

Chapter 9

Designing Mega Delta Interactions

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Abstract Indian and Chinese urbanization is rich with possibility for global urban design theory and practice because the village city systems in India and China offer a reevaluation of what we consider a city to be and how design is to be engaged within it. The mix of urban and rural has very different definitions in India and China, which again are different than those in the United States and Europe. This chapter, which is paired with a drawing set, is a study of this urban form in order to support better India–China interactions and to question the reproduction of unsustainable heterogeneous mixes globally. In the context of the rapid urban transition of today it is important to imagine ways that an inclusive, but not totalizing, regional outlook can support action against environmental unsustainability. This chapter is a contribution toward this goal.

Keywords Ganges-Brahmaputra-Meghna Mega Delta • Bhagrathi-Hooghly River • Delta interactions • Ecological Urban Design • Metamosaic approach • Yangtze-Qiantang Mega Delta • Patch dynamics

9.1 Introduction

This chapter is a design project and a situated study of urban forms in transition. It is located in wet landscape village city systems in Asia, and these are visualized in the same way that urban ecologists approach urban ecosystems. Seeing ecologically is a spatiality that takes into account urban heterogeneity, which is the messy mix of urban elements that make up our city systems, and environmental subject formation, which is the way people understand themselves and their agency within this shifting mix over time. In addition, the visual ecologies presented in this chapter are designed politically. What this means is there is a participatory focus and the

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drawing methods engage visual tools that are familiar, qualitative, and easily assembled in a chaotic urbanizing context.

Geographer T. G. McGee argued in 1971 that there is a unique blend of urban and rural in the village city systems specific to Asia he named *desakota*, based on Jakarta in Indonesia (McGee 1971). Desakota was an attempt to explain the growth of non-agricultural activities in the space between urban and rural regions of many of Asia's largest cities. Today, it is considered a part of a larger discussion on urban transitions, and it is used as an example of why a linear and inevitable transition model is flawed as a model to investigate urbanism (McGee 2009). As described by McGee, traditional urban transition characteristics were the modernization transition from traditional to modern societies, the demographic transition from low growth to high growth to low growth societies, the urban transition from low to highly urbanized societies, the environmental transition, and the transportation and information transition. McGee's observation was that the pace is occurring at a much faster rate than that of earlier transitions, and transitions are now overlapping or "telescoping" (Marcotullio and Lee 2003). In addition, and most importantly for today, the urban transition is being driven in new ways. In his words, "interaction and linkage is a more accurate reflection of reality than the idea that rural and urban are undergoing somehow spatially separated transitions" (McGee 2009: 6). This chapter takes account of the nonlinear spatial effects of these interactions and linkages in order to create means for imagining more equitable futures in mega deltas.

Ecologists Steward Pickett and Mary Cadenasso and urban designers Brian McGrath and Grahame Shane have focused on city modeling in similarly nonlinear and nuanced ways. They engage a nested mosaic framework that they entitle a metacity approach for modeling urbanization and shaping change (Pickett et al. 2013; also see Shane 2011, 2016; McGrath and Pickett 2011, 2016; McGrath and Shane 2012). Pickett, Cadenasso, and McGrath describe three types of urban mosaics: process mosaic, choice mosaic, and outcome mosaic; together these constitute the urban metamosaic. They state that "The metacity is a scale-independent concept that can be placed in a nested hierarchy of mosaics like a moving window of observation," and continue "These mosaics, like the metapopulations and metacommunities of ecological science, are thus systems of systems" (Pickett et al. 2013: 477). To date the metamosaic conceptual tools have been explored using a patch dynamic approach for the Gwynns Falls Watershed in Baltimore, USA (Grove et al. 2015). This chapter elaborates the patch dynamic approach in urbanizing wet landscape contexts in Asia, with an experimental participatory lens, and a focus on drawing as a practice for understanding and shaping subjective environmental knowledge and design.

The research presented in this chapter is directed toward an assumption that better situated ecological understanding must be created for politics—to support emerging open society and global civil society (see Chaturvedi, Chap. 8 in this book) and the new Asian city. McGee explains that "the inner city, urban periphery, and urban rural mix are seeing a trend toward increased land conversion practices and auto-centered transportation systems all ordered by shifting networks of linkages, as described above. Each is a zone of contact between macro processes and

micro processes, a place of decisional congestion, environmental conflict, landuse conflict, and social tension” (McGee et al. 2007: 214). Patches are, therefore, sorted in this chapter to illustrate changes in urban form and public space encountered during extensive and repeated fieldwork by the author from 2010 to 2013. In this case, fieldwork is not only a practice of ground-truthing satellite imagery. It is also a practice of querying a patch mosaic in order to redraw it and reveal meaningful emerging patterns. Although peri-urbanization in Asian deltas functions within scales other than the hyper-local, it is the repetition of elements, effects, and exchanges that form patterns of complex mosaics and when compounded have ecological effects of regional reach. These changes are not smooth; they are actually patchy and this phenomenon is poorly researched.

In addition to the metacity, urban designers Brian McGrath and Grahame Shane theorized two other city models as meaningful terms for urban theory and design practice, particularly architecture: the metropolis and the twinned megalopolis and megacity (McGrath and Shane 2012). They note that a proliferation of definitions and meanings of the terms city, metropolis, and territory has emerged in the last 30 years. They explain that there has been competition between normative models each with its own formal order, metabolism, and role for architects in the shaping, imagining, representing, and modeling of the city. Rather than claiming that one city is a megacity and another is a megalopolis, they state that all models “currently coexist and interact in the contemporary urban landscape but rarely in the designer’s imagination, as they become distinct territories of both theory and practice” (McGrath and Shane 2012: 642). Therefore, they offer these co-present city models in an urgent conciliatory manner, as a shared organizing system for critical reflection and collaboration between architects and urban designers, while acknowledging the limits of such a task.

Geographer Jennifer Robinson in her survey of the comparative gesture in urban theorizing imagines a mode of learning where a more interconnected field of research could draw both inspiration and method from the cities that form its objects of study (Robinson 2011). She explains further.

“Their interconnectedness might inform our eagerness to proliferate conversations across scholarships embedded in different urban contexts at the same time as it directs us to new units of comparison. Their diversity and multiplicity might inspire us to be quick to unsettle parochially derived theoretical certainties through engagement with different cities even as we embrace more nuanced forms of explanation and method appropriate to the complexity of cities. An urban theory on a world scale could, then, potentially draw more cities into shared fields of analysis, and be characterized by multiple, frequently unsettled and hopefully unsettling conversations about the nature and the futures of cities in the world. This style of theorizing would be neither a parochial universalism nor a uniform global analytical field but a rich and fragmented array of ongoing conversations across the world of cities” (Robinson 2011: 19)

Comparison is engaged in this chapter as paired research in order to test a framework and its applicability beyond the American Northeast. Cities in this chapter are not viewed as complex wholes, but rather, learning from McGrath and Shane, atten-

tion is given to the special mix of city models that have informed their development over time. Unlike McGrath and Shane, this chapter engages paired research beyond conciliation. Learning from Robinson, paired research is engaged in such a way to disambiguate situated unsustainable heterogeneous mixes in order to open a dialog between people in two mega deltas and to further open up critical urban theory and practice.

Mega Delta is a generic term given to the very large Asian river deltas: the Yellow (Huang He), Yangtze (Chang Jiang), Pearl, Red, Mekong, Chao Phraya, Irrawaddy, Ganges-Brahmaputra, and Indus. The Asia-Pacific Network for Global Change developed this term in 2004 as a shared concept toward establishing capacity building networks amongst fluvial and coastal specialists of the Asia Pacific regions (Chen 2004). Inspired by this convivial capacity building goal as well as an understanding that the largest Asian cities continue to grow fastest, particularly coastal cities, many of which are located in these fertile river deltas (UN 2011), this research, therefore, aims to increase awareness of Indian and Chinese peri-urban systems. The case study areas are east Kolkata in the Ganges-Brahmaputra-Meghna Mega Delta and east Shaoxing in the Yangtze-Qiantang Mega Delta. In addition to earth scientists, all mega delta residents are included here as fluvial and coastal specialists.

This chapter comprises four sections that are introduction, visual ecology, paired research, and conclusion. Visual ecology explains the methods used to address the research question: how might cocreated models of patch dynamics address environmental unsustainability in peri-urban wet landscape environments in India and China? First, metamosaic theory is described as an innovation in the context of the field of ecology. Then, patch dynamics is explained through the making of a paired inter-referenced drawing set. There is an emphasis on describing ecological concepts, drawing tools, and the design decisions made in constructing the drawings. This is so that readers, who may not consider themselves visually inclined, may understand the compositions more fully. Paired research is the case study section and is, therefore, the illustration and narration part of the design project. It includes an India case study and a China case study as well as a reflection that further clarifies how the inter-referenced drawing set is a project for the public realm. The chapter concludes by resituating peri-urban patch dynamics within mega delta village city systems, the subject of what constitutes a city, and how design is to be engaged within it.

9.2 Visual Ecology

In 1985, ecologists Steward Pickett and Peter White noted that “ecologists have always been aware of the importance of natural dynamics in ecosystems, but historically, the focus has been on successional development of equilibrium communities” (Pickett and White 1985: pxiii). They continue, “While this approach has generated appreciable understanding of the composition and functioning of

ecosystems, recently many ... have turned their attention to processes of disturbance themselves and to the evolutionary significance of such events.” This shift in interest has since inspired studies of diverse systems, including cities, a relatively new site for ecology research. Pickett and White use the term patch dynamics to describe the common focus of the disturbance-related phenomena, to stimulate the generation of explicit hypothesis and theory, and to identify areas of future research. This shift in interest is also explained as a shift from equilibrium ecology to disturbance ecology and it was an important development in the history of ecological thought.

Today, patch dynamics is explored as a shared conceptual tool between urban ecologists and urban designers at the Baltimore Ecosystem Study (Cadenasso et al. 2013; Cadenasso 2013; McGrath et al. 2007). The BES is a long-term ecological research project funded by the United States National Science Foundation, and the author is a member of this research team (BES 2015). A patch may be considered a shape that is fixed; however, the concept of a patch in this case is relational. It describes a set of patches or a mosaic that changes over time. “Patch implies a relatively discrete spatial pattern, but it does not establish any constraint on patch size, internal homogeneity, or discreteness; patch implies a relationship of one patch to another in space and to the surrounding, unaffected or less affected matrix; patch dynamics emphasizes patch change” (Pickett and White 1985: 4). Patch dynamics was created because existing ecological frameworks were inadequate for understanding the heterogeneity of urban systems.

The disturbance ecology approach changed many shared scientific understandings between ecologists. In 2007, Pickett and Cadenasso summarized the new set of background assumptions (Pickett and Cadenasso 2007). These are: ecological systems can be open to material exchange with other systems; factors from outside a specified system can regulate system behavior; there may not be a single stable equilibrium point for system composition or behavior; disturbance can be part of the dynamics of a system; succession or response to disturbance can be highly unpredictable or probabilistic; and humans, including their institutions and behaviors, can be parts of ecological systems. They then posed a question: how can urban designs be models of patch dynamics? In this chapter the relation between design and ecological models is arranged differently. Here, the question is framed as follows: how might models of patch dynamics be critically co-created by residents, urban designers, and ecologists?

Rather than a linear urban to rural transect, village city systems intensify and age in patchy and complex spatial patterns with urban forms and ecosystem processes, degrading, densifying, or diversifying in similarly fragmented ways. This chapter features a set of digital drawings that illustrate this fragmentation as patch dynamics. The drawings are made by hand and are sorted to reveal heterogeneous mixes of land cover and that change over time in both shape and content. They are made of layers and are subjectively edited to reflect observations made during extensive fieldwork in the urban periphery of east Kolkata, India and east Shaoxing, China—areas that were selected for their heterogeneity, visible evidence of urban change in the past 10 years, and the availability of quality aerial imagery (Marshall 2013).

The six drawings titled *Patch* that are featured in the case study section are a time series. Aerial imagery from Kolkata and Shaoxing created in 2002, 2007, and 2011 are arranged side by side. Patch boundaries were drawn on each aerial image so that patch change might be studied. In order to see change, white space is used as a visual element. Any patch boundary color might be used; however, white is useful in this case as it creates a strong contrast with the blue, green, brown, and black that dominates aerial imagery in these mega deltas. When certain types of patches are turned off, they become masked by the white space and emerge as figures and form the subject of the image. When each edited aerial image is viewed in relation to the next a dynamic pattern is revealed. For example, patches disappear, new ones emerge, some change shape, and some change content.

Two patterns are explored in the paired research case study section and are introduced here as fine grain and coarse grain patterns. Fine grain is a term that references small buildings or small areas of vegetation such as yards, and coarse grain is a term that references big buildings or big areas of vegetation such as fields. Both patterns also include patches dominated by water bodies such as ponds, canals, and important roads. The fine grain and coarse grain patterns are arranged in ascending and then descending temporal order. In other words, the images are sorted as follows: fine grain 2002, 2005, 2011, and then coarse grain 2011, 2005, 2002. Selecting, tracing, sorting and arranging patches like this is a nuanced method for viewing regionally. In this case grain has been chosen because it is an earthy term that can be understood historically in these rice-growing regions, as well as formally, because different granularity of urban forms shape environmental effects and social relations. In addition, the ascending and descending register is also intended to productively unsettle familiar categories. Like the tide or monsoon, and unlike a linear rural to urban transition or a growth obsession, the ascending and descending register is a nonlinear spatiality.

Drawing is a way of thinking visually. The experience and practice of drawing is an act of finding a balance between visual and conceptual intrigue surrounding a particular question, issue, or observation. It is “halfway between intellectual understanding and sensual experience” (Garner 2008). It does matter what tool is being used, as this informs the designers body sensations and imagination; however, this is not the defining factor. For example, a tool might be a pencil and a paper sketchpad. The drawings titled *Scroll* that are also featured in the case study section were created with the following tools: camera, GPS device, mouse, computer, software, web sites, and an Internet connection. Similar to the patch drawings described above, the scroll drawings were made with layers and employ, color, line, scale, pattern, balance, indexing, and depth. Design decisions were made at various stages in creating and assembling the drawing parts, and these are explained below however, it is important to explain more about ecosystem boundaries first.

Ecosystem scientists practice by asking research questions about a place. In order to do this, they often use ecosystem boundaries to define the scope of their research (Cadenasso et al. 2003). In other words, an ecosystem boundary is created at the same time as a research question is formed. In this sense, ecosystem boundaries are

question specific and not preexisting conditions. For example, a boundary could be small or big, depending on the question. This type of positionality, where a boundary is formed by a question, is different than other types of boundaries such as property boundaries, or neighborhood and social boundaries. In the scroll drawings, ecological positionality is emphasized. Every photomontage in a scroll drawing is a scene, which informs the boundary that surrounds it. Scene in this sense is a moment in place. Increasingly, ecosystem scientists are asking research questions *with*, not *of* communities (Chapin et al. 2011). Therefore, these drawings aim to provide a visual explanation of how ecological research practice might be introduced and communicated to other scientists, residents, designers, artists, organizers, officials, etc. The patch and scroll drawings visualize non-equilibrium ecological spatiality within a socially engaged urban design drawing system.

Along the top of each scroll drawing are three patches, along the bottom are three scenes that are each bound by a square frame. The design process of selecting what frame matches what scene is a decision based on information because the frame is also an image that has a meaning; it represents an ecosystem boundary. The patches at the top are the location there the scene below was encountered during field-work. The scroll drawings are therefore, also maps and they bring forth questions: What scene would you create? What frame would you select? Who would you share this with? Why? What sort of discussion, negotiation, and actions might emerge? How might environmental unsustainability be engaged here? The scenes are arranged in six sets of three images and roughly correlate with the patch drawings as follows: scenes from fine grain patterns are highlighted first, and then scenes from coarse grain patterns, in India and then in China. Each is given a title that is a shared quality or a location, such as ‘persistence’ or the ‘big pond’, for example. A compositional decision was made to align the three scenes across the image, rather than aligning the boundaries—this is called visual hierarchy. What this means, in this case, is there is an emphasis in seeing the scenes as a scroll, rather than a set of ecosystems adjacent to each other all lined up in a neat row. The horizontal movement between the scenes is privileged, inviting a type of visual back and forth journey for the viewer within the periphery of Kolkata and then Suzhou.

9.3 Paired Research

This section presents a paired research application of the metamosaic approach. The Ganga Brahmaputra-Meghna Mega Delta and Yangtze-Qiantang Mega Delta are situated historically, and peri-urban Kolkata and Suzhou are explained and visualized in detail. Six patch dynamics drawings (Figs. 9.1, 9.2, 9.3, 9.4, 9.5, and 9.6), six scroll drawings, and two metamosaic drawings are illustrated and explained with detailed captions. In particular, the train networks in each region are emphasized because they are an immediate and familiar reference.

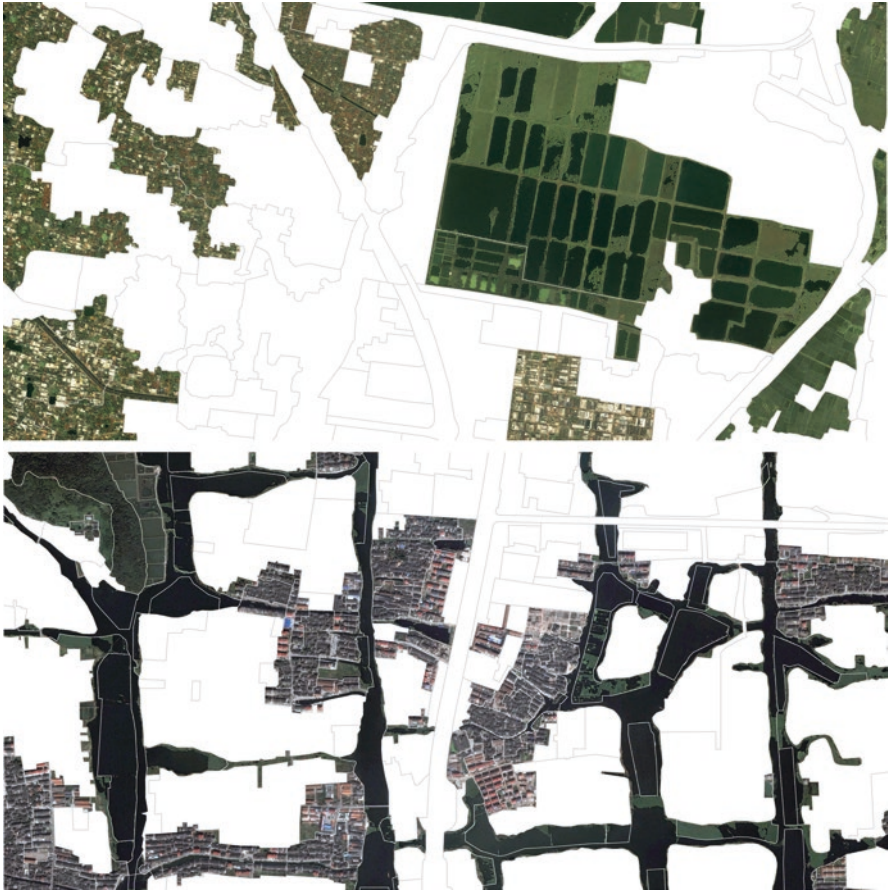


Fig. 9.1 Patch Dynamics 2002. *Top*: India fine grain: This is the first in a sequence of three images that illustrate an increase in density and number of housing and mixed-use patches in relation to a nearby very large pond system that is decreasing in size; *Bottom*: China fine grain: This is the first in a sequence of three images that illustrate a decrease in village patches in relation to the removal of fish farms in a canal waterway network

The train network of West Bengal has a form that radiates unevenly from Kolkata, and therefore serves as a useful introduction to the Ganga-Brahmaputra-Meghna Mega Delta. On both sides of the Bhagrathi-Hooghly River train tracks run close to the shore, reflecting its long history as a port for trade such as Falta, Calcutta (Sutanuti, Kalikata, Gobindapur), Serampore, Chandernagar, Chinsurah, Hooghly, and Cossimbazar (Schwartzberg 1992). To the east the absence of train tracks reveals the wetness of the many lobes of the mega delta, and therefore it is a long northerly journey that connects Kolkata to Dhaka—the two city centers of the mega delta. In addition, there are no easterly train lines beyond Canning and Hasnabad, and today the international border with Bangladesh positions these towns as two of

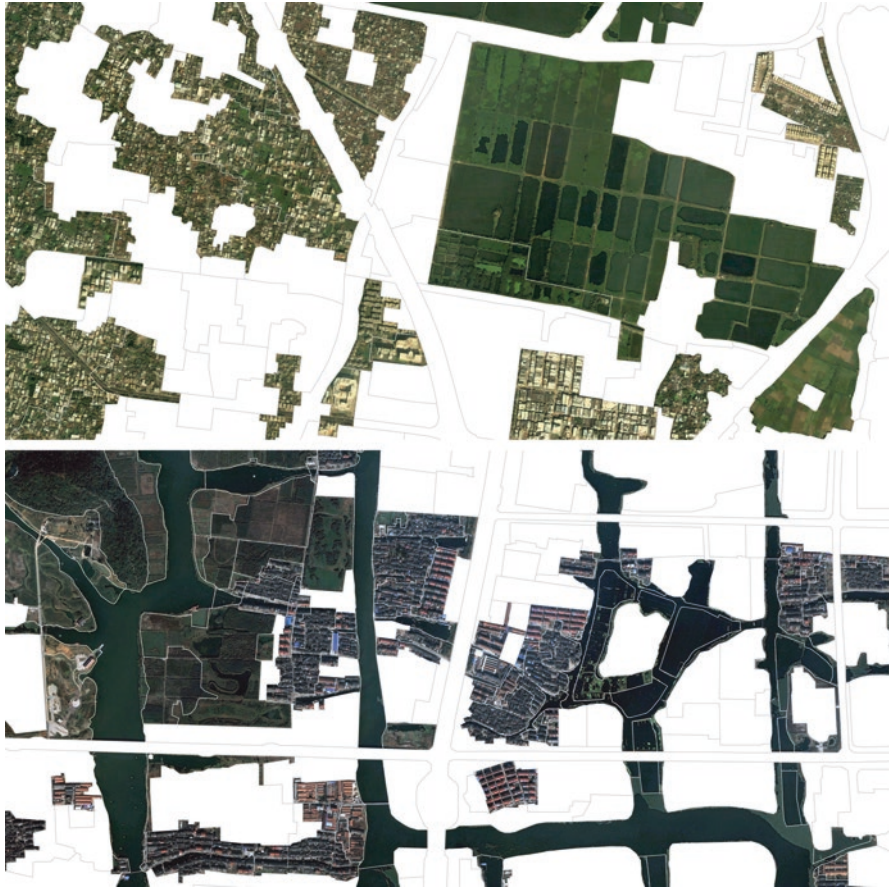


Fig. 9.2 Patch Dynamics 2007. *Top:* India fine grain: In this image, you will see a large ponded area to the right that is also an eco-park. It is adjacent to and outside of the East Kolkata Wetland boundary, which is further toward the east. On the *top right* is a resettlement colony; *Bottom:* China fine grain: In this image, you will see that some canal waterways are now wider and have less fish farms than in 2002. This is because this part of the canal waterway is being transformed into an inland water highway

many in a long north-south porous borderland (yellow line) (Fig. 9.7). In the urban periphery train tracks, roads, and canals in the flat delta are also dikes that are support and delivery corridors, as well as water storage and distribution systems.

To the west and south, and in general, trains orient life in the countryside with urban commuters who return to their rural towns and villages at night. This phenomenon, which is a type of urbanization on the move is also called circulatory urbanism (Srivastava and Echanove 2015). A pressured congestion is tangible in the train carriages that arrive and leave each day with their workforces, as well as in the intense street life in Kolkata. In the inner city, the train tracks form long borders adjacent to dense neighborhoods that become even more congested and multilayered

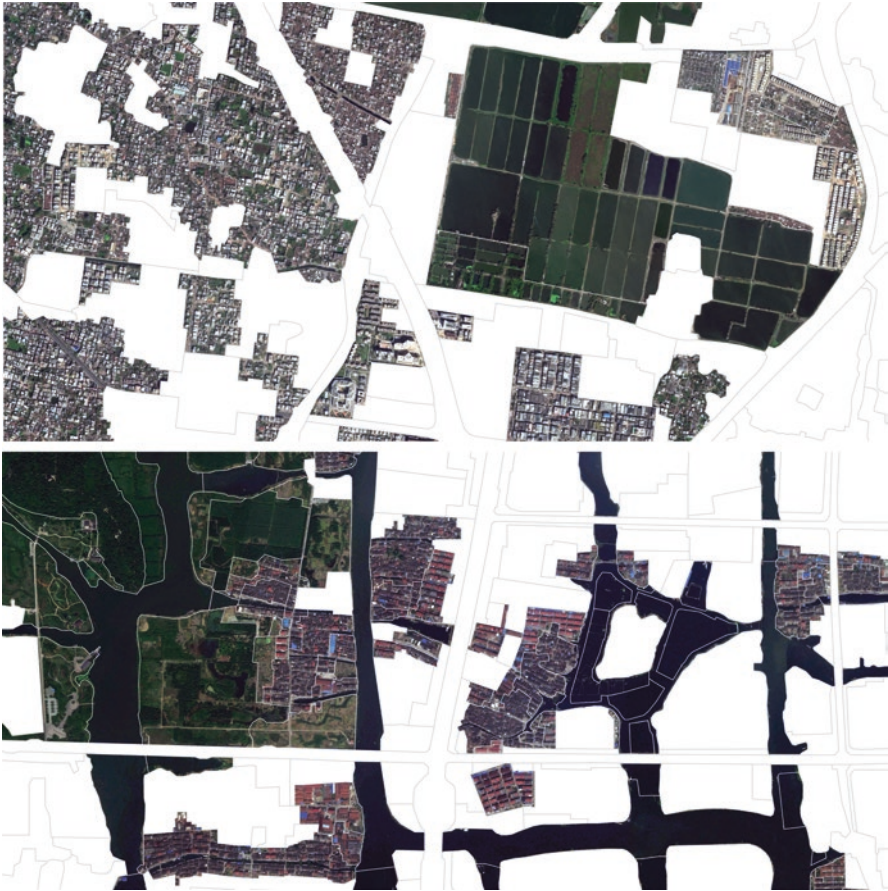


Fig 9.3 Patch Dynamics 2011. *Top*: India fine grain: In this image, you will see that the fine grain housing and mixed-use patches are denser, bigger, and there are more of them; *Bottom*: China fine grain: In this image, you will see that many patches that include villages have been removed. In the *top left* corner, you will see a new eco-park with demonstration wetlands and boardwalks, hiking trails to a viewing pagoda, and reforested paddies

at rail crossings. In the eastern edge of Kolkata, east of the two train lines that branch out from Sealdah Railway Station (toward Barasat to the north and Sonarpur to the south) reveal changes that have occurred in the last two decades are described below as sequential and invisibly sectional.

A newly built wide and straight road, the Eastern Metropolitan Bypass, has fostered the conditions that make it economically viable for landowners to transform ponded, waterlogged, and wetland into dry land. This pattern of transformation is adjacent to and increasingly inside the 125 km² territory designated as the East Kolkata Wetlands - a RAMSAR site. This region was formerly tidal and it was therefore, a salt-tolerant ecosystem and it is imagined in this research project as a

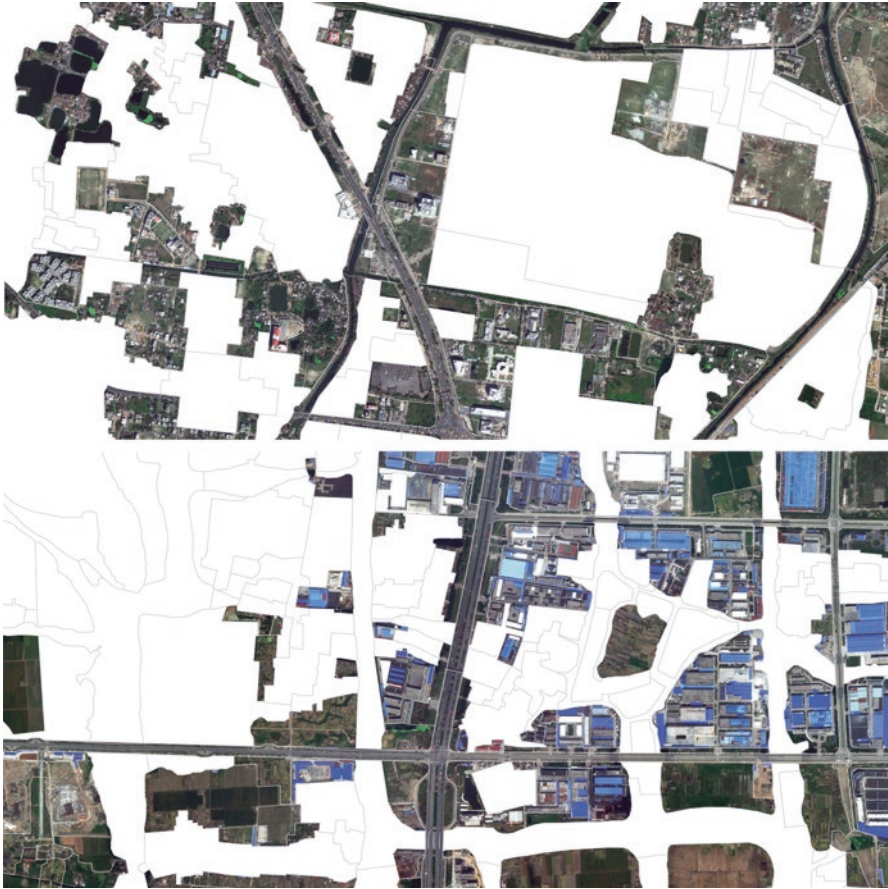


Fig. 9.4 Patch Dynamics 2011. *Top*: India coarse grain: This is the first in a sequence of three images that illustrate the emergence of large land parcel development along the main road in relation to small ponds and long wastewater canals; *Bottom*: China coarse grain: This is the first in a sequence of three images that illustrate the emergence of many new factories that have blue roofs in relation to the construction of a new road network that is laid out as megablocks. According to a recent strategic master plan, this new factory area is soon to be replaced with a residential zone of the nearby new town to the west

type of ocean shore. A new town, information technology zone, new hospitals, five star hotels, fancy schools, shopping malls, big box retail, gated high-rise housing clusters, resettlement districts, government offices, and business headquarters now line the road and are reshaping this former shoreline. Across this mix of coarse grain patches are newer projects such as a flyover, light rail, subway extension, street widening, sewage canal upgrading, and an eco-park. In between are fine grain patches and these are where people who live in old villages, old and new housing colonies, and old and new bustees sleep and work. They renovate their homes floor-by-floor, wall-by-wall, room-by-room, and well-by-well as they become more pros-

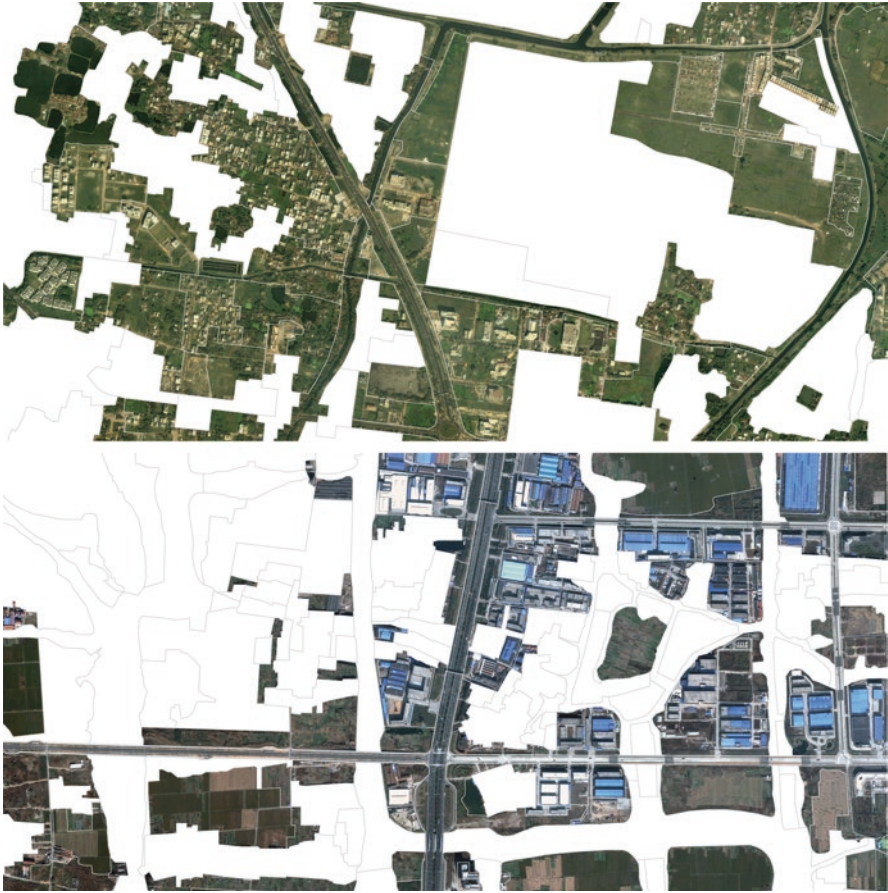


Fig. 9.5 Patch Dynamics 2007. *Top*: India coarse grain: In this image, you will see the wastewater canals that have recently been renovated using funds from the World Bank. The north south main road is the Eastern Metropolitan Bypass (EM Bypass). *Bottom*: China coarse grain: In this image if you look closely, you will see many small peri-farming gardens. Look for areas that have a more mixed green texture than say a monoculture field of crops, weeds, or bare soil

perous, or to make ends meet. The site-by-site, fragment-by-fragment micro changes in these fine grain patches are relational to the coarse changes brought by the Eastern Metropolitan Bypass. Once a short cut to the airport, the eastern edge of Kolkata is now a work, entertainment, recreation, and shopping destination with major traffic, and encroachment issues. Both roadsides are lined with commuters waiting for trucks, buses, taxis, vans, carts, and auto-rickshaws. A view from the road reveals displays of giant billboards selling jewelry, holidays, and apartments. Also for sale are marble products, decorative pots, house plants, and cars. The shoreline is either dusty or muddy and it is always noisy because Kolkata drivers use the horn to communicate all sorts of polite and assertive vehicle maneuvers.



Fig. 9.6 Patch Dynamics 2002. *Top*: India coarse grain: In this image you will see the large areas of open land, dispersed housing colonies, and villages with ponds and lush vegetation. You will notice that the EM Bypass is narrower. Today it is being widened again for an elevated highway and metro. *Bottom*: China coarse grain: In this image you will see the many rice paddies that were under cultivation in 2002 as well as the first factories that are aligned toward the new road, rather than the waterway canals

The Ganga-Brahmaputra-Meghana Mega Delta was settled by clearing the formidable tiger inhabited jungle for farming and trade settlements. Access was via rivers, braided tidal creeks, and much later via the Grand Trunk Road. According to Bengal historian Eaton, around 1666 the Ganges channel to the Portuguese trading station of Satgaon was finally no longer navigable (Eaton 1993). The siltation process was the result of an avulsion, one of many in an ongoing hydrogeological process of the eastward stepping of the lower delta plain of the Ganga-Brahmaputra-Meghana Mega Delta (Allison et al. 2003). Rivers switch channels toward the east here because of the ongoing collision of the Burmese plate overriding the eastern margin of the Indian continent and its adjacent oceanic



Fig. 9.7 Ganga-Brahmaputra-Meghna Village City Region

crust. The Bengal Basin has been subsiding since the Eocene (Kuehl et al. 2005: 414). In everyday terms, the avulsion was explained to the author with some melancholy, like a friend who has gone away and won't be coming back. "The Ganga has gone to Bangladesh." Today, the Farakka Barrage replenishes the water flow in the Bhagrathi-Hooghly River—which continues to be respected as the Ganga. The barrage was built in 1975, and it is a type of dam that also diverts water along many feeder canals.

There are two key physical environments to the Ganga-Brahmaputra-Meghna Mega Delta, the upper delta plain and flood basins (3 m > 15 m) which extends 200 km landward of the second part, the salinity influenced lower delta plain and delta front (<3 m) (Kuehl et al. 2005: 417). Kolkata is just north of the transition between the upper and lower delta plain. Common features of the upper delta plain are meander scars, abandoned channels, oxbow lakes, as well as levees and back swamps in between inter-distributary levees. Common features of the lower tidal plain are tidal creeks, tidal mudflats, distributary levees, and inter-distributary marsh complexes (Bhowmick et al. 2012). Siltation continues to pose a navigation challenge in the Bhagrathi-Hooghly River. A new port at Sagar Island is under

review by the Kolkata Port Trust and the Government of West Bengal. At 100 km south of Kolkata, the new port is much closer to the Bay of Bengal and is adjacent to the Sundarbans National Park. Port funding comes from public–private partnerships and the reallocation of funds for dredging therefore, in future the Bhagrathi-Hooghly River will see more barge traffic. In addition, the grand metropolitan riverfront of Kolkata will transition further into a seasonal spillway and a tidal creek, seeming closer to the shifting shoals and mangrove forests of the lower delta plain.

In Kolkata, there is currently a groundwater deficit and what this means is that groundwater flows toward the inner city from the countryside, and not toward the sea (CGWB 2015). This is because more water is drawn out of the groundwater than flows in naturally. Most of the inner city has been settled above a layer of clay that protects the ground water from contaminations. On the eastern edge of Kolkata, the clay layer is thin and groundwater is hydraulically connected to surface water bodies and is polluted. The heterogeneous peri-urban changes described above are, therefore, invisibly sectional in ways that are important to understand for human health and livelihood sustainability. The drawing titled *Cloud* (Fig. 9.8) illustrates this spatial arrangement. Included are the Eastern Metropolitan Bypass, the East Kolkata Wetland, mega development blocks (yellow zones), ponds (white dots), and canals (pink lines). The groundwater sink is represented as a singular forceful circular shape (grey zone), and all of these elements are layered into an aerial image that includes an ominous monsoon cloud and the Hooghly River (wide white line).

The Beijing-Hangzhou Grand Canal and the Zhedong Canal formed an important trade, transportation, communication, and cultural connector between northern and southern China from the Sui dynasty (518–618 AD) to Qing dynasty (1644–1912 AD). In the Yangtze-Qiantang Mega Delta, it is a useful base upon which to describe how this z-shaped urban region (traditionally called *Jiangnan*) formed hydrogeologically (Fig. 9.9). According to the China historian Yoshinobu Shiba, the canal (pink line) is indicative of a boundary between the old and new delta where the landward side was settled earlier than the ocean side (Shiba 1998: 139). On the landward side of the Beijing-Hangzhou Grand Canal were settlement patterns of hills and fan/slope complexes. On the ocean side were the low-lying plains, sandy elevations, and lowlands. What is important to note is that the present day shoreline is a relatively recent sedimentary geology formation and the result of centuries of human–water interactions such as the construction of dikes, canals, and water gates.

Shiba explains that the earliest village settlers built reservoirs at the heads of alluvial fans and created the fan/slope complex. These reservoirs served to manage seasonal rainwater that rushed off the hills and created a permanent fresh water supply, as water tended to percolate through the loamy soil. The low-lying plains, sandy elevations, and lowlands nearer the ocean, expanded eastward into the sea up to the fourth century at a rate of about 1 km every 40 years, and from the fifth to the twelfth century a pace of 1 km every 27 years (Shiba 1998: 231–232). Environmental historian, Mark Elvin explains that the rapid filling of many deltas in China, including the Yangtze, can be attributed to eroded soil dislodged by upstream deforestation (Elvin 2004: 23). These silty shores formed swampy areas and lagoons that were

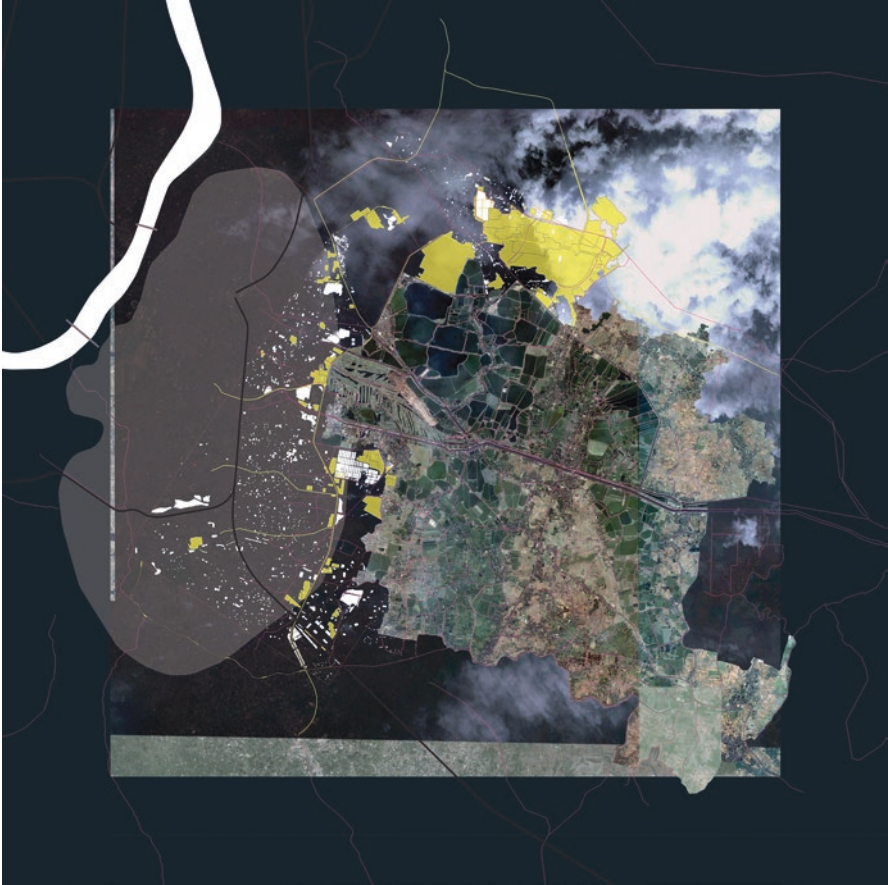


Fig. 9.8 Cloud

protected from ocean tides and currents by river levees and sand bars, and were used for salt production and fishing.

In the eighth to thirteenth century there was a population migration and reclamation intensified the sedimentation process. Earthen sea walls were built to separate fresh from salt water, to harvest land from the sea, and enclosures were made to convert the new delta plains to paddy (Shiba 1998: 231). The “reclamation is what created much of the Jiangnan region ... The site of what is now its greatest city, Shanghai, only emerged from the sea in about the thirteenth century. Jiangnan is thus, in a sense, a ‘Chinese Netherlands’” (Elvin 2004: 24). Shaoxing is a smaller city located in between the larger cities of Hangzhou and Ningbo. Located on the southern shore of Hangzhou Bay, Shaoxing is where the author participated in a competition to design a coastal new town (Haar and Marshall 2012). It is also where



Fig. 9.9 Yangtze-Qiantang Village City Region

the early settlement patterns described above were first created and then expanded elsewhere in the Yangtze-Qiantang Mega Delta (Shiba 1998: 144).

The Nanjing-Hangzhou Passenger Railway was completed in 2013. It bypasses Shanghai and travels directly between Nanjing and Hangzhou along the western edge of Lake Tai. High-speed train tracks in China are elevated where they cross water bodies—and there are many in the mega delta—therefore canals, farm roads, and fields are connected below them. In Shaoxing, there are two fast trains and one is faster than the other. The old fast train enters the northeastern edge of the city adjacent to the old slow train. It is aligned with the wall of an old reservoir that supported the fan/slope complex—described above. The newer faster train is located farther away toward the Bay of Hangzhou. The tracks curve across many former seawalls and shorelines that were once part of the ocean. This is the new delta where land continues to be annexed from the bay even today. Standing at the edge of the shoreline one can see large earth moving equipment and government contractors building new levees, rather than organized group activities of farmers or the military of earlier times.

The area in between the high speed trains and in between the old reservoir and an earlier old seawall is the peri-urban area of focus for Shaoxing in this chapter. In Kolkata, change was described as sequential and invisibly sectional; here, it is simultaneous and visible. In Shaoxing many new towns, economic and technological

development zones linked by new roads are planned, are under construction, and have been built. It seems as if the whole area is in flux all at once. The region is part of the expanding port of Shanghai, and it is also within the gigantic coastal development planning area created by Zhejiang province. Designed and arranged according to the planning protocols of the Chinese government these coarse grain changes are led by multiple 5-year concurrent and coordinated strategic land-use master plans.

Rural factories, water villages, rice wine paddies, and a network of inland canals, creeks, and lakes that once supported a prosperous market town economy with international trade are changing rapidly. When a new town is built, the megablocks are constructed first. Their giant rectilinear measures form a vast open grid within which water villages sometimes persist in the rapidly filling or filled in gaps. The village residents witness change all around them, shifting livelihoods while staying in place, relocating nearby, or migrating to a new city and adapting to new lifestyles while keeping old livelihoods. For example, residents continue everyday fine grain practices such as vegetable and clothes washing in canals, and fish farming wherever water and soil remain healthy. There is much industrial pollution in the waterways from textile and paper factories. When rice fields are closed down some people tend peri-farms. This is possible because fertile farmland soil is excavated and moved around in preparation for the basement level of new office towers, residential building clusters, industrial estates, tree lined boulevards, and eco-parks. Peri-farms are also created on roadsides, tracts of land adjacent to new relocation housing, bridges and islands not yet connected by the megablocks.

In the water, new bamboo stakes and floating nets made from plastic water bottles are used to mark out fish farms and are aligned to accommodate increased boat traffic on the Zhedong Canal. Old bamboo stakes mark out fish farms adjacent to new industrial estates that are the site of former villages. Many fish farms have been removed completely and farmers become fishermen and simply cast nets from their boats. The drawing titled *Tide* (Fig. 9.10) illustrates the spatial arrangement of the megablocks (yellow lines), water villages (small white blobs), fields, fish farms, train lines (black lines), canals (pink lines), water highway, eco-parks, industrial and residential estates. The old reservoir and some of the many former shorelines are represented as forceful shapes (white transparent zones). All of these elements are layered into a geo-located aerial image that is striated. The stripes are sort of temporal error in which differences in seasons and weather events are visible as satellite scans that are aligned.

In Kolkata, there is an urban pattern of very small urban ponds and very large lakes that are a type of commons. The small ponds are called *pukurs* in Bengali (a larger water body is called a *dighi* or *jhil*) and were typically excavated as a pious activity, and as a practice for the salvation of the soul (Ray 2010a, b: 19). The excavation of ponds was also a practice where the earth dug was used for the construction of houses and to store water. Large ponds were shaped from the East Kolkata Wetlands, the gigantic wetland system that is today an infrastructure for wastewater, food production, and livelihoods. In Shaoxing, canals and lakes formed from shallow



Fig. 9.10 Tide

water held in place by sea walls. The most famous lake *Jinahu Lake* or Mirror Lake had its water source in the hills and served to regulate water supply during the dry part of the year. As lakes silted up over time, many narrow water passages remained between reclaimed islands and were used as transit corridors to connect water-villages. The patchy changes described above are splitting and sorting all of the island and canal-based villages of the Yangtze-Qiantang Mega Delta into blocks of discrete land uses, simultaneously. In Kolkata, there is extreme pressure to fill in ponds and lakes on a sequential parcel-by-parcel basis. In both regions, there are new special administrative districts such as state sponsored new towns, single developer led for-profit enclaves, public-private partnerships, smart cities systems, and inner city and periphery leisure/culture districts.



Fig. 9.11 Recycling. This scroll connects three scenes of gestures of making and unmaking. The *left* scene is a new middle-class colony. A woman with an armful of firewood walks past a big pile of sand that is used for making concrete. There are typical low brick walls that are built to mark private land that also store water, often unintentionally. The boundary is a nearby rice paddy, and its bright green seedlings indicate the land use that the colony has replaced as well as the way that water was stored and released here. The *middle* scene is a small industrial area that is located in the *middle* of many ponds. A group of men are unloading clay from a truck. Beside them are clay teacups (*bhanr*) waiting to be fired in the nearby kiln. The boundary is a tea stall located near Park Circus, in the inner city. Chai served in these low-fired clay cups has a much-loved earthy taste. They are then smashed, discarded, and returned to mud. The *right* scene is a stack of recycled plastic, sorted according to different grades, and colors. This village has many such compounds, and the pond has since been filled in to make way for more compounds. The boundary is a roadside, just up the road and further into the wetlands, that is lined with fertilizer drying in the sun—a by-product from the leather industry

The drawings titled Scroll (Figs. 9.11, 9.12, 9.13, 9.14, 9.15, and 9.16) are the outcome of observations and experiences in this complex system of wet landscape patch dynamics and socio-morphological change. Infinite scenes are possible and eighteen are illustrated here as a prompt for further research. The drawings titled Metamosaic (Figs. 9.17 and 9.18) are a conceptual rescaling of the scrolls into a map so that they might be understood in the aerial view as spatially nested within each other as well as places along a journey.



Fig. 9.12 Big Pond. This scroll connects three scenes around one of the largest bodies of water in the area. The *left* scene is a new street corner. A fancy new hospital is across the street from a new teashop whose customers are drivers, construction workers, and others who work in servicing this new area. They throw their trash into the pond. The boundary is a view looking up. The hospital is a landmark, and patients enjoy views across the pond. The *middle* scene is a fisherman's cooperative eco-park. Two men stand by the gate and collect a small fee that pays for choice picnic spots for family gatherings. The boundary is the fence of the park that has roses, and many breezy palm trees. The *right* scene is a government-built colony that is adjacent to a Buddhist temple that has a beautiful garden, a cemetery, and a big locked gate; many of its Chinese visitors having since left the city, particularly after the 1962 war. A woman is returning home after visiting the street market. This is a resettlement colony—many people have moved here to make way for the many new infrastructure projects being built in Kolkata such as restoring canals, new flyovers, and the elevated metro train. The boundary is the interior of a small furniture shop that can be seen behind the vendor

9.3.1 Reflection

Design is a type of excursion and stretching exercise into new interactions between things. Urban ecological design practices need to better augment the visibly sequential, invisibly sectional, fine, and coarse grain changes described in this section. Geographers Ananya Roy and Aihwa Ong offer the concept of “worlding practices” that are “constitutive, spatializing, and signifying gestures that variously conjure up worlds beyond current conditions of urban living. They articulate disparate elements from near and far: and symbolically resituate the city in the world” (Roy and Ong 2011: 13). Inspired by this, urban designers and ecologists might, therefore, resituate their practices in these peri-urban areas and support new associations,



Fig. 9.13 Horizon. This scroll connects three scenes that hold a long view—a precious experience in Kolkata. The *left* scene is a pond that is surrounded by housing colonies. Small urban ponds are used for washing, fish farming, submersion of idols, and fire fighting, and as biodiversity hot spots; however they can get overly polluted in the absence of a caretaker such as a temple or club, and some simple rules. Clothes have been left out to dry along power lines that offer an ample expanse for stretching out a sari. A paved path along the edge of the pond has been swept and is a convenient place to park a motorcycle. The boundary is sunset, the loveliest time of the day for a stroll next to a pond. The *middle* scene is a new wide and straight road that cuts past the edge of a village pond. A man is building a goddess by hand, and others are bathing at the end of the day. At the end of the road is an elite high school, and behind the pond is a multi-tower, high-rise, nonresident-Indian (NRI) complex called Urbana. The prosperous middle class enjoys the East Kolkata Wetlands from air-conditioned comfort. The boundary is tilled soil. The *right* scene is a fish farm. A curious buffalo wanders from behind fishing nets drying in the sun. A dirt path leads to a village, over a little bridge, and further to the next village, and the next village. There are few roads here. The boundary is a basket of small fish, caught very early in the morning, and being carried by foot to a nearby market

contests, and geographies against and beyond environmental unsustainability and inequitable socio-morphological change. The paired research case studies in this section have been designed to open up, through visual reassembly and narrated description, moments for urban practice in the metamosaic. A successful result would be multiple tangibly unconventional spatial expressions of power and knowledge that support equitable public realms in formation.

It is important to foster ways that people can recognize the ecology of the city and not just ecology in the city (Pickett et al. 1997). The search is not to find or create the best patch mosaics and make them function in the most resilient ways according to a set of best management practices. Instead, the paired research



Fig. 9.14 Pose. This scroll connects three studies of famousness, of scenes that have become commodities. The *left* scene is a brand new eco-park. Smile poses on the waterfront promenade; she has a hat and an umbrella because having white skin is important to her boyfriend. A new pagoda provides a 360° panorama, a destination for lovers, friends, and families. There is also a constructed wetland, gift shop, restaurant, and a big parking lot. A village was demolished in order to create this new town. The boundary is a street scene in the central government district that is located in the center of this new town. The *middle* scene is a water village with white buildings with tiled roofs, an enchanting arched bridge, and ducks. This picturesque view is something that supports tourism in Shaoxing with its sightseer boats that ply its many canals. In this village many people have left and it appears abandoned. New factories surround it. The boundary is a rural factory that recycles textile scraps—a type of rural industry in the village. The *right* scene is a fish farmer feeding his fish. The boundary is a tiled façade of a new rural house. The elegant poise of the farmer seems timeless, as if from a famous Chinese painting

described and illustrated in this chapter support the patchy transformation of urban ecosystems according to the environmental and social realities of their inhabitants coupled with actual ecological data created with, from, and for the residents of that place in formation. This is therefore a porous approach that affords a discursive realm, where issues can be defined locally and addressed (or ignored), continuously. It is an approach to urban design practice that permits a diversity of research questions to emerge from overlapping adjacent, and quite similar urban processes; it allows for contesting views and practices to coexist, allowing democratic politics to arise quietly and incrementally through persistent questioning of environmentally unsustainable processes, strategies, and spaces as well as supporting projects, actions, and infrastructures that inspire.



Fig. 9.15 Persistence. This scroll connects three resettlement cultures. The *left* scene is a demolished water village. A man rides a bike over a bridge and past a stone canal edge, and some isolated farmhouses. In the distance is a stadium complex, part of the recreation and entertainment zone that this area is transforming into. The boundary is an office tower in the central government district that is located in the center of this new town. The *middle* scene is an office tower in the central government district that is located in the center of this new town. The *middle* scene is a market garden. A man is tending his allotment that is made of neat rows of vegetables and narrow dirt paths. It is next to a low-rise farmer resettlement housing estate. The boundary is a new residential tower that is being built nearby. Gardeners move their gardens to new plots, as the new town is built, according to a set of locally brokered agreements. Most gardeners are elderly, and possibly former farmers. The *right* scene is about washing clothes in the canal. Two women wring a bed sheet while a boat goes by with two men who are foraging for scrap metal along the shore. This waterfront promenade is new and it was designed with steps to allow for washing clothes and vegetables. The boundary is a housing estate where the women live. It is the same estate as the gardener, and the same canal as described in the next scroll

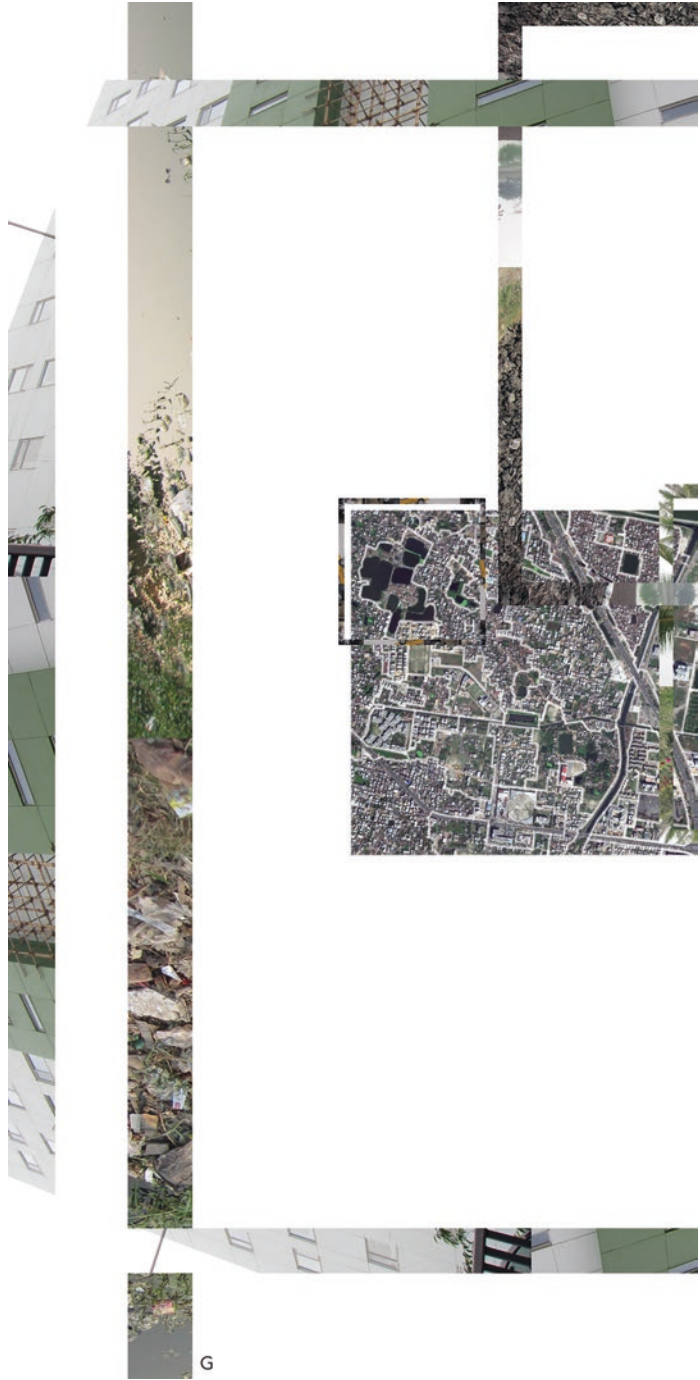
Paired research is engaged here to open a type of communication that does not currently exist. Effort has been made to not flatten the complexity of forms, systems, and practices in order to fit one into the lens of the other. Nevertheless, when one condition emerged in the research process a search for a corollary was a normal impulse and served to expand and then bracket the research project. The case studies are regional perspectives that are based on socially engaged ecology frameworks, theories, and practices. They have been designed as shared tools for critical practices of democratic visuality, informed ecological spatial imaginaries, and action (Marshall 2014).



Fig. 9.16 Shiftwork. This scroll is a walk through an industrial zone on a Sunday. The *left* scene is a new megablock intersection, with a billboard announcing an even bigger intersection planned for nearby. The scene has that special mix of peaceful undercapacity that fills such mega zones when they are brand new. Imagine the calm before a storm. The border is a pile of rice wine jars, a famous product particular to this region of the mega delta. Today the factories manufacture paper and textiles, industries that similarly need a lot of water. The *middle* scene is a vendor on the roadside near a small electronics factory that operates 24 h a day. The workers are enjoying fresh, hot noodles for breakfast, and a break in their 12 h shift. The boundary is a wall of handwritten phone numbers that advertise services or products. These signs are often seen near the smaller rural factories in China. The *right* scene is a water highway that is part of the Zhejiang Inland Waterway Renaissance Action plan. Fishermen using hand nets float by big green traffic signs that provide directions for boats, to guide them to nearby ports such as Shanghai. The boundary is a small canal-side port facility, with piles of sand, new warehouses, and *red* cranes

9.4 Conclusion

In this chapter, I have argued that cocreated models of patch dynamics can address environmental unsustainability in peri-urban wet landscape environments in India and China. I have shown a design project that translates a spatial framework that is shared by ecologists and designers into visual tools so that a systems approach to studying urban ecologies might better shape the public realm. I drew patch dynamic boundaries and created drawings that illustrate peri-urban change. In addition, I complemented this with a narrative of wet landscape non-linear urban transitions. I assembled and sorted scenes that were the outcome of extensive and repeated



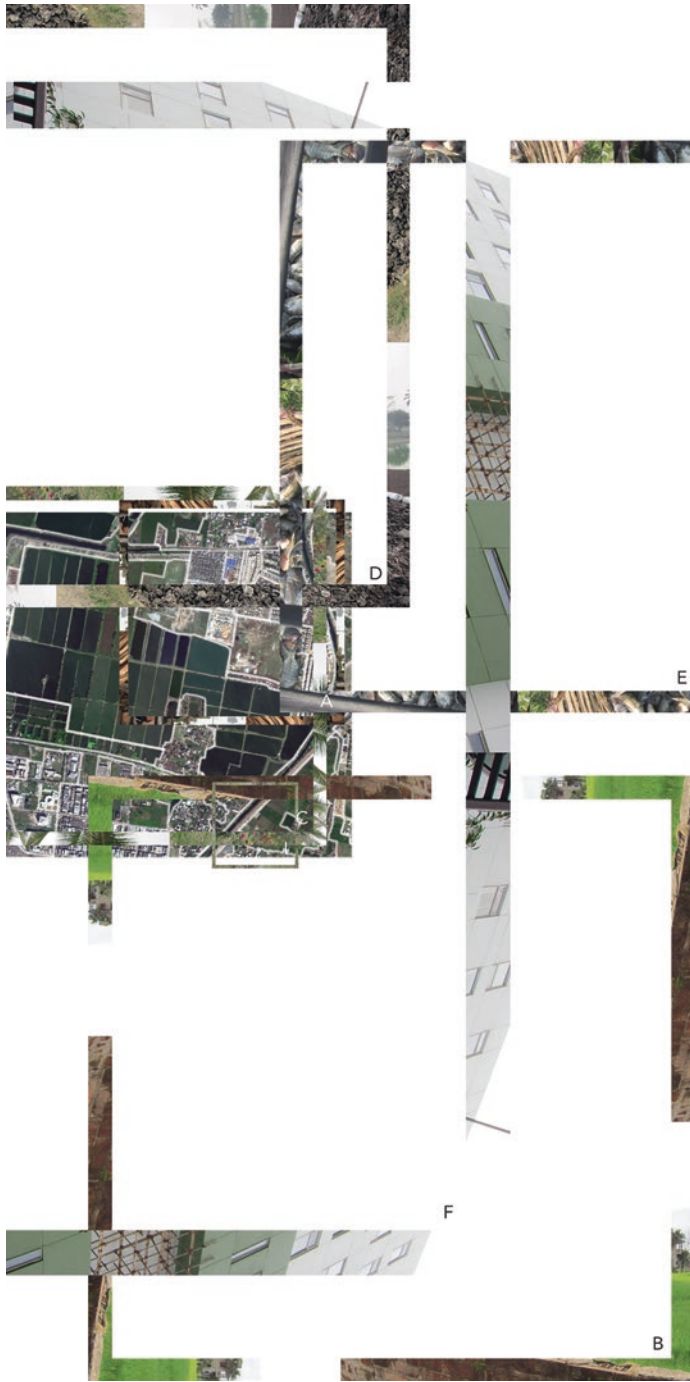


Fig. 9.17 Caption for the figure available on p. 228

Fig. 9.17 Metamosaic India. In this drawing the ecosystem boundaries are scaled to illustrate the relation of each scene to its area of concern. They are described here as follows. (A) The interior of the furniture shop in the resettlement colony is a personal site of concern for the livelihood of a family. The shop is one shack on many that form a new commercial street that is the main corridor for the new colony. The colony is distant from the main road, and the surrounding land that is used as a cricket field is also a staging ground for precast concrete elements for a new bypass. This is state land and several very large ponds were filled in to create this area. (B) The woman carrying firewood amongst the multifamily homes is witnessing parcel-by-parcel change of land from rice paddy to middle-class colony and adjusting her foraging practices accordingly. She may be someone who lives in the village nearby. How does she know which farmlands or gardens are open to her for foraging? How far does she walk? (C) The cooperative that manages the eco-park built a fence around the property to increase its value as a special recreation destination and to protect it from encroachment by the owner, which is the state. In addition environmental activists monitor this pond, and many other water bodies on this eastern edge of Kolkata. This is an unusually large pond, and it is therefore considered highly vulnerable in as it is extremely difficult to assemble very large plots of land for development here. (D) The workers and families who created the plastic recycling compounds and leather-paved roadsides have shaped a type of specialized linear recycling district, which both serves to reduce landfill waste and relies on the waste that is created by residents and businesses in Kolkata toward the west, as well as the industries at the Calcutta Leather Complex toward the east. This linear recycling district is aligned adjacent to the main sewage canal as well as the only main road that bisects the East Kolkata Wetlands. (E) The owner of the basket of fish might be concerned with the timely delivery of quality wastewater to his ponds. Many canals channel these blackish smelly streams toward the east where there is a contest of political favors to obtain its nutrients. Smaller fish are prized by Bengalis both for their sweetness and the belief that younger fish hold less accumulated toxins. (F) The drivers drinking tea next to the hospital are part of the new workforce of the linear road-based urban corridor that is the Eastern Metropolitan Bypass. Significant air pollution and medical waste are two new flows that the much-celebrated East Kolkata Wetlands recycling system can't absorb. There is need of a parallel sanitary-city infrastructure for removing heavy metal contaminants, and disposing of hazardous waste. (G) Beholding sunset next to a pond is a precious experience that is repeated at many ponds in the mega delta. Ponds are also used for bathing and for exercise. For example, ponds with paths around them are used each morning and evening for casual social strolls, purposeful walking, as well as stretching and breathing exercises such as yoga, and laughter yoga. Other ponds are used as sites to dump household and construction waste and are therefore sites for foraging and protest. Similar to parks, each pond has a certain mix of men and women that create and protect them as type of commons. (H) Tea stalls with clay or plastic teacups are found throughout Kolkata. The teacup kiln village is at the intersection of a debate between hygiene, taste, and tradition. Plastic teacups are discarded in the gutter, swept into piles at the end of the day, and are lit to form little chemical bonfires. Clay cups are considered less hygienic, but more green. (I) The goddess maker next to the pond displays his trade and craft in anticipation for the festival. His deities are purchased and installed in a neighborhood (*para*)—and are later transported and immersed in the Ganga ceremonially, and then recycled by others

fieldwork. The scenes are composed movement images of everyday life that are framed, named, and narrated in such a way to form a provisional catalog of situated environmental subjectivities. The scenes are, therefore, examples or possible entry points for a resident, designer, or researcher to ask more questions in order to advance meaningfully situated urban ecological design research questions. The scrolls made of scenes as well as the metamosaic drawings are composed so that various urban actors can view their environmental realities in relation to others, as well as within patchy land cover dynamics that have specific forms that shape unsustainable effects in ways that are important to know better.

In the Ganges-Brahmaputra-Meghana mega delta, the patchy heterogeneity explored in this chapter is found on the edge of the big cities such as Kolkata and Dhaka and the port, trading, and regional towns that are part of the old train network and along a few new highways. In Shaoxing, patchy peri-urban heterogeneity is being formed in the scattered areas between the old and new cities that are arranged like a net across Yangtze-Qiantang mega delta and are connected by many new highways and fast train corridors. Kolkata and Dhaka have more megacity model urban processes, and Shaoxing has more megalopolis model urban processes; however, village city systems and land cover heterogeneity completely encompass both mega deltas. The patch, scroll, and metamosaic conceptual tools and drawing methods could be applied anywhere in the mega deltas; however, they are engaged here as paired research located in peri-urban mega delta landscapes because this specific type of urban heterogeneity hasn't been fully explored, and it is where inequalities are most evident. In addition, it is a significant type of village city urban form for emerging open society and global civil society to know better. For this reason, it is important that they support critical urban ecological design research practices in India and China that are being shaped in response to peri-urban environmental unsustainability.

Urban ecology has been defined mostly by ecosystem scientists and less so by urban designers. This chapter critically elaborates an ecosystem science framework and integrates it as a socially engaged urban design and ecology practice with the intent of making sensible the combined actions and effects of open society and global civil society to change environmental unsustainability. When design is located in relation to ecology and politics in this way, it is a contribution to the public realm. To focus on the village city mix is to bring all urban forms, land covers, and experiences of the mega delta into situated focus. In addition, to design with ecology, ecosystem boundaries, and aerial imagery in this way is to advance participatory practice in critical ways. Might the next Indian and Chinese urbanisms be shaped and augmented in a nonlinear context of diverse engagement? Might the village city systems that are a moving mix full of subtle nuance and conflict become no longer a chaotic peripheral vision but rather form a central figure against unsustainable environments? Toward this goal, India and China in this chapter are situated in a hopeful lens and connections have been made between everyday life and the epic civilizational sphere in order to create tangible possibilities for seeing our urban futures differently.



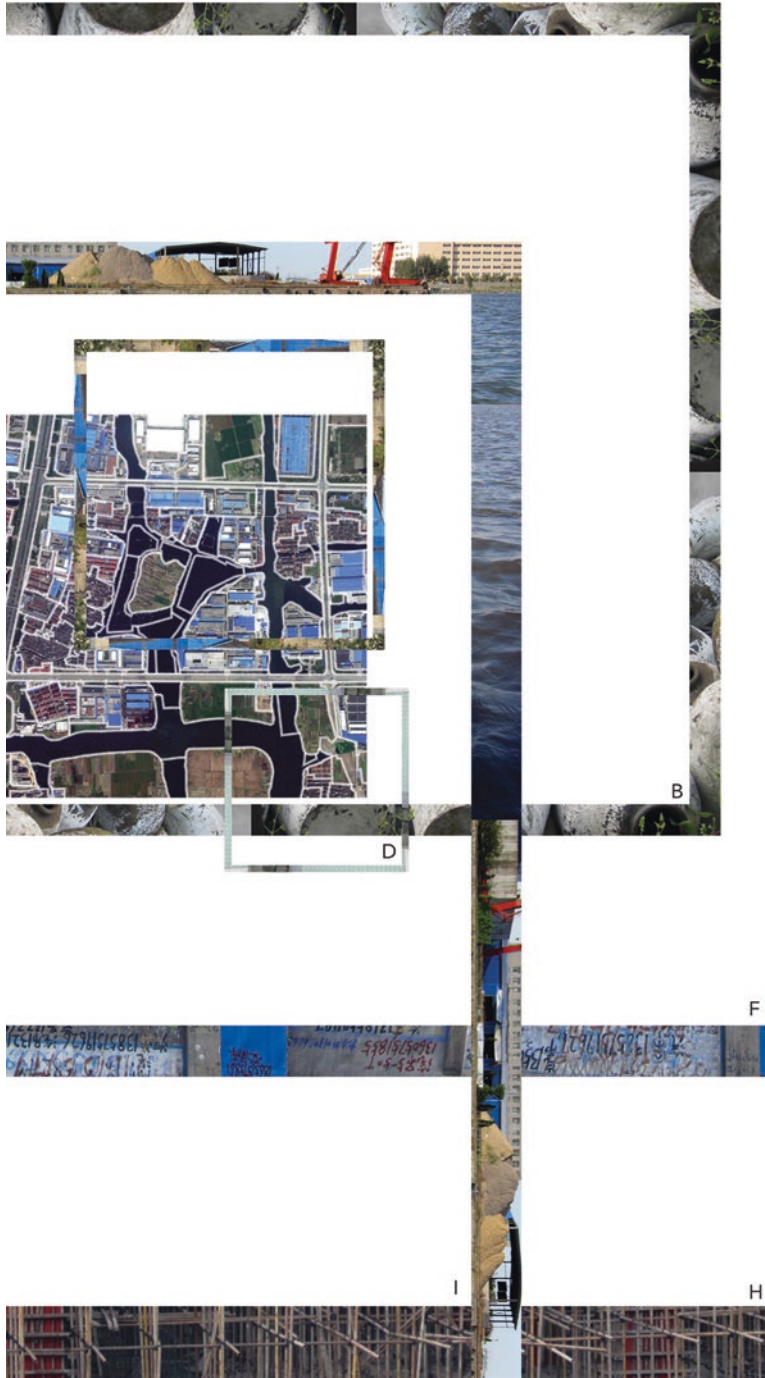


Fig. 9.18 Caption for the figure available on p. 232

Fig. 9.18 Metamosaic China. In this drawing the ecosystem boundaries are scaled to illustrate the relation of each scene to its area of concern. They are described here as follows. (A) The man on the bike lives in one of the few houses remaining in this area. His family raises ducks and offered to cook lunch for curious foreigners who were passing by. It is rare for ordinary homes to remain in new town zones like this. His area of concern might be his new home, its location, and opportunities to find work or education nearby. (B) Shaoxing is famous for its rice wine. The woman crossing the megablock intersection is part of the new economy workforce for this area that has replaced the rice farmers and wine makers that made a living from the land and water and Jiangnan market-town network. Factory work today is linked to global markets and the port of Shanghai. The vegetative strategy employed here is now based on the reasoning of buffers and beautification of the industrial park. (C) The eco-park is a new type of landscape project that is a hybrid between an entertainment park and nature reserve. In addition, landscapes such as this are designed to function ecologically in order to clean water and the air, and act as an education resource. In this new town, that is a mix of demolition and construction, it is one of the few completed projects. (D) It seems that fish farms can be moved. They are made of bamboo posts and nets, rather than ponds, as in Kolkata. While many farms have been removed, many also remain. The farmer feeding his fish from his boat lives in a modern village and the quality of the water is critical to his livelihood, in this increasingly industrial shoreline. (E) Walking through the village with the arched bridge felt like a visit to an evacuation zone; however there is life, such as elderly people and small-scale factories that print paper placemats and recycled textile scraps. On Sunday families return to the village to visit parents and grandparents and floating gambling barges serve wine and cater to workers. (F) Micro-economies are linked to the new factories. The vendor served fresh noodles that were neatly arranged in portion-sized bundles. While the workers were eating a man nearby began foraging through a pile of rubble and wood scraps. He was foraging and was soon asked to move on by a factor guard. The cell phone numbers that are written or posted on walls, poles, and anything vertical also form this landscape of work. (G) In the mega delta there is a special type of small canal called a *lou* and this is where people might wash clothes or vegetables. The women washing their sheet on the main canal are from a village and live in this resettlement complex. Further along the canal a man was long-distance swimming, for exercise. Similar to the fish farmer, they might be concerned about water quality. (H) Small market gardens are also called peri-farms. The concern is with soil quality, proximity, and theft. In some large farms there seems to be a gatekeeper, someone who others entrust to be present. Other farms seem more precarious such as those that are filled on freshly excavated soil immediately adjacent to a main road. On the other hand some are less collective, such as those found next to bridges that are also home for the gardener. (I) Some canals are being widened, and realigned in order to accommodate larger and faster barge traffic. The fishermen in their boats are floating in the canal, using a simple paddle to gather fish in their underwater nets. There are large tide gates that separate this water from the sea, and so these canals are a type of hybrid, a fishpond and a water highway. How might these two systems coexist?

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