of the lake (with complications following floodplain development, overfishing, forest loss and the proliferation of invasive species and pollution) [3]. An increase in cultivation and fish−farming activities in the dry season goes hand−in−hand with forest burning. In many places, the original vegetation has been entirely cleared [14]. Since the second fishing reforms of 2012, community−scale initiatives led to reforestation, the development of floating nurturing gardens and breeding ponds as well as local fishing management[2]. In 2021, more stringent conservation measures further restricted fishing [15,16]. All seasonal migration fishing, including small−scale fishing, has been forbidden [17] (Figure 3)[3].

Figure 3. Ecological crisis due to over−exploitation. Abandoned fishing areas and strict control of local activities are consequences of the government's conservation policy. (Linh Vu, April 2022).

2. Prei, Phum, Srok, Ktom Neak Ta and Wat

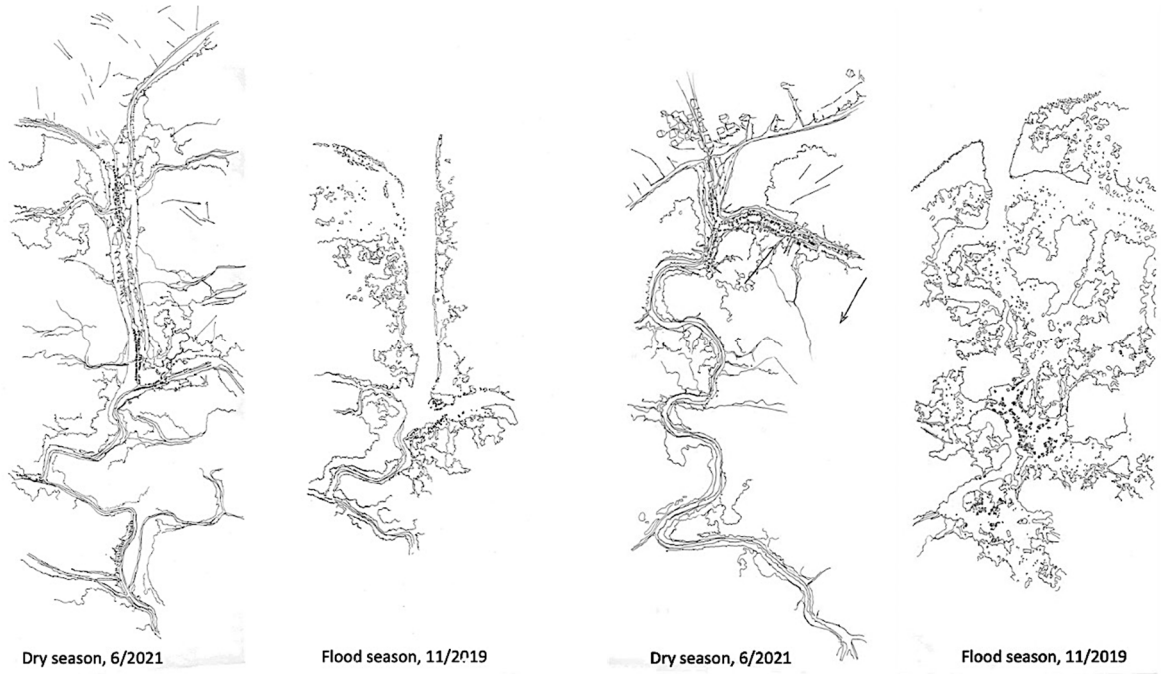
In the Khmer language, there is a precision in the vocabulary associated with inhabiting the landscape. The *prei* (forest) is considered a place of ancestral genesis while the wild swamp is a place of refuge. The swamp forests of the Tonle Sap Lake therefore have an ambiguous meaning. Historically, the swamp forests were primarily refuges, not destinations. They were a sanctuary for those escaping domestic threat or external upheaval [18]. During the ancient civil wars and when the capital moved from Isanapura (Sambor Prei Kuk, 7–9th century) to Angkor, people escaped into forests to avoid being enslaved for temple construction or for the military. When Angkor collapsed under Siam in 1431, the swamp forests of Boeng Chhmar were allegedly the place of refuge for a princess escaping an enforced marriage[4].

Until colonial times and even recently, swamp forests including Boeng Chhmar were still unregulated spaces, considered a dangerous realm, but also a vital source for local livelihoods. For scholar Penny Edwards, the *prei* is replete with its own complex cosmology as a place of transformation and transit—daily, seasonally, and through history. *Prei* is an important component of Khmer myths, and representative of a ritualistic journey, embodying the knowledge of the real−world (spatial) relationship between humankind and nature that has changed over time with religious expansion, colonial appropriation, and all modern forms of institutional and political domination.

Inhabitation of the swamp forests is defined by *phum*—which are neither an ecclesiastical unity nor an administrative unit, but a range of activities and movements which create dynamic settings in various seasons. In the swamp, *phum* were born as a refuge into the *prei*, with floating extensions, settling concentrations, community appropriation, and regular human paths [19]. The *phum* consists of either domesticated vegetation, water gardens or inundated farms with an assortment of floating structures for housing, cultivating, fishing, and gathering. The configuration and boundaries of *phum* are marked by movements and practices of landscape−making in the form of paths and daily activities with the interactive forces of flood, mud, and vegetation. What is interesting is that nearly all the settlement configurations, paths, boundaries, and the complex of water−mud−vegetation−human artifacts seasonally transform with the rhythms of floods and monsoons. All is ephemeral and goes through a continual process of construction and destruction (Figure 4)[5].

Inland, settlements are *sroks*, which exist as clearings in the *prei* (forests). The *srok* is an inhabited or 'civilized territory,' opposed to the wildness of the *prei*. The *srok* is defined with a territorial limit and an installation of a neak ta, or guardian spirit. In earlier times, there was dynamic exchange between the *srok* and *prei*. There was no clear boundary, but a flexibility and freedom of movement between the two systems. In the floodplain, the *srok* often contains rice paddies, vegetable fields, fruit orchards, and stilt houses. Rooted in Khmer rice civilization, *srok* was further stabilized and institutionalized with the physical appearance of Buddhist monasteries and Khmer temples, both of which were defined with clearly constructed boundaries. From the times of the French protectorate (1863–1953) until now, political notions of spatial and conceptual boundaries have been restricted and solidified. The French installed a hierarchical administration to allow control and to

facilitate exploitation. Clear boundaries were rigorously marked for villages, communes, districts and provinces and forests, water, land, and soils were systematically categorized. These survey categories implied legal (or illegal) (colonial) rights of access, use, passage, etc. Simultaneously, locations for commerce, sites for industrial development programs and various projects were defined. They usually surrounded the existing settlements and induced their transformation. Ever since colonial times, the state has continued this colonial track of surveying, categorization, zoning and restricting rights. Clearly, over time, the *srok* has been increasingly transformed, administrated, and disconnected from the *prei* [18,19].



(**a**) Peam Bang (**b**) Pov Veuy

Figure 4. Transforming configurations of *prei* and *phum*. In Peam Bang and Pov Veuy, there is an impermanence of landscape and settlement morphologies as determined by the flood−pulse regime. Productivity and safety define the seasonal location of the *phum* in the *prei*. Meanwhile, waterways and land determine the settlement structure in the dry season, in the flooding season, settlements clusters deeply inside the forest under tree canopies (Linh Vu, 2022, based on Google Earth).

As important as settlements for the living were a range of structures that center on cosmologies and various ritual symbols. *Neak ta*, a range of rituals and beliefs, operates as a system of exchange and regulation between 'two' different worlds, the *prei* and *phum*/*srok*. *Ktom neak ta* (spirit houses) (Figure 5) are considered nesting places for negotiation between humans and the wild, between land and water and are strategically located between *prei* and *phum* on the water or in the muddy forest itself. The *ktom neak ta* is part of the spiritual pathway of living with the forest. Also, in the flooded forests of the Tonle Sap exists *prei ktom neak ta*, rituals to water (*toeuk*) and their attendant spirit houses that protect the community and fishermen from the dangerous water regimes of the Tonle Sap Lake [20][6].

(**a**) (**b**) (**c**)

Figure 5. *Prei ktom neak ta* and *wat*. The small, impermanent form with perishable materials (wood and bamboo) of the *ktom neak ta* reveal a humble attitude of humankind towards nature. The strategic location of the spirit houses is between *phum* and *prei* and is an intensely utilized space for fishing, cultivation, and inhabitation. Meanwhile, the dominant size and permanence of the *wat* strongly differentiate it from its surroundings. From left to right: (**a**) *Prei ktom neak ta* in Daun Sdeung village; (**b**) reconstruction in Pichakrei village; and (**c**) the *wat* in Pov Veuy village. (Linh Vu, April 2022).

Meanwhile, *wats* (Thevaranda Buddhist pagodas) (Figure 5) are found throughout the region. Buddhism thrived in Cambodia following the collapse of the Angkor Empire. *Wats* are located at the center of the villages on naturally or artificially constructed higher land. A *wat* is a protected place (literally and spiritually) for villagers from the vagaries of nature and its hazards. Although Thevaranda Buddhist ideology is premised on the notion of harmony with nature and the connection of the individual with the cosmos, the *wat* itself is an institutional framework with norms and habits of ritual practices. *Wats* embody a social hierarchy, mirroring that of Khmer rice culture. *Wats* are most often developed as a complex, which includes a school or conservation center, built by the government or an NGO. *Wats* are set in a clearing of forests, and water elements are part of its carefully designed landscape.

3. A Transect and Five Floating Villages

The more general concepts elucidated above were precisely studied in 2021–2022 during two fieldwork visits, one in the dry season and another in the wet season. A transect of 25 by 60 km (Figure 6) reveals territorial transformations through evolving local practices and development projects and policies of the State. The transect in Boeng Chhmar was selected since it still contains key ecological conditions of the swamp forest. The transect follows the Stung Staung River through different habitats and productive terraces, passing the flooded forest territory to the Tonle Sap and up to the mountain foothills, where hydraulic structures significantly alter the water flow. The river, as the center of ecological linkages, is the regional corridor for people and species traversing the topography. From the lake to the mountain's foothills, a system of submerged forests along the river supports the seasonal movements of species, soil, and organisms. The river course and the water flows explain the logic of dynamic morpho−typologies subsequently transiting from *phum* to *srok*— from floating villages to river−side villages, rice field villages, to urban areas, and foothill villages. Along the transect, *prei ktom neak* marks relations of the *phum* or *srok* with the landscape of either forests, rice fields or plantation terraces (Figure 6).

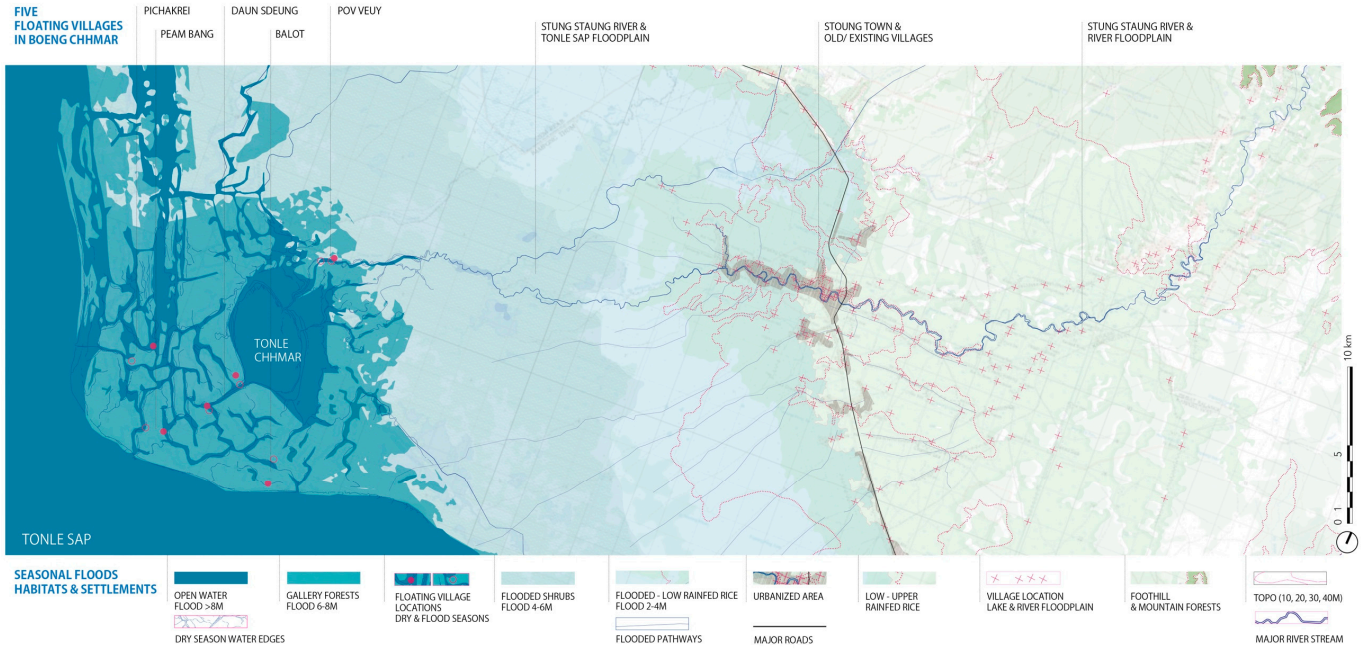


Figure 6. Territorial transect (Tonle Sap and Stung Staung river floodplain and settlements) and Boeng Chhmar's floating villages. An overlay map of habitats, flood conditions, topography, village system, and urbanized area (Linh Vu, 2022, mapping from GIS open source, Cambodia topography, google earth, and fieldwork observations of floating village locations in dry and flooding seasons).

In the Peam Bang Commune, five small floating villages (Peam Bang, Pov Veuy, Daun Sdeung, Balot and Pichakrei) totaling approximately 3068 people/743 households (2019) [21] are dispersed along the seasonal waterways yet relate differently with the waterway, land, and forest. They have different configurations, though all transform under the same water rhythm. The five floating villages are hence a case study demonstrating traditional ways of life that until recently resonated with the water−forest rhythms, and this despite the restrictions to the living spaces of the villagers since colonial times (while giving space to commercial fishing lots). This evidently affected the traditional forest domestication lifestyle.

Most of the village's inhabitants are Khmer, but there are as well groups of ethnic Vietnamese (known to be expert fishermen in the region). There has always been Vietnamese in the area, but their numbers increased dramatically during French colonialism. Due to contemporary politics, the Vietnamese are today (along with the Cham, a Muslim ethnic group) marginalized and living in the vulnerable landscapes, such as the open waters of the lake, since they cannot obtain land tenure. Fieldwork in Peam Bang village recorded approximately 50 Vietnamese households, living side by side with the Khmers, but closer to the lake shore and further from the *wat*. Their houses occupied both sides of the settlement's deeper internal waterway and included commercial activities. At the same time, other villagers mentioned that, recently, many Vietnamese have sold their houses and moved out of the village due to the decline in fish and new fishing laws.

Nonetheless, all inhabitants rely entirely on water and forest cycles for settling, subsistence fishing, gathering and wet cultivation; remarkably, entire villages move from one place to another, depending on seasonal water conditions. For hundreds of years, the movement of settlements with the rhythm of water and forest regimes followed similar patterns. Housing clusters, always recognizable as groups, are a part and parcel of the water−forest transformation. Changes in water levels, monsoon (wind, rain, and wave) and land conditions define when and where floating clusters move and settle. Whole villages move once or twice each season, adjusting to the most critical water condition. Individual houses move or adjust their position at least six times per season. The waterways

are the link between major fishing areas, markets, and the vein for movement between the vast open lake and the protection of the canopied forest.

In the dry season (from November to April), the floating villages anchor to land which becomes the common area for social and intuitional formation through the building of ritual and social facilities. Inhabitation occurs either on the muddy, shallow waters bridging the open water and land or by moving through the waterways to upstream areas where family members can have rural−urban jobs on the higher terraces of the floodplain. Fishing is very locally based on the muddy water's edge and small fishing traps are used. Compared to the wet season, there are few fishing activities and cultivation is the primary economic and subsistence activity. The settlements work with micro−topography and develop as parallel lines. For example, in Peam Bang, three lines of floating structures at the water's edge define different topographical levels of wetness: on the water, at the edge of the water, and on the waterside banks (Figure 7).

Figure 7. Subtle differences of land−water−vegetation compositions. The widths of the waterways and the microtopography greatly influences the configuration of the villages. (Linh Vu, April 2022).

During the wet season (from May to October), entire villages move out to the open waters and cluster in the vast expanse of the Tonle Sap. Floating structures are often tethered to one another, with houses also in lines (with open waterways in between for daily movement) with social infrastructure buildings in strategic locations. There are abundant fish in the area, since the lake becomes an environment for feeding and breeding. Until 2021, commercial−scale fishing was dominant, with sophisticated fishing traps and nets, which created an intricate, geometric order on the water and produced relatively high yields, where fishermen generated income that sustained households throughout the year. In addition to the large−scale fishing gear, there are numerous vernacular tools, including hand capture, scoops devices, wounding gears and hooks and lines [22]. There was a dramatic change in 2022, when the Cambodian government officially banned the commercial fishing lots in response to overexploitation. The long−term repercussions on local livelihoods have yet to be seen.

4. Water Gardens and Amphibious Living

Dry and wet season living is based on the conceptual notion of water gardens and amphibious living. The Boeng Chhmar forest settlements can be related to Scott's "domus

complex" concept, where he proclaims that humankind has so extensively domesticated the planet that many plants and animals changed their physiognomy. He wittingly refers to a late neolithic 'multi−species resettlement camp.' The domus became a human−driven ecosystem with a concentration of productive fields, seed and grain stores, domesticated animals, and thousands of uninvited hangers−on all which thrived and coevolved with dire consequences. The process of domestication, centered around agriculture, annual and daily routines with rituals, defined the domus configuration and its architecture [23].

The concept of the garden as a domesticated wild for food sources, can be used for the whole Boeng Chhmar swamp and the seasonal cultivated area related to settlements. There are then gardens in the gardens, corresponding to each village's mud−water condition and local traditions of subsistence developed over generations. In addition to fishing, there is a diverse set of practices related to the forest gathering of firewood, herbs, and aquatic plants, all which were domesticated. The landscape mosaic reflects subsistence livelihoods and the typo−morphologies that emerged from daily practices reveal unique ecological knowledge—as ways to shape and sustain life configured by water−land−vegetation (species) interaction [24] (Figure 8). The 'commons' in the settlements are the open water paths (defined by settlement and fish−net arrangements) and the shared and constructed ecological patterns of the water−forest landscape. The material culture and local practices define the common space and simultaneously construct local ecological knowledge [25–27]. Recently, other economic activities have transformed new seasonal 'commons.' For example, in the dry season, clam raking (which occurs in the shallow waters) yields vast quantities that are brought to the *psah* (market), which also serves as a port. A host of informal stalls sell modern wares, including gasoline for boats that have moved from traditional rowboats to efficient engine−driven means of mobility.

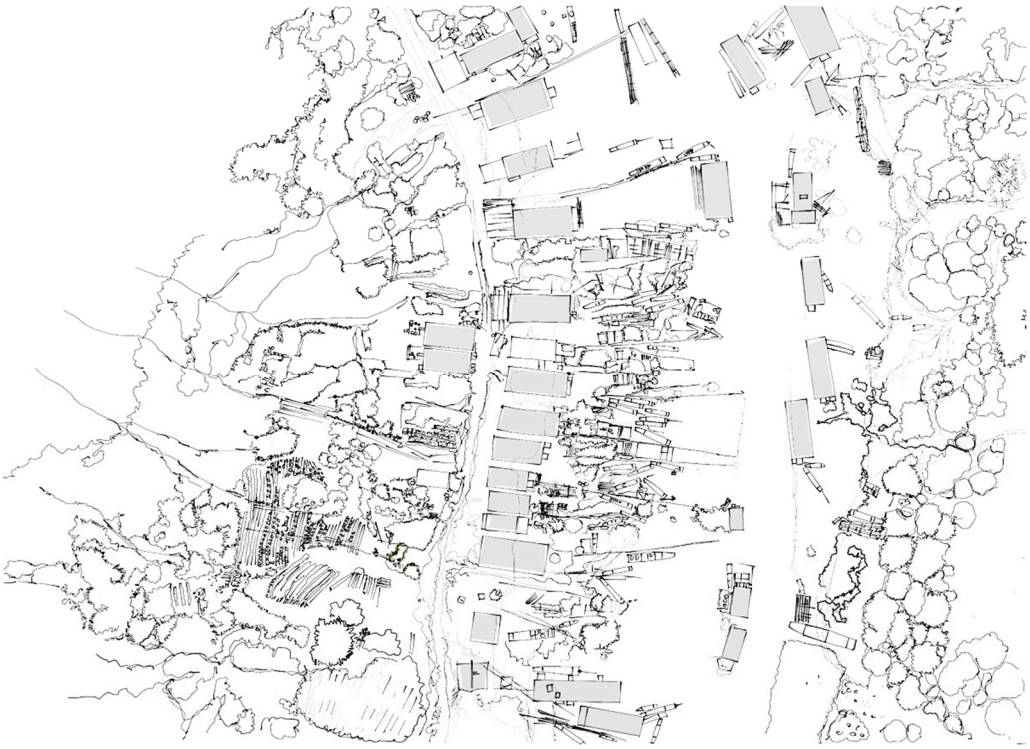


Figure 8. Village tissue in Peam Bang (dry season). The rich landscape/settlement mosaic reveals the living conditions at the land−water margin. Incredible systems of pathways, bamboo bridges, link various landscape and settlement structures. The domesticated micro−habitats are associated with the subtle change degrees of wetness. From the water to the edge of the forest, there are fish traps, hanging vegetable gardens, corn fields, grass fields, shrubs, and higher trees (Linh Vu, April 2022).

As the landscape itself is constantly transformed by the rhythms of nature and the ever−changing water levels, so too are the settlements and living spaces. The configuration of the floating settlements can be understood as seasonal mosaics in themselves. Due to the strong and unpredictable storms that come to the area of the lake, individual buildings, and small clusters of them are occasionally swept away by the flood pulse. Others remain, and new constructions create a dynamic pattern and way of settling around the lake. In the dry season, people live with the condition of the muddy land in just a small section of the waterway with various forms adjusted with the micro−topography and the wetness of the landscape. In the flooding season, inhabitants live and move in their floating houses in the vast water landscapes and between large tree canopies of the flooded forest. Boeng Chhmar's shallow water, dense forests, and large trees help to mitigate floods compared to other areas in the lake's open−water or larger rivers.

Amphibious living is natural for the symbiotic survival species in muddy waters. Plants, animals, and humans developed specific ways to settle in such landscapes. For the floating villages, the spatial arrangement and associated meanings dramatically changes between seasons, and between the shifting relations to the water and land. The houses themselves are simply constructed, most often with bamboo frames and palm leaf panels. The basic structure of the house is similar to the Khmer traditional *phteah rong* or *kantaing* (with sloped roof panels), or the outdoor gathering/rest house *sala* (an elevated and roofed shelter for relaxing, sleeping or daily activities) [20], often with two sloping roof panels (Figure 9). However, the architecture and geometrical proportions are modified due to different materials and in accordance with a social hierarchy [28,29]. Three types of houses are observable in Boeng Chhmar: ferry houses, traditional boat houses and bamboo−structured houses (Figure 9). They all float due to their construction on bamboo rafts, with buoyancy from metal barrels. The floating component is separable from the house, meaning that the house can sit on land or at the water's edge in the dry season. The major components of buildings (including collective structures such as markets and schools) are repaired (and sometimes completely reassembled) every season due to havoc wrecked by weather, particularly wind and water. The life cycle of the houses or different parts of the houses depend on the relation of the weather tectonics and materials. Maintenance is part of dry season activities for the lake's nomadic populations. The reconstruction often includes the creative multiple use of materials, evident, for example, with the prevalence of large fabrics used to filter strong sunlight in open spaces connected to houses and boats, that are also employed for hunting, fishing and even bed sheets for fishermen out on the lake. In recent years, a majority of floating houses on the lake also have extended floating structures for docks for boats, cages of fish and/or aquatic vegetables or platforms for fish processing or other manufacturing and commercial activities.

The specificity of the houses and buildings in Boeng Chhmar is their simplicity (since reconstruction is often required) and intimate relation to nature. Traditional floating houses normally have one interior partition, but in Boeng Chhmar, there are often no partitions. Occasionally, there is an extra separation that sets apart commercial or production areas of the house. There is also observable local specificity in the various villages. In Peam Bang, the materials for the floating structures are wooden or metal frames, with bamboo screens, bamboo rafts, recycled barrels, leaves for screen and roofs, metal or plastic roofs/cover sheets, fabrics, and fishing nets. In Pichakrei, the typical traditional Khmer floating houses are fully made from self−sufficient local materials including wood−boards or bamboo trunks for the structure, with straw panels and leaf roofs. Meanwhile, in Pov Veuy there is a clear link to urbanization with cheap, modern materials; constructions combine the use of wooden boards with corrugated metal, prefabricated elements, MDF, and laminated chipboard.

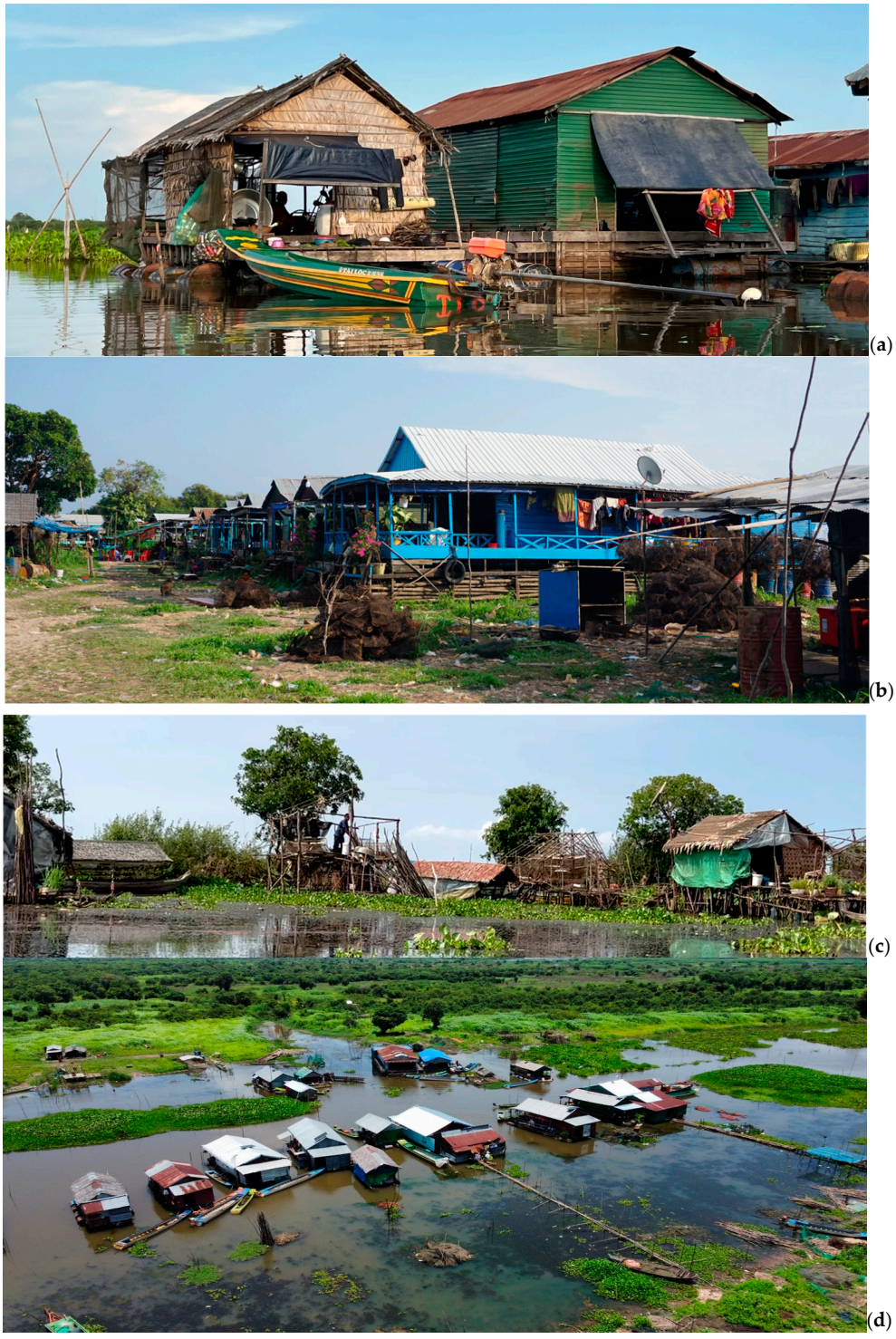


Figure 9. Amphibian housing and seasonal (re)construction. The 'amphibian' settlement dramatically changes with the seasons. The traditional boat houses and bamboo−framed houses have frames that support the floating component, usually a bamboo raft and/or platform with metal barrels. The house structure can stand on land or at the water's edge in the dry season. The house and floating parts are reassembled and repaired every dry season: (**a**) floating houses in Daun Sdeung village; (**b**) floating houses stand on dry land adjusted to the shallow river in Peam Bang village, (**c**) Stage of reconstruction in Pichakrei village; (**d**) a house cluster responding to small gradients of wetness and inundated topography in Pichakrei village (Linh Vu, April 2022).

For the Tonle Sap Lake's human inhabitants, living in the muddy water was more than a pragmatic exercise; all their building typologies became part−and−parcel of a complex cosmology [28,29]. The house is defined in relation to the notion of the forest as protector and all the living spaces are designed to interact with the wider environment. As well, seasonal connectivity with the surroundings—water, land, and climate define the activities in and outside the houses. In the dry season, the connection between the house and the land defines movement of village life. Meanwhile, in the wet season, the floating architecture is directly related to the regimes of life on water and fishing. There is a constraint of human movement due to its floating nature—all movement is related to the water.

5. The Tragedy of Development

In Cambodia, generally, and the area of the Tonle Sap Lake, particularly, the history of water and forest extraction dates to the times of the mighty Angkor Empire and the acts and explicit expression of humankind's power over nature. During the period of French colonialism (1863–1953) and reign of Pol Pot (1975–1979), extractivism continued, albeit along very different ideological regimes. Under the government of Hun Sen, exploitation and capital accumulation continues, most recently with massive Chinese investments (often substantial acquisitions for land development projects) [30,31]. The cumulative result of urbanization and modernization has been severe ecological and socio−cultural erosion. In the Tonle Sap, there is a visible contestation between State norms, public and private investment, and community land/water values and daily material culture and practices. In recent years, there has been a wave of land−grabbing in the so−called uninhabited forest. The lives and livelihoods of villagers, with their deeply developed traditional systems kinships and co−existence with non−human species, is largely ignored through wholesale land/water ownership conversion to developers, investors and/or for government programs of water management. The traditional Khmer commons in Boeng Chhmar are rapidly disappearing and in many instances, the expropriation of communal land occurs without local consent, raising multiple issues related to not only socio−cultural justice (property rights and human rights) [32,33], but also ecological justice.

More specifically, in the area of the Tonle Sap, forest concessions and capitalization of fishing lots dramatically changed the ecological health of lake's ecosystems (Figures 10 and 11). Forestry has a long history in Cambodia, being both local and commercial (begun with the French). Until the first half of the 20th century, the use of wood was vast and plentiful, from charcoal to mass−housing construction, furniture, fishing, and agricultural tools and structures [20]. During Vietnam's protection (1979–1989) after UNTAC (United Nations Transitional Authority in Cambodia in 1992–1993, in which a UN peacekeeping mandate took over the government administration to implement the political transition from the aftermath of two decades of violence), logging was largely uncontrolled due to bad forest governance. With economic liberation, Hun Sen proclaimed forestry as one of four economic spearheads. As forestry concession reached its zenith, massive deforestation occurred resulting in the denuding of approximately a third of Cambodia's surface area and most of the country's forests [34]. The Tonle Sap today has only 10% coverage of submerged forest [35,36], whereas once upon a time it was densely covered. Villagers claim that they still remember present−day scrub areas as forests [2,35] (*). The total area of the floodplain forest cover has decreased significantly from one million hectares in the 1930s to 614,000 ha in the 1960s and 360,000 ha by the 1990s [35]. During the era of French colonial administration, the Tonle Sap produced 85% of Cambodia's firewood and charcoal [35]. Afterwards, both increased commercial exploitation for firewood and charcoal and conversion of forest land to areas for rice production.

Figure 10. The Tonle Sap's flooding area was transformed and confined by the progressive buildup of national roads and urban development projects (from the French colonial era until today). (Lanessan, Jean-Louis de (1843–1919). Cartographe. Cambodge/de Lanessan; gravé par Erhard Frères. 1888).

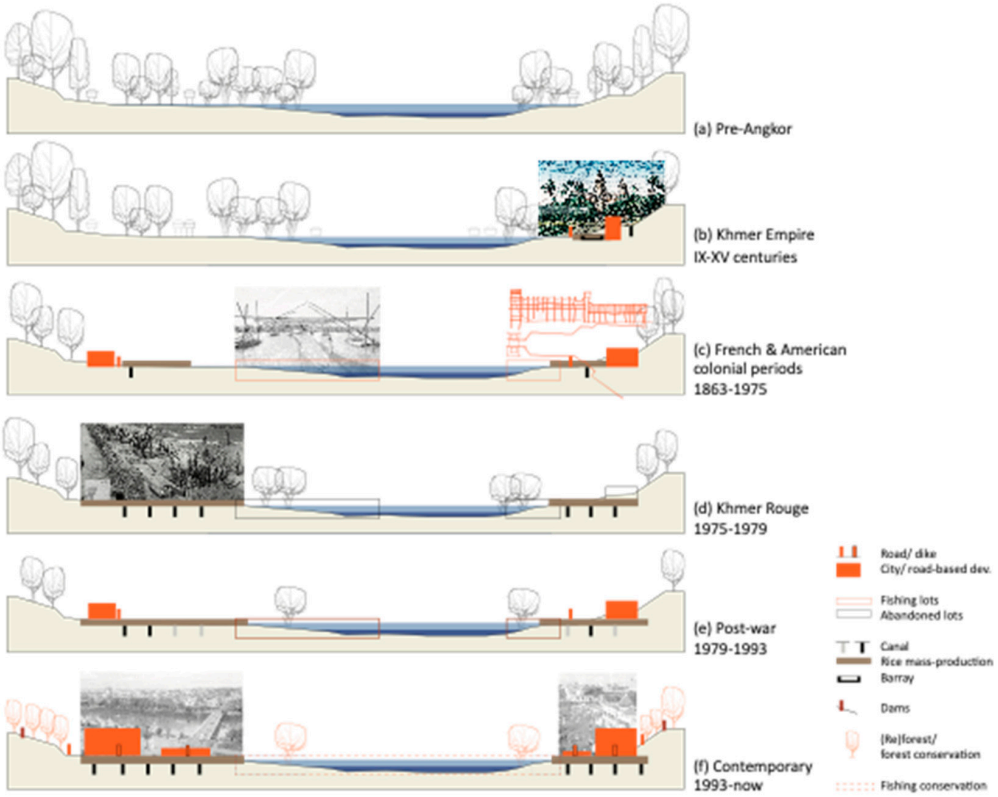


Figure 11. Evolution of the Tonle Sap's development. A great deal of urban and infrastructure development propelled deforestation that dramatically altered the lake's hydro−ecology. Over time, hard engineering, and simplification by the State of the area's nuances continued a legacy of exploitation (Linh Vu, April 2022).

Meanwhile, the fishing lot system once covered almost the entirety of the Tonle Sap floodplain. It was first introduced in the Mekong River and the Tonle Sap during French colonialism. The system of physical and administrative boundaries defined areas of water privatization and seasonal occupation for capital accumulation [37]. The extraction continued during American time of modernizing the Mekong Delta (1955–1975, with aid for aggressive infrastructure development during the Cambodia and Vietnam War), and (from 1985) vast extraction techniques were introduced which further industrialized fishing. The large−scale fishing operations were designed to take advantage of the flood−pulse regime and the natural fish flows. In the high season, from October to May, fences of the fishing lots were closed to maximize catches. Most small−scale fishermen were excluded from these practices [14,33]. In 1999, there were 139 lots in the Tonle Sap which continued operation until 2011, when the government issued a law which closed all industrial fishing lots due to overfishing [13,38] (Figure 12). Fieldwork in Boeng Chhmar evinced the degraded landscape, replete with abandoned fishing nets and minimal survival of traditional fishing practices.

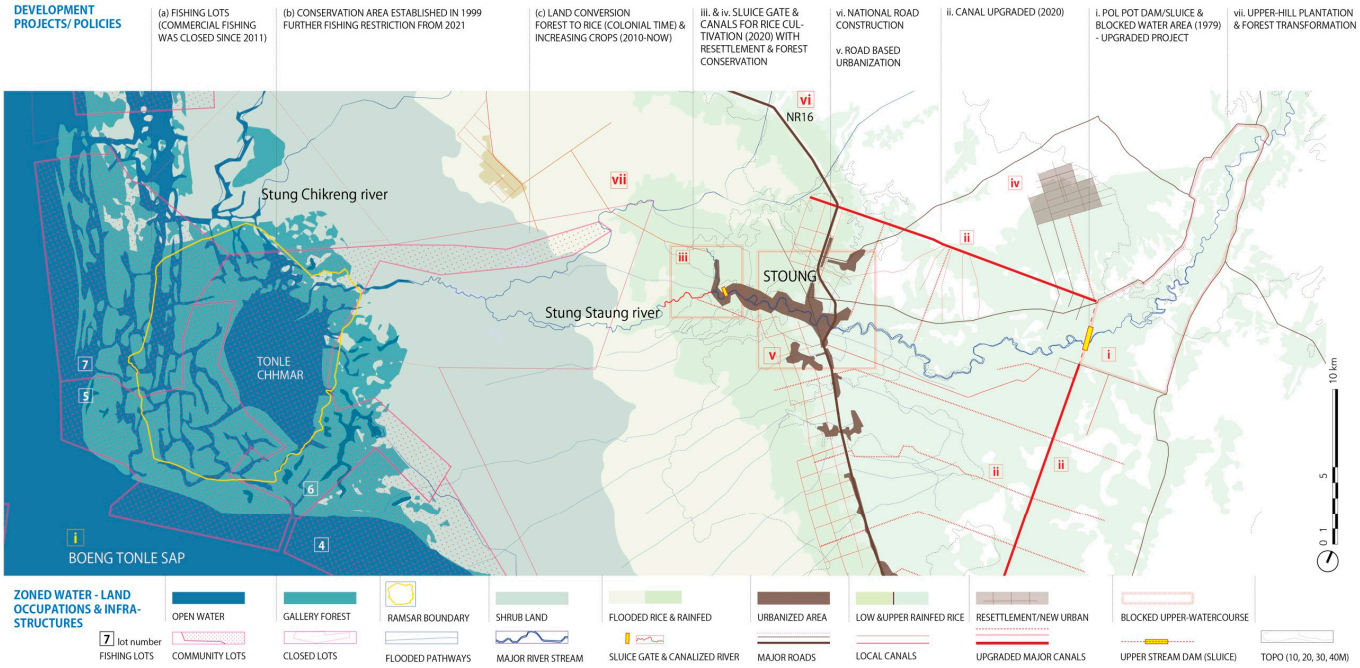


Figure 12. The Boeng Chhmar−Stung Staung River catchment transect (see location indicated on Figure 1). The natural geometries of the lake's nature contrast sharply with the human−made system of infrastructure and agricultural land areas. The transformation adversely effects the forest water regimes, habitats, and local livelihoods of Boeng Chhmar (Linh Vu, 2022 from GIS open source, Google Maps).

6. Ways Forward

Clearly, there are a series of paradoxes between indigenous practices and modern development. At the same time, there are numerous lessons to be learned from the indigenous practices and ways of settling with the landscape. First and foremost, Boeng Chhmar, the inhabited swamp forest, is an incredible case study of the undeniable power (literal and figural) of a dynamic nature of flood−pulse, degrees of wetness, and (vanishing) biodiversity. Traditional ecological knowledge survives (although significantly marginalized) in the five floating villages—revealing a coexistence of settlement and daily practices which is largely in−sink with the rhythms of nature. There is a strong relation of cosmology and rituals to practices of survival and a subsistence economy.

The reading of Boeng Chhmar as a water and forest garden, seasonally reconstructed by monsoons and its flood pulse, underscores the conscious necessity of the design of

spaces, strategies, and practices for living with nature. The progressive buildup of 'high modernist' [6] projects disturbed the intimate relationship that inhabitants had with the (Figure 13). Yet, despite continued marginalization and the strong hand of an authoritarian State, daily material culture and practices thrive.

Figure 13. Land conversion and irrigation projects in the Stung Staung River. Major projects impact Boeng Chhmar's hydro−ecological condition, inhabited forest and local livelihoods: (**i**) land conversion of forest to rice field and reforestation; (**ii**) part of the Asian Development Bank's (ABD) irrigation upgrading project; and (**iii**) a flood gate and canalized river project in Pralay commune (Linh Vu, April 2022).

The traditional subsidence system exists in parallel (or in spite of) strong impositions of control and (over)exploitation from above regarding 'development.' The traditional subsistence system allows a freedom of movement and conscious choice of practices, carefully calibrated in relation to the interaction of all natural forces and species (human and non−human). Conversely, policies, program and projects of the State undermines the long legacy of such ways of settling and severely compromises the ability of traditional ecological knowledge to continue as a process of adaptation. Yet, the modern system often fails to totally control nature. There continues to be forms of resistance. Practices of survival, of subsistence thrive in the margins and neglected areas of State purview. Villagers continue to live with the water−forest, in their daily routines, according to seasonal rhythms, and with a deep respect for nature [27].

There is clearly a need of a paradigm shift, where settling with/in Inhabited flooded forest is re−valued and explicitly pursued. There are lessons that can be drawn from the past for a more balanced way living in today's Boeng Chhmar, and indeed in other vulnerable flooded forests. Firstly, flooded forest−settlement linkages can be strengthened with a renewed understanding of and respect for the rhythms of flooding and the varying carrying capacities of specific areas of the wetness gradients. Secondly, the entire notion of subsistence fishing/farming/hunting and gathering can be understood not as a set of 'backward' practices, but instead as feasible alternatives to the overwhelming and socio−culturally and ecologically destructive processes of imposed economies, norms, and standards.

Author Contributions: Conceptualization, V.T.P.L., K.S. and B.D.M.; methodology, V.T.P.L., K.S. and B.D.M.; investigation, V.T.P.L.; writing—original draft preparation, V.T.P.L.; writing—review and editing, K.S. and B.D.M.; visualization, V.T.P.L.; supervision, K.S. and B.D.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received internal funding from the KU Leuven Department of Architecture from 12/2019—present.

Informed Consent Statement: Informed consent was obtained from all subjects in the study.

Conflicts of Interest: The authors declare no conflict of interest.

Notes

1 Observation and conversation, during April and October-November fieldwork 2022, on EU funding projects which have been carrying out in Boeng Chhmar. The projects have been implemented by the International Union for Conservation of Nature (IUCN) and the Fisheries Action Coalition Team (FACT) in 2013–2016, and continued with the World Conservation Strategy (WCS) in 2021–2024.

2 Observation and conversation, during April and October-November fieldwork 2022, on EU funding projects which have been carrying out in Boeng Chhmar. The projects have been implemented by the International Union for Conservation of Nature (IUCN) and the Fisheries Action Coalition Team (FACT) in 2013–2016, and continued with the World Conservation Strategy (WCS) in 2021–2024.

3 Information gathered from the fieldwork in April and October-November 2022.

4 Many folktales recounted by Khmer monks reflect a deep Khmer kinship with the forest. As well, David Chandler and his students highlight two forms of the forest as refuge. Firstly, a retreat to the forest as form of rejection (or response to mistreatment) in the 'civilized world' and secondly, a conscious choice for disappearance into the fores to achieve by Buddhist enlightenment. For a Southeast Asian and Chinese synthesis, see James C. Scott.

5 See the discourse as developed by Penny Edwards, David Chalder and Alain Forest; for more on ritual terminologies see Darryl Collins and Hok Sokol.

6 See the discourse as developed by Penny Edwards, David Chalder and Alain Forest; for more on ritual terminologies see Darryl Collins and Hok Sokol.

References

1. *Tonle Sap Information Guide*; The Ministry of Environment (MoE) and Live & Learn Environmental Education: Cambodia, 2007; pp. 83–85. Available online: https://angkordatabase.asia/libs/docs/TonleSap_NEEAC_infoguide_eng.pdf (accessed on 14 October 2022).
2. RSIS.RAMSAR. Information Sheet on Ramsar Wetlands (RIS) for Boeng Chhmar Ramsar. The Convention on Wetlands. 1999. Available online: https://rsis.ramsar.org/RISapp/files/RISrep/KH997RIS.pdf (accessed on 14 October 2022).
3. Meynell, P.J.; Kong, K.; Sorn, P.; Lou, V. *Climate Change Vulnerability Assessment for Boeung Chhmar*; IUCN: Bangkok, Thailand, 2019; Available online: https://www.iucn.org/sites/default/files/2022-07/climate_change_vulnerability_assessment_boueng_chhmar_ramsar_site_cambodia.pdf (accessed on 15 October 2022).
4. Campbell, I.C.; Poole, C.; Giesen, W.; Jorgensen, V.J. Species diversity and ecology of Tonle Sap Great Lake, Cambodia. *Aquat. Sci.* **2006**, *68*, 355–373. [CrossRef]
5. Tsukawaki, S. Lithological features of cored sediments from the northern part of Lake Tonle Sap, Cambodia. In Proceedings of the International Conference on Stratigraphy and Tectonic Evolution of Southeast Asia and the South Pacific, Bangkok, Thailand, 19–24 August 1997; Available online: http://mekong.ge.kanazawa-u.ac.jp/Paper/PDFfiles/Tsukawaki97.pdf (accessed on 15 October 2022).
6. Scott, J.C. The golden age of the barbarians. In *Against the Grain: A Deep History of the Earliest States*; Yale University Press: New Haven, CT, USA, 2017; pp. 219–256. [CrossRef]
7. Scott, J.C. *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*; Yale University Press: New Haven, CT, USA, 1998; Available online: http://www.jstor.org/stable/j.ctt1nq3vk (accessed on 15 October 2022).
8. Phasuk, S.; Stott, P. *Royal Siamese Maps: War and Trade in Nineteenth Century Thailand*; River Books: Bangkok, Thailand, 2006.
9. Brenier, H.; French Indochina. *Essai d'Atlas statistique de l'Indochine française. Indochine physique—Population—Administration—Finances—Agriculture—Commerce—Industrie*; Impr. d'Extreême-Orient: Hanoi—Haiphong, Vietnam, 1914; p. 25. Available online: https://archive.org/details/sc_0000867365_00000000679696/page/n23/mode/2up (accessed on 3 November 2022).
10. Carte de L'indochine au 1:2.000.000. Carte Ethnolinguistique. Available online: https://gallica.bnf.fr/ark:/12148/btv1b53197047g (accessed on 3 November 2022).
11. Carte de L'etude Chevey Le Poulain, 1940, Conserve a L'institut Geographique National, p.264, in M Guérin (2019) Habituation à Diriger des recherches. Dossier de synthèse. École des Hautes Études en Sciences Sociales. Available online: https://hal.archives-ouvertes.fr/tel-02427730/document (accessed on 3 November 2022).
12. JICA. Profile on Environmental and Social Considerations in Cambodia. 2013, pp. 204–218. Available online: https://openjicareport.jica.go.jp/pdf/12144754.pdf (accessed on 16 November 2022).
13. Seak, S. The Typical Intervention Systems of Natural Resource Management in Tonle Sap Lake, Cambodia: The Community Based and Modern Approaches. *GSID Discuss. Pap.* **2012**, 1–36. Available online: https://agris.fao.org/agris-search/search.do?recordID=AV20120101633 (accessed on 3 November 2022).
14. Lamberts, D. Tonle Sap Fisheries: A Case Study on Floodplain Gillnet Fisheries in Siem Reap, Cambodia. 2001. Available online: http://www.fao.org/3/ab561e/ab561e07.htm (accessed on 3 November 2022).
15. Dara, V. No more large-scale illegal fishing taking place at Tonle Sap Lake: Fisheries head. *The Phnom Penh Post*. 2022. Available online: https://www.phnompenhpost.com/national/no-more-large-scale-illegal-fishing-taking-place-tonle-sap-lake-fisheries-head (accessed on 16 November 2022).
16. Flynn, G.; Srey, V. Fisheries crackdown pushes Cambodians to the brink on Tonle Sap Lake, 26 August 2022. *Mongabay, conservation news and environmental science platform*. 2022. Available online: https://news.mongabay.com/2022/08/fisheries-crackdown-pushes-cambodians-to-the-brink-on-tonle-sap-lake/ (accessed on 16 November 2022).
17. Khan, S. Fishers Leave Crisis-Hit Tonle Sap Lake in Search of Livelihoods Ashore. *VOA Cambodia*. 2022. Available online: https://www.voacambodia.com/a/fishers-leave-crisis-hit-tonle-sap-lake-in-search-of-livelihoods-ashore/6695988.html (accessed on 16 November 2022).
18. Edwards, P. Between a song and a prei: Tracking Cambodian history and cosmology through the forest. In *At the Edge of the Forest: Essays on Cambodia, History, and Narrative in Honor of David Chandler*; Hansen, A.R., Ledgerwood, J., Eds.; Cornell University Press: Ithaca, NY, USA, 2008; pp. 137–162. [CrossRef]
19. Forest, A. *Le Culte Des Genies Protecteurs Au Cambodge. Analyse Et Traduction D'un Corpus De Textes Sur Les Neak Ta*; L'Harmattan: Paris, France, 1992; p. 15.
20. Collins, D.; Hok, S. *Cambodian Wooden Houses: 1500 Years of Khmer Heritage*; Sipar: Phnom Penh, Cambodia, 2021.
21. The General Population Census of Cambodia 2019 (GPCC 2019); Issued by National Institute of Statistics, the Ministry of Planning of Cambodia. Available online: https://www.nis.gov.kh/nis/Census2019/Final%20General%20Population%20Census%202019$-$English.pdf (accessed on 15 October 2022).
22. Loeung, D.; Degen, P.; van Zalinge, N. *Fishing Gears of the Cambodian Mekong*; Mekong River Commission: Department of Fisheries; DANIDA: Phnom Penh, Cambodia, 2003; Available online: https://www.mrcmekong.org/assets/Publications/Fishing-Gears-of-the-Cambodian-Mekong-_webpage.pdf (accessed on 14 October 2022).
23. Scott, J.C. Landscaping the World: The Domus Complex. In *Against the Grain: A Deep History of the Earliest States*; Yale University Press: New Haven, CT, USA, 2017; pp. 68–92. [CrossRef]

24. Gadgil, M.; Berkes, F.; Folke, C. Indigenous Knowledge for Biodiversity Conservation. *Ambio* **1993**, *22*, 151–156. Available online: http://www.jstor.org/stable/4314060 (accessed on 6 November 2022).
25. Scott, J.C. Subsistence Security in Peasant Choice and Values. In *The Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia*; Yale University Press: New Haven, CT, USA; Yale University Press: London, UK, 1976; pp. 35–55. Available online: http://www.jstor.org/stable/j.ctt1bh4cdk.6 (accessed on 15 October 2022).
26. Scott, J.C. The Economics and Sociology of the Subsistence Ethic. In *The Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia*; Yale University Press: New Haven, CT, USA, 1976; pp. 13–34. Available online: http://www.jstor.org/stable/j.ctt1bh4cdk.5 (accessed on 15 October 2022).
27. Bicker, A.; Ellen, R.; Parkes, P. (Eds.) *Indigenous Environmental Knowledge and its Transformations: Critical Anthropological Perspectives*, 1st ed.; Routledge: London, UK, 2000. [CrossRef]
28. Roshko, T. The Floating Dwellings of Chong Kneas, Cambodia. *Build. Landsc. J. Vernac. Archit. Forum* **2011**, *18*, 43–59. [CrossRef]
29. Waterson, R. *The Living House: An Anthropology of Architecture in South−East Asia*; Oxford University Press: New York, NY, USA, 1990.
30. The World Bank. Cambodia Economic Update: Living with COVID—Special Focus: The Impact of the COVID−19 Pandemic on Learning and Earning in Cambodia. 2021. Available online: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099350012062137172/p1773400f35a770af0b4fa0781dffcd517e (accessed on 15 October 2022).
31. Open Development Cambodia: Reassessing China's Investment Footprint. Available online: https://data.opendevelopmentmekong.net/vi/library_record/briefing-paper-on-reassessing-china-s-investment-footprint-in-cambodia (accessed on 15 October 2022).
32. Hammer, P. Development as tragedy: The Asian Development Bank and indigenous people in Cambodia. In *Living on the Margins: Minorities and Borderlines in Cambodia and Southeast Asia*; SSRN Electronic Journal, Hammer, P., Eds.; Center for Khmer Studies: Krong Siem Reap, Cambodia, 2009. [CrossRef]
33. Sithirith, M. *Political Geography of the Tonle Sap: Power, Space and Resources*; Lambert Academic Publishing: Germany, 2012.
34. Andrew Cock. Chapter 4: Cambodia's timber boom and external pressures for reform. In *Governing Cambodia's Forests: The International Politics of Policy Reform*; Nias Press: Copenhagen, Denmark, 2016.
35. Poole, C.F.; Briggs, E. *Tonle Sap: The Heart of Cambodia's Natural Jeritage*; River Books: Bangkok, Thailand, 2005.
36. Evans, P.; Marschke, M.; Paudyal, K. *Flooded Forests, Fish, and Fishing Villages in Tonle Sap, Cambodia*; Asia Forest Network: Bohol, Philippines, 2004. [CrossRef]
37. Mimi, E.L. The Ethics and Sustainability of Capture Fisheries and Aquaculture. *J. Agric. Environ. Ethics* **2016**, *29*, 35–65. [CrossRef]
38. Jones, R.; Suk, S. Impacts and Implications of Deep Fisheries Reforms on the Governability of Small−Scale Fisheries in Tonle Sap Lake, Cambodia. In *Interactive Governance for Small−Scale Fisheries, Global Reflections*; Jen, T.S., Chuenpagdee, R., Eds.; Springer: Cham, Switzerland, 2015; Available online: https://link.springer.com/chapter/10.1007/978-3-319-17034-3_28 (accessed on 15 October 2022).