FISH FOR THE CITY: URBAN POLITICAL ECOLOGIES OF LAGUNA LAKE AQUACULTURE

A Dissertation

by

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ABSTRACT

The dissertation tells the story of the production of socionatures through the development of aquaculture in Laguna Lake. The state introduced lake aquaculture to supplement fisherfolk livelihoods and improve fish production in part to provide nearby Metro Manila with its fish requirements. Half a century of aquaculture in the lake, however, has transformed ecologies, landscapes and livelihoods. Flows of fish to the city encounter socioecological contradictions in lake production and urban consumption. This dissertation examines these transformations and how state policies, livelihood activities and fish demands produce particular socionatures. Using the urban political ecology concept of urban metabolism, the dissertation frames the production of Laguna Lake socionatures as a city-lake dynamic. It employs qualitative and multi-sited ethnographic methods to follow Laguna Lake fish from sites of production to consumption and to identify actors, relations and practices that shape access to these flows of fish. The state embarked on projects aided by scientific institutions and foreign donors to enable aquaculture production through simplification of complex lake socioecological processes. These resulted in capitalist fishpen aquaculture expansion that transformed lake ecologies and village livelihoods. Capitalist aquaculture continues to confront nature's materiality in water-based production, which provides constraints and opportunities for aquaculture expansion. Village producers, intermediaries and urban consumers also continually work with the materiality of nature to secure livelihood and sustenance benefits from fish as they flow from the lake to the city. However, the

distribution of access to fish flows is uneven, with urban-based fishing corporations that own the largest fishpens and fish market brokers deriving the most benefit as a result of their political and economic power. Other commodity chain actors attempt to gain access to these fish flows through formal and illicit strategies. By following the flows of Laguna Lake fish, the dissertation weaves stories of the urban metabolism as producers, traders, consumers, laborers and the state transform and produce lake and urban socionatures.

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NOMENCLATURE

ADB	Asian Development Bank
BAS	Bureau of Agricultural Statistics
BFAR	Bureau of Fisheries and Aquatic Resources
GCC	Global Commodity Chain
GIFT	Genetically Improved Farmed Tilapia
GMT	Genetically Male Tilapia
GPN	Global Production Network
GVC	Global Value Chain
LDBDP	Laguna de Bay Development Plan
LDBFDP	Laguna de Bay Fishpen Development Plan
LLDA	Laguna Lake Development Authority
NHCS	Napindan Hydraulic Control Structure
NSCB	National Statistical Coordinating Board
PFDA	Philippine Fisheries Development Authority
SEAFDEC	Southeast Asian Fisheries Development Center
SOGREAH	Societe Grenobloise d'Etudes et d'Application Hydrauliques
UN	United Nations
UNDP	United Nations Development Programme
UPE	Urban Political Ecology
ZOMAP	Laguna de Bay Zoning and Management Plan

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CHAPTER I

INTRODUCTION

1.1 Fish, the lake and the city

El Filibusterismo (*The Subversive*), Jose Rizal's[1] satire about late 19^{th} century colonial Manila society, begins with an image of a white steamship navigating upstream along the Pasig River towards Laguna Lake. The ship sails slowly, as skippers and sailors attempt to negotiate the river's meanders, its shallow waters, and the stretch of sandbars at the river's mouth. While most passengers crowd below the ship's deck, the Europeans, friars and colonial officials sit shaded on the deck, gazing at the still waters as they debate on how best to solve the problem posed by the river and the lake. Proposals discussed on the deck include digging a stream channel through the city using forced labor, and deepening the sandbars by encouraging snail gathering for the production of the local food *balut* (fertilized duck embryo). At one point, the latter proposal elicits a snobbish retort from one of the deck's passengers: "if everyone were to breed ducks there would be an excess of *balut* eggs. Ugh! How disgusting! Leave the sandbars alone!" (Rizal, 2007, p. 10).

A parallel image opens Ishmael Bernal's[2] (1976) film, *Nunal sa Tubig* (*Speck in the Water*). A foreigner and his local business partner stand gazing at the landscape as

[1] Jose Rizal (1861-1896) is the Philippines' national hero. His two novels and his execution inspired the Philippine revolution against Spanish colonial rule.
[2] Ishmael Bernal (1939-1996) is a National Artist of the Philippines for Film. A number of his films made during Ferdinand Marcos' martial law rule depicted lives of ordinary Filipinos that contrasted with Marcos' utopic visions of the New Society.

their white boat speeds across the calm waters of Laguna Lake. The fast, modern boat visually contrasts with a slow, crowded passenger boat that it meets along the way. The businessmen observe daily life in the lake, pointing to women catching fish underneath water hyacinths and passing by imposing guardhouses built next to large fishpen enclosures in the middle of the lake. Satisfied with their survey of the lake as a potential business venture and sensing the threat of a storm, the two men then return to shore. The harbinger of an approaching storm, represented by several shots of a threatening sky, signals a shift in the film from the nameless businessmen to the stories and struggles of lake villagers in the face of social and environmental change, which become the core of the film's drama.

Rizal's first chapter alludes to state power, elite interests and concrete labor in making lake environments. While fictional, the debates between the characters of the ship's upper deck presented a prelude to real 20th century state infrastructure projects that asserted a sense of control, even if illusory, over lake nature. These massive projects, as attempts to master the lake nature, rely on the objectification of nature, a process that entails its separation from society and history. Bernal's example of businessmen assessing the investment potentials of Laguna Lake suggests that the creation of the lake as a resource is often tied to the economic interests of outsiders. The foreboding storm seemed to anticipate the rapid socioecological transformations in the lake that accompanied the fishpen sprawl and intensified industrialization a few years after the film's release. The struggles of fisherfolk working with lake ecologies produced by aquaculture and urban activities, furthermore, reflect the disruption and reconfiguration of nature-society relations in light of these changes.

I draw on these scenes from Rizal's novel and Bernal's film to introduce the dissertation as a story of the production of socionatures[3] in Laguna Lake through the development of aquaculture. I also invoke these two opening scenes to provide a counterpoint to a recent claim made in the United Nations Millennium Ecosystem Assessment that identified the root cause of the Laguna Lake's socioecological transformations as "human population and its unbridled exploitation, use and abuse of the lake's resources" (Lasco & Espaldon, 2005, p. 110). The dissertation shows that it is not population numbers *per se* nor an undifferentiated and timeless human desire to exploit that shapes the fate of Laguna Lake. Rather, it is the historically-specific organization of nature-society relations that produces particular lake socionatures. This production of socionatures benefits some groups more than others through hybrid human and natural processes that spill beyond the borders of the lake. In emphasizing the production of the lake, I read its socioecological conditions as constituted by processes and practices that mediate nature-society relations.

This dissertation's narrative begins with aquaculture in Laguna Lake but extends to the nearby megacity of Metro Manila, which is home to 12 million people. Less than half a century of aquaculture production in the lake, the largest in the Philippines, has transformed ecologies, landscapes and livelihoods. The Philippine state introduced lake

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[3] I employ the terms "socionature" and "socioecologies" to capture the unity and mutual constitution of humans and natures.

aquaculture in 1970 to supplement fisherfolk livelihoods and improve fish production. The latter goal was situated within the context of a stagnant commercial deep-sea fisheries sector that confronts the crisis of producing increasingly expensive marine fish. Aquaculture – the "blue revolution" – promised to provide a stable supply of affordable fish. Owing to its proximity to Metro Manila and unique ecological characteristics, Laguna Lake has played an increasingly important role in provisioning the city with its requirements for cheap fish. However, these flows of fish to the city encounter socioecological contradictions both in lake production and in city consumption.

This dissertation's research question has three interrelated components: (1) which socioecological transformations enable and result from aquaculture in Laguna Lake? (2) in which ways does the materiality of nature shape aquaculture production in the lake and fish flows to the city? (3) which social relations constitute fish flows from lake to city and how do actors benefit from these flows? I frame the production of Laguna Lake socionatures as a city-lake dynamic to situate Laguna Lake aquaculture as part of broader socioecological processes associated with urbanization. I follow Laguna Lake farmed fish from sites of production to exchange and consumption to identify actors, relations and practices that shape these flows of fish. I also examine various mechanisms by which actors gain access to these flows.

In the remaining sections of this chapter, I discuss the conceptual frameworks that guide the dissertation, detail three research objectives and corresponding strategies, and present a roadmap to the organization of the dissertation. In the next section, I indicate the usefulness of urban metabolism, commodity flows and materiality of nature as frameworks to examine the production of socionatures in Laguna Lake aquaculture.

1.2 Conceptual frameworks

This dissertation contributes to urban political ecology by integrating urban metabolism with analyses of commodity flows and materiality of nature using the case of the co-production of Laguna Lake and Metro Manila socionatures. In the following discussions, I examine the main themes of urban political ecology and identify the dissertation's four contributions to this field.

1.2.1 Urban political ecology

Urban political ecology (UPE), a term first coined by Erik Swyngedouw (1996), emerged as a distinct field of inquiry that combines insights from urban studies and political ecology. UPE attempts to address urban studies' neglect of nature, and political ecology's insufficient treatment of urbanization (Keil, 2003). It builds on pioneering work by geographers who considered the unity of city and country (Mumford, 1956) and the expansion of environmental transformations (Berry, 1990) in the process of urbanization. Decades before UPE, Lewis Mumford remarked that the notion of cities as the pinnacle of human mastery of and independence from nature (i.e., country) was illusory. Emphasizing the symbiotic relations between city and its hinterland in organicist terms, he wrote: "urban and rural, city and country, are one thing, not two things" (1956, p. 382). This dissolution of city/country and nature/society is an argument echoed by UPE scholars. However, they seek to transcend the association of nature with country and of society with city by considering cities as socionatural hybrids – simultaneously natural and social (Swyngedouw, 1996). UPE therefore highlights the historical-geographical production of socionatures through urbanization. UPE scholars see the urbanization of nature as an historically specific, spatially uneven, and inherently power-laden process (Heynen, Kaika, & Swyngedouw, 2006a).

Because of the broad scope and process-based understanding of urbanization of nature, UPE works have employed diverse approaches to various topics framed at different scales. These works, however, share a number of common themes. Sociospatial processes (e.g., production of urban space) are based on production of natures (Smith, 2008). The urbanization of nature transforms both social and natural worlds (as mutually constituted by each other), which are historically produced through labor. These transformations of socionatures advance some interests at the expense of others, thus emphasizing importance of social power relations and processes by which groups create their own environments (Heynen et al., 2006a; Loftus, 2012).

UPE scholars employ various approaches guided by multiple understandings of the urban, the political, and ecology (Keil, 2003). Neo-Marxist approaches combine with actor-network theory and science and technology studies to explore urbanization of water, food, forests, lawns, wastes, fat, and alcohol, among other topics. Transformations of urban socionatures are situated in bodies (Heynen, 2006; Lawhon, 2013; Marvin & Medd, 2006; Shillington, 2013), homes (Biehler, 2010; Kaika, 2005), lawns, gardens and backyards (Domene & Sauri, 2007; Perkins, Heynen, & Wilson, 2004; Robbins, 2007;

Shillington, 2013), neighborhoods (Lawhon, 2013; Loftus, 2012), infrastructure and technological networks (Cooke & Lewis, 2010; Gandy, 2004; Kaika, 2005; Kaika & Swyngedouw, 2000; Marvin & Medd, 2006; Monstadt, 2009), and city-hinterland relations (Gandy, 2002; Swyngedouw, 2004).

This dissertation contributes in four specific ways to urban political ecology in terms of conceptual and methodological gaps. First, I aim to address UPE's "methodological cityism" (Wachsmuth, 2012) or its nearly exclusive emphasis on transformations within the traditionally-delineated territorial bounds of cities. In this dissertation, I present a narrative of mutual production of "urban" (Manila) and "nonurban" (lake) natures.

UPE scholars conceptualize the city as constituted by a plethora of multilayered flows ranging from the local to global. As Erik Swyngedouw and Nik Heynen (2003, p. 899) argued, "there is no longer an outside or limit to the city." Urbanization therefore "produces both a new urban and rural socio-nature" and constant "extension of urban socioecological frontiers" (Swyngedouw, 2006, p. 114). These comments parallel recent claims by urban studies scholars that have built on Henri Lefebvre's concept of "planetary urbanization," which call for a reconceptualization of the urban beyond traditional territorial delineations (city/suburban/nonurban) inherited from 20th century urban studies (Brenner, 2013; Brenner & Schmid, 2012; Merrifield, 2013).

Despite the theoretical claims of a city constituted by transformations and flows from within and outside, the co-production of "urban" and "nonurban" socionatures remains poorly examined on empirical grounds in UPE (Braun, 2005). UPE scholars have mainly emphasized urban processes within the city. This is at the expense of processes that constitute urbanization which may not necessarily be within its traditionally-conceptualized boundaries. The focus on cities is perhaps an artifact of UPE's initial attempts to bring nature back in the city, and to carve a different path from the nonurban focus of political ecology (Keil, 2003). However, in order to understand how urbanization transforms nature, we need to pay equal attention to the material/symbolic production of socionatures in both cities and nonurban places, as well as to the processes that underlie this co-production.

Within UPE, the volumes by Erik Swyngedouw (2004) and Matthew Gandy (2002) on the urbanization of water from distant places are two notable exceptions that link urban and nonurban natures. Outside UPE, William Cronon's (1991) urban environmental-economic history of Chicago and its hinterlands is an example of a work that hints at this co-production by narrating stories through commodity flows of grain, lumber and meat. These exceptions are historical-geographical accounts that highlight city-hinterland dynamics. While a city's hinterland could extend anywhere from its fringes to distant places on the other side of the planet, urbanization "fixes" particular places to the city as a result of particular political economic and ecological processes. It is therefore necessary to examine how and why these places come to be "fixed," and their implications on both urban and nonurban socioecologies.

The arguments that urbanization extends beyond the boundaries of the city, that there is no limit to the city, and that all nature is urban nature (Gandy, 2002) pose methodological and conceptual challenges that are not yet resolved. If various spaces and socionatures are metabolized in urbanization, how can we empirically examine these processes in particular historical and geographical moments? At least two routes, centered on the commodity[4], are possible to extend the focus beyond cities. One is by tracing technological networks that link socionatures of distant places to the city, an approach employed, for example, in studies of urbanization and commodification of water (Gandy, 2002; Kaika & Swyngedouw, 2000; Loftus, 2006). The other is through commodity flows that tie together production, exchange and consumption spaces and practices (Cronon, 1991). In this dissertation, I will employ this second method of investigating urban metabolism through commodity analysis.

The use of commodity analysis in examining the urban metabolism is the dissertation's second contribution to UPE. UPE scholars place central emphasis on commodities and their flows to frame the urbanization of nature and the extension of the city's socioecological frontier (Heynen et al., 2006a; Swyngedouw & Heynen, 2003). However, UPE has limited engagement with the extensive literature on commodity studies and their methodologies partly because of UPE's analytical focus on lived environments *within* cities rather than the geographical dynamics of commodities displaced as "things in motion." In this dissertation, I seek to address this gap by focusing on flows of commodities as a useful approach to examine the co-production of city and lake natures through aquaculture. Analysis of commodities, as fundamentally

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[4] A common thread in the multiple approaches to commodities is the notion that these are produced for exchange. Some scholars have built on Karl Marx's (1990) analysis of commodities as the building blocks of capitalism. Capitalist exchange alienates the producer from his/her product, and reifies the commodity as an object rather than as a social relation. Others have sought to examine the cultural meanings attached to commodities as they move in and out of the commodity state (Appadurai 1986).

social relations, not only dissolves nature/society dualisms but also links various places (e.g., sites of production and consumption) as geographical moments of the same process. Rather than the static and reductionist notion of nature as material flows (as used in industrial ecology, for example), commodity flows enable a conceptualization of metabolism as fundamentally socionatural and sociospatial. Furthermore, commodity analyses identify concrete practices and social relations among various actors enlisted through the displacement of commodities.

A commodity analysis would foreground the dissertation's third contribution to UPE, which is to employ an actor-oriented approach that centers on labor and practical activity. Urban metabolism has been deployed outside of UPE (for example in industrial ecology) primarily through the scale of the city, conceptualized as a homogenous territory with a particular agency to drive flows. UPE's notion of urban metabolism is less scale-specific, suggesting that cities are not homogenous units but are instead constituted by socionatural transformations that are multilayered, multi-scaled and unevenly experienced. UPE scholars have disaggregated urban metabolism from the scale of the city by identifying the multiple struggles and contestations that surround environmental change in cities through emphasis on intra-urban environmental politics, environmental justice movements and discursive conflicts. However, one crucial component of urban metabolism that has received less attention is the role of labor in socionatural transformations (see for exceptions Loftus, 2012; Perkins, 2007). This is an odd omission particularly since UPE views urban metabolism as being mediated through labor, broadly understood. Of the 12 case studies in the seminal UPE volume edited by

Heynen, Kaika and Swyngedouw (2006b), for example, only Robbins and Sharp's (2006) essay on the making of turfgrass subjects explicitly discussed actors who labored to produce urban socionatures.

I seek to contribute to efforts in UPE to de-center urban metabolism from the scale of cities to those of individuals or groups by employing an actor-oriented approach that emphasizes concrete labor and practical activities (Ekers & Loftus, 2012; Loftus, 2012; Zimmer, 2010). Both city dwellers and lake producers metabolize commodity flows by working with socionatures according to their own interests and limited by constraints of produced socionatures. These actors perform economic/cultural practices and everyday activities to secure their own livelihoods[5]. Producers, intermediaries and consumers all engage in activities to transform socionature for their own use, albeit in different contexts and implications. In the process, they also produce new socionatures (Ekers & Loftus, 2012).

The dissertation's fourth contribution to UPE is topical. While several UPE studies have focused on the contradictions of urbanization of water, only a few have examined food (see for exceptions Heynen, 2006; Shillington, 2013). This is in contrast to political ecology and its strong tradition of investigating food production in the rural global south (Bassett, 2010; Carney, 1993; Moseley, Carney, & Becker, 2010; Zimmerer, 1991). Political ecologists have situated agrarian food production in the context of global restructuring to analyze how food chain governance and global north

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[5] Strategies to secure livelihoods depend on capability to access a wide range of assets, such as social capital and material resources (Bebbington 1999).

consumption practices shape agro-food systems (Freidberg, 2004; Galt, 2007; Watts & Goodman, 1997). This linking of various sites of production and consumption finds parallels in city-hinterland dynamics of food provisioning.

An extensive literature outside of UPE exists on rural food production for urban consumption, including political ecology and other approaches to social and environmental transformations in rural and peri-urban spaces of production (Freidberg, 2001a; Guyer, 1987; Guyer & Lambin, 1993; Rigg, 1998; Simon, 2008; Simon, McGregor, & Thompson, 2006). Urban food systems have also been examined in the city in terms of historical changes in urban food provisioning, diets and access (Drakakis-Smith, 1991; Freidberg, 2003; Gertel & Kuppinger, 1994; Guyer, 1987). These approaches to urban food provisioning argue that the transformations in the urbanization of food involves not only cities but also nonurban places, a claim that is less empirically established in UPE. In most of these works, however, nature is found only in sites of production. Scholars frame nature as something that is transformed in the process of producing food; moreover, nature is notably absent in cities where the food is consumed. In this regard, a UPE approach can contribute to the urban food provisioning literature by emphasizing the production of socionatures in cities. Urban and nonurban productions of socionatures are two sides of the same coin, and therefore require the simultaneous examination of the historical and socioecological processes that underpin their co-production.

Food, as a material basis of social reproduction, presents an opportunity in UPE to further examine the processes that co-produce "urban" and "rural" socionatures

(Braun, 2005; Keil, 2003; Shillington, 2013). Because much of the food consumed in the cities is produced elsewhere, urbanization is accompanied by corresponding socioecological transformations in these places. Food, itself a socionatural hybrid, embodies these transformations that produce particular socionatures in sites of production. City-dwellers transform food through various cultural and economic practices as it circulates via production, economic exchange and consumption, which in the process produce new socionatures.

The process of metabolizing water and food differs materially when they require transformations to be consumed in cities and are accessed unevenly by city-dwellers. Fish provides a good example. Fish, a perishable biological commodity, requires particular organization of distribution that involves movement across space within a short span of time. Fish exchanges hands several times before it is transformed into food in kitchens, enrolling various actors through its displacement. In sites of production, complex social and a/biotic processes influence fish growth. In this context, the materiality of nature in shaping commodity flows and urban metabolism is an important component of the production of natures.

UPE scholars organize their analysis of the urbanization of nature by employing urban metabolism as a central metaphor. It is a particular understanding of urban transformation that not only carries the promise of dissolving nature-society and urban-nonurban dualisms but also the possibility of change through politics and everyday activities of producing socionatures (Smith, 2006). Therefore, I seek to address the aforementioned gaps in UPE through specific interventions on the urban metabolism approach. First, I extend the scope of UPE's deployment of urban metabolism to transformations and exchanges beyond cities. Second, I place commodity flows as an essential component of urban metabolism in these transformations. Third, I disaggregate urban metabolism as comprised of individual/group transformations centered on practical activity. And fourth, I emphasize the material aspects of urban metabolism by providing an example of how the materiality of nature shapes urban food provisioning. In the next three sub-sections, I provide further discussions of urban metabolism and how it can engage with commodity flows and materiality of nature literatures.

1.2.2 Urban metabolism

Urban metabolism refers to the circulation, exchange and transformation of socionatures in the process of urbanization. The concept developed within a tradition in urban thought that sought to question the entrenched dualisms of nature-society and country-city (Harvey, 1996; Mumford, 1956; Williams, 1973). As a metaphor borrowed from the biological sciences, metabolism is deployed, often with varying conceptual and methodological implications, by a variety of fields. Whereas urban ecology and industrial ecology focus on the measurement of material and energy flows to inform urban governance, political economy and political ecology underscore historical and political dynamics of metabolism.

Framed within notions of urban sustainability, urban metabolism in industrial ecology emphasizes quantification of material and energy fluxes in urban areas through methods such as material flow analysis, mass balance accounting, and life cycle analysis

(Kennedy, Cuddihy, & Engel-Yan, 2007; Pincetl, Bunje, & Holmes, 2012). Following Abel Wolman's (1965) lead, various assessments of existing cities – considered as bounded, homogenous territories – have been undertaken in contexts such as Hong Kong, Toronto, Brussels and Sydney. While useful in measuring input and output flows of energy, materials, nutrients and wastes, the industrial ecological approach has been criticized by several authors for a wide range of reasons. These include inappropriate use of the organism metaphor to refer to complex and open urban systems (Golubiewski, 2012), lack of attention to the political, historical and social processes (Broto, Allen, & Rapoport, 2012; Gandy, 2004; Keil, 2005; Pincetl et al., 2012), technocratic prescriptions for resolving urban socioecological issues (Keil, 2005; Wachsmuth, 2012), and dualistic separation of nature and society (Gandy, 2004; Wachsmuth, 2012). Nonetheless, despite the approach's fetishistic concern with accounting, and its reductionist conception of nature as material fluxes and the city as territorially bounded, it contributes to understanding how material flows link various spaces and natures entangled in urbanization beyond cities.

Metabolism has been employed in an alternative sense in urban political ecology, drawing inspiration from Karl Marx's (1990) reformulation of the biological concept to refer to the mutual constitution of nature and humans in the process of laboring to produce for one's own material conditions (Foster, 2000; Swyngedouw, 2006). This socionatural relation, embodied in the metabolic process of material exchange and transformation, provides the basis for social production, reproduction and history. Metabolism, thus, presents a process-based understanding of nature-society relations by focusing on productive labor. The concept has been deployed in a political economic sense to argue how the development of capitalism has widened “metabolic rifts” between humans and nature and between city and the country (Foster, 2000; McClintock, 2010; Moore, 2000, 2011).

Works within UPE adopt urban metabolism as a metaphor central to understanding socionatures in cities and the urbanization of nature (Heynen et al., 2006a). In place of a systems model that employs metabolism in organicist and functionalist terms (used for example in industrial and urban ecology), urban political ecologists aim to emphasize socionatural relations through a historical and political approach to urban nature. Matthew Gandy (2004, pp. 373-374) remarked that:

> a dialectical or hybridized conception of urban metabolism can illuminate the circulatory processes that underpin the transformation of nature into essential commodities such as food, energy and potable water: the idea of metabolism in this sense derives not from any anatomical or functional analogy but from an emphasis on the interweaving of social and biophysical processes that produce new forms of urban nature in distinction to the rarefied realm of nature which remains dominant within much urban and environmentalist discourse. A scientistic model is replaced by a historically driven conception of urban nature which is rooted in the political dynamics of capitalist urbanization as a contested and multi-dimensional process of urban change.

UPE explicitly frames the urbanization of nature and transformation of socionatures in cities within capitalist relations centered in and embodied by contemporary cities (Perkins, 2007; Swyngedouw, 2006; Swyngedouw & Heynen, 2003). The city-countryside dynamic is conceptualized as a spatial relation of the logics of capital (Moore, 2011) and as dualistic ideas that reflect historical moments in capitalist development and that reinforce particular ideologies (Williams, 1973). The production of urban space associated with capitalist development requires a corresponding material and symbolic production of nature (Braun, 2005; Gandy, 2004; Smith, 2008). The transformative metabolic process that produce natures is also initiated through concrete practices of laboring (Ekers & Loftus, 2012; Loftus, 2012; Smith, 2008). Laboring to produce new things, a transformative act that brings together the human and nonhuman, produces new socionatures. While production is universal regardless of historical moment (Eaton, 2011; Smith, 2008), it is under capitalist relations where the implications of the production of nature on transformations of socioecological relations of places within cities (the urban) and beyond (the rural) become more pronounced and contradictory. Due to capital's constant search to deepen and expand what can be commodified, more places undergo transformations as they increasingly become implicated in the process of creating spatial fixes to the socioecological crises created by capital's contradictions (Harvey, 2003, 2006; Moore, 2011). As a result, the urban frontier is continually expanding (Swyngedouw, 2006).

Urban metabolism is a power-laden and spatially uneven process. The transformation of socionatures through urbanization benefits a group of people or particular places at the expense of others. Urban socionatures are contested through and constituted by social power as a result of attempts of various groups to mobilize their interests (Cooke & Lewis, 2010; Swyngedouw, 2004). Social power is produced and reproduced through the ability to control or gain access to metabolic flows , whether materially, physically, discursively or ideologically (Broto et al., 2012; Heynen et al., 2006a). Swyngedouw (2004) provides an example of how control of where water flows and how it is transformed shaped the history of urbanization of Guayaquil. This resulted in the highly uneven distribution of access to abundant potable water among urban residents.

On the scale of city-hinterland relations, urban metabolism can be reframed as a conceptualization of the city and its sociospatial relations with other, sometimes distant places and ecologies. The city/urban and the country/rural/nonurban are co-constituted in the urban metabolism (Harvey, 1996). This is not an argument that cities have a distinct agency to metabolize other places – as proposed, for example, in industrial ecology (Gandy, 2004; Golubiewski, 2012) – but rather that various concrete acts, practices and relations by groups or individuals constitute this urban-rural metabolism. Attention to these activities and practices allows us to disaggregate urban metabolism and to identify which groups control and benefit from production of particular socionatures.

1.2.3 Commodity flows

Metabolism is a process, and flow is an important metaphor to describe its dynamics. Flows imply movement and circulation, both of which are constituted by various sociospatial and socionatural relations (Kaika, 2005; Swyngedouw, 2006). The concept of flows connects the urban and nonurban. Driven by similar processes, urban and nonurban metabolisms produce socionatures, albeit in different contexts. As Heynen et al. (2006a, p. 5) remarked:

> In capitalist cities, nature takes primarily the social form of commodities. Whether we consider a glass of water, an orange, or the steel and concrete embedded in buildings, they are all constituted through the social mobilization of

> metabolic processes under capitalist and market-driven social relations. This commodity relation veils and hides the multiple socio-ecological processes of domination/subordination and exploitation/repression that feed the capitalist urbanization process and turn the city into a metabolic socio-environmental process that stretches from the immediate environment to the remotest corners of the globe. The commodification of nature also permits imagining a disconnection of the perpetual flows of metabolized, transformed and commodified nature from its inevitable foundation, the transformation of nature.

Various UPE works have focused on metabolic transformations of socionatures in the lived environments of the city. However, city-dwellers also encounter socionatures through circulation of commodity flows produced elsewhere. In the sphere of exchange, commodities become mere objects with exchange value, rather than social relations that embody socioecological transformations in other places. The example of food as transformed socionature is illustrative. Since the city sources most of its food from outside, city-dwellers consume food primarily as commodities via market exchange. Under capitalist relations, this exchange severs and veils the historical and socioecological conditions of production through a fetishistic reification of the thingness of commodities (Castree, 2001, 2004; Kaika & Swyngedouw, 2000; Loftus, 2006). However, food is also further metabolized and transformed through various practices in order for it to be consumed.

The socioecological transformations to enable the production of commodities (i.e., production of “nonurban” natures) require various aspects of commodification linked to cities through flows. Capitalism continues to geographically stretch and deepen the scope of the commodity form (Prudham, 2009), thereby expanding the reach of urbanization (Brenner & Schmid, 2012; Smith, 2008; Swyngedouw, 2006). Smith (2008,

p. 71) argued that, "capital stalks the earth in search of material resources; nature becomes a *universal means of production* in the sense that it not only provides the subjects, objects, and instruments of production, but also in its totality an appendage to the production process."

Privatization, alienability, individuation, abstraction, valuation and displacement are crucial elements in this commodification of nature and its transformation to an exchange value (Castree, 2003). The first four processes rely particularly on the role of the state to enable commodity production through various interventions. These include enclosures and changes in property rights that displace people from their means of production, sometimes violently, in the continuing process of primitive accumulation (Glassman, 2006; Hall, 2012; Harvey, 2003; Kloppenburg, 2004; Mansfield, 2004; Nevins & Peluso, 2008; Peluso & Watts, 2001; Sneddon, 2007). Commodification also necessitates the production of knowledge about nature, which is often mobilized through scientific institutions and which makes both natures and spaces legible for governance and measurable for valuation through their objectification (Kloppenburg, 2004; Prudham, 2003; Robertson, 2006; Robertson & Wainwright, 2013; Scott, 1998). In these sites, the production of commodities and resources out of nature often results in ecological contradictions, political contestations and social movements that need to be managed constantly through institutional and ideological means (Bridge, 2000; Bridge & McManus, 2000; Huber & Emel, 2009; Kaup, 2008; Prudham, 2005). Inextricably tied to urban metabolism, these practices and dynamics together constitute urbanization's production of nonurban socionatures.

Displacement, meanwhile, creates flows and reinforces links between spaces as commodities travel from sites of production to sites of exchange and consumption. Scholars within the commodity studies literature have explored various aspects of displacement and the geographical lives of commodities (Castree, 2004; Cook & Crang, 1996). In economic sociology, economic geography and agro-food studies, the commodity chain was developed as an umbrella term (for other concepts like *filiere*, commodity system, global commodity chain, global value chain and global production network) that examines the social organization surrounding commodity flows as these enroll groups of actors, firms, places and relations (Bair, 2009; Gereffi, Korzeniewicz, & Korzeniewicz, 1994; Hughes & Reimer, 2004; Stringer & Le Heron, 2008; Watts, 2005). Cultural economic and material cultural approaches, meanwhile, have emphasized the material-discursive reconfiguration and cultural constitution of commodities as they move in and out of commodity states (Appadurai, 1986; Cook, 2004; Hudson, 2008; Mansfield, 2003a, 2003b; Miller, 1998; Robbins, 1999).

Approaching urban metabolism through commodity chains broadly understood offers potential conceptual and methodological contributions. First, commodity chains bring together seemingly unconnected places and distantly related groups of people through a focus on flows. Tracing commodity flows allows us to identify actors that mediate, and historical processes that create and maintain these flows. Commodity chains create spatial and temporal “fixing” of flows through everyday interactions between groups of people and the daily acts of laboring to metabolize commodities (Hudson, 2008). In this sense, metabolic practices at the scale of bodies, homes or farms also constitute the metabolic flows between cities and hinterlands. While indeed there are no limits to a city constituted by multiple flows from everywhere, following commodities examines the complex historical-geographical processes of the "fixing" of a specific commodity flow, such as the case of farmed lake fish destined for urban consumption. These processes necessarily include the material and symbolic production of urban and nonurban socionatures at various scales in order for commodities to be produced and displaced.

Second, commodity chains describe the social organization of commodity flows, and identify the direct social and power relations between different groups of actors in different nodes of the chain (Bair, 2005). These include mapping distribution of benefits – a central concern in urban metabolism studies – within chains through notions of institutions, access and exclusion, as well as through practices that shape the structure and governance of the commodity chains (Coe, Dicken, & Hess, 2008; Gereffi, Humphrey, & Sturgeon, 2005; Raikes, Jensen, & Ponte, 2000; Ribot, 1998). Various agents in the chain unequally capture benefit from flows as a result of differences in market power, connections with the state, and social differentiation (e.g., urban elite influence over small-scale producers). Explicitly political economic commodity chain approaches seek to contextualize these direct and concrete social relations not only by historicizing commodity flows but also by framing relations as expressions of abstract power associated with circulation of value through the commodity (Bernstein, 1996b; Bernstein & Campling, 2006a; Starosta, 2010; Taylor, 2007). In this context, commodity flows and co-production of urban/nonurban socionatures are inseparable from the dynamics of capital and labor, both in the concrete and the abstract. Emphasis on history and power relations simultaneously socially embeds commodity chains and urban metabolic material flows.

Third, cultural economic approaches to commodity chains overlap with the meaning-production aspect of urban metabolism. This highlights the inseparability of material and discursive transformations of socionatures as they circulate in commodity form through exchange and consumption. For instance, Maria Kaika and Erik Swyngedouw (2000, p. 121) note in the case of commodification of water that "nature itself becomes reinvented in its urban form…and severed from the grey, muddy, kaleidoscopic meanings and uses of water as a mere use-value". Nature is largely absent or invisible in commodity chain approaches, and is often relegated to a component of the metabolic process in the realm of production (Bernstein & Campling, 2006a; Goodman, 1999, 2001). Urban metabolism's notion of socionatures suggests that commodities undergo material and discursive transformations even as they are metabolized in cities. It is thus important to examine material and symbolic practices that attempt to smoothen or overcome obstructions, frictions and blockages in the flows of commodities.

1.2.4 Materiality of nature

Metabolic processes and the production of commodities encounter nonhuman natures that are neither inert nor passively acted upon by the agency of humans. Focusing on the co-production of socionatures suggests that the materiality of nature matters in significant ways (K. Bakker & Bridge, 2006; FitzSimmons, 1989; Goodman, 2001). Materiality, in this context, pertains to the “ontological existence of those entities we term ‘natural,’ and the active roles those entities play in making history and geography” (Castree, 1995, p. 13). The materiality of nature is central in the historical process of production of socionatures as much as what we term the “social”.

Scholars in agrarian political economy presented early attempts to put matters of nature centrally in theorizing capitalist production in nature-based industries. Starting with the recognition of natural obstacles to capitalism and agriculture’s recalcitrant materiality (Mann, 1990; Mann & Dickinson, 1978), volumes by Goodman, Sorj, and Wilkinson (1987), Henderson (1999) and Kloppenburg (2004) showed how capital overcomes, circumvents or takes advantage of the problem that nature poses in agriculture through the processes of appropriation, substitution, circulation and primitive accumulation. In an attempt to put these arguments together in a coherent framework, Boyd, Prudham, and Schurmann (2001) argued that capital in nature-based industries confronts the problem of nature either through the ”formal” subsumption of nature in extractive, abiotic industries such as mining, or the ”real” subsumption of nature in biological industries such as agriculture. The materiality of nature in political economic discussions in various nature-based forms of production has also been explored in terms of its implications on institutions, scale and dispossession, among others (Bridge, 2000; Bumpus, 2011; Huber & Emel, 2009; Kaup, 2008; Sneddon, 2007).

In this tradition, materiality of nature matters in the production of socionatures as it shapes social relations of production, including the organization of labor processes, institutions, and relations between producers (Benton, 1989; Mann, 1990; Prudham, 2005). Producing water or producing through water, for example, encounters material properties distinct from land-based production, such as fluidity, circulation, and the complex biotic/abiotic factors that comprise water quality (K. Bakker, 2004; Fougeres, 2008; Mansfield, 2004; Sneddon, 2007). These properties have implications on the development of capitalist relations in agriculture and their relations with industrial capital and non-capitalist production (e.g., peasant and subsistence production). Nature is thus central to the agrarian question (Akram-Lodhi & Kay, 2010; Kautsky, 1988; Mann & Dickinson, 1978). Therefore, in order to understand metabolic processes through the lens of co-production, we need to pay attention to the "lively" materiality of nature as it is constituted by and as it constitutes metabolic flows. Focusing on how producers metabolize material natures through concrete and various acts of laboring, the locus of the socionatural metabolic process, is a crucial undertaking.

Materiality of nature also influence commodity flows. Perishability and freshness, for instance, has historically shaped trajectories of food production, distribution and consumption (Freidberg, 2009). Materiality can also illuminate commodities and their geographical lives beyond sites of production (K. Bakker & Bridge, 2006; Miller, 1998). This cultural approach to the material allows discussion of practices and laboring with nature, as well as changing meanings in the exchange and consumption spheres. In cities, for instance, city-dwellers encounter socionatures through commodities that require both material acts and symbolic changes in meaning in order for them to be transformed and metabolized.

1.3 Research objectives and strategies

I organize the dissertation around three research objectives that address the three components of the research question. I employ the co-production of natures through urban metabolism framework in order to weave a narrative from different threads that center on commodity flows situated in various sites.

1.3.1 Which socioecological transformations enable and result from aquaculture in Laguna Lake?

First, I describe the production of Laguna Lake as a resource through aquaculture, and the corresponding socioecological transformations associated with its introduction. I undertake an institutional-organizational history of state and scientific interventions in Laguna Lake beginning with the creation in 1966 of the Laguna Lake Development Authority (LLDA), the state body that governs the lake. This account includes discussion of various infrastructure developments, research projects, livelihood programs and territorial regulation designed to enable, maintain and manage the production of fish through aquaculture. These efforts aim to improve aquaculture by working to produce better fish, improve production techniques and change lake water conditions, often through simplifications of complex lake socioecologies.

I also trace the historical transformation of socioecological relations in the lake as a result of aquaculture expansion. Aquaculture introduced a distinct method of producing fish that changed existing relations of production among lake villagers and created radically new ones. The entry of urban capitalists and corporations through fishpens resulted in the reconfiguration of property rights, displacement of traditional fishers from their fishing grounds, and social conflicts in the lake. Stationary aquaculture production with fixed property rights to fish contrasted with traditional mobile subsistence capture fisheries that follow fugitive fish regardless of location. Resulting social conflicts between producers ranged in form from furtive poaching to overtly violent encounters between pen producers and fishers. Aquaculture, however, became the primary livelihoods for some lake fisherfolk through fishcage production. This has led to dual trajectories of aquaculture development in the lake: a capitalist, large-scale aquaculture that employs migrant wage labor coexists with a household-based, small-scale aquaculture based in the villages. Furthermore, the expansion of aquaculture, specifically reflected in the fishpen sprawl of the 1980s, transformed lake ecologies as a condition of production, which continues to be shaped by productive activities (e.g., agriculture and industrialization) and urban processes (e.g., wastes, floodwaters and drinking water extraction) outside the lake.

I situate this history of reworking of lake socionatures within the state's dual desire to produce fish for urban consumption and to offset declining commercial capture fisheries catch by relying on aquaculture. State plans sought to take advantage of the unique eutrophic character of the lake to produce food at a low cost by converting abundant nutrients to consumable protein for a growing megacity. Plans viewed subsistence lake capture fisheries as incapable of this task, in marked contrast to their espousal of the promise of control, ordering and stability associated with aquaculture commodity production. Through aquaculture, the lake, therefore, became "fixed" to the city as supplier of cheap fish commodities, which have been produced primarily by large fishpens operating under capitalist relations. Furthermore, this fixing of commodity production transformed socionatures by reconfiguring social and ecological processes in the lake. Aquaculture in Laguna Lake has also been touted as part of the solution to the crises in commercial ocean fisheries experienced in the city through higher marine fish prices. In terms of the question of urban social reproduction and fish consumption, aquaculture presented an opportunity to produce affordable fish for low-income city-dwellers. I show, however, that this requires practices to make farmed freshwater lake fish more acceptable to fish consumers.

The case of Laguna Lake aquaculture contributes to understanding the complex dynamics of the production of nonurban socionatures tied to the city through commodity flows. In this sense, the socioecological transformations in Laguna Lake are inseparable from urbanization processes (and production of urban natures) in Manila. However, focusing on sites of production and on state and producer interventions provides only a partial picture of urban metabolism. The materiality of nature in shaping commodity production, and the practices that constitute commodity flows in the spaces of exchange (e.g., production of urban socionatures via fish flows) both deserve equal attention.

1.3.2 How does the materiality of nature shape aquaculture production in the lake and fish flows to the city?

My second objective is to examine how the materiality of nature shapes aquaculture production and how producers work with dynamic materialities of water-based production. Laguna Lake, a complex assemblage of socionatures, is not a passive and inert entity that is acted upon by humans and encountered in production unproblematically. On the contrary, materiality of nature matters in crucial ways to the organization of production, the work that producers do to grow fish, and the characteristics of commodity flows. I examine the practices, social relations of production and village differentiation associated with pen and cage aquaculture.

I discuss the materiality of nature in Laguna Lake aquaculture through frameworks developed in resource geographies, political ecology and agrarian political economy that consider how the material matters in the capital-labor-nature nexus. I show how the dual trajectories of aquaculture – pens as capitalist and cages as less capitalist – are shaped by the constraints and opportunities of producing in a eutrophic, periurban lake that experience seasonal saline fluxes. In contrast to land-based production, I identify various materialities that allow pens to produce fish at a much cheaper cost but that simultaneously constrain their intensification and expansion. These also configure deployment of labor in pens, and their relations with other lake producers.

I take the case of two villages to illustrate how the shift from traditional capture fisheries to small-scale cage aquaculture is partial, nonlinear and spatially uneven. Cage producers encounter the materiality of the lake through responses that align with social differentiation and ability to take advantage of the opportunities of aquaculture. Villagers continue to work with the dynamic materialities of nature that are increasingly transformed by large-scale pen operations, state interventions and urban activities. I identify the ways that lake villagers produce socionatures by laboring with lake natures not necessarily of their own choosing.

Materiality also matters in the spheres of exchange and consumption. I present examples of how material properties in the lake shape commodity transformation in cities. In sum, emphasizing the lively materiality of nonhuman nature and the work associated with metabolism highlights the mutual constitution of nature/society in the production of socionatures. However, urban metabolism is forged through uneven processes that reflect uneven relations of social power to access or benefit from flows.

1.3.3 Which social relations constitute fish flows from lake to city and how do actors benefit from these flows?

My third objective is to examine the processes by which particular groups benefit from the urban metabolism of commodity flows from Laguna Lake. By following the "thing," I aim to construct a narrative of fish flows through commodity chain analysis. Through this method, I characterize the material commodity flows between the lake and the city, identify groups or individuals that work to constitute these flows, and describe the social relations and concrete practices involved in the displacement and transformation of fish commodities. These are, of course, embedded in historical processes that may not necessarily be readily visible in commodity flows, but that shape the everyday relations between groups of people.

I aim to characterize both material commodity flows and the social relations that constitute them to emphasize the social embeddedness of commodity chains fixed in urban metabolism. Urban metabolism does not simply imply a homogenous entity (the city) transforming nature from elsewhere (the countryside). Rather, various everyday and concrete material and interpretive practices surrounding commodities comprise urban metabolism. This process is uneven and power-laden, as commodity flows and metabolisms are mobilized toward the interests of some over others. I employ the access analysis framework in tandem with commodity chain analysis to excavate the mechanisms that enable or constrain access of groups or individuals to flows of fish. These mechanisms shape commodity flows from sites of production to consumption.

Commodity chain analyses have primarily focused on inter-firm relations and drivers that govern the often global chains. I contribute to this literature by presenting narratives that foreground the importance of place, non-firm actors, and labor in exchange in commodity chains more than just mere context. Nature outside the realm of production is also largely absent or invisible in commodity studies. By complementing commodity chain analysis with material cultural approaches, I describe practices of transforming fish commodities that simultaneously produce new (urban) socionatures. I take the example of the bighead carp, a farmed Laguna Lake fish introduced to address problems associated with the materiality of lake production. As the cheapest fresh fish available in the city, bighead carp has been used as a substitute for more expensive marine fish supplied by an increasingly problematic commercial fisheries sector. However, I narrate how this process involves practices that distance the fish from its farmed freshwater lake origins and characteristics to encourage urban consumption. The social biographies of bighead carp not only reflect urban-rural relations but also contrast lake and city production of socionatures.

Direct social relations between actors and mechanisms of access in the commodity chain are concrete slices of broader historical geographical processes that embed commodity flows. Laguna Lake aquaculture, for example, plays a role in maintaining the social power of urban elites in the Philippine fishing industry by providing a fix to problems in commercial deep-sea fisheries. Furthermore, cheap Laguna Lake farmed fish have played a significant role in the social reproduction of city-dwellers in light of rising costs of marine capture fish, framed by the state and pen producers as an urban food security issue. Laguna Lake therefore can be viewed as both a sociospatial fix to the problem of urban fish provisioning and socionatural fix to the crisis in commercial capture fisheries.

By narrating the production of Laguna Lake through aquaculture development, I aim to contribute to urban political ecology by providing an account of socioecological transformations that weave urban-rural relations and that center on commodity flows. Urban metabolism presents a theoretical framework that sheds light on the co-production of socionatures in both the lake and the city. Policy-related discussions of lake governance, livelihood and ecological sustainability, and urban food security therefore need to take into account the complexities of this co-production.

1.4 Organization of the dissertation

This chapter presents an overview of the research questions, objectives and theoretical frameworks that will be used in the subsequent chapters. In Chapter II, I describe the study area and outline research design. I also situate the context of the field research and its challenges.

The succeeding five chapters are grouped into two parts. The first part (Chapters III to V) details how the state made the lake to produce fish through aquaculture which, in the process, produced lake socionatures that confront aquaculture producers. The second part (Chapters VI and VII) examines the processes by which fish commodities from the lake flow to the city, and the corresponding mechanisms of gaining benefits from these flows. While the first part deals with the production of "nonurban" socionatures and the second with "urban" socionatures, this separation is meant not to reinforce dualisms between the urban and nonurban but rather to help organize the narrative.

Chapters III, IV and V focus on processes within Laguna Lake. Chapter III describes the institutional-organizational history of Laguna Lake aquaculture ("blue revolution"). I trace the process of aquaculture introduction and improvement, emphasizing state and science interventions in the lake and in fish production. These interventions include hydraulic control projects, livelihood programs and research programs aimed at creating better fish, production techniques and lake environments. I also describe the dynamics by which entry of urban capitalists and fishing corporations resulted in social conflicts between producers and ecological contradictions that continue to impact traditional users of the lake. I argue that state interventions relied on simplification of complex lake socioecologies. Also, aquaculture development in the lake resulted in further social differentiation, displacement of subsistence users, emergence/resurgence of elites, and contradictory socioecological transformations in the lake.

In Chapter IV, I examine how the materiality of nature shapes Laguna Lake aquaculture. I argue that water-based production presents distinct dynamics from those on land. The result is a historically and geographically specific organization of aquaculture production that seeks to work with and around the materiality of nature. I take the examples of saltwater intrusion, reliance on planktons and fish as fugitive commodities to explain the continued coexistence of capitalist and less capitalist forms of aquaculture production. I also describe the constraints and opportunities to capitalist aquaculture expansion presented by the lake's materiality.

Chapter V situates the interventions discussed in Chapter III and the materialities in Chapter IV through the perspective of producers in Laguna Lake fishing villages. I take the case of two villages with differing degrees of engagement with aquaculture to illustrate the changes in social relations of production as a result of aquaculture introduction. I also describe how aquaculture territorialized fish access and how villagers view and respond to the implications of these state interventions. I illustrate the ways that village producers rework lake socionatures in the context of the materiality of saltwater intrusion, typhoons, and spread of invasive fish. I argue that these practices produce socionatures in the villages but that these are embedded in social differentiation and local histories.

Chapters VI and VII extend the narrative to various sites in Metro Manila. In Chapter VI, I employ a commodity chain and access analysis approach to characterize the commodity flows of Laguna Lake fish from production to consumption. I identify actors involved in these flows, the relations between them, and the mechanisms by which they influence and gain access to the benefits provided by these flows. I move beyond the traditional actors in commodity chain analyses to include labor in exchange and to ground chains in place through a focus on specific urban neighborhoods. I argue that pens and brokers derive greatest benefits from and exert the most influence in these flows. I claim that Laguna Lake aquaculture presents an opportunity for city-based fishing corporations who operate the largest pens and brokerage firms to expand control of fish flows to the city. This opportunity is situated in the context of stagnation in commercial marine fisheries and the increasingly significant role of aquaculture in providing fish for urban consumption.

Chapter VII presents a social biography of a Laguna Lake farmed fish to highlight the contradictions and complexities in the urban metabolism of commodity flows. I examine flows of bighead carp from production to exchange and consumption, and the practices that transforms the fish materially and symbolically. I argue that commodity chain actors smoothen commodity flows and make the fish more acceptable for urban consumption. Used as a cheap substitute for marine fish, bighead carp also reflects broader aquaculture-capture fisheries dynamics. As the most affordable fish in the city, bighead carp (and cheaper Laguna Lake farmed fish in general) plays an important role in the social reproduction of low-income city-dwellers.

Finally, I summarize the major findings of the dissertation in Chapter VIII. I organize this concluding chapter around the three research objectives and four contributions to UPE discussed earlier in this chapter.

CHAPTER II

STUDY AREA AND RESEARCH METHODS

This chapter presents an overview of the study area and a discussion of the methods I employed in the research. I begin by providing a context of the multiple sites and actors that comprise the field research. I also detail the research methods I used to gather and analyze data. In the final section, I describe the circumstances and challenges that shaped the research project.

2.1 Situating the study area

2.1.1 Laguna Lake and Metro Manila

Laguna Lake[6] (90,000 ha) is the largest inland and freshwater lake in the Philippines (Figure 2.1). The Pasig River, its only outlet to the sea, provides a channel for saline backflow to the lake during drier seasons when lake water levels fall below sea level. The lake is highly eutrophic due to the abundance of nutrients that encourages growth of phytoplankton. This property served as one of the primary justifications for the state introduction of extensive aquaculture. The lake's average depth of 2.5 m continues to decrease as a result of significant siltation from surrounding activities, which contributes to its seasonally turbid condition that in turn constrains fish growth. The saline flux from Manila Bay through the Pasig River regularly improves water

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[6] Laguna Lake is also known as Laguna de Bay, which translates to "Lake of Bay." Bay (Ba'i) is a small town on the southern shore of the lake. The province of Laguna borders the southern, eastern and western shores of the lake.

condition by helping reduce turbidity and encouraging plankton production. These limnological processes have historically supported capture fisheries in the lake, and since 1970, aquaculture production.

Figure 2.1 Laguna Lake, Metro Manila and Calabarzon Region (Basemap source: World Topographic Map, Esri)

The state introduced aquaculture as the blue counterpart to the green revolution, embodying parallel aims of improving food production through radical technological and institutional changes (see Chapter III). While land-based pond aquaculture has a long history in the Philippines, Laguna Lake was the first to host extensive commercial water-based aquaculture in the country. Coincidentally, the global center of green revolution in rice, the International Rice Research Institute, is also located along the shores of the lake.

Aquaculture production in the lake surpassed capture fisheries production only a few years after it was introduced (Figure 2.2). From a peak of 85,000 metric tons in 1985 and a near collapse in the mid-1990s, aquaculture production has since posted an average annual growth of 14%. Production of cultured species also outpaced the 14 indigenous species in both the aquaculture and capture fisheries sector.

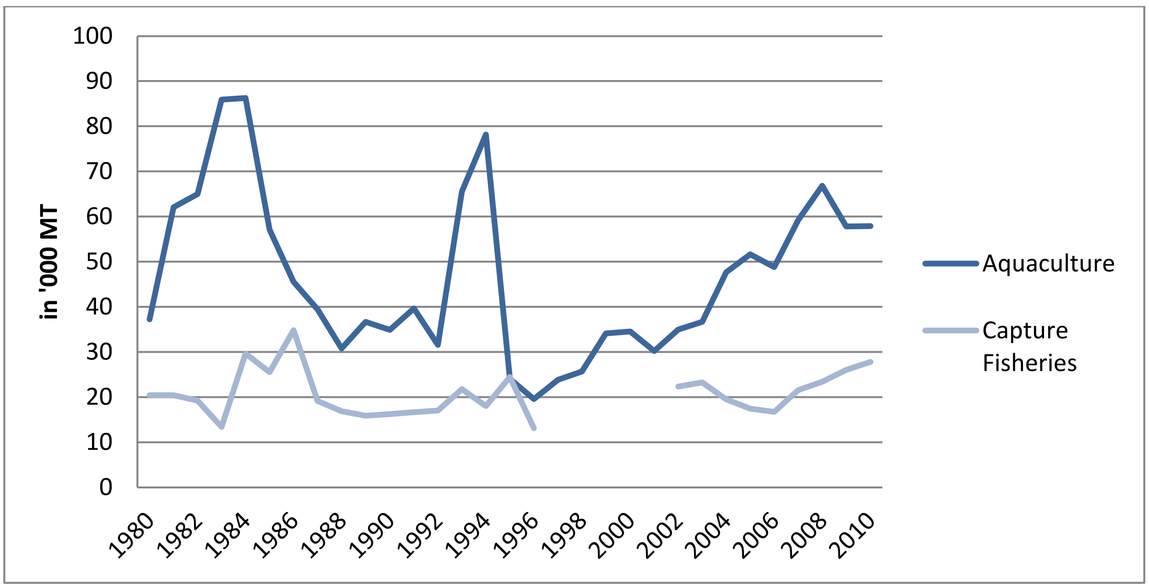

Figure 2.2 Laguna Lake fish production through aquaculture and capture fisheries, 1980-2010. (Source: BAS data 2011; LLDA, 1995b; NSCB, 1999)

Among the introduced fish species, milkfish (*Chanos chanos*), tilapia (*Oreochromis niloticus*) and bighead carp (*Hypophthalmichthys nobilis*) are the three most commonly produced in fishpens and fishcages, which are the two aquaculture production systems present in the lake (see Chapter IV for a detailed discussion of these two systems).

Capture fisheries production, meanwhile, declined during the aquaculture boom. It has since stabilized at around 25,000 MT annually, which is almost half the pre-aquaculture (pre-1970) production figures. Aquaculture radically transformed the fish catch composition of capture fisherfolk. In 2008, for example, introduced species for aquaculture such as tilapia and bighead carp comprised close to three-quarters of the open water fish catch, whereas almost all indigenous species declined from their pre-aquaculture levels in 1968 (see Figure 2.3).

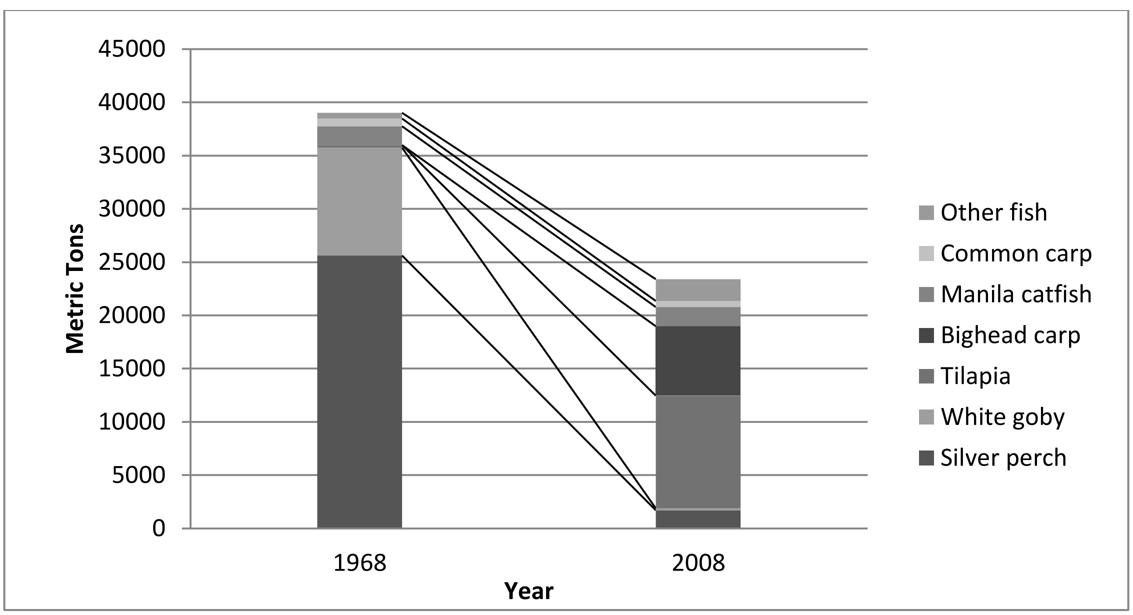

Figure 2.3 Laguna Lake open water fishery catch (excluding aquaculture), 1968 and 2008 (Source: Mercene, 1987; BAS 2008 data)

Fisheries and aquaculture production align with climatic patterns and disturbances. The monsoons – the wetter *habagat* (May to September) and the cooler *amihan* (December to March) – influence the types of species caught in capture fisheries and the cycle of production in aquaculture. Recurring typhoons, occasionally accompanied by strong winds and massive flooding, cause significant damages to pen and cage structures. The seasonal backflow from the Pasig River brings a mixed blessing of both salt-rich water that clears the lake for increased fish productivity, and polluted water that threatens fish health (Chapter IV).

Aquaculture produces most of the fish in the lake and pen and cage structures occupy 15% of total lake waters. While at least 3,000 lake producers engage in small-scale cage aquaculture, 35,000 fisherfolk still make a living from capture fisheries using various active and passive gears (Israel, 2007)[7]. The result is a complex mixture of livelihoods in lake fishing villages that include traditional capture fisheries production, recently-introduced aquaculture production and other fish-related activities (Chapter V). Aquaculture development in the lake and the surrounding activities in urban Metro Manila and industrializing Calabarzon region, however, have increasingly shaped fisherfolk livelihoods.

With a quarter of the country's population, Metro Manila and Calabarzon comprise the country's urban and industrial core. These two regions produce half of the

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[7] The figure for cage aquaculture includes only those producers who registered with the LLDA. Other examples of people engaged in aquaculture not included in this figure are traders, seed producers, agents and laborers. The figure for capture fisheries is the most recent estimate for total fisherfolk population. Other studies, such as those of BAS and Palma (cited in Palma et al. 2005), estimate lake fisherfolk population to range between 3,055 and 6,833. Based on my field work observations and on municipal profiles I collected, these numbers are unrealistic.

gross domestic product and two-thirds of value-added manufacturing, in addition to providing two-thirds of the country's manufacturing employment (Lambino, 2012; Shatkin, 2008). From a colonial gateway for export crops, Metro Manila expanded rapidly in the latter half of the 20th century to become Southeast Asia's second largest megacity. While population growth has slowed in the last decade, it continues to attract flows of global capital, particularly as a result of the state's recent neoliberal thrust to promote public-private partnerships (Ortega, 2012; Shatkin, 2004, 2008; Tyner, 2006). However, inequality in incomes and housing tenure remain pronounced, reflected in the landscape juxtaposition of slums and skyscrapers. While three-quarters of the urban population belong to the lower and extremely lower classes, between 25%-40% live in informal settlements (Ali & Porciuncula, 2001; Arn, 1995; Berner, 1997; Shatkin, 2004).

With goals to de-center Manila's economic primacy, the state embarked on the Calabarzon Project, a regional industrial development plan which carved a separate administrative region composed of five provinces immediately south of Metro Manila (DTI, 1991). This export-oriented program aimed to attract foreign direct investment by creating industrial estates and special economic zones. Combined with real estate development fueled by remittances from overseas Filipino workers, industrial development embedded in an agricultural landscape resulted in *desakota*, an urban-nonurban spatial pattern observed in many Asian cities (Kelly, 2000; McGee, 1991; Ortega, 2012). The industrial program and housing boom resulted in rapid social and ecological transformations, including land conversion, farmer displacement, and high in-migration from other rural regions of the Philippines (Canlas, 1990; Kelly, 2000; Lasco & Espaldon, 2005; Ortega, 2012).

Laguna Lake is situated in the midst of rapid Manila urbanization and Calabarzon industrialization. Aquaculture was introduced in Laguna Lake in part to produce more fish for an urban population, with the lake serving as Manila's "freshwater fish bowl" (Lasco & Espaldon, 2005, p. 39). However, with urban and industrial demand for cheap water and sink, the state has increasingly reimagined Laguna Lake as a multi-purpose resource that would serve various stakeholders (LLDA, 2007; RDC, 2011; Sly, 1993).

2.1.2 Major actors and the study sites

Flows of fish link the lake with the city and involve various actors in different sites. The year-long field research that commenced in January 2012 sought to identify these actors and sites. I began fieldwork in Laguna Lake villages, where fishers and small-scale cage aquaculture producers are based. I also visited fishpens, whose structures are in the middle of the lake but whose owners live in the city. Field research also brought me to the sites of fish exchange in municipal fishports and the Manila wholesale fish market. In these places, traders and brokers facilitated the movement of fish to wholesalers, retailers, and end consumers.

In Laguna Lake, I spent three months in two villages (*barangay*s) of two municipalities – Binangonan and Cardona – considered as the fishery center of Laguna Lake. Together, these neighboring towns located on the north-central shore accounted for approximately half of aquaculture area and half of capture fishefolk population in Laguna Lake. Cardona is the site of the earliest aquaculture experimental farms, and Binangonan still hosts an aquaculture research station. The administrative boundary of these municipalities cuts across the peninsula that juts into the lake and that almost connects to Talim Island (locally known as *Isla*), a narrow, rugged island that bisects the lake. Aside from charcoal making and limited swidden agriculture, the people of Talim Island primarily depend on the lake for their livelihoods.

I chose two villages from these municipalities as detailed case study sites: Navotas and Kalinawan. The choice is partly due to chance – I was able to establish contacts first with their village officials via the municipal governments – but also due to their differing engagements with aquaculture. Located at the northernmost tip of Talim Island, the village of Navotas hosts a diverse set of lake-oriented economic activities, including fishing (of all gears and techniques), fishcage nursery/grow-out, trading, and fishpen-related work, to name a few. Further north on the mainland but often considered part of *Isla* is the village of Kalinawan, known for its large two-storey houses that are products of the village's prosperity in tilapia cage nursery culture. Whereas one can find a variety of livelihoods based on the lake in Navotas, Kalinawan villagers are almost exclusively aquaculture producers. The contrast between the two villages provided me an entry point to understand the different impacts of aquaculture introduction on lakeshore people, ecologies and livelihoods.

In Manila, I spent most of my time in urban markets of varying sizes – wholesale, major retail and minor neighborhood markets that sold lake fish. The Navotas

Fish Port Complex[8], the biggest fish landing site in the country and Southeast Asia's biggest fish market, is located 10 kilometers north of Manila's old city center. Also referred to by lake-based traders as "Malabon" and "Boulevard", the fish port complex is where thousands of tons of fish of all kinds are unloaded, including those of the inland freshwater fisheries of Laguna Lake. From the fishport, wholesalers and retailers transport the fish to Manila markets and throughout Luzon. The next section describes the methods I used in the research.

2.2 Methods

2.2.1 Following the fish through multi-sited ethnographic methods

The research employs qualitative and multi-sited ethnographic methods (Freidberg, 2001b). A multi-sited approach is necessary to examine flows and relations of fish in various places, such as lake villages, urban markets and urban neighborhoods. The approach enabled me to follow the geographical lives of the fish commodity from fry to food, and to examine the social practices and relations that constitute them (Cook, 2006; Freidberg, 2004; Ribot, 1998). While the spatial scope of these fish flows is domestic, Burawoy's (2000) extended case method provided a guide for doing fieldwork in various sites. This realist method emphasizes considerations of research-subject relations, the multiple spatial and temporal scope of the research involving various

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[8] Navotas Fish Port Complex is located in the city of Navotas, Metro Manila. This is a different place from the Navotas village in Laguna Lake. In succeeding sections I will use the term "urban wholesale fish market" to refer to the Navotas Fish Port Complex to avoid confusion.

agents, the macro processes that constitute the context, and flexible engagement with theory.

Ethnographic methods I employed in various study sites include semi-structured interviews, informal interviews and participant observation. These were supplemented by gathering of published and unpublished documents. I planned on administering household surveys in two lake villages, but canceled them because of flooding in the lake (see section 2.3). The succeeding sub-sections elaborate each method used to collect and analyze data.

2.2.2 Interviews

I conducted semi-structured interviews with 103 fish commodity chain actors and other informants in the lake and the city. Table 2.1 summarizes the profile of interviewed informants according to their primary occupation or livelihoods. Lake residents employ multiple livelihood strategies either seasonally or simultaneously. For example, it is common for tilapia cage nursery operators to have tilapia cage grow-out, bighead carp nursery, and fish corrals. Traders and the laborers they employ are also often fish producers themselves. Thus, the categories in Table 2.1 should be seen as flexible, dynamic and porous.

Table 2.1 Number of research informants according to primary occupations

Category	Informants
Lake producers	***51***
• Fishers (gill, push, cast nets, drift long lines and push nets)	10
• Cage nursery/grow-out owners	34
• Pen operators	4
• Bighead carp hatchery owners	3
Intermediaries	***29***
• Traders/assemblers (*naghahango*/*digaton*)	7
• Brokers/broker caretakers	4
• Wholesale buyers	1
• Retailers/market vendors	3
• Supermarket administrator	1
• Fishport laborers (*batilyo*)	8
• Trading laborer (*tauhan*)	3
• Agents/boat owners/purse seiners (*takibo*)	2
Urban consumers	***9***
• Lower-income	7
• Middle-income	2
Government officials	***7***
NGOs	***5***
Scientists	***2***
Total	***103***

I conducted interviews with 51 producers from two lakeshore villages, most of whom were small-scale fishcage nurseries or grow-out operators (34). These cage nursery (*semilyahan*) operators breed and rear tilapia fry and fingerlings in the lake waters. They also rear bighead carp fingerlings through a process called "trading." I also talked to 10 fishers who used varying fishing gears such as gill nets (*pante*), motorized push nets (*sakag/suro*), cast nets (*dala*), drift long lines (*kitang*) and fish corrals (*baklad* and *skylab*). I use the term "fisher" in the dissertation to refer to producers who capture fish independently in small groups (usually two to three men in a boat with gill or cast nets), to those who own passive gears (fish corrals), and to the crew members of larger fishing boats with five to fifteen men (usually in motorized push nets boats). I also interviewed four medium-sized fishpen operators based in Manila, and three lakeside bighead carp hatchery owners who produce fry by induced spawning in inland tanks. Among producers, fishpen operators require the most capital investments, followed by bighead carp hatchery operators, fishcage operators and small-scale fisherfolk.

I interviewed 29 informants in the exchange nodes of the fish commodity chain, which encompasses a wide variety of lake, city, and lake-to-city actors. Traders (*naghahango*) are lake-based intermediaries who harvest and buy fish from pens and cages, and sell them in the urban wholesale fish market. They are differentiated from lake-based assemblers (*digaton* or *naglalakad*) who collect fish regularly from smaller-scale producers (fishers and cage operators) and sell them in the municipal fishport. Traders usually handle greater volumes of fish (a ton or more) and earn more income than assemblers. However, both regularly employ laborers (*tauhan*).

Brokers are owners of consignment establishments in the urban wholesale fish markets. Rather than owning fish, they receive a share of 5-6% for every tub of fish that they help sell. I talked to two administrators or "caretakers" (*katiwala*) of a large broker, and to two medium-sized brokers based in the city. Other traders I interviewed were urban wholesale buyers, retailers and a supermarket administrator. I interviewed eight casual laborers in the urban wholesale fish market (*batilyo*). In the lake, I talked to two drag seiners (*pukot* or *takibo*), who are tasked to herd the fish to an enclosure in the pen to prepare it for harvesting. The purse seine boats typically carry a crew of 10 to 20 men.

For both producer and trader interviews, I employed purposive and theoretical sampling, which combined snowballing and stratified purposeful techniques that targeted individuals from specific subgroups referred to me by other informants (Miles & Huberman, 1994). My two host families provided an initial list of producers that I could interview categorized according to the most common primary livelihoods in the villages. The limits of the snowballing method are that informants tended to refer me not only to their friends or *kumpares* (co-parent via baptism) but generally to those whom they perceived were successful producers.

I used semi-structured interview schedules for the traders and producers (see Appendix A). These were composed of several questions that were subsequently adapted to fit the informant's livelihood and initial responses. The interview schedule for the producers and traders inquired about production and trading practices, access to means of production, commodity chains of fish, relations with other producers and traders, valuation of fish, and socioecological changes in the lake, among others.

In Manila, I interviewed fish consumers in an urban community that I chose because of its proximity to a neighborhood market where I did interviews and observations, its large population of informal settlements, and its distance from the urban wholesale fishport. I interviewed seven low-income and two middle-income fish consumers about fish preferences, consumption patterns, and culinary practices. I also talked to elected government officials, LLDA officials, flood control engineers, fisherfolk organization officials, and lake and fish scientists. The interviews revolved around issues such as lake governance, socioecological problems in the lake, fishery production, flooding, and lake livelihoods.

2.2.3 Participant observation

I employed participant observations in varying ways throughout the fieldwork (see Appendix B for a list of events). I devoted most of the time that I spent on each village to understanding practices and relations surrounding aquaculture production or capture fisheries. This included joining trips out in the lake to seine a fishpen, harvest fish in a corral, feed tilapia fingerlings in nurseries, harvest tilapia from a grow-out cage, and haul gill nets that have been set earlier. On dry land, I also observed the process of strip spawning of bighead carp in tanks, preparing fish for drying, assembling fish for trade, and unloading harvested fish at the municipal fishport for transport to the urban wholesale fish market. While my participation in some of the fishing, culture and trading practices were limited to observing rather than actively participating, I nonetheless gained insights about the processes surrounding them. I also took note of non-aquaculture events such as the rhythms of daily life, and special village events like fiestas and religious processions.

In Manila, I paid several visits to the Navotas Fish Port Complex, initially on my own, and later accompanied separately by a fishport administrator, a wholesaler, and a fishport laborer. In these visits, I was able to walk through the different markets in the complex, once during daytime and several more during the busier nighttime, as my companions explained to me the complex processes involved in fish trading and fishport work. Their different backgrounds provided the richness of hearing different perspectives on similar practices. The type of observation I employed in the urban wholesale fish market is similar to the inquisitive observation used by Bestor (2003) in Tokyo's Tsukiji fish market.

I also made visits to the major retail fish markets (*palengke*) throughout Metro Manila. I based my choice of these markets on the Bureau of Agricultural Statistics' (BAS) list of the major markets it regularly surveys for fish prices. I took note of where I could find freshwater fish, specifically those from Laguna Lake, to trace where fish from the lake go. I made fish stall counts and recorded average fish prices to help determine price margins of fish in the commodity chain nodes. Similarly, I visited a neighborhood market (*talipapa*) in the northern section of the city and four supermarkets.

I visited the flood control office that overlooked one of the floodways that channel water from the city to the lake during periods of intense rainfall. I saw how these flood control infrastructure worked and I understood the role of the lake in the hydrogeography of Manila. I also attended a fish symposium sponsored by the Bureau of Fisheries and Aquatic Resources (BFAR), where various speakers from the fisheries sector talked about issues such as lake management and invasive species. I gained a glimpse of how fisherfolk from the lake interacted with state officials and scientists regarding these particular issues.

2.2.4 Document collection and secondary data

I spent a few weeks at the start and end of my fieldwork in the libraries of LLDA, BFAR, the University of the Philippines, the National Library, and the City of Malabon. I found annual LLDA reports dating back to the 1970s; laws, policies and project documents pertaining to Laguna Lake and fisheries; pamphlets and information documents; articles and theses on Laguna Lake fisheries and trading in Navotas Fish Port Complex; and project documents for infrastructures like the Napindan Hydraulic Control Structure and livelihood projects like the Laguna de Bay Fishpen Development Project.

I obtained the latest statistics on aquaculture structures (size, count, location, status) from the LLDA, and on aquaculture and fisheries production from the Bureau of Agricultural Statistics. I collected statistical data for fish production for a number of missing years through various published sources. These documents also provided older water quality measurements that supplemented the recent ones published monthly by the LLDA. Fish unloading statistics on the Navotas Fish Port Complex and municipal fishports came from the Philippine Fisheries Development Authority (PFDA). BAS also regularly posts wholesale, retail and supermarket fish prices in Manila, and has published marketing studies useful for commodity chain analysis. This government agency also published data on fish and food consumption in Manila.

I collected newspaper articles about Laguna Lake from the 1980s to 2012 covering topics such as aquaculture, lake ecology, flooding and water. I gathered profiles of lake and urban villages and municipalities. Publications by the two fisherfolk and food security NGOs I came into contact with were also valuable, as were various scientific journal articles dating back to the 1930s that examined various aspects of Laguna Lake fisheries, limnology, and governance.

2.2.5 Data analysis

Whenever possible, the interviews were recorded and transcribed. Prior to each interview, I requested permission for recording. I wrote field notes for interviews that were not recorded (i.e., respondents who declined to be recorded) and for parts of the interviews where I had the recorder switched off. Interviews and field notes were then coded for emerging themes through a grounded theory approach (Charmaz, 2001; A. E. Clarke, 2005; Glaser & Strauss, 1967) but also guided by the particularities of the extended case method (Burawoy, 2000). I took daily field notes while in the field, and these, along with the notes I made on the participant observations were similarly coded (Emerson, Fretz, & Shaw, 1995). These themes served as the focal points of Chapters IV to VII. The writing of Chapters III and, to some extent, Chapter IV relied mostly on the secondary data gathered.

2.3 Situating the research

A narrative about a broad and geographically expansive topic such as urban metabolism requires making choices about which agents, relations or places to include in the analysis. These choices are reflected in the dissertation output, which is a partial, selective and situated understanding of urban metabolism. However, this does not imply that the world I (re)present in this narrative is merely a product of my analytic interpretation. In this section, I provide a brief account of the challenges of the research project.

The creases and messiness of field work tend to be smoothened out in final output. I feel, however, that various socionatural circumstances greatly influenced the shape of my research project. On the first week of August 2012, a typhoon-intensified southwest monsoon (*habagat*) dumped almost a month's worth of rain in three days in southern Luzon. To prevent further flooding in Metro Manila, state officials diverted water from urban streams to Laguna Lake, which resulted in near-record lake water levels. While Metro Manila quickly recovered from floods in less than a week, Laguna Lake villages lived with a swollen lake for three more months. I was not in the lake when the water levels rose, but when I visited a few weeks and months after, I saw how villagers tried to adjust and how producers tried to rebuild their livelihoods. Pushing through with my planned household survey and conducting further interviews seemed to me unfeasible and insensitive. As a result, I decided to shift my focus for the remaining field research period away from the lake.

The floods brought attention to the unnaturalness of the disaster, to the lake's tight bond with the city, and to the unevenness of these spaces. Whereas the urban was in the background of my initial research proposal, the floods convinced me that it was important to integrate it more centrally in understanding lake processes. Reframing my research problem as an urban metabolic issue enabled me to view processes and relations that I might otherwise have missed if I had focused only on Laguna Lake villages.

Research employing multi-sited ethnographic methods face multiple logistical, temporal and positional challenges (Freidberg, 2001b). Because of the large number of actors and the short field research period of one year (January-December 2012), I was limited in what I could accomplish and in the type of subject-researcher relations I could build. In this context, my insider/outsider position as a Filipino student based in an American university provided advantages. For example, my US ties were helpful in gaining access to elites, such as some large pen operators and brokers. Despite this, however, I encountered difficulty in locating and identifying fishpen informants in part because of the challenges of matching fishpen structures with their real owners as a result of their practice of creating shell or dummy corporations. Furthermore, because of my limited fishpen contacts and their physical inaccessibility, I was also not able to conduct interviews with fishpen laborers who live in the middle of the lake.

In the villages, my "insider" status as a Filipino student who speaks the local language made it easier to gain entry and build trust. I entered the villages through the village officials, who helped me secure host families and facilitate requests for interviews. This tie, however, may have limited some types of answers I elicited from villagers as a result of existing local village politics and kin relations. While the concept of a researcher or an ethnographer is novel to the villagers, they had prior experiences with students who lived among them for an extended period of time. I was seen as *nakikipamuhay* (someone who lives with them), and often initially mistaken for a seminarian or an activist, the two types of students that villagers are familiar with. A few informants also thought I was a microfinance officer and a potential financier or investor, and this initially affected how I was received when requesting for an interview. In general, however, I did not encounter major research obstacles while in the villages except for some reluctance among motorized push net owners and crew in agreeing to an interview. This was because some types of motorized push net gears and boats that were common in the village prior to the 1998 Fisheries Code are now prohibited.

In the urban fish market, I first gained entry through the state agency that administered fish port transactions. I realized that this was very limiting because agency workers did not have strong personal connections with the fish market actors, who viewed them primarily as regulators and collectors of fees. It was through the help of a food NGO and a personal friend's father that helped me gain access to the brokers, wholesalers and fish market laborers. However, because of safety concerns and financial constraints, my engagement with fish market actors was not as strong as the ones I had in the lake villages. I was not able to spend the time that I had initially wanted in the urban fish market and I could not go there unaccompanied by a fish market actor.

One of the faces of power that Burawoy identified in ethnographic research was the relations of domination between researcher and subject. In several interviews, one way informants subverted these relations was by reversing the interviewer-subject position. After answering my questions, informants tended to ask me their own questions in return. These were not only about the research, but also about where I stayed, where I am from, my age, civil status, and family background. In some instances, the interviews became an extended conversation about village life, family problems, health concerns, and religious testimonials. Many also used humor to respond to my questions, particularly when in the presence of other villagers. Joking became a means for some informants to assert in a nonthreatening way their social position within the village and destabilize my role as the one asking questions. These examples point to informant resistance in my attempt to set order in our interviewer-subject relations. However, despite these efforts at subverting the rigidity of the interview process, I believe I gathered reliable stories from my informants. Particularly in the villages, informants readily welcome a conversation about their everyday lives and concerns.

Having described the study area and research methods in this chapter, I present a history of Laguna Lake interventions in the next. The discussions in Chapters IV and V remain within the lake, while those of Chapters VI and VII extend to the city.

CHAPTER III

PRODUCING FISH COMMODITIES BY REWORKING LAKE SOCIONATURES

Enabling the success of aquaculture production in Laguna Lake required a radical reconfiguration of the lake's social and ecological complexities. This chapter presents an institutional-organizational history of aquaculture introduction, improvement and regulation through various state interventions that range in scope from massive infrastructure projects for hydraulic control to social programs aimed at improving livelihoods. These efforts are situated within broader mid-20th century state visions of the development of a lake as multi-use resource to supply the expanding megacity of Manila with fish and water, and to serve as a sink for wastes and floodwaters. The chapter begins with an account of how aquaculture or the "blue revolution" took hold in the lake in the 1960s and 1970s in line with the creation of a lake management state entity and emergence of various aquaculture research projects. Aquaculture's rapid expansion in the 1980s brought producer conflicts, socioecological changes in production, and subsequent state responses through shifts in governance over the succeeding decades. This chapter provides the historical context of state interventions for discussions in the subsequent chapters.

3.1 Introducing and improving aquaculture: 1966 to 1982

3.1.1 Introducing aquaculture

3.1.1.1 Problematizing lake fisheries

Laguna Lake was an important supplier of freshwater fish to lakeshore and surrounding areas even before the first fishpens were constructed. Of the non-aquaculture fish in the lake, the most commonly caught by fishers were native species like silver perch (*Therapon plumbeus*), white goby (*Glossogobius giurus*), Manila catfish (*Arius manilensis*) and mudfish (*Channa striata*). Manila catfish, the dominant and important species in the 1930s (Aldaba, 1931a, 1931c; Villadolid, 1934) was eventually replaced by silver perch and white goby, which respectively comprised 65% and 25% of total fish catch three decades later (Mercene, 1987).

While capture or open water fisheries in the lake produced 350,000 MT in 1963, 70% of the catch comprised of snails and crustaceans used for feed by a flourishing duck industry that primarily produced a popular delicacy called *balut* (fertilized duck embryo) rather than for direct human consumption (Davies, Lacanilao, & Santiago, 1986; Rabanal, Acosta, & Delmendo, 1968; Richter, 2001). Finfishes only utilized a meager 7% of the primary production in the lake, suggesting the vast potential for further use of the lake's naturally-occurring phytoplankton to convert abundant abiotic nutrients to fish flesh and human food (Delos Reyes, 1993; LLDA, 1970, 1978b). Most of the indigenous fish in the lake were omnivores and carnivores rather than specifically planktivores, which is the type of fish that could efficiently transform nutrients into consumable protein. Planktivores, as biological solution to water quality problems, can also remove excess nutrient input from agricultural and domestic activities in the surrounding areas (LLDA, 1978b; Richter, 2001).

Lake development studies commissioned by the state in the later 1960s and early 1970s argued that while catch volumes were high, the fish were small in size and fetched low prices (Davies et al., 1986; LLDA, 1995b). These identified the lake's proximity to Metro Manila as an opportunity to be tapped, and the city as a potential market for a commercial aquaculture industry (Delmendo & Gedney, 1976). Higher-priced fish species, when introduced in the lake, were expected to further contribute to the livelihoods of the fisherfolk and to the improved production of a declining lake fishery. A team of state fishery scientists' (Rabanal et al., 1968, p. 107) assessment summarized the problem in their limnological survey of the lake:

> In spite of the apparent high yield per unit area of lake water (1,130 kg) and the relatively satisfactory earning of the fisherman estimated at about P1,900 per year… the present diagnostic characteristics of the lake fisheries have varied indications that, unless drastic steps are taken to regulate withdrawal of fishery resources in the lake, coupled with positive measures, such as periodic stocking, the lake resources will continue to be rapidly depleted. There are some 13,000 full-time fishermen upon whom 55,000 people directly and 500,000 indirectly depend for their livelihood from the lake fisheries. Also, the entire population of Rizal and Laguna and Manila and suburbs, totaling some 3 million people, derives some advantages from this lake.

Capture fishery production suffered significant declines with the introduction of highly efficient fishing gears and motor boats beginning in the late 1920s but intensifying in the 1950s and 1960s (Arriola & Villaluz, 1939; Delmendo & Gedney, 1976; Mane & Villaluz, 1939; Tamayo-Zafralla, Santos, Orozco, & Elegado, 2002; Villadolid, 1933, 1934). The use of fine-mesh gill nets, drag seines, and motorized push nets to catch fish and snail damaged lake benthic environments and captured immature fish. Production was dramatically halved in a five-year span in the mid-1960s (LLDA, 1995b). The state's regulation of fisheries proved difficult and ineffectual, and it considered positive measures like stocking and aquaculture development as the more practical alternative.

These three reasons – underutilized primary productivity, dominance of low-value finfishes, and decline in total fish production – served as main justifications for the introduction of aquaculture in the lake. They were coupled with the dual desire of meeting food security – tied with supplying fish for a growing metropolis nearby – while simultaneously improving fisherfolk incomes affected by declining productivity (LLDA, 1995b). Embedded within broader postwar state visions of development, Laguna Lake became a natural resource whose potentials could be tapped to provide food, water and incomes to the inhabitants of both the lake and the city. It was with the creation of the Laguna Lake Development Authority or the LLDA, and the initiation of its programs that these visions bore fruit.

3.1.1.2 Developing Laguna Lake: converting dreams to reality

> The rich but untapped resources of the Laguna Lake Area which covers substantial portions of Rizal and Laguna Provinces have to be harnessed by a fully organized, long-range development strategy into an effective development event that will yield the best results…. The Dream for Laguna Lake Area - It is envisioned that … the Laguna Lake Area will be a highly developed agro-industrial area…Laguna Lake will abound with fresh fish throughout the year, sufficient to meet the needs of the inhabitants along the lakeshore.… If this dream is converted into reality, the provinces of Rizal and Laguna stand to

> benefit most as the development of the lake area will contribute to the economic development of these two provinces. (LLDA, 1966, pp. 6-8)

The above quote, contained in a prospectus published during the year of LLDA's creation, outlines the dream for the lake and the role of fisheries in the development of a modern and productive agro-industrial region. Capture fisheries alone could not meet this dream, since it only maintained "fishing families on subsistence level of livelihood and failed to tap the lake's potential as a major fishery resource" (LLDA, 1982b, p. 5). Thus for the first time, the state identified the lake as a resource that could be harnessed for developmental goals through the use of "advance agricultural and fishery technology" (LLDA, 1970, p. 27).

Prior to the formation of LLDA, state intervention in Laguna Lake primarily involved capture fisheries regulation. Efforts to develop Laguna Lake as a resource through aquaculture and large-scale infrastructure projects emerged only with the realization of LLDA's mandates. These were embedded within the broader developmental orientation of the postwar Philippine state that sought to build on the import substitution industrialization spurt in the 1950s (Kelly, 2000). The initial years of Laguna Lake development planning reflected the triple technocratic developmental focus of Ferdinand Marcos' two-decade regime (1965-1986) – green revolution, export agriculture, and foreign borrowing (Boyce, 1993; Ofreneo, 1980). As the blue counterpart to the green revolution, aquaculture introduction and other projects designed to develop the lake's water resources were characterized by external financial and technical assistance, and the application of scientific technology and infrastructural control to enable and improve production.

The Philippine Congress created the Laguna Lake Development Authority on 18 July 1966 through Republic Act No. 4850 and mandated it to “promote and accelerate the development and balanced growth of the Laguna Lake area and the surrounding provinces, cities, and towns” (Chapter 1, Section 1). LLDA is a unique body: it is both a developmental and regulatory agency organized as a self-sustaining semi-government corporation that generates its own funds through its programs and investments. As the only lake-based authority in the country, its powers and jurisdictions extend beyond the lake itself and onto nearby administrative units, including several local government units in the provinces of Rizal and Laguna, and in Metro Manila. Presidential decrees and executive orders in 1975, 1983 and 1993 strengthened, reoriented and expanded the mandate, responsibilities and functions of the LLDA (Oledan, 2001; Santos-Borja & Nepomuceno, 2006).

Despite its present size and its ambitious original mandates, LLDA began as a modest organization that got off to a shaky start. It was under-staffed and often ran into conflict within its ranks as well as with other local government units under its jurisdictions (Cruz, 1982; Delmendo & Rabanal, 1982). In spite of its organizational problems, the LLDA is credited as pioneer of aquaculture introduction in the lake. Informed by a series of fisheries and water resource studies of United Nations Development Programme (UNDP) consultants between 1967 and 1972, the LLDA embarked on one of its first major projects – the introduction of aquaculture in the lake

(LLDA, 1978b). It aimed to "meet the current shortage in national fish requirement with particular emphasis on addressing the current fishing catch problems in Laguna Lake" (LLDA, 1970, p. 27).

3.1.1.3 From experimental farms to profitable pens

To determine the viability of lake aquaculture, the LLDA established an experimental farm in a 38-hectare section of the lake in 1970. The Looc Fish Pen Demonstration Project was the first to successfully introduce both the fishpen technology and the established pond-farmed species milkfish in the lake. Milkfish was chosen because it fetched higher prices in the market and it fed primarily on the lake's abundant phytoplankton, therefore addressing two of the rationales for aquaculture introduction. It was considered as a more efficient fish in terms of both its market price and its conversion of energy to protein (Davies et al., 1986).

Despite the setback of a typhoon destroying the first pen, subsequent assessments found the biological and economic feasibility of culturing milkfish to market size within five months. The first harvest on 9 July 1971 was graced by the presence of then President Marcos's executive secretary (LLDA, 1971). Market prices of the first milkfish harvest, whose sizes ranged from half a kilo to a kilo and a quarter were more than twice those of indigenous species (Delmendo & Gedney, 1976; LLDA, 1971). The annual yields of 4 to 10 tons per hectare were 4 to 7 times better than pond-based milkfish production at the time (Dela Cruz, 1982; LLDA, 1978b). Subsequent typhoons and floods (notably in 1972) initiated innovations in sturdier fishpen materials and design (LLDA, 1972b). Other experiments in the demonstration farm included fry rearing (LLDA, 1976); identifying the role of temperature in fish growth (LLDA, 1977); assessing the feasibility of tilapia and carp culture in fishcages (LLDA, 1975); and establishing the optimal tilapia sex ratio (LLDA, 1981, 1982a, 1983a), among others.

Within the fishpens, LLDA aquaculturists also experimented on a different production technique. As part of the Floating Cage Project, the feasibility of raising carps, tilapia and milkfish were tested in cages beginning in 1973 and continuing until the 1980s. Nile tilapia displayed the best growth among these three species, growing to a marketable size in four months, according to initial assessments (A. M. Garcia & Medina, 1987; Guerrero, 1981; LLDA, 1974). The project enabled the fisherfolk adoption of small-scale aquaculture.

From its origin, LLDA had a goal of commercial-scale operations in view, including an expansion to 20,000 hectares through a fishpen development project supported through external funding from organizations including the Asian Development Bank (ADB) and the World Bank (Delmendo & Gedney, 1976; LLDA, 1970, 1972a). The intention was to design the fishpen technology for the use of fisherfolk, but delays in instituting financial assistance mechanisms for fisherfolk, the attractiveness and profitability of pen operations, and regulatory conflicts with local governments in issuing pen permits contributed to the rapid entry of well-capitalized businessmen (see Chapters IV and VI) at the expense of fisherfolk involvement in fishpen aquaculture (Delmendo & Rabanal, 1982). Thus, despite successfully proving the technical feasibility of growing fish in the lake through pens and cages, the LLDA failed to recognize the social contexts of fisherfolk livelihoods, the political and economic power of urban elites and middle-class entrepreneurs, and the complexities of lake governance.

3.1.2 Improving aquaculture

Various elements of aquaculture production needed to be improved and controlled to meet the promise of growth in fish production. Producers can enhance the speed of fish growth through a variety of ways, including altering the stocking densities, attempting polyculture rearing, adjusting feeding rates, finding appropriate techniques for each species, or genetically improving the strains. The extensive type of aquaculture that developed in Laguna Lake, in particular, relied heavily on the ambient conditions of the lake. These continually posed problems for facilitating fish growth and improving aquaculture production. In this context, taming the lake's unpredictability through control of water quality was as crucial as the attempts to make better fish or use appropriate production techniques.

3.1.2.1 Producing fish better and producing better fish

While the LLDA had the primary role in introducing aquaculture in the lake, various agencies – based in the lake or elsewhere in the country – supported its attempts to culture fish through better techniques or to develop better fish strains. Due to limited expertise (with one aquaculturist staff during the height of the fishpen boom), the LLDA partnered with other scientific institutions on aquaculture improvement work and focused more on lake resource development in general rather than on fish (Delmendo & Rabanal, 1982).

A key partner to the LLDA was the Southeast Asian Fisheries Development Center (SEAFDEC), a regional intergovernmental fisheries development organization, which established its Aquaculture Department in the Philippines in 1973. Four years later, the Department constructed its inland freshwater aquaculture station in Laguna Lake (Platon, 2001). The station has played a prominent role in the development of lake aquaculture through its fishery and limnological researches, and its development and dissemination of fish seeds to villages (see Chapter V).

SEAFDEC and LLDA studies examined various production techniques for applicability in the lake. Other species like tilapia and carps were tested in various production scenarios. For example, the Mozambique tilapia (*Oreochromis mossambicus*) was the first tilapia species introduced in the lake in the 1950s by the Fisheries Bureau. However, the speed of its growth and its market desirability were found to be low (ADB, 2005). Nile tilapia was then introduced in pens, but their behavior of burrowing under the mud during harvest and ability to escape fishpens required adjustments to the technology. LLDA-SEAFDEC researches found floating cages to be more appropriate due to this fish behavior and due to tilapia's tolerance for higher stocking densities that addresses its territorial and cannibalistic behavior (Richter, 2001). Furthermore, studies conducted under the Polyculture Development Program in the mid-1980s observed better growth for tilapia when it was paired with other fish, such as bighead carp in cages (Tabbu, Lijauco, Eguia, & Espegadera, 1986). Ten fisherfolk were initially given polyculture models to manage (Gonzales, 1984; LLDA, 1985; Tabbu et al., 1986). Polyculture in cages (and in fishpens) then became a common practice in the lake and improved yields that offset declining productivity in the 1980s.

The experimental farm and associated SEAFDEC and LLDA studies demonstrated that planktivores such as milkfish and tilapia can grow without supplemental feeding. Studies have also examined fish nutrition and the (im)practicality of formulated feeds (Platon, 2001; Richter, 2001), while SEAFDEC has continued research on introducing the culture of less established species like prawn and shrimp (Cuvin-Aralar, Aralar, Laron, & Rosario, 2007; Cuvin-Aralar, Lazartigue, & Aralar, 2009). Most of SEAFDEC's previous researches involved the Nile tilapia, and to a lesser extent, the bighead carp, enabling the widespread production of the two species in the lake (Basiao, 1994; Bautista, Carlos, & San Antonio, 1988; Fermin, 1991; Gonzales, 1984; Romana-Eguia & Doyle, 1992; C. B. Santiago, Aldaba, Laron, & Reyes, 1988).

SEAFDEC's tilapia research complemented other research projects that aimed to improve tilapia production. The most comprehensive of these was the Genetically Improved Farmed Tilapia (GIFT), which used selective breeding methods to improve Nile tilapia strains. The GIFT Project, funded by the ADB and UNDP, was established in 1988 by Philippine public research agencies through a state agency-university partnership in collaboration with international research institutes (Eknath & Acosta, 1998). GIFT strains and its derivatives currently comprise two-thirds of improved seeds production in the Philippines, and the project improved tilapia growth by 54-85% over six generations of selective breeding (Eknath & Acosta, 1998; Khaw, Ponzoni, &

Danting, 2008; Yosef, 2009). Subsequent assessments found the project to have improved yields, lowered market prices and increased production (Dey, 2000; Gupta & Acosta, 2004).

GIFT was followed by other genetic improvement projects based in the Philippines, such as the Genetically Male Tilapia (GMT), which designed to produce an all-male tilapia progeny via chromosome manipulation (Acosta et al., 2006; G. Clarke, Mair, Morales, Black, & Sevilleja, 1999). It is unclear as to what extent the tilapia strains in Laguna Lake benefited from GIFT and GMT given the extensive and informal hybridization of strains in seed production, but these technologies have contributed to faster-growing tilapia strains in the lake (L06 fishery scientist 2012). In sum, these efforts showed how attempts to produce bigger and better fish for human consumption were done through alterations of production techniques, fish behavior, and nature of the strains of the fish itself.

These studies, including the genetic improvements of tilapia, considered growth (production of bigger, better-growing fish) as the most important factor of improvement. However, producing better fish alone is not enough to ensure higher productivity. Laguna Lake fisheries depended heavily on the quality of water in the lake. The state saw knowledge and control of the water quality and the lake environment as crucial to the success of increasing aquaculture’s productivity.

3.1.2.2 Producing a better lake environment

> Control of the lake is an indispensable element for the proper physical planning and development in the area affected by its hydraulic regime, including the City of Manila itself…By preventing pollution and the intrusion of salt water, the lake can be developed as a source of water supply for the communities along the lake shore; the duck raising industry will be regenerated; municipal fishing within the lake will be improved; and the lake can be made a source of water for irrigation. In addition, control of the lake is an important factor in solving the sewerage problem of the City of Manila through the reduction of flooding. (LLDA 1966, 2)

Laguna Lake fish production relies on complex and dynamic factors that are only partially understood, and therefore escape the full control of the production process. This complexity is especially problematic in the case of fisheries, wherein biotic and abiotic processes (nutrients in the water, turbidity, chloride content, plankton and algae abundance, etc.) are inextricably tied (Sneddon, 2007). Projects that attempt to tame the wildness of production environments upon which fisheries heavily depend often begin with scientific studies that aim to understand – sometimes in isolation of each other – the different but interrelated elements of the production environment. Laguna Lake, a shallow, eutrophic, periurban lake is a good example of how the control of the environment is necessary to achieve improved fish production and to enable various other aspects of development of a resource. The complex socionatures and spatialities that produce the lake – biotic/abiotic, urban/rural – often escape the narrow focus of such efforts.

Studies about Laguna Lake abound, with published scientific articles on the state of its fisheries and limnology dating to as early as the colonial 1930s by Americantrained fisheries scientists. Early studies described the state of the fish production, identified threats to the fisheries and recommended appropriate regulatory actions (Aldaba, 1931b; Mane & Villaluz, 1939; Villadolid, 1933). The lake's complex limnological processes were also subject to early research, particularly the seasonal saline backflow from the Pasig River and its contradictory but important effects on the fisheries (Cendana & Mane, 1937). Later limnological studies, responding to the growth in aquaculture, set to measure the lake's carrying capacity for aquaculture based on primary productivity and algal standing crop, establishing a figure of 12,000 ha for aquaculture production (LLDA, 1983a, 1995b; Tamayo-Zafralla et al., 2002). This carrying capacity served as basis for delineation of aquaculture zones, fishpen/cage belts, and the regulation of aquaculture in the lake (LLDA, 1996).

Coinciding with the creation of LLDA in 1966, the Philippine government requested assistance from the UNDP to produce studies on the development potentials of the lake as a water and fishery resource (LLDA, 1966). These were supplemented by similar water quality studies sponsored by USAID and ADB in the first half of the 1970s. With particular aspects of the lake environment identified as problematic, findings proposed interrelated interventions through hydraulic control and aquaculture introduction (Delmendo & Gedney, 1976). Water management – for public water supply, irrigation, fisheries and flood control – was considered essential in the overall developmental blueprint of the lake resource. Prior to 1966, the lake was primarily a source of fish and snails for the lakeshore population. The new focus on water management aimed to expand the lake as a resource that could supply broader benefits to other users, including city dwellers. The recommendations that were realized out of this expanded notion of the lake as a resource brought conflicts among various users and reworked lake nature.

Building on the UN findings, SOGREAH (*Societe Grenobloise d'Etudes et d'Application Hydrauliques*), a French consultant firm hired by the ADB, undertook limnological studies in 1972-1974 that focused on understanding the unique hydraulic regime of the Laguna Lake-Manila complex with the purpose of recommending appropriate interventions. SOGREAH's Laguna de Bay Water Resources Study seconded the earlier UN-funded Feasibility Survey of the Hydraulic Control Structure and Related Development (1967-1970) and its recommendation of the construction of a hydraulic control structure that will regulate Pasig River backflow to the lake (see Figure 3.1). The structure was necessary to optimally realize the lake's potential for economic production (LLDA, 1978b; Rey, 1987; Santos-Borja, 1994; SOGREAH, 1991).

SOGREAH identified backflow from urban Pasig River as the biggest threat to the lake as a source of fish, drinking water supply, and irrigation. This backflow brought excessive nitrogen flux which they observed was responsible for a fifth of total nitrogen load in the lake and for episodes of *Microcystis* algal blooms that caused massive fish mortality in fishpens in 1972 and 1973 (LLDA, 1978b; NSCB, 1999; A. E. Santiago, 1993; SOGREAH, 1991). Furthermore, the saltwater intrusion in the lake limited the potential for further use as sources of potable water supply and irrigation. Thus, the need for a hydraulic control structure became a priority program of the state, one that aimed to "check saline and waste pollution and conserve the freshness of the lake and utilize it as a major source of water supply" (LLDA, 1971, p. 6). Control of nutrient flux from the Pasig River was seen as necessary to maintain a healthy fishery while enabling further prospects for the lake as a multi-use water resource. The flood control component of the project was similarly bolstered by severe flooding in the Laguna Lake and Manila areas on August 1972 (LLDA, 1972a).

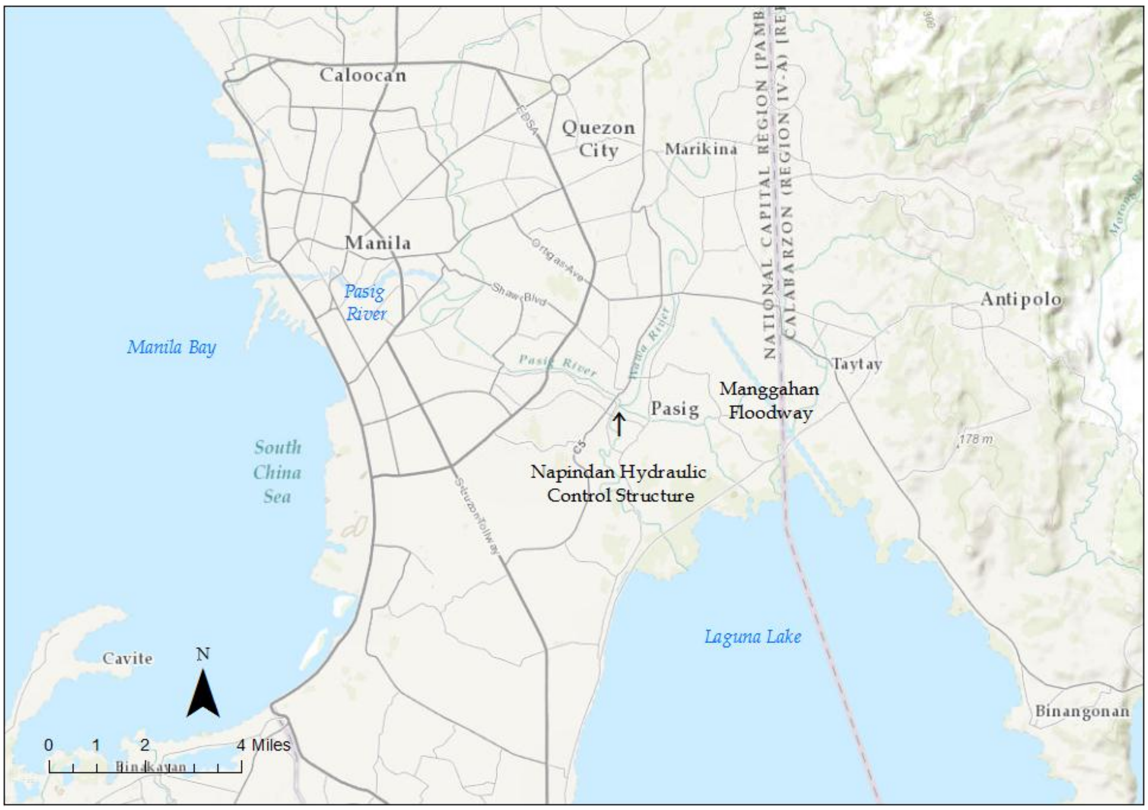

Figure 3.1 Pasig River and the Napindan Hydraulic Control Structure (Basemap source: World Topographic Map, Esri)

The Napindan Hydraulic Control Structure (NHCS) was constructed in 1977-1982 by the Ministry of Public Works and Highways with financial assistance from the ADB. The gated dam and navigation locks of the structure were constructed in Metro Manila near the confluence of the Pasig-Napindan-Marikina channels. These were designed to control lake level, quality of lake water, and floods. The ADB-hired consultants described the importance of such infrastructure:

> The construction of the gated dam is to check any of such intrusion completely. This will have marvelous effects on the improvement of the quality of the lake water together with the dilution effects of fresh waters coming from the Marikina River through the Mangahan Floodway and the watershed of the Laguna de Bay itself. It is also very important to check the intrusion of nutrient waste loadings or other pollutants from the area along the shore (Pacific Consultants International, 1978, p. 7)

Due to unified opposition from both fishpen operators and fisherfolk groups, the structure was only in operation until 1985, two years after it started operation, but studies point to its long-term effect on lake ecology and many fish producers still blame it for the poor water conditions that cause slow growth in fish (Platon, 2001; Santos-Borja, 1994). They argued, partly based on their ecological knowledge, that although intrusion of saltwater during the dry months causes fish mortalities in certain areas (NSCB, 1999), it clears the turbid lake, increases plankton production, speeds up growth of fish in pens, and improves open water fishery productivity. Limnological researches explain that sodium cations in saline water react with the suspended particles that cause the lake to be turbid, thereby increasing light penetration and photosynthesis, and improving primary production a few months after the intrusion (A. E. Santiago, 1990; Santos-Borja, 1994).

The construction and operation of the hydraulic structure created conflicting responses not only between the government and fish producers, but also among scientists and experts. In an assessment two decades after their initial studies, SOGREAH (1991) stood by its recommendation of the need for a hydraulic control structure that would regulate the influx of polluted water from the Pasig River to improve water quality for other uses. Though the structure might have prevented the entry of saltwater, they suggested the closure might not be the primary reason for decline in productivity, and that excessive fishpen development might have also played a major role. They found no correlation between yield decrease and the operation of the NHCS, observing that yield increases were noted when the structure was operational. While some models found dangers in further nutrient inputs from the backflow (Mitsumito & Santiago, 2001); others found no relationship between photosynthesis and salinity (Lasco & Espaldon, 2005).

Given the complex and contradictory impacts of the backflow on the lake (and even within lake fisheries), one of the points of contention in these debates was which particular environmental factor needed to be controlled. SOGREAH and previous external assessments identified that reducing nitrogen from the backflow through the NHCS would reduce algal blooms (LLDA, 1978b; SOGREAH, 1991), a problem in which SEAFDEC and earlier researches found was offset by the benefits that the intrusion brought to the fisheries (Cendana & Mane, 1937; Platon, 2001; A. E. Santiago, 1990, 1993). Other scientists further argued that saltwater intrusion was also important in preventing growth of undesirable macrophytes (e.g. water hyacinths, *Eichornia crassipes*) and pathogenic microorganisms (Palisoc, 1988).

The hydraulic control of saltwater intrusion provides an example of the necessary simplification of the complex socioecologies of the lake (Scott, 1998). In an effort to produce the lake as a multi-benefit resource and make it legible for developmental intervention, the spatio-temporally specific and uneven processes in the lake were smoothened and simplified to make them amenable to technical control. Technical assistance through feasibility studies and scientific assessments laid the foundation for production of knowledge about the lake, but such assessments were made within the limnological contexts and experiences of foreign consultants (A. E. Santiago, 1993). Observations by prewar fishery scientists and fisherfolk ecological knowledge about the contradictions of saline backflow were overlooked in favor of a simplifying discourse that identified the backflow as an ecological problem – with nitrogen as the limiting factor – that constrained the development of the lake as a multi-use resource. This points to the complications with the desire to expand the benefits derived from the lake beyond merely as a source of fish. In this example, elimination of the backflow through hydraulic control potentially benefited the use of the lake as a public water supply (for urban usage) and irrigation, but threatened the more traditional use of fisheries.

3.2 Boom-and-bust aquaculture: 1983 to 1990

3.2.1 Boom: capitalist aquaculture and fishpen sprawl

The success of the experimental farm initiated the entry of commercial-scale aquaculture producers in the lake. From 38 hectares in 1971, total fishpen area increased to 4,800 in 1973, 10,400 in 1980 and 35,000 in 1983 (Figure 3.2).

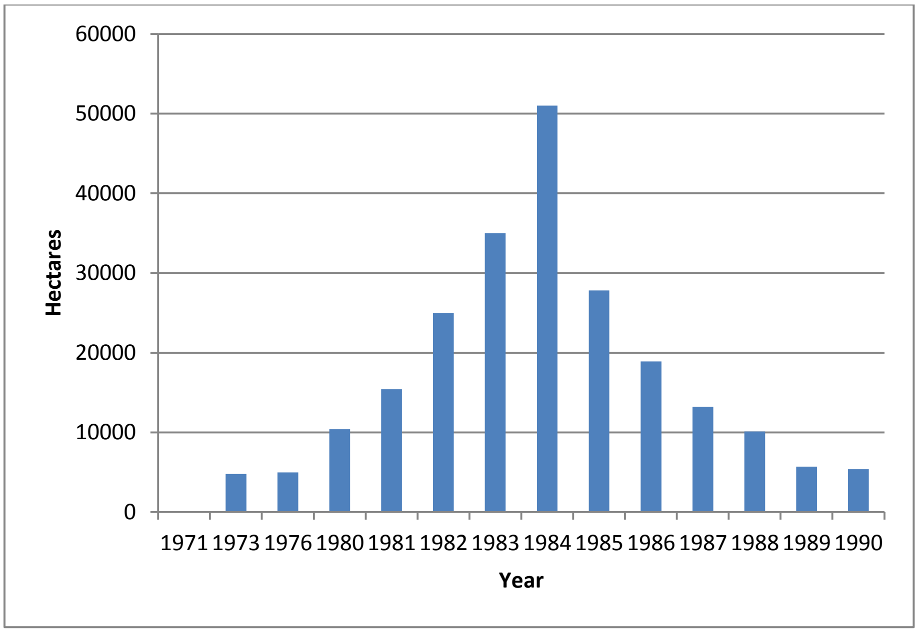

Figure 3.2 Laguna Lake fishpen area 1971-1990 (Sources: Delmendo & Rabanal, 1982; Eleazar, 1992; LLDA, 1995b)

In 1973, there were 993 fishpen structures in the lake or an average of less than 5 ha per operator, a figure that suggests production was initially small-scale (Dela Cruz, 1982). However, a decade later, 209 operators had more than 50-ha fishpens, producing in an average of 290-ha area and occupying a sixth of the total lake area (Eleazar, 1992).

This trend of a small number of large-scale fishpen operations occupying hundreds of hectares of lake area that began in the late 1970s continues up to the present (see Chapter IV).

Alongside the demonstration of fishpen feasibility in the lake, LLDA planned on identifying qualified fisherfolk for fishpen development through lakeshore municipal governments. These local government units were to recommend to the LLDA which of their constituents were to be granted permits for construction. In the absence of clear implementing rules, however, interest swelled from well-capitalized individuals based in Manila and surrounding areas, who took advantage of affordable leases and ease of gaining permits to establish fishpen investments in the lake (Delmendo & Rabanal, 1982; Ruaya, 1994). LLDA and the municipal governments were granting permits separately, which allowed further entry of fishpen operators with little regulation. Meanwhile, aquaculture production remained inaccessible to fisherfolk due to the high construction and operating costs of fishpens (Dela Cruz, 1982; Delmendo & Gedney, 1976).

With good water conditions conducive to biannual fish harvests and without devastating typhoons, the fishpen rush intensified in the last three years of the 1970s and in early 1980s, peaking at a record of 51,000 ha of fishpen area in 1984. Included among those who established fishpens in the lake were politicians, military officials, film celebrities, professional basketball players, foreigners, and other individuals or groups who had enough capital to start commercial-scale operations (Cruz, 1982; Ofreneo, 1980; Santos-Borja & Nepomuceno, 2006). The first to invest were individuals and fishing corporations based in the northern Metro Manila coastal cities of Malabon and Navotas, who had well-established deep-sea or pond aquaculture investments and know-how as traditional elites (Jose, 1994b) (see Chapter VI). The height of the fishpen boom was characterized by proliferation of registered and unregistered fishpens who occupied navigational lanes, ignored standards on stocking densities and distances between structures, and overfed their fishpens with redundant supplemental feeds (F. T. Rivera, 1987).

Despite intentions of making fishpen aquaculture accessible to the poor, the prohibitive costs of its construction and operation, and the institutional confusion between the LLDA and municipal governments in granting permits to producers and regulating existing structures, caused the displacement of fisherfolk from the lake by urban entrepreneurs and corporations. This conflict escalated in the 1983 when the shooting and killing of a fisherfolk by an armed fishpen guard brought national attention to the lake's condition.

3.2.2 Conflicts: displacement, violence and resistance

The introduction of fishpens and aquaculture was accompanied by institutional changes in lake space rights, usage and enforcement. Before the 1970s, fisherfolk can set up lines or nets almost anytime and anywhere in the lake, with informal rules based on mutual respect of rights to fish (Eleazar, 1992). While there have been government regulations pertaining to limits of mesh sizes, closed season for drag seines, use of destructive gears, and fisherfolk registration through the municipal government (Eleazar, 1992), territorial exclusion by limiting access to particular sections of the lake was uncommon. This was perhaps due to the fugitive character of fish and the variety of gears operating at different territorial scopes. Conflicts were about incompatible gear use, such as those between the fish corrals and the drag seines. Enforcement of the registration and regulation use was not practiced, and stronger and active state involvement in capture fisheries came only after the heels of the passage of the Fisheries Code in 1998.

Fishpen development highlighted the novel concept of an exclusive and bounded space for production in the lake. Fish corrals, structures that enclose fish, existed prior to fishpens but at a much smaller scale and these were operated by fisherfolk without having to pay any rents or fees. The fishpens were different because they occupied tens or hundreds of hectares, usually in the most productive portions of the lake, and their ownership was formalized by permits and annual payment of fees to the LLDA. It was thus possible for one wealthy individual, often through a dummy or shell corporation, to have exclusive rights to hundreds or even thousands of hectares of lake space (Yap, 1999).

Since fishpens are costly investments that produce highly profitable fish, many operators guard their structures vigilantly. In the 1980s, hiring armed guards was a common practice to ward off poaching of fish and sabotage of nets by fisherfolk displaced from their fishing grounds (Cruz, 1982; Delmendo & Gedney, 1976). Fishpens also made navigation physically difficult and costly for fishers, who now had to maneuver around the perimeter of the enclosures to reach a much reduced fishing ground. Fishers recall guards who shoot at them if they or their nets drifted close to the fishpen grounds. Cruz (1982) documented incidents of guards beating up fishers who strayed too close, pointing guns at their heads, and extorting money or fish before allowing passage in the waterways. Fisherfolk lost access to lake space that was once open to them and which has been enclosed by large-scale fishpen expansion. Fisherfolk took action by forming an alliance (*Samahan ng Mangingisda ng* Laguna Lake or SMLL), demanding action from the Ministry of Defense, and helping demolish unregistered fishpens (Cruz, 1982). Everyday forms of resistance included sabotaging nets and fences, and poaching, which continues up to this day (Chapter V).

3.2.3 Bust: crisis in pen aquaculture

Total fishpen area in the lake began to decline after the 1984 peak, falling to a tenth of peak size in 1990 (see Figure 3.3). Two sets of reasons explain this decline. The first pertained to limnological changes brought about by fishpen expansion, the hydraulic control of saline backflow, damage brought by typhoons, and other activities that caused a decline in primary productivity or increase in algal blooms, both of which made fishpen production less profitable. The second involved efforts at regulation such as the dismantling of fishpens and establishment of a zoning plan.

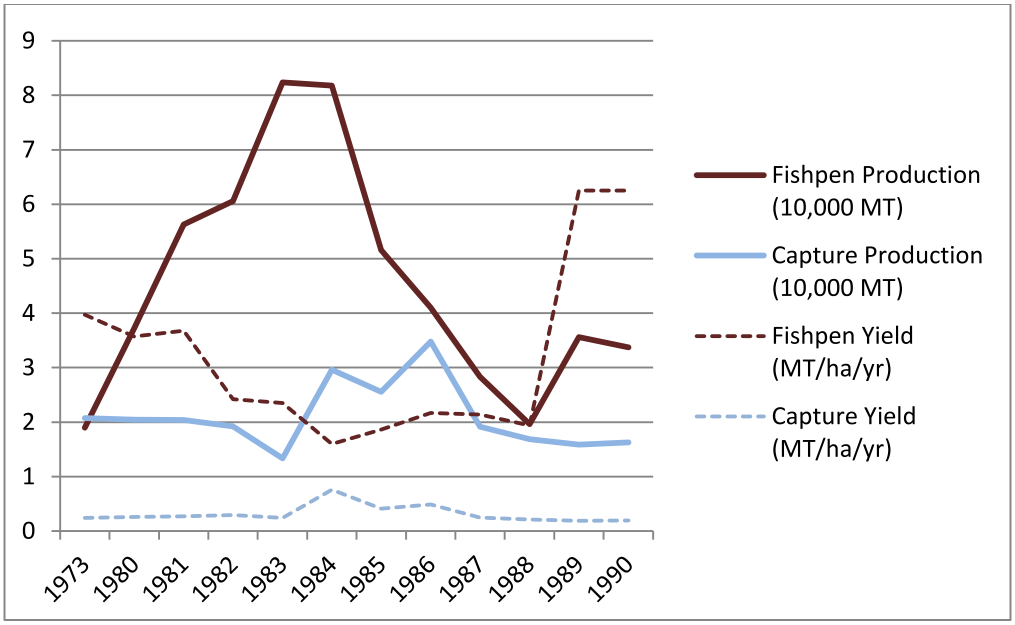

Figure 3.3 Fishpen and capture fisheries production and yield, 1973-1990 (Sources: LLDA 1995b; NSCB 1999)

Explaining decreasing fish yields in aquaculture and open waters involves understanding the complexities of factors that determine primary productivity. In the case of a eutrophic Laguna Lake, the presence of nutrients is important in producing phytoplankton that the fish consume for growth. Yet, too much nutrients can also cause algal blooms that contribute to large-scale fish kills when algae die off.

Figure 3.3 shows that highest fishpen production coincided with the years with the largest extent of fishpen. Yields during these years were also the lowest, and milkfish yields were halved between 1973 and 1983. Prior to 1976, twice or thrice a year cropping was common practice. This proved more difficult in the 1980s however when rearing that once took three months took 8-10 months (Palisoc, 1988; Richter, 2001). Studies proposed a variety of explanations to account for how aquaculture proliferation in the lake caused its own decline in productivity. First, pen structures affect water circulation because the drag effects on water flow by the fences led to a reduction of dissolved oxygen (Delos Reyes, 1993; Lasco & Espaldon, 2005). Second, fish excreta and the supplemental feeds given to the fish to spur growth contributed to increased ammonia and nitrogen loading in the lake that contributed to algal blooms and fish mortality (Delos Reyes, 1993; Richter, 2001; Zafaralla et al., 2005). Third, detritus from fish and fishpen structures increased in ratio in comparison to phytoplankton and reduced fish intake of lake food (Richter, 2001). Fourth, very high stocking rates (of up to 1 million fingerlings per hectare in a quarter of fishpens) contributed to fish morbidity and mortality and low productivity (LLDA, 1999; Richter, 2001).

Yet aquaculture is also affected by other limiting factors that influence primary production beyond itself. Along with fishpen sprawl, the construction of the hydraulic control structure had significant impacts on primary productivity. Data from Palisoc (1988) support claims that the operation of the NHCS increased turbidity and decreased water transparency, leading to lower primary production, phytoplankton biomass and zooplankton biomass (Lasco & Espaldon, 2005; Tamayo-Zafralla et al., 2002). Industrial, domestic and agricultural wastes that flow into the lake from the watershed also caused increased nutrient loading and caused lake shallowing, increased turbidity, and higher biochemical oxygen demand, all of which affected fish production time, yields and health.

3.3 Regulating aquaculture: 1983 to 2012

3.3.1 Governance by regulation

Changes in lake governance also caused the decline in area occupied by fishpens in the 1980s. However, it was not until the mid-1990s with the formulation of the Laguna de Bay Development Plan (LDBDP) and the enforcement of the Zoning and Management Plan (ZOMAP) when regulation of aquaculture became pronounced.
The LLDA's lack of enforcement capacity despite well-intentioned rules (e.g. LLDA Board Resolution No. 9) and jurisdictional conflicts with the local government enabled the fishpen sprawl of the early 1980s (LLDA, 1995b). As a response to the social unrest by displaced fisherfolk, the LLDA revisited earlier proposals for establishment of zoning that identified belts for fishpens, fishcages, open water fishing, sanctuaries, and navigational channels (LLDA, 1977, 1983b). The LLDA formulated an initial ZOMAP in 1983, with the immediate aim of reducing fishpen area by a third to meet the carrying capacity established by the UN studies. Closer to the shore were the fishcages, which were set to occupy 8,000 ha. The ZOMAP was framed within the languages of "rationalization" of aquaculture and "democratization" of lake use. It was designed not only to reduce fishpen size (and thus improve production), but by doing so would also lead to equity and improvement of fisherfolk livelihoods through improved capture fisheries production (LLDA, 1983b).

It was with the revised ZOMAP more than a decade later, however, when the territorial delineation of the lake actually took shape. This 1996 version, which came with the LDBDP decreased total fishpen area to 10,000 ha and fishcage area to 5,000 ha.

It set maximum areas for corporations (50 ha), individuals (5 ha) and cooperatives (25 ha), as well as fishcages (2 ha). It established distances between structures, between pen and shore, and between pen and navigational lanes. The revised ZOMAP also established a stocking density of 30,000 fingerlings per ha, much less than the 250,000/ha-average in the early 1980s (LLDA, 1995b). Annual permits cost for fishpens and fishcages were established and new permits for vacant areas within the belt were won by public bidding.

The failure of the initial ZOMAP, despite sporadic successes in fishpen demolitions and decreasing aquaculture size below carrying capacity, was due to strong opposition and the bargaining power of the fishpen producers and their association which joined with local government resistance to LLDA authority in granting licenses (Jose, 1994a). These issues were taken to the Supreme Court, which upheld the LLDA's sole authority to collect fees and grant permits (Santos-Borja & Nepomuceno, 2006). Revenues from aquaculture leasing fees provide a significant source of income for the LLDA. Fishpen opposition to LLDA demolitions and fee increases, however, continued.

Between 1994 and 1995, three typhoons damaged as much as 90% of fishpen structures in the lake. The LLDA took the moratorium in fishpen repair issued by the Department of Environment as an opportunity to implement the revised ZOMAP. Ground checks identified structures outside of the fishpen belts, and unregistered and improperly located fishpens were demolished (Jose, 1994a; Ruaya, 1994). Between 1994 and 1998, more than 5,000 ha of fishpens were demolished by the LLDA and local governments (LLDA, 1995a, 1999). In 2005, a moratorium on further fishpen construction was passed.

3.3.2 Addressing displaced livelihoods

The revised ZOMAP promised not only to regulate the fishpen sprawl, but also to ensure equitable access to lake resources with the establishment and enforcement of belts and lanes based on the lake's carrying capacity. This reflects LLDA's evolution as an agency that was set out to be a holistic development authority, but has functioned since as a regulatory body sustained by revenues from its regulatory functions.

Through various programs, the LLDA and government agencies attempted to make aquaculture, notably fishpens, accessible to fisherfolk and thus address the social problems aquaculture expansion had caused. The first few years of the experimental farm was devoted to technical and production improvements. However, detailed plans for its adoption by lake fisherfolk beneficiaries came only in 1978, when a fisheries loan proposal was incorporated into a broader Laguna de Bay Fishpen Development Program (LDBFDP). Funded by the Asian Development Bank ($90 million) and the Organization of Petroleum Exporting Countries ($4.5 million), the program proposed the creation of 2,500 ha of fisherfolk-operated 10-ha fishpens. The project sought to provide loans to identified fisherfolk cooperatives and approved fisherfolk individuals (LLDA, 1977, 1978a, 1979, 1980, 1981). By 1985, the LLDA had issued permits to 1,373 members in 88 fisherfolk cooperatives that it helped organize (LLDA, 1985). The program broadened its portfolio of livelihood projects to include fishpen rearing of tilapia in cages, which a study found to be as profitable as fishpens (Dela Cruz, 1982).

Coinciding with the LDBFDP, a separate but related program called UNLAD was implemented between 1983 and 1985 with the approval of then President Marcos, in part to ease social conflicts generated by the fishpen sprawl and fisherfolk displacement, and as part of Marcos's thrust towards reinforcing his vision of self-reliant livelihoods in the New Society (BFAR, 1981). It called for the fishpen and fishcage development for 3,000 fisherfolk households, and gave birth to two sub-programs – the Laguna Lake Cooperative Development Program and the Polyculture Development Program. The latter involved research on aquaculture improvement that explicitly addressed local needs for diversification, urban demands for fish, and potentials of earning foreign exchange though export of high-demand species (LLDA, 1984).

The Laguna Lake Cooperative Development Program, meanwhile, aimed to organize 20,000 fisherfolk into 400 cooperatives that would manage fishpens with newly-acquired entrepreneurial skills (LLDA, 1982b). The project ceased in 1986, with only 105 cooperatives organized, because of internal disunity and uncertain feasiblity among the reasons cited (LLDA, 1986). However, in at least one village, cooperatives were important in initiating aquaculture adoption by certain fisherfolk, even after their dissolution (see discussion of Kalinawan village in Chapter V).

Like the cooperative organization component of the UNLAD program, the LDBFDP failed to meet its target goals. None of its component project exceeded 2% of projected outputs when it ended in 1988. The fishpen cooperative component failed miserably, with 99% suffering damages from typhoons and fisherfolk cooperatives burdened with significant debt that reached more than a million pesos per module (Yap, 1999). The fishpen sprawl also limited expansion of fishpen area for target beneficiaries because individuals and corporations from elsewhere already occupied much of the available ideal areas (e.g. productive and sheltered areas) for construction (Eleazar, 1992; Yap, 1999).

The implementation of the revised ZOMAP was greeted with enthusiasm and promise for an equitable access to lake opportunities for the marginalized and displaced (LLDA, 1999). However, both the old and revised ZOMAP legitimized the contentious place of fishpens operated by non-lake residents so long as their total size remained within the established carrying capacity, that they operated within the bounds of identified belts, and that they registered with the LLDA annually. The ZOMAP spatially legitimized the existence of fishpens by apportioning the most productive parts of the lake for large-scale aquaculture, despite LLDA's avowed attempts to put fisherfolk back at the center of lake development. Regulation via the ZOMAP shifted the early LLDA emphasis of assuring that primarily lake fisherfolk and residents derive benefits from aquaculture to the much more modest effort of making sure that the fisherfolk have at least some access to the largely urban-driven fishpen development.

Continued aquaculture production necessitates not only improvements in the fish, technologies and lake environments, but must address social conflicts associated with its rapid expansion. In the case of Laguna Lake, this was done by state regulation of lake space through its apportioning of use, and the provision of support to improve livelihood and access of fisherfolk. However, fishpen producers have exerted their influence, as seen in the delays of enforcing the ZOMAP and their bargaining power in the issues of demolitions and fee increases. Their role in meeting the nutritional demands for fish – a discourse deployed at the lake, urban and national levels – has been invoked whenever they have been threatened with plans of complete eradication in the lake. A fishpen operator noted their importance in food security.

> Many years back, there were talks of removing all the fishpen operation because they are clogging the lake because they want the lake to be beautiful, and even cabinet officials were fighting about it. If you remove aquaculture in Laguna Lake without the government coming up with provisions to produce what they are producing there, fish might cost P200, P250 in the market. Since we have some people in the government who are knowledgeable about the food requirements of the country, they argued against it. If they wanted to clean the lake, okay, but start improving our inland fishing. They must be able to produce what Laguna Lake is producing. (L07 pen operator 2012)

Since the 1990s, however, other demands on the lake, apart from as a source of food, have intensified. The lake is increasingly viewed as a resource that could contribute to solve urban problems in water supply, flooding and waste disposal. This has resulted in contradictory flows between lake and the city and a reorientation of governance strategies.

3.3.3 Controlling water and wastes

Threats to sustained production through aquaculture come not only from within its own sector but also from other uses, including as a source of domestic and industrial water and as a sink for wastes and floods. In 1988, the LLDA initiated attempts to use

Laguna Lake as a source of potable water for Manila by considering upgrading lake quality classification from Class C (for fisheries) to Class A (for domestic water supply). This entailed a reorganization of lake usage and governance, including stricter standards for effluents flowing into the lake, the phasing out of aquaculture, and the re-opening of the NHCS to control salinity (LLDA, 1995b). This plan was intended to support the water needs of expanding Metro Manila, as well as the industrial development in the newly-formulated Calabarzon Project (Sly, 1993). Threats of water shortages during dry El Nino years pushed the state to look for other water sources for Metro Manila apart from the Angat Reservoir north of the city (Esplanada, 2012; MST, 2012).

Water extraction in the lake for domestic use, however, started only with the operation of a water treatment plant by a private water concessionaire in 2008. The plant converts the Class C waters of the lake to Class A waters through reverse osmosis or hyperfiltration. It extracts 100 million liters per day from the lake to supply potable water to more than a million city-dwellers in southern Metro Manila (Olchondra, 2010; D. O. Rivera, 2012; Sarmiento, 2010; M. Villanueva, 2011). Proposals for expansion both by this concessionaire and the other Metro Manila private concessionaire are under way (ManilaWater, 2011; Maynilad, 2010). This threatens aquaculture because of its need for lower saltwater content in the water (Tabios & David, 2004). Control of salinity is important in this case because conventional water treatment can only work with a maximum chloride content of 250 mg/L. The lake’s chloride level averages between 150 to 300 mg/L (Santos-Borja, 1994).

Hydrology and subsequent flood control infrastructure projects are also part of new demands on the lake. The Manggahan Floodway and the NHCS were constructed to regulate stream flow of the two major Manila streams – the Marikina and the Pasig Rivers. The floodway was designed to channel excess flow from the Marikina River to the lake to avert flooding in the urbanized Marikina Valley. The NHCS would then control the release of water temporarily stored in Laguna Lake to avoid flooding downstream along the banks of the Pasig River, where important industrial, commercial and administrative areas are located (Tabios & David, 2004; B. Villanueva, 1987). This hydraulic control system causes extensive and longer-term flooding along the shores of the lake. It threatens aquaculture by raising water levels during times of floods above the levels of the nets, causing spillage of fish, particularly in smaller fishcages. Furthermore, proposals meant to solve the recent string of heavy flooding (2009 and 2012 being the worst years) called for dikes, dredging and spillways, which have been seen by both fishers and fishpen operators as detrimental to fish production (Corpuz, 2005; Mayuga, 2012; Morales, 2009).

The increasing number of industrial establishments (4,300 as of 2003) along the shores of the lake and within its watershed, intensified by the Calabarzon project in the 1990s, contributes to increased pollution loading (Santos-Borja & Nepomuceno, 2006). This adds to the effluents from domestic and agricultural sources, which together account for 70% and 11% of loads respectively (RDC, 2011; Zafaralla et al., 2005). The threats to aquaculture of increased pollution loading and siltation include higher turbidity that decreases yields and eutrophication that causes fish mortalities (Barril, 1993;

Tamayo-Zafralla et al., 2002). Food safety concerns have also been raised given fish bioaccumulation of heavy metals and organic residues, including lead and estrogen (Chavez et al., 2006; Cuvin-Aralar, 1990; Lasco & Espaldon, 2005; Molina, Espaldon, Flavier, Pacardo, & Rebancos, 2011; Paraso & Capitan, 2012). These have long-term health effects on lake dwellers and the urban poor, two groups that rely on affordable lake fish for daily sustenance.

3.3.4 Shifts in governance

From the initial focus on aquaculture and fisheries development, the LLDA has embraced a view that designates the lake as a multi-use resource that needed to be balanced among the many stakeholders, including urban users, industries, agriculture and others. Sustainable fishery management gave way to resource conservation and sustainable development, reflecting the shift away from the primary focus on fisheries. In 1995, LLDA General Manager Carlos Tomboc, summarized this as such:

> In essence, we at the LLDA will undergo a dramatic shift in our policy thrust from sustainable lake fishery to environmental protection and resource conservation as well as equitable management of the shoreland areas….We are currently establishing active partnership with stakeholders and strengthening institutional linkages with other sectors to make this networking for the environment an efficient machinery in pushing for the direction we have set. (LLDA, 1995a, p. 4)

The spatial scope of LLDA's governance has expanded from the lakeshore communities to the whole lake basin, and thus extending its regulatory power over five provinces and several local government units in Metro Manila. The LLDA aimed to transform its role towards more client-driven and partnership-oriented management (Oledan, 2001). It believed that "partnership brings together stakeholders formed by a common interest, mobilizes their joint resources, and creates a platform for dialogue, negotiation, sharing, conflict resolution, capacity and consensus building" (LLDA, 2007, p. 1). In its regulatory functions, the LLDA also deputized fisherfolk in lake management by capacity building and equipping them with "knowledge of monitoring important aspects of lake conditions such as illegal fishing, including apprehension procedures, water quality, illegal structures and fish kills in Laguna de Bay" as a way to build partnerships with the fisherfolk sector (LLDA, 2007, p. 8).

The reformulation of lake governance included more territories and more actors, whose position in lake use seemed to be equalized by the new language of stakeholders and partnerships that suggests a smoothening of conflicts and power. The creation of the lake as a resource that needed to be shared through appropriate governance strategies relegated fisherfolk, traditionally the primary producers in the lake, to one stakeholder that needed to coexist with urban elites, fishing corporations, industrial establishments and urban water concessionaires, among others.

3.4 Summary

The state, through the LLDA and with external technical and financial support, introduced aquaculture in Laguna Lake as part of broader developmental goals of producing the lake as a multi-use resource (see Figure 3.4 for a timeline). It framed capture fisheries as a problematic sector in crisis and proposed aquaculture as an efficient solution to address declining yields, improve incomes, and tap the underutilized potentials of converting abundant nutrients to fish in order to supply food to a growing metropolis. These are three reasons where subsistence capture fisheries production is seen to fall short.

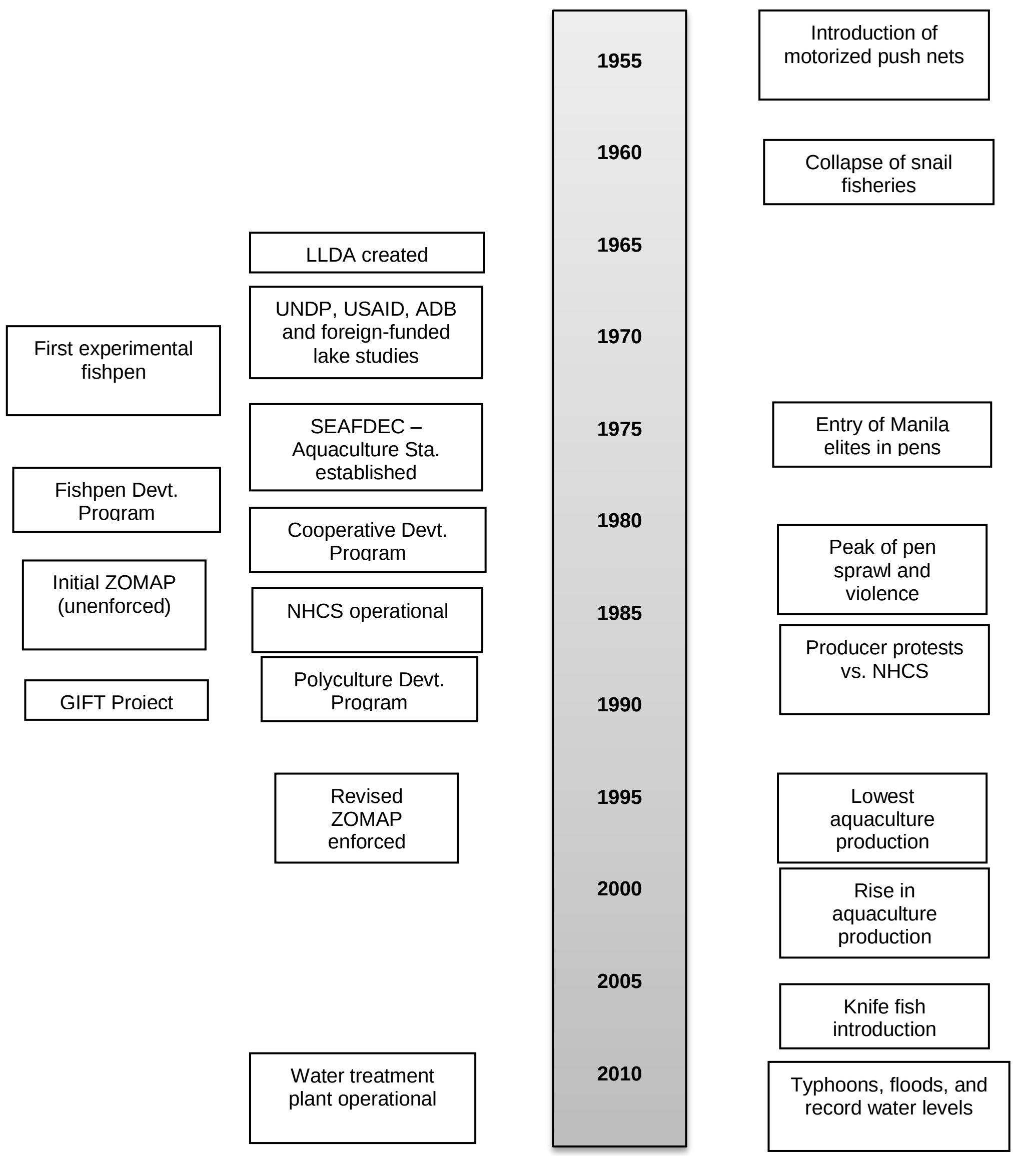

Figure 3.4 Laguna Lake timeline, 1955-2010

Enabling the growth of aquaculture production required the reworking of fish, techniques of production, and the lake environment. Experimental farms, research stations and scientists contributed to the first two needs, while infrastructure and governance strategies were necessary in the more complicated task of the third. These processes simplified the highly complex socioecologies of the lake in order to allow interventions through externally-funded projects such as the hydraulic control of a problematic saline backflow.

The initial successes of the experimental farm enabled adoption of fishpen technologies by urban elites. Along with weak regulation, rapid entry of urban elite investments resulted in the fishpen sprawl that displaced capture fisherfolk and fueled conflicts brought about by practices of pen exclusion and changes in property rights. Rapid aquaculture expansion itself created contradictory ecological effects, and along with the limnological impacts of the hydraulic control structure and typhoons, contributed to decline in aquaculture productivity after reaching its first peak in 1983.

LLDA designed a zoning plan to mediate the conflicts and arrest pen expansion through territorial strategies that delineated belts for specific producers. Despite successes by fishpen producers in resisting regulations that led to delays, the zoning plan was established in the lake and resulted in the easing of violent conflicts. However, this apportioned a significant part of the lake for fishpen production, which remained inaccessible for fisherfolk, and legitimated urban elite use of the lake. LLDA also instituted a series of much-delayed and often unsuccessful livelihood projects to enable participation of fisherfolk in aquaculture. Shifts in governance strategies to frame the lake as a multi-use resource solidified in the 1990s, expanding the objects, subjects and spaces of lake governance.

As with its green counterpart in lowland rice agriculture, the blue revolution in the lake resulted in rural social differentiation, displacement of subsistence users, emergence of new (and maintenance of old) elites with the development of capitalist aquaculture, and contradictory socioecological transformations. The succeeding two chapters discuss these processes in greater depth through a focus on pen and cage production, as well as through case studies of two lake villages. While Laguna Lake contains a long history of efforts to produce an environment amenable to human intervention, the next chapter shows how these encounter nonhuman nature in unpredictable ways, with corresponding consequences on the organization of aquaculture production.

CHAPTER IV

NATURE'S MATERIALITY AND AQUACULTURE'S DUAL TRAJECTORIES IN LAGUNA LAKE

The previous chapter narrated an institutional-organizational history of aquaculture in Laguna Lake that emphasized the successes and failures in taming lake socioecologies to produce fish. Fishpens designed for lake fisherfolk use became a profitable operation for wealthy urbanites whose rapid entry in the lake led to the fishpen sprawl that displaced the very people they were intended for. Fishpen sprawl was regulated by the Laguna Lake Development Authority, but fishpen production - and other productive activities within and beyond the lake - continues to undermine its own conditions of production, threatening its sustained productivity and profitability. Yet the fishpens continue to supply a significant portion of total lake production volumes, and they have coexisted with smaller-scale, fisherfolk-operated fishcages.

This chapter examines some of the contradictions in the history of Laguna Lake aquaculture by placing the materiality of nature at the heart of discussion. It builds on the claim that matters of nature matter in production in historically and geographically contingent ways. Specifically, it argues that water-based aquaculture production confronts the materiality of nature in ways that shape the organization of production and relations. To produce fish in a fluid environment is to encounter interacting properties and complex processes that create both intended and unintended outcomes. Three interacting "materialities" are discussed: saltwater intrusion, dependence on plankton, and fish as a mobile living commodity. "Nature" in water-based production is understood, following Prudham's distinction (2005), according to three dimensions: as land or space (aquaculture production size and scale), time (biological production time of fish) and form (fluidity and mobility as it impacts production).

In this chapter, I apply insights from "nature's materiality" literature, drawing from Prudham's (2005) and Mann-Dickinson's (1978) work, to understand how "nature" creates obstacles or challenges for aquaculture production in Laguna Lake. I will focus on what production in a fluid environment entails for the organization of aquaculture, relations within production, and relations between fish producers. The chapter also frames the history of aquaculture development within the materialities of the capital-nature nexus to propose why aquaculture followed a specific trajectory. However, there is a need to situate materiality and nature in historically- and geographically-contingent ways so as to avoid rigid determinisms if such materialities are applied mechanistically or independently (Mann, 1990). It is in this purpose that the final sections of the chapter examine how engagement with the production of nature thesis, developed by Neil Smith (2008), provides a way to think historically of materialities as produced and without appeal to the idea of a nature that is external and universal. This chapter argues that the materialities that matter in aquaculture production are of a nature that is constantly being produced within aquaculture and beyond. It is perhaps more useful, therefore, to speak of materialities of *produced* natures.

The task of the succeeding section is to summarize key themes and borrow useful approaches from literature that reports and explains nature's materiality within a political economic framework. After providing a brief comparison of production relations in the two aquaculture systems – fishpens and fishcages – the chapter then illustrates how both systems confront material natures with particular implications on practices and relations, as well as historical trajectories of production. It concludes with an elaboration of the argument that materiality needs to be situated within a non-dualistic and non-deterministic understanding of nature-society relations. An engagement with the thesis of the production of nature situates the material historically within productive activities in the lake and beyond.

4.1 Thinking and working with materiality

This chapter builds on works that theorize materiality in response to calls for taking the matter of nature seriously in resource and human geographies (K. Bakker & Bridge, 2006; FitzSimmons, 1989; Latham & McCormack, 2004). Materiality as a concept has been deployed beyond political economic approaches, as for example through the lenses of cultural studies of commodities, corporeality, actor-network theory and economic performativity (K. Bakker & Bridge, 2006; Goodman, 1999, 2001; Lansing, 2012; Mansfield, 2011; Pereira, 2010). However, I will take Castree's (1995, p. 13) definition of materiality as the "ontological existence of those entities we term 'natural,' and the active roles those entities play in making history and geography" as starting point to examine the place of material natures in the history of Laguna Lake aquaculture.

Several scholars of agrarian political economy highlight the ways that materiality of specific natures are important in enabling capital-nature relations (Boyd et al., 2001; Goodman et al., 1987; Henderson, 1999; Kloppenburg, 2004). One of the most empirically rich case studies that draw on this understanding of nature's materiality is Prudham's (2005) book on the commodification of timber in the Pacific Northwest. He examined how particular flexible production relations – some of which were oppressive labor arrangements – in logging and reforestation were a complex product of firms attempting to deal with the organic character of the industry that still depended on long biological times of trees. Specific material characteristics and properties of production have also shaped the historical trajectories of the economic geographies of timber production in the US, and particular state/scientific institutions arose in the attempt to subsume the biological materiality of trees to enable further commodification via tree improvement research.

In agriculture, however, interest in theorizing nature in production began with the publication of what came to be known as the Mann-Dickinson thesis (Mann & Dickinson, 1978). Drawing from a line of work that attempted to explain uneven capitalist development in the countryside – works that sought to resolve this "agrarian question" – Mann and Dickinson placed agriculture's unique dependence on natural conditions at the center of their analysis. Specifically, they argued that the coexistence of noncapitalist petty commodity production with capitalist production in agriculture is partly a result of capital's messy encounters with various natural obstacles that inhibit its further penetration in certain spheres of agriculture. Because they are unattractive to capitalist intrusion, these spheres are then left to peasant farms, until such time that these obstacles are overcome by capital.

The thesis developed further in Mann's book (1990) proposed that there are "natural" barriers (more pronounced in agriculture) to the use of wage labor in the countryside, particularly the nonidentity of production time and labor time in agricultural production. Production time, the relatively fixed biological time that it takes to grow crops, does not coincide with labor time or the period when labor is deployed in production. The thesis argued that in those spheres where these times meet (e.g. through reduction in production time or shifts in labor time) are often where capitalization of agriculture progresses the quickest. This nonidentity reduces the turnover of capital (and profits) because of the time it takes to initiate another cycle of production, while the long production time makes it difficult for farmers to immediately adjust to price fluctuations. Also, farm machinery is deployed inefficiently because there are periods when they remain idle, thus the inability to produce continuously, and derive surplus value from labor.

Mann observed that aquaculture is one of the spheres where capitalist penetration has been slow and where family farms have dominated production due to extensive "natural" obstacles. Because of its dependence on water conditions and its relatively recent technological development, aquaculture confronts these obstacles in more pronounced ways. Mann noted, however, that generalizations about aquaculture and obstacles are difficult, given the diversity of commodities and environments. In the succeeding sections, I examine the case of Laguna Lake aquaculture to provide a historically- and geographically-specific account of these dynamics.

4.2 Dual trajectories of aquaculture: fishpens and fishcages

Fishpen and fishcage production in many ways parallel the distinction between capitalist and petty commodity production that works attempting to resolve the agrarian question(s) (including that of Mann and Dickinson's) have built upon (Akram-Lodhi & Kay, 2010; Bernstein, 1996a; de Janvry, 1981; Goodman & Redclift, 1981; Kautsky, 1988). On the one hand, fishpen producers operate in large areas and employ wage labor, closely resembling capitalist relations of production in terms of risk exposure, capital investment, and potential returns. On the other, smaller-scale fishcage producers rely on wage labor to supplement high reliance on family labor in a manner similar to peasants or petty commodity producers. If translated into agrarian terms, pens are the large, well-capitalized farmers who captured benefits of state-led efforts described in Chapter 3, while small farmers or peasants employ cages for aquaculture production. While the coexistence of both forms of production is hardly surprising, the role of unique materialities in their development deserves further attention. The next few sections briefly compare differences in production practices and relations summarized in Table 4.1.

Table 4.1 Comparison of production relations between pen and cage production

Category	Pen Production	Cage Production
Average size of production unit (2010)[1]	27.9 ha	0.6 ha
Total area occupied (2010)[1]	11,430 ha	2,000 ha
Total number of operators (2010)[1]	410	2,920
Ownership	Mostly absentee urban entrepreneurs registered as individuals or corporations. Some large fishing companies and a few fisherfolk cooperatives	Mostly lake residents. Some enter into partnerships with urban financers.
Pen/cage investment requirements (2006)[2]	P3.72 million for a 50-ha pen P0.74 million for a 5-ha pen	P0.16 million for a 1-ha cage
Total costs (2006)[2]	P7.46 million for a 50-ha pen P1.10 million for a 5-ha pen	P0.12 million for a 1-ha cage
Annual net revenue (2006)[2]	P6.54 million for a 50-ha pen P0.43 million for a 5-ha pen	P0.19 million for a 1-ha cage
Production volumes of species grown (2010)[3]	Total: 48,500 MT (milkfish: 43%; bighead carp: 31%; tilapia: 25%)	Total: 12,300 MT (tilapia: 86%; bighead carp: 14%; milkfish: 0%)
Intensification	Extensive and semi-intensive	Extensive and semi-intensive
Stocking density (2007)[4]	35,000 pieces/ha	133,000 pieces/ha
Frequency of harvest in a year (2007)[4]	16	1
Yield (production/area in 2010)	4.24 MT/ha	6.15 MT/ha
Labor arrangements (permanent waged and seasonal hired labor)	Permanent: caretaker and wage laborers (average of 14 for a 50-ha pen); usually migrant labor Seasonal: seiners for pre-harvesting	Permanent: 0-1 wage laborer for a 1-ha cage; usually village labor Seasonal: village labor hired for many tasks

[1] LLDA data
[2] Israel, Boni-Cortez, and Patambang (2008)
[3] Bureau of Agricultural Statistics data
[4] Tan et al. (2010)

Fishpens occupy a much larger area than fishcages (Figures 4.1 and 4.2). In 2010, the 410 registered operators occupied 13% of total lake area or an average of 28 ha per fishpen. This is in contrast to the 0.60–ha-average of fishcage operations, which numbered 2,920 in the same year. In the case of fishpens, these averages can be misleading. As Chapter III has described, fishpens are able to operate well beyond the ZOMAP-delineated sizes by creating several dummy or shell corporations. Thus, large-scale fishpen operations are able to range in size anywhere from 100 to 1,000 ha, and the 410 registered operators may actually be far fewer in number. Both pay a fixed annual rent per hectare to the LLDA in order to continue leasing lake space.

Figure 4.1 Fishpens with guardhouses (background) in Laguna Lake (Photo by author, 10 May 2012)

Figure 4.2 Inside a fishpen. Pen enclosures are made from bamboo poles and palm trunks. (Photo by author, 24 April 2012)

There is a distinct difference in ownership of pens and cages. Due to the prohibitive costs of constructing much larger-scale pens (more than 20 times that of cages), most of the pen operators have been entrepreneurs from Metro Manila or the province of Bulacan, who have the financial capacity to invest (businessmen/women, politicians, celebrities, foreigners) and/or the know-how (pond aquaculture producers) in large-scale aquaculture operations. Informants also frequently mention deep-sea fishing companies based in Manila, who use lake-produced fish to supplement their marine production (Chapter VI). Involvement in daily fishpen operations differ, with some absentee owners financing operations, and others taking a more active supervisory role. Cage operations, on the other hand, are usually owned/operated by lake fisherfolk or residents even as some enter into partnership with urban-based financers (Chapter V).

In terms of inputs, both pen and cage productions are generally extensive to semi-intensive, with limited to no supplemental artificial feeding, relying primarily on naturally-occurring planktons. Despite this, together they produced more than 60,000 metric tons of fish in 2010. Pens have traditionally relied on the production of milkfish, but have since cultured tilapia and bighead carp. Cages on the other hand produce primarily tilapia, with some practicing tilapia-bighead carp polyculture. While there are no definite, fixed growing seasonal cycles (due to multiple stocking and staggered harvesting), most pens and cages stock fingerlings in the dry months of April and May (Dela Cruz, 1982; Israel, 2007). In good production seasons, fish can grow to marketable size – ranging from 150g to 500g for milkfish and tilapia – within three or four months from fingerling size, making possible two or three croppings per year. In poorer conditions, such as years without saltwater intrusion, these production times can stretch to as much as one or two years.

Labor arrangements differ between pens and cages. Fishpen owners/operators hire a caretaker or administrator (*katiwala*) who is made in-charge of daily production operations involving permanent waged laborers (*tauhan*), who are hired to do all-around work such as stocking pens, repairing nets and fences, surveillance, and other daily maintenance work. Fifty-hectare pens employ around 14 laborers, while smaller pens would require less. Wage laborers in pens often come from outside the lake, usually from the poorer central Philippine regions of Bicol and the Visayas. The aversion of local lake people in working for the pens is primarily due to the low pay. Wage labor in pens is unattractive to fisherfolk not only because the monthly wage of P3,000 is less than half the minimum wage for the area, but because it ties them to full-time work in the pen, leaving no room for taking up other livelihood opportunities. Pen operators, on the other hand, view lake villagers as lazy, untrustworthy, and not amenable to labor discipline in pens. A fishpen operator remarked:

> We get laborers from Bicol, Mindanao, Masbate because people here are lazier. They like to complain…Some of the people we hire used to be fishers at sea, others were charcoal-makers. Sometimes we teach them to swim because they do not know how to. What is important is trustworthiness and diligence because at least they will try to learn. But if one is lazy and steals, it does not matter what you do. When you are away from the pen, your fish will be gone. (L13 pen operator 2012)

While wage laborers live on the mainhouses or the guardhouses in the fishpens throughout the year (Figure 4.3), fishpen operations also rely on seasonal hired labor for pre-harvesting practices such as seining. Seining is a task performed by lake fisherfolk who are organized as a boat of a dozen or more workers, paid on a pre-arranged rate per area seined.

Because cages are much smaller operations, wage laborers (*tauhan*) are less common or, if present, are in small numbers. Household labor is employed for daily tasks and maintenance. Hired labor, usually performed by village men without cages, is required for tasks that are impossible to perform by one or two persons, such as replacement of nets and poles. In the case of cage hatcheries, this may involve grading or harvesting fingerlings for delivery. In times of poor productivity or after typhoons, cages often adapt by downsizing production and employing less hired labor.

Figure 4.3 Mainhouse of a fishpen (foreground) and southern Metro Manila skyline (background) (Photo by author, 24 April 2012)

Pens and cages share some common production features but they differ in scale, tenure and labor deployment. The next section identifies the importance of materiality of nature in aquaculture production in the lake, and its implications on the organization and relation of production in the dual trajectories of aquacultural development. Various materialities influence the possibility of continuous production, species reared, timing of production tasks, ability to intensify production through increased stocking or feeds, deployment of labor, and inter-producer relations.

4.3 Materialities of production in a fluid environment

This section examines how materialities of water-based production, taken as holistic and interacting, recursively shape organizations of aquaculture production in Laguna Lake. It follows similar works that examine the ways materialities create particular labor arrangements and economic geographies (Prudham, 2005), as well as social institutions of production and relations (Birkenholtz, 2009; Kaup, 2008; Mansfield, 2004).

Aquatic production is in many respects different from agriculture based on land. While land is often considered immovable and fixed, water is characterized by properties of fluidity, flows and circulation. This has implications not only on the difficulty of defining property rights in water and its commodification (K. Bakker, 2004), but also in the process of producing commodities from bodies of water (Mansfield, 2004). Fisheries and aquaculture, for instance, confront the multiple complex biotic and abiotic factors that make up the materiality of such a resource (Fougeres, 2008; Sneddon, 2007). The production of fish, a biological commodity, requires specific interactions between photosynthesis, temperature, turbidity, oxygen levels, nutrients, planktons, and other microorganisms, to name a few (Richter, 2001). Fish bodies, therefore, are materially constituted by the interactions of properties and processes of the aquatic environment from where it is produced (Mansfield, 2011).

Apart from enabling production of commodities, water bodies also serve as sinks to various effluents from surrounding flows and activities. Problems result from this property, making it difficult to monitor, regulate and govern activities within and around water bodies. The production of the nature of water bodies as a result of its capacity to absorb its surrounding activities is inextricably tied to the production of fish natures, as is the case with the tendency of fish to bioaccumulate pollutants from its aquatic environment (Mansfield, 2011). In the case of aquaculture, there is a contradiction in that its waste byproducts from both fish and organic inputs tend to undermine the condition of the water necessary for sustained production. Excessive nutrients, for example, cause eutrophication and algal blooms that may result in fish mortalities or reduction of production time and yields.

Laguna Lake aquaculture is unique, not only as a water-based production, but as one that relies on "natural" food abundant in the eutrophic lake (Chapter III). Laguna Lake's spatial position, a periurban lake located in an industrializing and urbanizing region, is similarly unique, and one that highlights the contradictory materialities associated with aquaculture production. This section discusses how large-scale pen aquaculture, and smaller-scale cage aquaculture both encounter the materialities of lake and fish natures. The focus on fluidity as a property allows a discussion of three examples: saltwater intrusion, plankton abundance, and fish as fugitive biological commodities. However, these materialities are not the only ones that matter as other properties left out in this narrative, such as typhoons and flooding, are equally significant.

4.3.1 Saltwater intrusion and lake fluidity

Producer interviews and published studies attest to the importance in production of seasonal incursion of saline water from Manila Bay to Laguna Lake via the Pasig River. Occurring during the dry months of April and May, when water level begins to fall below sea level, the circulating saltwater helps clear the turbid lake, thereby improving photosynthetic activity and increasing primary productivity (i.e., conversion of abiotic components of the lake into biotic through photosynthesis). This is usually followed by increased abundance of phytoplanktons and zooplanktons in the lake, which then improves fish growth by providing food and reducing pathogenic microorganisms (Cendana & Mane, 1937; Palisoc, 1988; A. E. Santiago, 1990; Santos-Borja, 1994). The flux of saline water is also a spatially and temporally uneven process, with areas of the West Bay closest to the river receiving it first and most, making them the most productive areas in terms of net primary productivity (NSCB, 1999). Producers and scientists describe this complex process and its implications on fish production.

> The second and third quarters of the year can be considered months with more sunny than cloudy and rainy days over the Laguna Lake region, and this is theoretically favorable for photosynthetic production. If turbidity is decreased in April through seawater intrusion, higher and longer production days are possible. Reports showed that transparency increased in a few weeks following the first intrusion of seawater to the lake in the second quarter, followed by stimulation of [primary productivity] and a build up of plankton component…Growth rates of *O. niloticus* in net cages in Laguna Lake were highest (106-124 g in 4 months) between April and July of 1980. Both peaks of phytoplankton and zooplankton were observed in June after seawater intrusion. Likewise, tilapia stocked in other months did not exceed 50 g weight increment in four months…The small fishermen of Pipindan village and other nearby villages in Binangonan, Rizal have attested that whenever turbid waters prevail, open water finfish catch is low, fishes caught are thin, and snails are scarce. (A. E. Santiago, 1990, pp. 90-94)

> What we need here is seawater. With saltwater intrusion, the lake clears, and when the lake clears, it provides more food. Back when we had intrusion, cage producers were able to harvest three times a year. Every three months they were able to harvest tilapia. These days, fish already celebrated two birthdays, yet they are still this small. (K17 cage producer 2012)

> Those commercial feeds are useless as long as there is saltwater intrusion. I used to work in a fishpen, we were in-charge of taking care of milkfish fry and fingerlings. They used to dump sacks of feeds but they would not grow as fast. When saltwater came in, fish grew in two weeks what they would in in two months without saltwater. That is the number one factor – saltwater. If you want

> to revive fisheries in Laguna Lake, that is the solution. Otherwise, it is hopeless. (K23 cage nursery producer 2012)
>
> In the fish culture of Laguna Lake, saltwater intrusion is very vital because that is when the fingerlings are stocked during the dry season. Fingerlings adapt better to the lake conditions with salinity because it takes milkfish so many days to adapt. Fingerlings also survive better. It also has a cleansing effect. Salinity kills parasites, and so milkfish fingerlings survive better. Without saltwater, like this year, many fishpen operators are not doing so well. The only ones who survive are the well-off ones because they just keep on stocking even with low survival rates. With saltwater in the Taguig-Napindan area where I am, our survival rate is about 65%. If there is none, we have 10, 15, 20% survival rate. (L07 pen operator 2012)

Saltwater intrusion is able to speed up production time and allows faster turnover of capital whenever two or three crop cycles in a year becomes possible. Following the Mann-Dickinson thesis, the coincidence of shorter production times and the deployment of labor may help explain why fishpen production was very profitable during the height of the fishpen sprawl when saltwater intrusion was yet unaffected by the construction of the Napindan Hydraulic Control Structure (NHCS), which was designed by the state to control the saline backflow (Chapter III).

However, saline incursion is not without contradictions since the same backflow poses risks to fish health depending on location and circumstance. Passing through Pasig River, a polluted river that cuts across the heart of Metro Manila, flows of saline water are also accompanied by excessive nutrient fluxes, particularly of nitrogen, which can cause sudden fish kills, especially in areas closest to where the river meets the lake (NSCB, 1999; SOGREAH, 1991; Villadolid, 1933). One pen operator referred to his location near the junction of the river and the lake not only as the first to receive "blessing" (*grasya*) of this resource but also as the first to receive "curse" (*disgrasya*) in terms of being able to benefit from higher productivity but also being exposed to greater risk of sudden fish kills.

The fluctuating production times associated with poor water conditions enables a host of responses in production organization and relations both in pens and cages. Supplemental feeds are given to fish in the hopes of speeding up their growth to marketable size. However, while it can increase the live weight of fish, the costs of artificial feeds are high enough to make unattractive continued reliance on artificial feeds. Both cage and pen producers comment that the benefits of faster growth of fish through supplemental feeding in the end are countered by the high costs of feeds. Providing supplemental feeds also encounter another materiality of the lake – water's fluidity and the pen/cage fixity – a point discussed further in the next section.

Another response to fluctuating production times is to stock fish species that grow better in poor water conditions. Pens shift from milkfish monoculture to bighead carp mono/polyculture because they observed that this fish grows better in turbid and less productive periods (Baluyut, 1989). Despite fetching much lower prices in the urban market, bighead carp culture allows pens to circumvent the long production time of milkfish (Chapter VII).

Long turnover of capital due to poor water conditions often associated with absence of saltwater intrusion involves downsizing, which is done particularly by employing less labor. In pens, this would entail more work for remaining hired caretakers and laborers. In cages, this usually implies greater reliance on family labor than wage labor (Chapter V).

> It is good when you have more laborers because you feel more secure that the pen will get the care it needs. If you have only two, both of them will not get enough rest. If the operator wants to cut back on labor costs, he/she will often join in surveillance. (L14 pen operator 2012)

One of the coalitions that arose as a result of the materialities of saltwater fluxes is that of fishpen operators and fisherfolk organizations who joined together to protest against the operation of the Napindan Hydraulic Control Structure. They believed that the structure prevented the intrusion of saltwater, which led to a decrease in the productivity of the lake fisheries. Their actions were enough to influence state administrators to allow the gates to open indefinitely in 1985, two years after its completion (Santos-Borja, 1994).

Despite the structure remaining open to allow the flow of water from the river to the lake, producers still experience years without saltwater intrusion. A few reasons have been proposed by producers and limnologists. First, water levels do not subside low enough to below sea level. Second, siltation from intensifying agricultural, industrial and domestic activities around the lake has caused a shallowing in certain parts of the lake, such as the river-lake junction, which prohibited adequate seawater flux. Third, increased nutrient loading has pushed the lake to a hypereutrophic state, such that even saline intrusion has minimal impacts on primary productivity (Zafaralla et al., 2005).

4.3.2 Plankton abundance and lake fluidity

One of the results of saltwater intrusion in the lake is the increased abundance of plankton. The high-nutrient or eutrophic character of the lake enables higher primary productivity whenever the turbid lake is cleared to allow more light to penetrate and photosynthesis to take place (see Figure 4.4 for relationship between water quality parameters and production). Studies commissioned by the state advocated the efficient utilization of the lake's eutrophic character through aquaculture introduction (Chapter III). This property has allowed pen operators to produce fish that are comparatively cheaper than similar fish species produced in other lakes or in ponds where artificial feeds comprise a significant bulk of expenses.

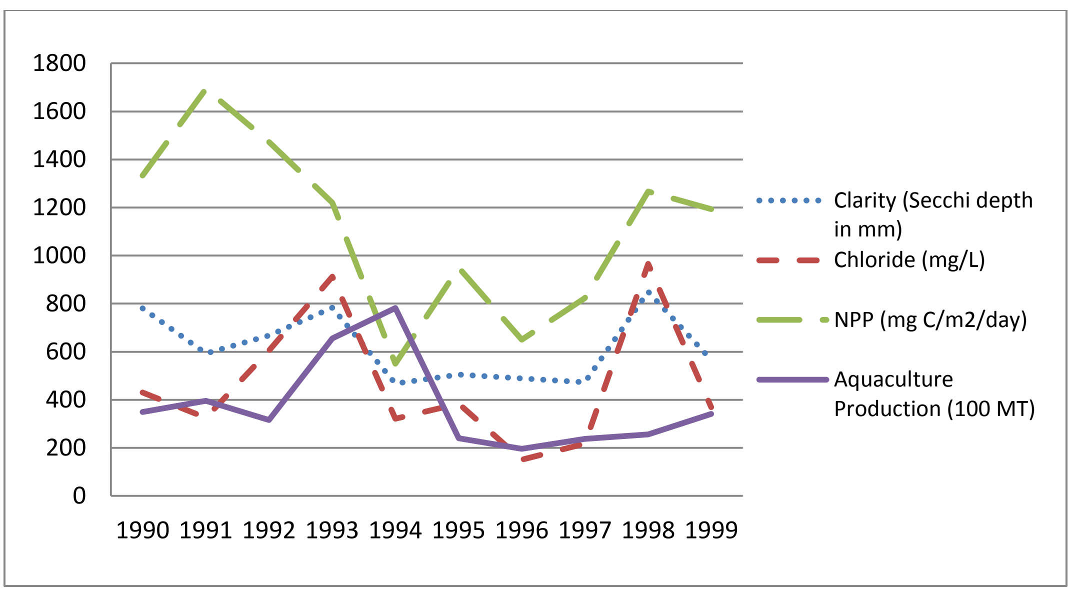

Figure 4.4: Aquaculture production and selected water quality parameters in Laguna Lake (1990-1999) (Sources: BAS data; LLDA, 1995b; Zafaralla et al., 2005)

Pen operators attest to the limitations of feeding and the price advantages of Laguna Lake fish as a result of reliance on lake planktons.

> In the lake, we do not feed, everything is natural. It will depend on the plankton growth. First of all, you cannot do feeding. If you intensify through feeding, other fish and birds will get to the feeds first. You cannot feed, unlike in Pangasinan where they have full feeding because they do not have natural food. When the water and weather were good many years back, Pangasinan producers would stop harvesting whenever we started harvesting here in Laguna Lake because they could not compete with our low prices. Instead they would harvest bigger fish. (L07 pen operator 2012)
>
> Pangasinan milkfish can only sell as low as P60 per kilo. If they go further down, they sell at a loss. I remember when I would go to “Boulevard” [Navotas wholesale fish market], Pangasinan producers would sell fish at a much lower price when they hear that fish from Laguna Lake is on its way. Milkfish in Laguna Lake can sell as low as P40, P30, because we do not spend on feeds. (L14 pen operator 2012)

Plankton abundance has been seen by pen operators as a way to profitably produce fish by reducing required costs of inputs and supply fish at a cheaper price. In the case of milkfish, most other producers in areas such as Pangasinan, Bulacan and Taal Lake spend more than half of their costs on commercial feeds. In contrast, Laguna Lake pens can supply milkfish at up to 25% lower price than these areas (Tan et al., 2010).

Dependence on lake planktons for feed instead of commercial feeds however poses several problems in production. First, it creates high reliance on lake processes such as saltwater intrusion, increasing operator vulnerability to fluctuating production times. While reports indicated that pens produced two to three crops per year in the late 1970s before the height of the fishpen sprawl, various factors – such as increased turbidity and siltation – contributed to the decline in plankton abundance making it nearly impossible to repeat this level of productivity at present conditions (Richter, 2001).

Second, dependence limits potential for intensification of production. Increasing the stocking densities of fish per unit area has contradictory effects in that a pen operator might be able to grow more fish, but doing so increases the production time before fish is ready for harvest (Richter, 2001). Furthermore, intensification by supplementing feeds is not only economically unattractive, but it also leads to added nutrient inputs when feeds are not fully consumed by the fish. Additional nutrient input in the lake contributes to conditions perfect for algal blooms that can increase demand for oxygen when these decay, and can cause mass fish mortalities. It may also contribute to increased levels of eutrophication that can contradictorily reduce primary production (Tamayo-Zafralla et al., 2002; Zafaralla et al., 2005). Water's capacity to circulate also implies that feeds do not necessarily stay within the area for which they are intended, and it is common for neighboring pens to benefit from feeds distributed in another (A. M. Garcia & Medina, 1987; Richter, 2001). A cage producer described the reasons why he does not use feeds.

> We won't necessary run at a loss but our revenues will be spent on feeds. If you feed your fish with pellets, which are expensive, they will grow. But that requires investment, and you are producing in a lake. What if your nets have holes and your fish escape? You invested in feeds and so your losses will be greater when compared with, say, hogs which you can see. If the net gets damaged, you will lose your fish. This is why I do not want to use feeds. (K14 cage nursery producer 2012)

Third, control of market size of fish is less predictable. This implies that fish cannot be grown to larger sizes when compared with those fed on an artificial diet. It imposes constraints on the attractiveness of producing for the export market, since export fishes require much bigger sizes to be amenable for filleting. In less productive years, pens harvest even before the fish reach market size to hasten the turnover cycle and limit non-production time. The varying sizes of fish produced in the lake, including smaller ones, finds a market with poorer urban consumers (see Chapter VII).

Fourth, fish acquires an unpalatable earthy-muddy taste (*lasang gilik*) whenever blue-green algal blooms (*Microcystis* spp.) occur during the transition from the dry to the wet season. This makes it nearly impossible to sell the fish at a desired price because consumers are repelled by the taste and smell of any fish harvested during this period. The taste is said to wash off with the onset of the rainy season. Villagers described the market impacts of this property:

> Prices drop when fish acquire the earthy taste. It happens once water starts to clear before the onset of the wet season. Fish smells of *gilik*. When buyers smell the fish you are selling and they frown, that means the fish has a taste already. They won't buy it no matter how much you reduce the price (N17 fisher 2012).
>
> You cannot harvest fish that smells of *gilik*, it would be like selling shit; no one will buy from you, not even fishball processors. That is why before I harvest from pens, I smell the fish first, sometimes I would fry one piece to make sure there is no smell…So once I get to the pens and notice the smell, I won't buy the fish even if they sold it to me for P1 a kilo because no one will buy them from me in the wholesale fish market (N22 trader 2012)

Fishpen and cage operators adapt to these materialities by adjusting the timing of harvests to avoid the earthy taste. The staggered process of harvesting in pens, however, enables them to adjust better to the disruption in production time and turnover of a new cycle of production. More importantly, the dependence on lake plankton for fish food is at the center of the difficulty of large, capitalized fishpens to further intensify production. Intensification through more inputs of feeds or increasing stocking densities is thwarted by the lake's eutrophic (and eutrophying) character. Attempts to improve productivity toward these ends are met by contradicting results, as has been the result of the bust following the peak of the fishpen sprawl in the 1980s.

4.3.3 Fish as fugitive biological commodities

4.3.3.1 Bigger, faster-growing and better-reproducing fish?

The materialities of producing in a fluid environment are further complicated by the mobile character of living commodities grown within pens and cages. Chapter III showed how the development of technologies of aquaculture production in the case of pens and cages required consideration of which fish species to be introduced. Tilapia's ability to burrow in mud and escape seining made it difficult to harvest when reared in pens. Thus, cage technologies – cheaper to construct and more accessible to lake fisherfolk – became the preferred production technique for tilapia (Dela Cruz, 1982; A. M. Garcia & Medina, 1987). Milkfish, the higher-priced fish, remained the choice species in pens, since these fish do not grow well in the crowded conditions of cages. Bighead carp is the more versatile fish, since it can grow well in pens and cages in polyculture or monoculture and in good and poor water conditions. However, as Chapter VII shows, it faces obstacles in urban consumption. Bighead carp fry is also expensive, and it fetches low prices (around half of milkfish) in the market.

The relative ease of biologically reproducing tilapia by simple adjustments in sex ratios (as opposed to technology-intensive bighead carp or distantly-sourced milkfish) has enabled cage producers to produce their own seeds. Thus, it is possible to endlessly repeat the cropping cycle without buying new sets of fry. This is the case in one of the study villages, wherein knowledge of the tilapia breeding process has allowed simultaneous cage grow-out and hatchery-nursery production. This dual production implies that cage producers can complementarily produce seeds and fish at the same time in the same area (more in Chapter V).

Political economy of biotechnology studies (Kloppenburg, 2004; Prudham, 2003) show how production time can be speeded up through public science and private research. While comparatively recent, genetic improvements in fish biology have contributed to the development of faster-growing, higher-yield fish. Tilapia is one of first tropical finfishes subjected to genetic improvement projects via selective breeding (Chapter III). However, interviews with cage producers and a fish genetic scientist suggest that the impacts of improved seeds such as GIFT in production are unclear. This is due to the practice of hybridization of seeds (improved seeds mixed with other seeds from different places), and due to the greater dependence on water conditions such that whether a seed is improved or not matters little if the water itself is not conducive for production. This illustrates dependence on lake water quality and the constraints in improving production even with biological transformations in the nature of the fish used. A cage producer, for example, remarked:

> This past year, my *kumpare* [co-parent] acquired tilapia fry from Pampanga and we used that as our breeders because they said that the strain is good because it came from Munoz, Nueva Ecija [site of Central Luzon State University, which develops improved tilapia strains]. So we tried to change our *inahin* [dams or female breeders] because we thought they might grow better in poor water conditions. But it was the same, the fish still would not grow (K24 cage nursery producer 2012).

4.3.3.2 Size, stealing and surveillance

Since fish can only be stocked at certain densities without raising mortality rates or affecting overall production time, the tendency for pen operations is to expand in size. Taking advantage of economies of scale, producers can cut down on costs of materials for construction and operation as well as on labor costs (Israel, 2007; Tan et al., 2010). However, expansion of size encounters problems with LLDA regulations of maximum allowable pen size. In the absence of regulatory enforcement during the fishpen sprawl, expansion was only limited by the financial capacity to construct more cages and employ more labor. With more stringent LLDA zonation, pens were able to circumvent through the establishment of several dummy corporations that allowed them to contiguously or non-contiguously rear fish in hundreds or thousands of hectares of lake waters.

Pen size and bigness of operations makes it difficult to monitor fish. Labor deployed thus extends the practices of production to include surveillance against escaping fish and against poaching. This is done through regular monitoring by pen laborers of the conditions of nets though “visiting” (*pagbibisita*), through construction of guardhouses manned by laborers, and through nightly monitoring with the use of searchlights. Poaching is a common occurrence for both pens and cages due to both the difficulty in surveillance of large parts of the pen and the ease with which poachers (“seamen”) could swim to the pens, cut holes in nets underwater and set gill nets to trap escaping fish.

Surveillance is a crucial component of labor in fishpens, and it occupies a significant amount of labor time. Fishpens have organized various strategies of improving efficiency in surveillance, even during the early days of fishpen development. This includes management of labor spatially (distributing them throughout the fishpens) and temporally (shifts).

> Large fishpens have strategically located guardhouses and well-coordinated night patrols composed of caretakers that rove in motorized boats around the fishpen in shifts. One corporation uses teams of night patrols that watch the inside and outside of the pen enclosure. The inside patrol drags a hook for the purpose entangling gill nets or other gear that are usually used by poachers. These teams are provided with communication system for coordination and identification of position at any time (Dela Cruz, 1982, p. 3.1.2.3).

The remoteness of pens and the noncontiguity of laborers (distributed in various guardhouses) in pen operations stress the importance of trust relations between operators, caretakers and laborers. Absentee operators rely on caretakers to manage daily operations of the pen. Caretakers meanwhile need to ensure that the laborers are performing their tasks and that they are not stealing (or allow others to steal) fish in the pens. This mirrors relations in land-based fishponds elsewhere in the Philippines (Dannhaeuser, 1986) but is complicated by the size of operations and the extent to which surveillance is necessary. A pen operator noted this process:

> You cannot monitor a fishpen on your own. If you put surveillance cameras to monitor it, you will need a lot to cover just one hectare…I have a main caretaker, and then other caretakers per guardhouse. For example, I will call my main

> caretaker, and he will then call guardhouse caretakers, and they will then relay orders to the laborers….It's all about trust and caring for the fish. If you are too hard on your men, they will respect you out of fear. But once you leave, they will do bad things to you. Aside from wages, I give bonuses as well. If the pen earns big, they get a 10% share of the net profit. (L13 pen operator 2012)

It is only with pens that violence and conflicts are more pronounced because of the scale of their operations, of their employment of armed guards, and of their limited, largely impersonal interaction with surrounding fisherfolk communities. While cage producers also experienced poaching, it is viewed differently in light of relations within the community (Chapter V). Cage producers indicated that a lack of *pakikisama* (smooth interpersonal relationship) and *inggit* (envy) may have been the reasons why fish could be stolen. Nonetheless, surveillance is required for both pens and cages, especially close to harvest time when the fish is ready for the market. A pen operator discussed the stressful time leading to a harvest and his rewards after a successful harvest.

> You need to focus on your fish 24 hours a day. It's a blessing given to you, ready food that you only need to put in your mouth, so you guard the fish until you harvest. Then when you have a few left to harvest, you can rest. You can take a trip to Hong Kong, Singapore, and relax. (L14 pen operator 2012)

4.3.3.3 Responding to invasives

The edibility of fish in pens and cages makes them not only vulnerable to human poachers but also to invasive fish predators. Production time, particularly in pens, had been adversely affected by the proliferation of knife fish (*Chilata ornata*), a carnivorous ornamental fish that, based on producer accounts, was accidentally released in the lake between 2004 and 2009. Knife fish breed near pen poles, reproduce quickly, and are able to grow up to 5-10 kilos by consuming stocked fish fry and fingerlings. There are differential impacts between pens and cages. In cages, the presence of knife fish adds to labor requirements by forcing producers to regularly haul nets to remove knife fish fingerlings before they reach adult size and begin preying on fish stocked in the cage. In pens, however, this is not possible since a significant population of knife fish can escape seining. Several adult knife fish can consume up to 90% of fry and fingerlings stocked in a pen. Pen operators respond by stocking bigger, but more expensive fingerlings to reduce the mortalities from predation.

> Knife fish really give us headaches. I began noticing them since 2004, 2005, I did not pay attention then; I was more amused because I used to rear that kind of fish in my aquarium. But I observed that it could lay up to 20,000 eggs in one season, and they breed twice a year. Knife fish is our problem. Unlike typhoons, which occur once every few years, knife fish is here throughout the year… They used to be abundant along the shores and fewer out at sea, but now we catch a lot of them everywhere. They can eat seven or eight pieces of milkfish fingerlings a day, and I recently caught 250 pieces of knife fish in my pen. So if you compute it, in two months, those 250 knife fish can consume 105,000 fingerlings, which is equivalent to a hectare's worth of stock….What we do now is to stock bigger fingerlings so that if they are consumed, the predators will be full with three or four fingerlings. Unlike if you stocked 300 small ones, they can eat ten in a day. It is more expensive, however, since we spend more on the fish in our fishpond nursery in Bulacan to make fingerlings bigger, and you can transport less of them in a boat. (L13 pen operator 2012)

The proliferation of knife fish within pens has forged new forms of pen-fisherfolk cooperation, which runs counter to the historically adversarial character of their relations. Fishers have found that trawl line is the most effective technique to catch knife fish. Before stocking, pen operators would allow fishers to set drift long lines within the pens, pay them a couple of thousand pesos, and allow them to keep all of the knife fish catch.

> When we clean pens and get them ready for harvest, we hire people. I personally hire fishermen, because they catch a lot more inside the pens, they like it. Compared to the outside, knife fish gets really big inside the pens, and so they catch more. My deal with them is I give them P500 every day to buy bait. Whatever they catch is theirs. Last May, June, I had my pen cleaned. In 50 hectares, they caught 100 to 150 kilos of knife fish every day. But even then, it may just be 50% of knife fish in the pen. (L07 pen operator 2012)

While knife fish has had a profound impact on the indigenous and introduced fish catch of fisherfolk, it created an opportunity to shift techniques and strategies in fishing. As a fish with white meat like bighead carp, it has been transformed into a commodity by fishers selling them to traders who bring the fish to the urban market for processing into fishballs. It has become an even cheaper white fish alternative to bighead carp, which originally replaced a more expensive marine fish.

4.4 Discussion: materialities of produced natures

4.4.1 Which materialities matter?

Highlighting the various materialities that shape Laguna Lake aquaculture shows the mutual constitution of nature and society in the process of production. A focus on materialities is in some ways a corrective to heavily "social" explanations in that it gives as much attention to the intended results as to the unintended outcomes of confronting "nature." While Laguna Lake aquaculture was introduced and continues to be practiced with the desire to achieve specific relations with the natural world in mind, the latter resists being a passive object that behaves in predictable ways.

That materialities matter in shaping histories is a well-known argument (Castree, 1995; FitzSimmons, 1989). How such materialities matter, however, remains a fruitful ground for further exploration. The chapter took the example of how materialities of water-based production play out in the organization and relations in Laguna Lake aquaculture. Borrowing a framework from Prudham (2005), this chapter sought to analyze materialities of nature as space (bigness and scale), as time (production and biological time) and as form (fluidity and mobility) in water-based aquacultural production. Saltwater intrusion, plankton abundance and the biology of fish rework and are reworked in specific ways through the production of commodities.

In Laguna Lake, saltwater intrusion from the sea to the lake via an urban river sets up contradictory flows – one that simultaneously brings needed chloride that improves water quality and enables greater plankton presence, but this flow also adds excessive nitrogen that may lead to large-scale fish mortalities. The government built a hydraulic control structure to address the other half of this contradiction (saline backflow as pollutive) but ended up inciting cooperation among producers who protested the structure's impacts on reducing lake productivity. Continued siltation has caused a shallowing of the river channel, particularly at the point where it meets the lake. This meant that despite closure of the hydraulic control structure's operations, saline backflow may not reach the lake.

Laguna Lake aquaculture's dependence on plankton implied reliance on water quality conditions that enable plankton growth. This links to other materialities such as saltwater intrusion, and the lake as a sink of effluents and nutrients from its surrounding basin. Effluent and saltwater have created problems of control in production, since producers are not able to intensify by stocking more fish or feeding fish more to improve or speed up growth. Reliance on fluctuating water quality conditions affects production time and turnover cycle of capital.

Producers encounter fish as a fugitive biological commodity – mobile and hardly visible – from stocking to harvest. As a commodity, its production time is determined by the presence of plankton, which is influenced by saltwater intrusion and effluent influx. Particular fish species' feeding, breeding, rearing and harvesting behavior required developing techniques and forging relations that work to improve productivity. As a mobile and almost readily edible commodity, fish escape and they are stolen easily, which require organizing labor for surveillance against net damage or poaching. Productivity and production time are also shaped by the proliferation of invasive fish, which have differential impacts on pens and cages.

4.4.2 Materialities and dual trajectories

In framing historically the case of Bangladeshi pond aquaculture, Belton, Haque and Little (2012, p. 909) observed:

> Aquaculture becomes increasingly delinked from agrarian livelihoods as ever-more intensive culture systems and capitalist relations of production are encountered, and begins to feature market entry by entrepreneurial investors

> (often absentee urbanites) and, in some instances, vertically integrated agribusinesses. Production volumes and commoditisations also increase and the geographical boundaries of output markets tend to shift correspondingly, expanding beyond the immediate locality of the farm to district, national, international and, in some cases, global scales as output becomes increasingly integrated into ever wider circuits of exchange.

In some ways, the quote above fits Laguna Lake's case: presence of absentee urbanites entering lake aquaculture, increase of production volumes and expanding output markets, and forms of capitalist relations of production. However, much of Laguna Lake's aquacultural history seems to fit uneasily with the narratives of intensification and global market connections. The chapter showed how production's encounters with nature's materiality have played an equally important role as "social" processes (e.g. state interventions in Chapter III) in shaping the history of Laguna Lake aquaculture and the uneven trajectories of capitalist development illustrated in the continued coexistence of pens and cages. Water-based production in a periurban lake whose water quality is tied to productive activities around it confronts materialities that constrain or enable particular forms and geographies of aquaculture organization.

Works seeking to disentangle the capital-nature nexus conceptualize the materialities of nature as posing constraints to capital, which in turn finds opportunities in other spheres of production. Capital's penetration of a "recalcitrant nature" in agriculture is varied, multiple, and involves efforts to subsume nature or penetrate other aspects of agriculture from farming to inputs and credit (Goodman et al., 1987; Henderson, 1999). Certain spheres of agriculture are thus unattractive to capital at a particular space and time, and are left to noncapitalist forms of production. Nature thus factors centrally in the agrarian question, whether relating to land- or water-based production.

In Laguna Lake a parallel case exists where capitalist (pens) and less capitalist (cages) forms of production coexist. Indeed, if one follows the Mann-Dickinson thesis, Laguna Lake aquaculture has plenty of “natural obstacles” for capital, including its extensive character and highly fluctuating production times. Opportunities to overcome these obstacles by capitalist investment in other aspects of agriculture, such as the seed and feeds, have been limited. For example, capitalist appropriation of the development of improved fish seeds has occurred unevenly. While some improved tilapia strains have been developed by multinational biotechnology corporations, none of their seeds have been used in Laguna Lake aquaculture (Acosta et al., 2006; Sevilleja, 2006). The improved seeds used in the lake developed by public research institutions have contributed little to improving production times if water conditions are not optimal. The same is true for feeds, where efforts of agribusinesses to create a feeds market have have been limited by the artificial feeds’ ineffectiveness in improving production times.

It would seem that the materialities of Laguna Lake aquaculture make it unattractive to capital, and thus production could be left at the hands of less capitalist producers. Indeed, intensification has been thwarted primarily by the lake’s eutrophic character, and most pens are individually operated rather than organized in actual corporations despite being so in paper. Corporate structures and vertical integration are exemplified only by a handful of city-based deep-sea fishing companies who operate the largest pens and exert significant economic influence in the commodity chain (Chapter

VI). However, despite decades of state regulation, fluctuating limnological conditions, and undermining their own conditions of production, fishpen operations continue to produce much of the fish in the lake rather than leave lake aquaculture to household cage production. Explanations, drawing from the Mann-Dickinson thesis and related literature, may be framed in terms of four "solutions" or "fixes": abundant cheap labor; political ability to obtain large areas; "natural" solution by access to planktons and versatile fish species; and market solution in terms of a nearby metropolis with large numbers of poor fish consumers.

First, the availability of migrant labor, paid very low wages, allows pen operations to remain profitable in times of slow production times. Payment through monthly wages that are often well below the minimum supplemented by a share of the harvest enables flexibility on the end of pen operators during extended production cycles due to poor water conditions. Also, following Mann (1990), wage labor is more flexibly employed throughout the year to attempt to match the materiality of fluctuating biological production time of fish, given that laborers work on all types of tasks in pens and the degree and nature of work adjust depending on water conditions and fish growth. Second, the obstacle of size required for profitable production is overcome through the creation of paper corporations that allow operators to acquire contiguous pens of sizable areas through the political power of individual connections and the collective influence of producer associations. This process of expansion is not without contention, as pens run into conflict with fishers over issues of poaching and exclusion, and with LLDA, which has attempted to manage the fishpen sprawl by demolitions and zoning (Chapter 3).

Third, dependence on planktons, while a constraint in intensification, keeps production costs down during times of good water conditions. It allows continued production of cheaper fish sold in the urban market compared with those produced in other water bodies or in ponds that use feeds. Also, some pen operators shift their species of choice from milkfish to the more poor-water-condition tolerant bighead carp to be able to reduce production time and speed up the turnover of capital. Finally, the proximity of Manila and its demand for cheaper fish not only creates a steady market for lake fish but also becomes a discursive strategy framed within the languages of food security for the continued legitimation of pens whenever they are threatened with eradication. The interaction of these two solutions and the particular relations they reinforce is discussed more extensively using the case of bighead carp in Chapter VII.

Cages, on the other hand, persist in the lake partly because they produce a different species (tilapia as opposed to the milkfish of pens) that is destined for urban consumption in much lesser volumes (Chapter VI). Furthermore, as elaborated in Chapter V, cage production is a relatively profitable livelihood option in lake villages for fisherfolk who are able to overcome its barriers to entry. Village producers also employ a variety of strategies to respond to the materialities of cage production to continue production in less profitable conditions. Chapter V discusses responses and impacts of typhoons, saltwater intrusion and invasives from the perspective of lake villagers.

Materialities of nature shape the dual trajectories of aquaculture in Laguna Lake. While it mirrors other agrarian contexts in this duality, Laguna Lake aquaculture is unique not in the deterministic sense of diverging from predictions of how capitalist and non-capitalist production should develop, but in the co-evolutionary sense in that these processes are always spatially- and historically-contingent. This opens up an analysis of the role of nature's materiality in the lake's aquaculture history as a source of surprises as much as they are of obstacles and opportunities for capital. This argument is crucial, especially as we consider the lake's linkages with processes and productive activities beyond the lake, such as the discussion of urban metabolism in Chapters VI and VII, and how these complicate our understanding of capital-nature dynamics.

4.4.3 Toward materialities of produced natures

Work on materiality of nature has taken as given and emphasized that production relies on nonmanipulable properties and conditions (Benton, 1989; Burkett, 2006). Mann (1990), for example, argued how production times in agriculture are more or less fixed, and changes only through historical development in technologies like genetic improvement to speed up biological growth rates. The case of Laguna Lake aquaculture, water-based production in a eutrophic and turbid periurban lake, however, shows how materialities themselves are a product of interactions of various properties and processes deemed natural and material. Thinking further about materialities as themselves historically produced (whether intentionally or unintentionally) necessitates reiterating an engagement with the production of nature thesis (Smith, 2008).

Rather than merely focusing on how capital overcomes a recalcitrant nature (particularly in agriculture), the production of nature broadens toward a co-evolutionary understanding of nature as historically produced in the process of metabolic interactions between nature and society as humans labor to produce for survival and reproduction. In this sense, nature's materiality is understood not merely through capital acting on nature or nature acting on capital. Rather, capital is a socioecological relation wherein metabolism of nature is intrinsic in its logic. Furthermore, production of nature occurs in all types of production, whether peasant or capitalist. It is an approach that applies to all metabolic interchange between humans and nature, which necessarily involves transformation of both human and nonhuman nature in the process of producing for their own survival or for exchange (Eaton, 2011; Ekers & Loftus, 2012; Smith, 2008). A recourse to the production of nature is not a social constructionist argument since it argues that materialities of these produced natures are real and that these matter (Castree, 2000; Harvey, 1996; Smith, 2008).

Considering the materialities of natures in Laguna Lake aquaculture (natures of fish, lake, space, time) as produced allows three claims in understanding nature-society relations. First, it implies a nature that is not pregiven, timeless or universal (Smith, 2008). Indeed, while material properties such as photosynthesis are not produced by humans, what matters is how these materialities are imbricated in the process of production or metabolism, and with what effects. It is in this vein that nature is said to be produced materially and socially by the acts of producing though various notions of laboring (Ekers & Loftus, 2012). The lake's eutrophic property, for example, matter in the history of aquaculture development. However, it itself is not a fixed given, but actively constituted by aquaculture production and other forms of production around the lake (e.g. industrialization, agricultural intensification, urbanization, and hydraulic control) that continually produces particular natures. Thus, it can be proposed that various capitalisms – beyond merely the aquarian capitalism of pens – continually rework the materialities of Laguna Lake socionatures through their own productive activities that may sustain or threaten aquaculture production relations in the lake.

Second, the approach is a claim that avoids mechanistic discussions of materialities. Since natures are produced, particular materialities do not precede their enrollment in relation with other properties, and are viewed always as complexly interacting in the process of producing natures. The production of nature thesis applies to various forms of production, whether capitalist or not, and can thus account for the multiple interlinkages between the materialities of the natures that these produce.

Third, such an argument emphasizes a discussion of materiality that is not deterministic. The mutual constitution between societies and these materialities create paths that do not lead to expected, inevitable or universally-determined futures (Castree, 2000; Ekers & Loftus, 2012). Rather, these are historically and geographically contingent on multiple and varied ways that metabolisms are continually changing both people and their natures. This non-determinism also points to human agency and the possibilities of effecting positive change on existing metabolic relations.

Emphasizing how natures are produced thus allows a historical view of the material that recognizes its role in mutually constituting nature-society relations. It also paves the path for understanding natures in Laguna Lake as a product of productive activities not only within aquaculture in the lake, but also beyond. This chapter examined the history of Laguna Lake aquaculture by placing particular materialities of nature at the center of analysis. The next chapter tackles both materialities of production and the consequences of state-initiated and elite-led aquaculture expansion from the varied experiences of producers in two case villages.

CHAPTER V

ECOLOGIES OF AQUARIAN TRANSFORMATIONS IN TWO LAKE VILLAGES

Aquaculture's development necessitated a reworking of lake socioecologies to enable production of fish commodities. While large-scale pen aquaculture remained at the hands of wealthy urban entrepreneurs, small-scale cage aquaculture became accessible to lake fisherfolk. The fisherfolk adoption of aquaculture was accompanied by concomitant shifts in the organization of production and livelihoods in capture-fisheries-based villages. This chapter describes such transformations using the case of two Laguna Lake villages that have different forms and degrees of engagement with aquaculture. It uses qualitative data from interviews with purposively sampled fisherfolk (see Chapter II for methods) to argue that aquaculture adoption brought changes in the social relations of production, specifically in contractual arrangements, labor, ownership of the means of production, property rights, and inter-producer relations. However, shifts to aquaculture are partial and nonlinear, complicated by the process of working with the ecologies of making a living from the lake. Water conditions, typhoons and unintended invasives reconfigure everyday production in various ways and contribute to the spatially uneven development of small-scale cage aquaculture in the lake.

Chapter III described state efforts to introduce, improve and regulate aquaculture in the lake and Chapter IV showed the materialities that confront fish production. This chapter focuses on how state interventions (and their results) and the ecologies of production are experienced and interpreted by small-scale lake producers, including capture fisherfolk, cage producers, and lake-based traders. It begins by characterizing production arrangements in the two villages, and their transformations associated with aquaculture introduction. Using ethnographic data, it discusses who adopted aquaculture livelihoods and how. The latter half of the chapter focuses on individual and group responses to fishpen expansion, changes in access to lake resources, lake zonation, and materialities in production as they unevenly affect producer livelihoods. Producers differentially work around the consequences of these processes through various production strategies.

5.1 Fishing and aquaculture in two villages

This section describes the shift from capture fisheries to aquaculture in the case villages of Navotas and Kalinawan. While both engaged in similar capture fisheries livelihoods prior to 1980, Kalinawan more fully adopted cage nursery production than Navotas. In the case of the latter village, significant aquaculture engagement has been more recent through urban-oriented trading of fish harvested from pens. The varying forms and degrees of aquaculture adoption in the two villages have shaped relations of production and perceptions about aquaculture in different ways.

5.1.1 The lake villages of Navotas and Kalinawan

Separated by the narrow Diablo Pass, Navotas and Kalinawan are villages situated on the northcentral shore of Laguna Lake (Figure 5.1). Navotas is located in the northernmost tip of Talim Island (*Isla* in the vernacular), the large island that bisects Laguna Lake (Figure 5.2). One side of the village faces the deep waters of Diablo Pass, where currents are strong, while the Central Bay side (*Amihanan* or East-facing) is exposed to the strong winds of the northeast monsoon for half of the year.

Figure 5.1 Location of two case villages in Laguna Lake (Basemap source: World Topographic Map, Esri)

Figure 5.2 Navotas village (Photo by author, 10 May 2012)

Kalinawan is located northeast of Navotas, with a shoreline that faces the West Bay of the lake (Figures 5.3). While part of the mainland, people consider Kalinawan as part of the *Isla* due its lack of road access from the town center. As with the rest of *Isla*, the narrow flat shoreland where Navotas and Kalinawan villagers reside quickly makes way for the steep, sharp and rocky hills that characterize most of the island. Problems with slope and water limits livelihoods in the hills to bamboo harvesting (used for charcoal, fishpen poles and furniture-making), livestock raising, and patches of upland swidden agriculture (corn, rootcrops and vegetables) in both villages. It is no surprise that most villagers have traditionally made a living from the lake through fishing.

Figure 5.3 Cage nurseries off Kalinawan village (Photo by author, 13 June 2012)

Prior to aquaculture, Kalinawan and Navotas villages were primarily engaged in capture fisheries as a source of livelihood (Table 5.1). Large fishing boats that used motorized push nets and drag seines caught various kinds of indigenous fish and snails, and along with smaller fishing boats, these provided villagers with a means of subsistence. Male household members engaged in fish capture while women were involved in tasks such as fish trading, assembling, retail, drying and other forms of processing, as well as fishing using certain types of gear (e.g. fish corrals, fyke nets and manual push nets).

Table 5.1 Livelihoods comparison of two lake villages

Category	Navotas	Kalinawan
Population (2010)[1]	3,157	2,023
Households (2010)[1, 2]	631	405
Primary livelihoods[3]	Capture fisheries (motorized push nets, gill nets, drift long lines, drag seines, fish corrals/fyke nets, cast nets) for 65% of households Aquaculture (cages) for 10% of households Fish trading (urban-oriented, pen-related) and assembling (municipal-bound) for around 5% of households.	Aquaculture for 95% of households (primarily cage grow-out and nurseries; wealthier households operate bighead carp hatcheries)
Other fish-related livelihoods	Fish drying Drag seining of fishpens labor (5% of households) Fish trading labor (20% of households)	Capture fisheries through drift long lines (since 2012) and fish corrals/fyke nets Fish assembling and trading
Land-based livelihoods	Charcoal-making Swidden agriculture and livestock Off-farm work (urban/municipal casual and professional work; overseas employment)	Charcoal-making Swidden agriculture and livestock Off-farm work (urban/municipal casual and professional work; overseas employment)
Pre-aquaculture livelihoods	Capture fisheries (depending on location in the village: gill net, motorized push nets, drift long line, drag seine, fish corrals)	Capture fisheries (motorized push nets; fish corrals)
Adoption of aquaculture	Cage nurseries and grow-out started in early 1980s but limited to one section of the village most suited for cages. Pen-related fish trading started in early 2000s.	Cage nurseries and grow-out started in 1980 and expanded throughout the village.

[1] 2010 Philippine population census
[2] Computed from 2010 Philippine population census using 5 persons per household
[3] Estimates based on interviews and unpublished village documents

5.1.2. Relations of production in capture fisheries

Capture fisheries in Laguna Lake involves the use of several gears (Table 5.2 lists common gears). Motorized push nets (*suro* or *sakag*) are non-selective gears that are able to catch fish of all types and sizes. Highly efficient (up to 5 times more than other gears), this fishing technique was introduced in the 1950s, and employed most villagers for the next few decades (Figure 5.4). Since these large motorized boats had fine-mesh nets, they became technically illegal with the passage of the 1998 Fisheries Code. Drag seines (*pukot*) were the dominant fishing gears used at the turn of 20th century as noted by early Laguna Lake fisheries studies (Aldaba, 1931b, 1931c; Mane & Villaluz, 1939; Villadolid, 1934).

Table 5.2 Common capture fisheries gears in Laguna Lake

Category	Motorized push nets (*sakag*, *suro*)	Drag seine (*pukot*)	Gill net (*pante*)	Drift long line (*kitang*)	Cast net (*dala*)
Catch per unit effort (kg/hr 1995-1997)[1]	3.64	0.65	0.50	0.70	0.70
Species caught [1, 2]	Non-selective: all kinds such as shrimp and fish fry	Selective: silver perch, white goby, Manila catfish, mudfish	Selective: tilapia, bighead carp, Manila catfish, milkfish	Selective gear: knife fish, white goby	Selective gear: mudfish, catfish
Labor needs (persons/boat) [2]	5-12	10-16	2-4	2-4	2-4

[1] Palma, Mercene, and Goss (2005)
[2] Field work

Both motorized push nets and drag seines, owned by wealthier village households, employ a crew of more than a dozen, led by captains or drivers. With the advent of aquaculture and increased enforcement of the Fisheries Code, some of these boats and their crew were converted for fishpen work. Drag seine boats became seiners for harvest-ready fish in pens while several motorized push net boats were used by traders for hauling and transporting pen fish to the landing ports.

Figure 5.4 Motorized push net fishers off Navotas (Photo by author, 1 May 2012)

Gill nets, long lines and cast nets are active gears organized in much smaller boats, usually with 2-4 crew members (Figure 5.5). Gill nets are used for daily fishing trips, but they become more common after typhoons when milkfish and other fish enclosed in damaged pens escape. Abandoned due to the decline in white goby, the drift long line has gained renewed popularity because of its suitability for catching the invasive knife fish. Passive gears such as fish corrals (*baklad*) and fyke nets (*skylab*) are stationary gears of structures similar to cages that are staked in the lake to capture fish and are harvested regularly. Decisions on whether fish catch ends up for own consumption, for village retail or for exchange in municipal and urban fish markets depend on volume of catch and type of gears. Larger boats with motorized push nets bring catch directly to fishports or indirectly through village assemblers. This happens less often with the smaller boats, especially when catch is only a few kilos.

Figure 5.5 Gill net fisher off Navotas (Photo by author, 9 May 2012)

Despite technique differences, capture fisheries share institutional commonalities. A share tenancy exists similar to other marine fisheries institutions (Carnaje, 2007; Spoehr, 1984) and the *kasama* system in rice farming in the Philippines (Aguilar, 1989; Ledesma, 1982; Ofreneo, 1980; Takahashi & Fegan, 1983). Wealthier villagers own the boat and/or nets, and they employ village labor as share tenants (*kasama*) or as fishing crew members (*tauhan*). Crews organized according to fishing groups are more or less stable, with roughly the same laborers recruited for each fishing trip and occasional absences substituted by "extra" laborers. These laborers are primarily recruited according to kinship ties. Owners get half of the net income per fishing trip, while crew fishers divide the other half equally, with captains/drivers (in the case of the boats with more than 5 people) getting a few pesos more.

Strong patronage ties exist between fishing crew and boat owners, and between fishing crew and captains/drivers. For example, crew members get credit for daily household expenses from boat owners in exchange for their regular labor for the boat. In larger boats, drivers or captains make fishing decisions, with approval from the boat owner, in terms of who to hire, where to fish, when to unload, and so on.

5.1.3 Relations of production in aquaculture

SEAFDEC's aquaculture station (Southeast Asian Fisheries Development Center – Binangonan Freshwater Station), established in 1976, is located approximately equidistant from either village. Through its research and extension programs that coincided with LLDA efforts to promote fisherfolk access to aquaculture (Chapter III), early adopters of cage nurseries in Kalinawan and Navotas benefitted from the technical knowledge, breeders and fingerlings that the station disseminated. Kalinawan villagers embraced aquaculture more fully because of various reasons: locational advantages, more concentrated pre-aquaculture wealth distribution, an initially active cooperative established by a state program, and personal ties of villagers with SEAFDEC staff, among others.

Cage aquaculture in Navotas has been limited to two *purok*s (village sub-units) where the lake is shallow and sheltered enough to permit nursery construction. With an enforced Fisheries Code, several fishing boats in Navotas discontinued operations and were converted for aquaculture-related livelihoods. Trading of pen fish became the most significant aquaculture-linked livelihood in Navotas. While production relations in trading in Navotas mirror that of capture fisheries that use large boats, cage nurseries in Kalinawan required greater changes in the organization of production.

5.1.3.1 From capture fisheries to cage nurseries in Kalinawan

Referring to himself as the grandfather of tilapia, K23 narrated how aquaculture first came to Kalinawan in 1980 through SEAFDEC:

> SEAFDEC offered transfer of technology for tilapia breeding. That was how we started. I was a member of the *Samahang Nayon* (Rural Cooperative) and no one was willing to attend seminars. I volunteered, since I was a member of the Board of Directors. I attended seminars in SEAFDEC for a year. Then I taught people here how to breed tilapia. (K23 cage nursery producer 2012)

K23 recalled how the cooperative, a product of the Cooperative Development Program meant to improve fisherfolk access to aquaculture (see Chapter III), initially set up cage nurseries that were managed collectively. This did not work out in the long run due to conflicting interests within the cooperative, which led to individualized production of cage nurseries. Starting with 200 breeders provided by the cooperative, village producers learned the techniques of breeding tilapia within hapa net enclosures. The transfer of knowledge of tilapia breeding through experience and observation was simple and easy for almost everyone, but raising enough funds to purchase nets and poles for the enclosures was not. In 1982, a similar type of technological transfer using bighead carp was introduced by SEAFDEC.

Kalinawan became known as the fingerling center of Laguna Lake, supplying newly-hatched tilapia and bighead carp to cages and pens throughout the lake. Located a few hundred meters from the village, beyond the designated motorway for passenger boats, the cage nurseries (*semilyahan*) house breeders, newly-hatched fry, fingerlings of various sizes, and fish designated for sale in the market. Tilapia is reproduced through the manipulation of male-female ratio of sexually-mature breeders within a cage enclosure. Thousands of tilapia fry that spawn from the breeders are regularly graded and transferred to other cage enclosures every two weeks to avoid crowding and cannibalism. There are several of these enclosures with mesh nets of varying sizes that correspond to the sizes of the fry and fingerlings. Fry/fingerling and breeders require daily feeding and monitoring (Figure 5.6). Kalinawan cage producers also rear and condition bighead carp fry to fingerling size (bighead carp “trading”) ready for pen or cage stocking. These fry come from inland tank hatcheries that produce millions of bighead carp through a more complicated and technical process of induced spawning.

Figure 5.6 Visiting a Kalinawan cage nursery (Photo by author, 22 June 2012)

It is common for cage producers to set aside cages and fish for growout to be sold in the market. Cage aquaculture is, more precisely, production of fish through several cages (sometimes within one enclosure averaging half an hectare), both for nurseries and grow-out. Villagers often point to large, concrete houses as proof that cage nurseries have brought certain households prosperity. Stories of villagers who worked in wage labor in the city only to return to the village for aquaculture are common.

> Almost everyone here in the village is able to construct nice houses from cage aquaculture. Like that big yellow house over there, that came from nursery work. (K04 cage nursery producer 2012)
>
> When we began culturing fish here, our lives changed. First of all, you don't worry anymore about what to eat or how to put kids into school. Our lives became better when there were fishpens here. You can eat three times a day, construct a house, go wherever you please. But if you were only fishing, you cannot save up, what you eat is not enough. Back then, our earnings were fixed at P200 (K06 bighead carp hatchery owner 2012)
>
> My *kumpare* [co-parent through baptism] there used to work in Mitsubishi in the city. When he learned how to breed tilapia, his cages multiplied, he got startup

> money when he resigned from the company. He has a fishpen too. His house is tall. It used to be a small house he inherited from his parents but he made it tall. He has many big boats from cage nurseries. It's probably luck too. If he stayed on with work on the mainland, he probably would not have that house. (K09 cage nursery producer 2012)

Investing in new cages requires at least P15,000 depending on size and assuming one already has space in the lake, which is registered and leased annually from LLDA. Several producers were able to invest in cage production through money borrowed from better-off relatives or saved from urban off-farm work in factories or companies. Because starting up with new cage nurseries is relatively inexpensive and breeding is easy to learn, almost all households engaged in cage production in Kalinawan after it was first introduced in 1980. Coinciding with good and productive water conditions, villagers widely adopted cage nurseries in the early 1980s, and were able to maintain production in the next three decades despite socioecological challenges (see 5.3):

> Back then, SEAFDEC gave us several pieces of tilapia, around 500. We reared them to breeder size. We were taught how to breed them, and then we distributed them throughout Laguna and sold them in cages…During those times, Laguna Lake was still productive. In three months, you could harvest. Back then, there were only a few buyers, but we pushed on until fishpens multiplied in number. Financers came from different places and cities, and this kind of livelihood blossomed in our village (K15 cage nursery producer 2012)

While several fishers engaged in share-system type of partnerships – often with urban, middle-class investors who put out money in exchange for producer labor and knowledge – cage nursery aquaculture in Kalinawan involved a radical reworking of ownership and production distinct from the share tenancy system that prevailed in capture fisheries. For the first time, many producers were able to technically own their means of production, instead of relying on crew work in fishing operations owned by a few households. Villagers noted this change:

> Back then, we only had a few owners of the motorized push net boats (*panakagan*). You work for them. They are the ones who have money in the village then. Like in companies, they own the boats and we work for them. (K05 cage nursery producer 2012)

> Only two ran the village then. They are the ones who had money then. Now we can get many financers. Most cage producers here have financers. (K11 cage nursery producer 2012)

Household ownership and operation of cages take varying forms. A husband-wife household head can own and manage one or several cages, and employ hired labor or household labor (usually sons or other male relatives). Some cages individually owned by members of an extended family are managed by one household head.

> I take care of the fish on my own, but during grading, my sons help me. At night, sometimes my wife and I stay at the hut by the cage. We would go after dinner and sleep there and then return to shore the next morning…Before we do the tasks, we would eat first in the hut. Then we would work. After that we would cook again, take a short nap, then go back here. (K17 cage nursery producer 2012)

The decentering of ownership to several rather than two households in the village also increased the predominance of fixed wage labor for "stay-in" or all-around work in cages or small pens, and for the requirements of hired labor. Stay-in laborers, like fishpen work, are paid a fixed monthly wage apart from food, with some getting shares from harvest profits. Usually employed solo, a wage laborer's tasks include daily monitoring of fish, guarding from poachers, and repair and maintenance of nets and fences. These laborers are often found, however, in larger cages. Smaller cages, especially those which are downsizing, rely more on household labor, often unpaid but sometimes waged as well. Hiring of extra labor is necessary for cages and pens alike because tasks such as repairing of nets, and harvesting and delivery of fish (fingerlings and market-size) require at least three people. A day's labor is paid P200.

As with large pens (Chapter IV), cage aquaculture requires close monitoring and surveillance. The need for regular monitoring is tied to the invisibility or poor visibility of fish (as fugitive commodities underwater) and fish as a mobile resource fixed in space. Cages need to be visited every day (*bisita*) and regularly inspected to make sure that there are no breaks in the nets and that fish do not escape. Feeding, more than a means of nourishing the fish, becomes a way to monitor fish whenever they surface to feed. Cage nurseries work demands more care and vigilance, but involve less hours spent in the lake than capture fisheries.

Changes in inter-producer village relations came with the shift from group-based share tenancy in capture fisheries to a more individualized production in cages. The patronage relations between a few boat owners and several fishing crew were transformed to relations between several cage producers and wage or hired laborers. Producers prefer arrangements in cage aquaculture because they are able to make decisions on their own. As their "own boss," they are free to strategize production and supervise laborers that they employ as they please.

> Work here is comfortable, you have no boss. No one manages you. It's up to your own strategy to earn (K10 cage nursery producer 2012)

> I may not have money like my professional friends in the mainland, but I have people working for me. I am the boss, I have a small business. (K15 cage nursery producer 2012)

> Nurseries are better livelihoods than working in fishing boats. Since we finance them on our own, we make the decisions. If you do not set out to sea, no one will get mad at you. Unlike if you share (*nakikisama*) with a boat, if you don't fish, the owner will get mad at you. (K18 cage nursery producer 2012)

The appearance of atomism or individualism in cage production, however, hides forms of village-level inter-producer cooperation and sharing. Knowledge about breeding techniques circulates freely beginning with the initial stages of aquaculture adoption and continuing up to present. Ties with villagers who worked in nearby SEAFDEC were important in bringing technologies and knowledge to the village. Interviews also note that different strains of breeders from other parts of the country that are crossbred to improve fish growth are commonly shared among producers. Pooling of fingerlings to supply the requirements of large fishpens has been a common practice since the 1980s. Since average-sized nurseries can produce only 30,000-50,000 fingerlings and pens stock 100,000 to a million fingerlings, a producer usually asks neighboring cages to contribute so as to complete the order.

5.1.3.2 From capture fisheries to fish trading in Navotas

Navotas saw the beginnings of small-scale cage aquaculture at around the same time as Kalinawan. Unlike in Kalinawan, where capture fisheries operations were almost completely replaced by cage nurseries, aquaculture in Navotas is one of the several lake-based livelihoods that villagers draw upon for daily subsistence. Navotas did not possess the locational advantages and SEAFDEC ties of Kalinawan. N02, for instance, was the first to try tilapia grow-out cage aquaculture off the more exposed shores of Amihanan, but consecutive typhoons and strong waves made it difficult for him to recover from losses. Ownership of capture fisheries boats was also more decentered in Navotas, with several households owning boats of varying gears (from motorized push nets to gill and cast nets), rather than just the two in the case of Kalinawan. These reasons may suggest why cage aquaculture was not as widely adopted in Navotas. Indeed, until the urban-oriented trader (*naghahango*) tied to fishpen operations appeared in the early 2000s, motorized push net boat owners remained the most affluent villagers.

> The biggest earners here in the village are the motorized push net owners. They make a lot just by letting the boats spend a few hours at sea. As a crew member, you can earn P1,000. In poor times, P300 or P200. If you are just a crew member in motorized push nets, you'll just earn enough. The owner is the one that gets rich. This is because of the sharecropping system. (N21 cage nursery producer and former motorized push net crew 2012)

Faced with institutional and ecological challenges, motorized push net operations downsized and decreased. Stricter enforcement of the Fisheries Code in different lakeshore municipalities beginning in the early 2000s led to intensified regulation against motorized push nets. If caught by the *Bantay Lawa* (Lake Watch) in other lakeshore municipalities, boats are seized and confiscated, and crew members are temporarily jailed until the boat owner bails them and pays corresponding fines. The response of motorized push net owners was to downsize engine type and shift to shrimp capture. Others, however, sold their boats and invested in aquaculture though trading (more common in Navotas) or seine harvesting (less common) of pen fish. Pens, to reduce costs, hire these boats to undertake tasks that cannot be performed by their laborers. N11, for instance, used to be the driver/captain of a motorized push net boat. When fishing operations using this gear became harder, the boat owner shifted to trading. From driving a motorized push net boat, he became the driver of his aunt's newly-purchased trading boat. Navotas boat owners attest to the impacts of regulations:

> My boat was confiscated many times. And you need to pay P50,000 for fines. Here in Bay, it is P50,000. In Jala-Jala, you pay P80,000. In Sta. Rosa, I can't remember how much we spent there. That was why I thought let us not use it for fishing anymore, and just sell it. (N14 former motorized push net boat owner 2012)

> We used to have a boat for motorized push nets. It is now prohibited. In order for us to avoid getting apprehended, we converted the boat for motorized push nets to a boat for drag seine harvesting in fishpens…. Most motorized push net boats here were sold. Before there were more than 30. Now, there are only a handful, and most of them are smaller. (N12 drag seine harvest boat owner 2012)

In 2002, N15 became the first trader (*maghahango*) from Navotas to engage in aquaculture harvest trading. With help from two financial partners and building on her previous contacts as a fish retailer and assembler based in the municipal fishport, she established contacts with pen operators and caretakers. In the next few years, trading became a way for her to earn enough to have her kids finish college and to build a solid, concrete house. However, a few other villagers ventured in trading, which led to competition and the eventual decline in her livelihood. She narrated:

> If I learned that a fishpen operator has fish ready to harvest, I would go there. We have gone around the lake to different places, until my name became familiar to them. Now the pen operators would call me, since phones are common now, we would text. Then we would go and get volumes of fish from pens… We are not doing so well now, because many others have learned the trade. Of course, it is

heartening to see that they copied what they saw from me. Many from the village have learned…But I was the first here. They saw that it was a good livelihood, you are able to save money and buy things. (N15 trader-assembler May 2012)

Traders transport harvested pen fish to the lakeshore municipal fishports and the Manila fish market. After hiring seiners (from Navotas or other villages whose drag seines boats were converted for this purpose) to corral fish (Figure 5.7), pen operators would contact traders to negotiate a price for the fish, which the latter would buy from the former. Traders would then haul the seined fish to their boats through hired laborers. In the municipal fishport, laborers would load tubs of iced fish in trucks to be sold in the Manila fish market to buyers via the brokers (Figure 5.8). Some buyers purchase fish in the municipal fishports but most transact with the traders in the urban fish market.

Figure 5.7 Drag seiner corralling fish inside a pen (Photo by author, 24 April 2012)

Figure 5.8 Trader crew unloading tubs of pen fish at a municipal fish port (Photo by author, 11 May 2012)

N06 and N07 are both village officials, and were elected in position largely due to their success in trading. From working as fishing crew in motorized push nets, they were able to save enough money to start trading and purchase their own boats and trucks. Building fishpen contacts and relations is important. N06 worked as an agent for the bamboo purchased by fishpens for their fences and developed contacts through this work. All traders oversee the transport of fish from hauling to the unloading in fishports. N07 and N13 would go to the fishpens and manage the transportation process with a crew of laborers from the village. N09 and N13A, their father-in-law and wife, respectively, would take over the transport of fish from the fishport to the nighttime urban fish market.

Entry barriers to trading are significantly lower than the cost of investing in motorized push net operations. With access to credit to fund the hauling and transporting process (to cover for the costs of labor, boat/truck rental, ice, etc.), traders can earn enough to recover these initial costs within one or two trips to the market. N07 and N22 are only in their early 30s and both have already invested in boats that they use to transport fish. N07 saved up enough money from hog raising to attempt fish trading. N22 worked as a teacher for a while but decided it would not earn him as much as trading. For his first trips to the market, he borrowed from an urban-based broker originally from the village who loaned him money in return for consignment rights to his unloaded fish.

Income from trading is generated through proper timing of harvest in pens and unloading in the fish market. Since traders buy fish from pens at a certain price, it is important that prices in the fish market are at least a few pesos per kilo higher. A markup of P5 per kilo would earn a trader who harvested 3 metric tons of fish P15,000. A negative difference of P2 per kilo would mean the trader loses P6,000 on top of expenses in boat, labor, trucking, broker commission and fishport worker tip. Traders, and the corresponding income of their crew members, are thus tied to market factors beyond the lake.

> For every 10 harvests, you earn profits for 6 or 7. You lose money when you buy fish from pens at a higher price than that of the market. So we call our broker contacts in the fish market and ask them about prices. When fishpens agree, we will harvest the following day. (N22 trader 2012)
>
> Prices can suddenly drop. Because once you bought fish from the fishpens, he no longer cares for the fish. For example, you bought the fish at a rate of P20 per kilo. When you reach the Manila fish market, the price drops to P18. You are running at a loss of P2 per kilo. That's a lot of loss, given your expenses such as transportation and the broker's commission. Prices drop when there is a lot of fish unloaded in the market at the same time, whether from deep-sea fishing or

> from the lake. For example, you plan on unloading later tonight and the price is good when you get to the fish market and you earned a profit. So you'll call other fishpen operators and negotiate a price to harvest their fish the following day because you know the price is good in the market. Then, the next day, you find out that many others have unloaded and that caused the price to drop. If the buyers in the market hear about fish unloadings, they won't buy just yet. They will wait until there are more fish in the market. Then they will have the upper hand in bargaining for a lower price for the fish, and so you have no choice but to sell the fish at that price since you cannot return the fish to the lake. (N06 trader 2012)

The organization of fish trading has many similarities with capture fishing operations, but fewer similarities with cage production. Labor recruitment is limited to the village, with the crew composition more or less stable through time. Additional laborers are hired if there are more fish than usual to be harvested. The trader or the driver/captain of the boat decides on whom to allow to join in. Patronage and kinship ties are developed and strengthened in these relations. However, the share tenancy system common with fishing operations disappeared with the rise of trading. Crew members are paid a fixed wage, which fluctuates to some degree depending on the trader's net income for a trip. Income from trading, however, is less variable than from motorized push nets given the stable volumes and frequency of harvests. Laborer income from trading depends largely on the volumes harvested by the trader from the pens and the circumstances of unloading and market prices in the urban wholesale fish market. Income from push nets, on the other hand, depends on the seasonal and fluctuating productivity of the lake. Traders and their crew noted these processes:

> We can earn from trading more than P10,000 in one night. In motorized push nets, you take a share after deducting all costs. If you earn P3,000, half goes to

> the owner and the other half to the crew. In trading, you won't need to share P10,000 with anyone. (N13 trader 2012)

> Motorized push nets are harder. You work for longer hours. It is harder on the body than trading. In terms of income, we get more from trading. You work shorter hours and earn P200, P250…If sales are good, we earn P300, P350 each with 10 people in a boat. (N08 fisher and trader crew 2012)

> Motorized push nets are harder. And besides, your income is not assured there. Because there is the risk you will be apprehended. But in trading, you just take what is given to you. But sometimes there are times when we earn more in motorized push nets if you have more fish. But when the lake is not productive, you will not replace motorized push nets with trading. (N10 fisher and trader crew 2012)

> Some of those who join my trading crew are motorized push net fishers because fishing is hard these days and you only catch a few fish and get caught and jailed. (N22 trader May 2012)

The introduction of aquaculture involved significant transformations in the social relations and livelihoods of the villagers. Compared to capture fisheries, aquaculture development brought varying degrees of changes in how fish is produced and the institutional arrangements surrounding such process. Cage nursery production reworked ownership of means of production, labor arrangements and the patronage relations between villagers. A similar process happened in the case of aquaculture trading but differences with fishing institutions are not as significant. The next section focuses on changes in property rights to lake space and fish, the corresponding conflicts associated with the contradictions of such changes, and the complex relations of producers with the state, all viewed through the lens of producers from the two villages.

5.2 The state, pen-fisher conflicts and fisherfolk responses

This section builds on previous discussions on the role of the state in reconfiguring socioecologies of Laguna Lake (Chapter III) and differences in production relations between the two villages (Chapter 5.1) by examining fisherfolk perspectives on aquaculture expansion, the resulting social conflicts it generated and their subsequent responses.

5.2.1 Territorializing fish access

As discussed in Chapter III, fixing property rights in a fluid lake was concomitant to aquaculture's introduction by the state. Such fixing caused complications that made poaching easier and violent encounters between producers more common. These conflicts arose in large part due to the reconfiguration of property rights that accompanied aquaculture as a form of commodity production that continued to coexist with fisheries. While informal village-specific rules regarding fishing gears existed, the lake prior to aquaculture was generally open-access to fishers with capital, technology, labor, and knowledge necessary to obtain the resource (Eleazar, 1992). Through the introduction of fishpens and cages, the state assigned different property rights on lake space, water and fish to individual aquaculture operators.

One major contradiction between capture fisheries and aquaculture is that aquaculture production is fixed, while capture fisheries rely on the mobility and fluidity of fish. Aquaculture requires production particular to a designated and bounded lake space. Fish are owned by the producer from the moment of stocking to the time of harvesting. This is in contrast with fishing operations, which consider the whole lake as its production space, and which adjust spatially depending on the fugitive target fish that are only owned once caught and hauled in the boat (Figure 5.9).

Figure 5.9 Mobility of cast net fishers (foreground) and fixity of a fishpen (background) off Navotas (Photo by author, 26 April 2012)

It was inevitable for fishing boats to encounter pens, especially since fugitive fish apart from those stocked by operators are attracted to fishpen enclosures because of the calm and sheltered waters within and immediately outside these structures (Tan et al., 2010). Pens even become the *de facto* owners of non-stocked fish that grow and are harvested inside their pens. Fishers observed:

> Fish congregate near their nets. That is why we can only catch fish if we stray near the pens. But they keep on driving us away. (N17 gill net fisher 2012)

> Fisherfolk in the lake are at a losing end here. Instead of being able to capture them, the fish remain inside the fishpens. You stray too close, they get mad. The fishers probably don't have intentions of destroying the pens. They just want their share of the fish. But they get mad. (N16 gill net fisher 2012)

Thus, fishers are often seen to infringe the territorial bounds of pens. Given the fluid circulation of water, gears and nets set near pens sometimes crash into or damage pens (and vice versa). This has built a sense of mistrust between pen caretakers/operators and fishing crews. In response, pen owners exercise their power to exclude by demanding remuneration whenever there is damage to their nets, levying taxes or fees to passing fishing boats, and generally viewing all passing fishers with suspicion. The use of fireworks and firearms by pens to drive fishers away has resulted in a few reported deaths (Chapter III).

> The wrong thing about them sometimes is that when they construct a pen, they treat the waters around it as if it was theirs and they prohibit you from getting near. So when we set our long lines or gill nets, they would drive us away like the lake was theirs. (K08 drift long line fisher 2012)

With the heightening of conflicts, the state intervened through zoning and territorial regulation of lake waters (ZOMAP), apportioning specific lake spaces for use by fisherfolk, cage owners and pen operators. Through aquaculture, the state made fish production in the lake more legible and easier to measure and control in part by assigning clear property rights and ownership (Scott, 1998). Furthermore, it reworked the contradictions inherent in these new arrangements by increased territorial regulation through zoning when conflicts threatened to reduce production. In a way, this regulation of aquaculture through zoning (and rezoning) can be seen as a form of "territorialization" of state power (Vandergeest, Flaherty, & Miller, 1999; Vandergeest & Peluso, 1995).

5.2.2 Fisherfolk responses to territorialization of fish access

> Back then, even with your eyes closed and feet raised, you can operate your motorized push nets without encountering any obstacles. (N24 former fisherfolk 2012)

Fisherfolk recall of a time prior to aquaculture and state intervention in fish resources when the lake was "unobstructed" and they were "free to move and make a living" (quote above). The fishpen sprawl resulted in the displacement of fisherfolk and reduction of their fishing grounds that led to recurring and unprecedented violent encounters between pen and fisher producers. Kalinawan and Navotas villagers interpret fishpen expansion and state territorialization in various ways. Navotas fishers view the sprawl's impacts as an issue of legitimacy of lake use, and its maintenance as a consequence of pen political power and connections. Several Kalinawan producers also hold these views but these are complicated by the dependence and ties of their livelihoods with large pen operations.

The contrast between the fixity of aquaculture and mobility of capture fisheries stoked the tension between fishers and fishpens. The former viewed the latter as an outsider that displaced them, the legitimate users of the lake.

> No one owned the lake before. Only the Laguna Lake people used the lake. (N12 drag seine boat owner 2012)

> It is said that the rich keep getting richer. This lake used to be for the poor only. (N17 gill net fisher 2012)

Through time, fishers came to view pen-fisher antagonistic relations as part of their everyday encounters in the process of production. Fisherfolk distinguish between nice pen operators/caretakers, who would not mind them if they fished nearby, and those who are less tolerant. They describe fishpen attitudes that range from just strict (*istrikto*) and ill-tempered (*masungit*) to bad or nasty (*salbahe*). Fishers, for example, would know if a pen would allow them to drift close by the pen laborers' hand gestures or their use of guns or fireworks.

> There are large fishpen operators that are kind. There are nasty ones, like this operator from Malabon who has killed many. So, few fishing boats drift close to that pen. There are nice ones though who let us in their pens to clean them from knife fish invasives before they stock again. (N13 former fisher 2012)
>
> I tell the fish buyers in town who try to haggle with our fish that our investment is our lives. We don't know what kind of people we will encounter. I tell them that if they were in our shoes, it is possible to encounter evil ones where we go and fish…When you get close to the irritable ones, they fire their guns. Someone from this village already died. Good thing if you know which pens are responsible so you could get remunerated. But it should not be like that because we are talking about life here. Money, you could just earn that. (N21 drift long line fisher 2012)

The mistrust between the two is complicated by the intentional violation of the pen's property rights by some fishers who see the poaching of pen fish as retribution for pens being "too strict", aside from it being a means to arrest hunger and provide income for their daily needs. Poaching became a fisher strategy to gain access to fish that became the property of pens. The invisibility and stationary character of fish within enclosures have made it easy, common and lucrative for fisherfolk.

While Navotas fishers are generally in favor of removing fishpens or at least reducing their sizes, cage nursery producers in Kalinawan have a more ambivalent view about the pen-fisherfolk conflict. On the one hand, some empathize with fisherfolk displacement and violent encounters with pens, either because they were once fishers too, they still continue to fish, or they identify themselves dually as fishers and cage producers. On the other hand, they understand (as aquaculture producers themselves) the pen operators' desire to protect their investments, and recognize that they benefit from pens since they are the biggest clients for their fingerlings. Some view proposals of eliminating all fishpens - once a real threat in 2009 - as a significant threat to their livelihoods.

> I am in favor of removing pens for the ecosystem and for the good of the water here. Secondly, more people will benefit, right? Not just a few fishpen operators…They should be removed so that fisherfolk will be able to fish freely. Or maybe reduce the size to 5 hectares and keep them close to the shore, since large pens are in the middle of the lake, and several fishpen companies extend to 1000 ha. When you get close to them, they will chase you. Those are the ones that need to be removed (N09 trader crew 2012)
>
> Pens affect only those who fish using long lines and gill nets because when they sail near pens, the guards get mad. But to us cage nurseries, they don't have an impact. In fact, their presence is in our favor because we supply them with fingerlings. If the pens disappear, then we also lose our livelihoods. (K18 cage nursery producer 2012)

Poaching is also common in the cage nurseries of Kalinawan. However, they attribute such acts to outsiders from nearby villages ("seamen") in dire need who become more active at night and during difficult times when the lake is not as productive. Threats of poaching, while considered by many cage producers as inevitable and normal as climatic events like typhoons, necessitate surveillance and monitoring of fish and nets (Chapter IV).

Villagers view the state – embodied primarily through the LLDA and to a lesser extent the national government –as a distant entity that is largely apathetic to the plight of the lake people. For many fisherfolk, the state is on the side of large fishpen owners as a result of the latter's importance in generating income through the annual fees they pay, and of their strong individual or collective political clout (Chapter III). Some assign responsibility for the lake's ecological problems – such as poor water conditions and introduction of invasives – to the state's intervention. Many are left wondering, for example, why the state would want to keep the saltwater intrusion out of the lake, giving rise to speculations that it is in favor of certain interests such as urban private water concessionaires.

> Before the government meddled with the lake, it was clear. The water was not like that before Imelda [Marcos] meddled with it. When we were younger, the lake was really really clear, (K24 cage nursery producer 2012)
>
> I don't think the pens will disappear from the lake. Maybe it is the fishers who will disappear. The fishpens won't disappear because they pay a lot of taxes to the government. The government benefits more from the payments of pen operators compared to the small fisherfolk. (N15 trader 2012)
>
> The owners of the large pens are from Malabon, those who have deep-sea vessels as well…They have their own harvest boats, tugboats, and drag seines. So people here in the lake do not really earn from them. The only ones who do are the municipal governments where they are located. Of course they pay them fees. People here do not benefit. Not even through labor since no one here would suffer through low wages. (N12 drag seine boat owner 2012)

However, villagers see both agency for and responsibility to change to also lie with the state. This was a more common view among cage producers. The fact that they pay annual leases (despite running at losses in times of disaster) provided them a sense of right to demand that the state improve the condition of the lake for their production.

Producers from both villages recall the time in the 1980s when they were united towards a common purpose. The pen-fisher alliance to open the Napindan Hydraulic Control Structure was successful (Chapter III). However, production in the lake has seen various other challenges. According to them, they need collective action and a united voice to address these issues, but such actions have occurred less often since the protests of the 1980s.

> If people in Laguna Lake would unite, we would wage a war against the Napindan structure so that they would open the outlet to the sea. We are not united here. Nothing is happening, we would just rely on the government, on mayors who are nice, but nothing is happening…The government says that the Napindan channel is shallow so the saltwater could not come in. They should have dredged it. (N29 cage producer 2012)

5.3 Reworking production with reworked lake socioecologies

Agrarian transformations in the two villages resulted from the adoption of new forms of producing from the lake and included changes in the organizations, institutions and relations of production. However, village livelihoods remain tied to the changing ecologies of aquaculture and fisheries production. Building on discussions in Chapter 4, this section examines the complexities of laboring with the material ecologies of the lake through three examples: fluctuating water conditions, recurring typhoons, and proliferation of invasive fish. Villagers consider these as the most important issues affecting their production. In some ways, how these ecologies constitute and are constituted in everyday production reveal disruptions in attempts to order fish production in the lake through aquaculture.

5.3.1 Fluctuating water conditions

> There is no such thing as a skilled cage producer when the water is poor. (N21 cage nursery producer 2012)

Aquaculture in Laguna Lake relies primarily on complex interactions of lake processes that together comprise the conditions of production (Chapters III and IV). These processes sometimes bring contradictory effects and are highly varying such that productivity can fluctuate from year to year and season to season. The introduction of aquaculture, ambitious infrastructure projects, and various inflows from surrounding areas compounded these complexities, producing a historically- and geographically-contingent lake nature.

Fluctuating water conditions shape fisheries and aquaculture production in the two villages in several ways. In times of poor waters, producers respond by making strategic decisions regarding the stocking densities of fish in cages. The reduction from 15,000 to 3,000 fingerlings per cage, for example, allows faster and better growth, even if marginal, but this is at the expense of reducing total volumes of fish harvested or fingerlings sold. Cage producers have also experimented with polyculture, combining bighead carp with tilapia within one enclosure to maximize their differences in feeding habits that provide mutual benefits to growth.

Several nurseries have ceased producing tilapia fingerlings due to depressed demand from grow-out cages as a result of the increased production time of rearing tilapia. Bighead carp, meanwhile, have been increasingly stocked in both pens and cages during times of poor tilapia and milkfish growth. This type of fish grows better and faster when tilapia and milkfish do not. Bighead carp fingerling rearing provides cage nursery producers with a way to maintain operations when tilapia growth is slow. Producers noted the advantages of bighead carp:

> When water is poor, even if you feed your fish, they won't grow. So we just wait when water improves. But bighead carp, even if water is poor, it continues to grow, unlike tilapia and milkfish that do not. If you feed tilapia with turbid water conditions, they will grow fatter on the sides but not big. (N23 cage nursery producer 2012)
>
> These days not a lot of people buy tilapia fingerlings from us, not like bighead carp, which sells better here. It sells quicker and fetches a good price. When you grow 10-12 sized fingerlings, they are sold for two or two-and-a-half pesos. Tilapia fingerlings of that size can be sold for only twenty cents. Those pens who stock these days get bighead carp. (K09 cage nursery producer)

Tilapia nurseries in Kalinawan have engaged in the rearing of bighead carp fingerlings, either exclusively or in conjunction with tilapia. Unlike tilapia, bighead carp fry, however, are produced inland using tanks and hormones. The lake-based nurseries in Kalinawan are necessary in order to condition the bighead fry for a few weeks before they are ready to be stocked in pens or cages elsewhere. Because of the capital- and knowledge-intensive nature of bighead carp fry breeding, only a few, well-capitalized villagers – those who own several cages as well – are able to invest in hatcheries. A few of these have grown in size with increasing pen demand, in addition to village-based cages.

In terms of scheduling and timing of production tasks, poor water conditions force some cage grow-out producers to harvest fish before reaching optimal market size. Smaller fish, however, fetch much lower prices in the fish market. Poor demand for fingerlings also accompanies slow growth in pens and cages. Fingerlings would stay longer in nurseries and would slow down turnover. Unsold fingerlings would be reared to a size decent enough for household consumption or for the market.

> I have a grow-out cage with a size 8 net. And the tilapia has been there for more than a year because of poor water conditions, the fish won't grow. What we did was to sell the fish as fingerlings because a pen operator bought them from me. It was more than a year and it still was this big. You cannot sell them in the market, maybe for P10 a kilo because they are still small. What we do is to sell them as fingerlings to break even. We will just stock new ones since we have plenty of fingerlings. (K08 cage nursery producer 2012)

One strategy for both grow-out and nurseries is to wait for improved water conditions that results from saltwater intrusion before making further decisions on production. Those practicing both kinds of cage production would invest more in nurseries in the absence of intrusion and engage in grow-out in better water conditions. Producers have a spatially- and temporally-detailed environmental knowledge of the specific conjunctions of lake processes (e.g. water levels, tides, precipitation, El Nino) that enable the intrusion of saline water in the lake, as well as the impacts on their production.

> Selling of fingerlings is strong here when saltwater intrusion is present because we rely on that for the fish, especially tilapia, to grow fast. When the water clears, the plankton, the food of tilapia, multiplies. When they closed Napindan, several years passed without saltwater intrusion. Maybe you've heard of the slow growth of fish in the Laguna area, and of the fishkills. (K05 cage nursery producer 2012)

> It seems the government does not want to allow saltwater to enter Laguna Lake. When there is saltwater, people in the lake earn fast, especially us nursery producers. We can sell fingerlings quickly, almost every day, nonstop, because many buy tilapia from us….It is up to the government to release saltwater in the lake, if they want to improve livelihoods here. (K16 cage nursery producer 2012)

Because of its importance in production, fisherfolk describe saltwater intrusion through various metaphors – as nutrient-giving (in the corporal sense), wound-healing flow that gives life and spice to a fresh body of water. They also view saltwater intrusion as natural and the state's infrastructural interventions as responsible for its loss. While producers consider their responses to poor water conditions as strategy (*diskarte*), they are tied to forces that they consider external, hence their view of production as also based on luck (*swerte*) and similar to gambling (*sugal*).

Fishing operations are similarly affected by the poor water conditions through less volumes and diversity of catch. Compounded by damages in typhoons, both aquaculture producers and fishing operations downsize production and forestall expansion through a variety of means. This includes adjustments in labor (from waged to household), less frequent feeding and monitoring (to save on feeds and gasoline), and selling of nets.

> Because the Napindan Channel closed, the water here became turbid. They could not catch enough fish. Those who would set out to fish ran at a loss. The owner keeps on putting out money until there is nothing left to put out. So some

> motorized push nets ceased operating. What else can the owner pay or loan to the crew? (K18 cage nursery producer 2012)

> I used to have three wage laborers, but when the fingerling production weakened since two years ago, I removed the laborers because I get their salaries from the sales of fingerlings. I could not afford to pay them anymore… Now, what I do to save expenses in labor, I only hire laborers every 12 days, so I save on those 11 days. (N23 cage nursery producer 2012)

5.3.2. Typhoons

> If we did not have typhoons here in Laguna Lake, many people would probably be wealthy. (K04 cage nursery producer 2012)

All aquaculture producers deal with typhoons annually. Their impacts on production and the corresponding responses, however, vary between and among pens and cages. Pens are able to withstand stronger winds than cages. Some pens also use floaters so that the height of the nets would adjust relative to the water level and thus avoid the spilling of stocked fish. They are also able to bounce back and reinvest in production after typhoons more promptly than cages. Cage producers observed this difference:

> This southwest monsoon season is when some producers remove their cages from the lake because of the typhoons. When you lose your stocked fish, when you lose your nets, it is expensive. It is easy to breed fish here, but the net is expensive. Then you begin from scratch and invest again. That is why when typhoon season arrives here, producers haul their nets. Unlike the fishpens, which are stronger. They just laugh off Typhoon Signal Numbers 1 [30-60 kph winds] and 2 [60-100 kph]. Our cages are not like them, which can withstand Signal Number 3 winds [100-185 kph]….We have weathered several typhoons. But we rise again. Sometimes no nets remain, so we buy again and start from zero. It is like that here, if you have a source of credit, it is easier to recover and

> pay back. Those who can’t get loans, they are just more careful. (K04 cage nursery producer 2012)

> During typhoon season, producers here haul and reduce their nets. Others, those who have enough capital to recover, they fight it out. Even if there are typhoons, they don’t remove them. For us small producers, we remove all nurseries and just retain the grow-out. (K09 cage nursery producer 2012)

Nets are more valuable to cage producers than fish, since the latter can be reproduced at a very low cost while the former constitutes the bulk of the costs. Therefore, saving nets is more important for producers than losing fish. Small cage producers lose a lot more when a faulty forecast or an unexpectedly strong typhoon hits the lake. Fish escape when waters rise above overstretched nets or when nets are damaged by floating debris such as poles and water hyacinths. Some nets are washed out to other parts of the lake. Recovering these poses conflicts in property rights. Producers know which nets are theirs, but this ownership is hard to prove. Nets washed out to other pen or cage areas usually become the property of the user of that pen.

Better off cage producers in Kalinawan are able to respond to typhoons and reinvest after much quicker than others in the village. With stronger-engine boats and more labor at their disposal, they can haul nets before a typhoon strikes and reassemble them after. They also gain some advantage in the dash for recovering washed out nets when waters have calmed. Kalinawan villagers shared their experiences with typhoons:

> I often lose nets after typhoons and fail to get them back. Other people get there first because they have better and bigger engines, they could head out quicker. I cannot set out earlier, and my spot is furthest from shore. If your boat is small and slow, you won’t catch anything. (K09 cage nursery producer 2012)

> I used to have many nets but when Typhoon Basyang struck, they got washed out. I used to have 19 nets, after the typhoon only 5 remained. I was not able to get the others back because they were driven to the large fishpens. They would not let us retrieve them. They get mad at us if we try to retrieve them….But those nets are ours. What the pen laborers do is they sell them and they earn money. (K21 cage nursery producer 2012)

> It was Typhoon Basyang, we set out and saw everything was wiped out, no bamboo poles, no nets, nothing. It was like a tornado passed through. In my desire to recover nets, I was alone, I saw that most of the nets were washed out beside a large fishpen. I was able to take two back. When I was ashore, I had no one to help me because we were all affected. So I shared the nets with my brother, and he helped me set it up. I was able to rebuild five bundles of net, even if I used to have 25. (K13 cage nursery producer 2012)

Recovering from typhoons involve reinvesting in nets and poles, which require a significant sum of money, usually more than three quarters of cage construction costs. Cage producers in Kalinawan use the term of going “back to zero” to refer to this state. Furthermore, they need to pay the annual lease to the LLDA. Late payments earn penalties that add on to their leasing fees. Access to credit from kin and through other means such as microfinance is important in this recovery. Producers are forced to downsize production through reduction of number of nets or cages and through greater reliance on household rather than wage labor.

> When we had consecutive years of typhoons, I think it was three years of strong typhoons, my two huts were destroyed, my boats were submerged. It was one bad luck after another. And every hut had televisions and stoves for my men. They all got destroyed. I was not able to get them back so I invested in new ones. I recovered a few nets, those were what I worked with. Can you imagine that I used to have 10,000 breeders and harvested millions of fingerlings? Sixty nets for breeding and 30 nurseries plus 20 grow-out cages that totaled maybe half a million pesos were destroyed by the typhoon. I tried to recover, I worked with 20 nets and built from there, that is why I was thinking it’s just back and forth. The typhoon would spill it out, and you have to put out your remaining savings and

> start from there. Then another typhoon would wipe it out. (K15 cage nursery producer 2012)
>
> Before, I had wage laborers. Then we were struck by typhoon for three straight years. So I had nothing to pay them. So my three sons and I are just the ones working on the cages now. Some of the cages I could not recover anymore, so I sold the nets. (N24 cage nursery producer 2012)

Aquaculture producers see recurring typhoon damage as what prevents them from expanding production. It is to them something external and uncontrollable, and natural and part of life. But it is also more predictable than loss, for example, due to poaching. Thus, vigilance and preparations for typhoons are possible. Some would haul nets at the beginning of the typhoon season. Others would harvest or sell their fingerlings early when they hear of a typhoon on its way. A villager emphasized the importance of saving enough money from each sale to prepare for the damages of typhoons:

> When you hear of a typhoon coming, you harvest your cage so that you avoid losses. That is where strategy (*diskarte*) comes in. It is a gamble to continue producing during typhoon season, but you just have to learn to harvest the fish before it hits so that you will have money. (K07 cage nursery producer 2012)
> I save part of my earnings. Once you have bad weather at sea, you cannot recover if you did not save. It is part of breeding in nurseries. When destroyed, you rise again, right? (K16 cage nursery producer 2012)

Fisherfolk from Navotas, on the other hand, see typhoons in a different light. Benefitting from fish that escape from damaged pens, many fisherfolk (and some cage producers) reinvest in gill nets that catch milkfish and other pen-stocked fish. In this case, timing is important. The day after the typhoon is when fish in the lake is plenty enough but there is still no glut in the municipal fishport to depress prices. Navotas villagers observed:

> It's been a long time that we had slow business. It only picks up after typhoons. Like after Typhoon Ondoy, we had good business for a while, many people had money. As long as the typhoon is not that strong but enough to damage fishpens, people here, the ordinary fisherfolk, have money. But in times like these, they just get by. Sometimes I sympathize with the fisherfolk who bring me fish because they do not earn enough. (N15 trader-assembler 2012)
>
> It is common here that fisherfolk would be able to invest in boats and nets after bad weather and typhoons. But in ordinary days, they just get by with enough for subsistence. (N18 gill net fisher 2012)

Navotas traders work quickly to bring the fish to the urban wholesale fish market to capitalize on the temporarily high difference in prices in the lake and in the city. However, once the post-typhoon dash for escaped fish has waned, hauling of fish from pens become less frequent because it will take more time for some pens to stock again and harvest.

Capture fisheries production, given its mobile character, has not been significantly affected by typhoons. Production risks associated with typhoons only emerged with the introduction of aquaculture, a type of production fixed in space. Vulnerability to typhoons is differentially distributed according to producer groups, with the least capitalized producers hardest hit and slowest to recover. In this sense, typhoons only came to be an environmental phenomenon important to village production with increasing reliance on aquaculture livelihoods.

5.3.3 Knife fish invasion

While the proliferation of knife fish had significant impacts on pens by virtue of its size and design (Chapter IV), cage producers in Kalinawan and fisherfolk in Navotas are differently affected. Drift long line boats, once very common in the two villages, disappeared with the decline in the native white goby populations. However, villagers found that this gear best matches knife fish's feeding habits. This resulted in the resurgence of drift long lines in the two villages.

Navotas fisherfolk see knife fish as a scourge to their livelihoods, as it has contributed to the decline in native fish populations. The rapid reproduction of knife fish has reworked fisherfolk production. Motorized push net and gill net fishers have begun reinvesting in long lines as a supplement or alternative to other gears for fishing. This particular gear requires pooling and preparation of thousands of lines with hooks. In Navotas, fishers buy silver perch, a fish whose population has declined as a result of knife fish predation, to use as bait. Since knife fish is not consumed as food in the villages, these are sold to traders and assemblers who bring them to the urban market for processing. While the fish has provided an opportunity for fisherfolk to continue earning, it has come at the expense of their ability to provide food for their own consumption.

Fewer cage producers engage in long lines in Kalinawan but increasingly many villagers who have not fished for years or decades have begun reinvesting in long lines. Wealthier cage producers would use their boats and purchase long lines to be used by share laborers who set out at night to catch the fish, sometimes hauling as much as 100 kilos. Other less wealthy producers, particularly those who seasonally cease cage production during the risky southwest monsoon, would hire one or two laborers to join them in the boat to fish for the invasives. Kalinawan long line producers are able to save on the costs of bait by using their own tilapia fingerlings. Cage producers are also indirectly affected by knife fish when pens decide to postpone stocking or choose to stock bigger fingerlings to stand a better chance against the predator.

> We just learned about it recently. Because people here saw someone fishing out at sea, and he would catch a lot of fish all the time. So the news spread and people started investing in long lines. (K13 cage nursery producer 2012)
>
> The big pens stock bighead now because they grow faster. However, the problem is the knife fish, it's a pest in pens. Sometimes they won't get fingerlings from us because they know that their pens are full of knife fish. They consume a lot of the fingerlings. So if you have a pen and you need to stock, you will use bigger fingerlings, like 2- or 3-finger-sized ones. That is why fishpens don't get small fingerlings from us. (K09 cage nursery producer 2012)

5.4 Discussion and summary

Fluctuating water conditions, recurring typhoons and proliferation of invasive fish reconfigure the state ordering of lake socioecologies imposed by aquaculture introduction, in the same way that social conflicts and fisherfolk responses disrupted aquaculture expansion. While the transformations in relations of production associated with increasing engagement with aquaculture have been extensive in the case of the two villages, these remain complex and dynamic. The shift from mobile capture fishers to fixed cage producers in the two villages continues to be partial, nonlinear and spatially uneven.

First, the transition is spatially uneven because villages adopted aquaculture in varying degrees and forms. Due to advantages in location, ties with SEAFDEC, and the role of a state-formed cooperative, Kalinawan capture fisheries production relations dissolved in favor of individualized cage nursery production. This occurred to a much lesser extent in Navotas, where fish trading emerged as the more significant aquaculture-linked livelihood and maintained features of capture fisheries relations. Second, it is partial because aquaculture remains one in several livelihoods in the portfolio of villagers. Although present in differing degrees, capture fisheries production for subsistence and market remain in the two villages, despite being displaced by the fishpen sprawl and affected by changing lake ecologies. Third, it is nonlinear because cage producers revert to capture fisheries (and corresponding production relations) seasonally or temporarily to adapt to changing lake ecologies. Fluctuating water conditions, recurring typhoons and proliferation of knife fish in Kalinawan, for example, have contributed to cage producers' decision to return to capture fisheries

The state reconfigured lake socioecological relations through the introduction of aquaculture and related infrastructure projects through changes in property rights and increased territorialization of fish access. The contradiction between aquaculture's fixity and capture fisheries' mobility fueled conflicts between pen and fisher producers, which the latter viewed as an issue of legitimacy of lake use and connections with the state. Villagers' relations with pens ranged from fisherfolk poaching and sabotage to pen-related livelihoods in aquaculture among cage nursery producers, traders and drag seiners.

Villagers work with the materiality and ecologies of production, including responding to varying water conditions, typhoons and invasive fish. These responses, however, are tied to internal differences. For example, better off producers are more able to prepare, withstand, and recover from typhoons, and they possess a more diverse set of opportunities given poorer water conditions and threat of invasives. By working with and around lake materialities, producers continually produce socionatures, even though these are not necessarily of their own choosing. In sum, this and previous chapters showed how materialities of nature, state action and villager responses matter in the history of Laguna Lake aquaculture.

Thus far, this dissertation has analyzed processes regarding state action and materiality of lake ecology, both of which were observed with ethnographic detail in this chapter. In the next chapters, the focus turns to the fish that pens, cages, and capture fishers produce and deliver to markets for consumption. Flows and relations that comprise the production of Laguna Lake fish are certainly not bound within the confines of the lake. This and the previous chapters have suggested that urban processes play an active role in the history of the lake and vice versa. Urban capital is invested in pen production and expansion that continue to shape the lives of lake people. Partnerships between lake producers and urban investors in cage production have also become increasingly common. Urban market processes affect lake producer decisions. Fish and people regularly move from lake to the city, and flows of water and wastes from activities within the city have produced distinct lake socionatures. The next two chapters tackle more explicitly the socionatural and sociospatial relations produced in the urban metabolism of fish from the lake.

CHAPTER VI

FOLLOWING METABOLIC FLOWS: COMMODITY CHAINS OF LAGUNA LAKE FISH

Chapters III to V presented empirical discussions of the socionatures produced through aquaculture in Laguna Lake. State interventions that reworked the lake resulted in socioecological transformations that fisherfolk and pen and cage producers reconfigure in the process of producing fish. This chapter follows the flow of fish commodities from Laguna Lake to consumers in Manila, where a significant portion of fish produced in the Lake is distributed and consumed. I use commodity chain and access analyses to map flows and their implications for consumers and producers. I pose the question, who benefits from flows of Laguna Lake fish? The answer to this question informs a follow-up question: how and why do benefit flows persist?

The chapter aims to trace the flows of fish, identify the actors and relations involved, and examine the mechanisms of access of various actors in the chain. After a brief note about the framework employed, the chapter characterizes the changing material flows of fish from the lake to the city situated within broader shifts in the country's fisheries sector. The succeeding sections then identify the actors within the commodity chain nodes, and discuss the ways that groups of actors benefit from fish through access analysis. The method probes social mechanisms within which access to fish is controlled and maintained. The final sections consider labor relations in the fish market and situate the urban commodity chain of fish within the dynamics between aquaculture/industrial fisheries and lake-city relations.

6.1 Commodity chains

This chapter employs a commodity chain approach to examine the urban metabolism of fish. By putting commodities at the center of the narrative, it builds on the approach's strengths not only in empirically tracing the material circulation of commodities but also in highlighting social relations that constitute these flows. The commodity chain provides a heuristic tool to examine which actors, places and relations are imbricated in the flow of commodities along sites of production, exchange and consumption. More than just identifying nodes and organizations of specific markets, commodity chain analysis identifies points of control and exercise of power among various actors (Bair, 2009; Bernstein & Campling, 2006b; Watts, 2005).

I employ commodity chain as an umbrella term that encompasses similar but conceptually distinct concepts such as *filiere*, commodity system, global commodity chain, (global) value chain, and (global) production network. These all give attention to the constellation of relations, transactions and activities involved in the movement of commodities. However, they originated from different intellectual traditions with varying thematic and methodological emphases. The oldest metaphor, the *filiere*, for example, is rooted in the institutional analysis of local production-consumption dynamics of agricultural commodities (Raikes et al., 2000). On the other hand, global commodity chain (GCC), global value chain (GVC) and global production network

(GPN) are more concerned with global chains or networks that are enmeshed in the production of a product or service, usually in the context of manufacturing or export industries (Bair, 2005). The *filiere* tradition remains useful, since it investigates the journeys of agricultural commodities within a historical context, and is compatible with a materialist political economic analysis (Bernstein, 1996b; Ribot, 1998). However, it can be strengthened with engagement from conceptual and methodological innovations in the past two decades in GCC, GVC, and GPN works.

As indicated in Chapter I, bringing commodity chain and urban metabolism concepts in dialogue within a UPE approach offers several potential benefits. The GCC emphasis on input-output framing of commodity flows complements industrial ecology's concern with measuring material flows in urban metabolism (Gereffi et al., 1994). GCC, however, goes beyond mere accounting by socially embedding these material flows (Rammohan & Sundaresan, 2003) and focusing on power relations within the chain, a primary concern of urban political ecology's deployment of the urban metabolism metaphor. The implication is that commodity chains allow us to see a spatial and temporal "fixing" of flows through recurring, everyday social relations (Hudson, 2008). Actors in the commodity chains regularize the "fixing" of these flows through everyday practices and relations built with other actors. In Chapter 6.2, I will trace the material flows and the fixing of these flows through economic transactions and social relations between producers, traders, brokers, laborers, and other actors. I also situate change within these flows and chain within the broader stagnation in industrial fisheries and the rise of aquaculture production (Chapter 6.2.2).

The GVC approach is more developmental in orientation, identifying points wherein "upgrading" can be effected so as to increase the benefits derived by marginal actors in the chain (Bair, 2005; Gereffi et al., 2005; Kaplinsky, 2000). From this tradition, however, I draw on the GVC methodological strengths in determining distributional issues within the chain, particularly those surrounding inter-actor transactions (Kaplinsky & Morris, 2000).

The GPN approach has criticized the limitations of the linear chain metaphor and proposed in its stead the more inclusive and complex notion of networks (Coe et al., 2008). While I support this argument, I will retain the commodity chain term due to its more universal appeal, particularly in agro-food studies (Jackson, Ward, & Russell, 2006). However, I echo the GPN's call to democratize the actors that count in commodity chain analyses. While GCC and GVC approaches have privileged inter-firm (horizontal relations) and identifiably economic actors, GPNs have called for the inclusion of non-economic and non-firm actors (beyond mere "context") as well as focus on intra-firm dynamics (vertical relations). The former has focused on the grounding to place of commodity chains (Coe et al., 2008; Kelly, 2013), while the latter has given way for greater emphasis on labor (as more than an input cost) within such chains and networks (Selwyn, 2011, 2012; Taylor, 2007). In effect, these take from the more holistic commodity systems approach developed in the new political economy of agro-food systems that consider the totality of commodity relations (Friedland, 2001; Jackson et al., 2006; Watts & Goodman, 1997). In section 6.3.3, I provide discussion about the place within which flows of fish are grounded, and about the dynamics of labor that are often rendered invisible particularly in the sphere of commodity exchange.

The GCC, GVC and GPN frameworks have been influenced by new economic sociology's focus on the social embeddedness of economic activities in the Polanyian tradition that followed from Mark Granovetter's (1985) seminal work (Jones, 2008; Peck, 2005). While the chapter's description of trust, patronage and other social relations fits within this tradition, I aim to use these to foreground questions of access and control. The access analysis framework (Ribot & Peluso, 2003) is useful here, even if this approach does not delve into the structural sources of power, as one would find in a Marxian commodity chain approach (Selwyn, 2012; Starosta, 2010). Access, or the ability to derive benefit from flows of fish, however provides a unifying concept that ties the varying relations between actors from production to consumption, and opens the window for further examination of control and power. Chapter 6.3 details horizontal and vertical relations between actors in the lake, city and spaces in between.

6.2 Flows of Laguna Lake fish and the commodity chain

Fish from Laguna Lake distribute throughout Luzon Island but the most enduring flows are between the lake and the Manila. On one end, following industrial ecological notions of urban metabolism, this material flow can be viewed as exchange of nutrients and energy – as fish embodying nutrients in the lake consumed by urbanites. On the other, adopting concepts from urban political ecologies of metabolism, fish are circulating commodities. Not only are fish material objects produced through the lake nutrients and consumed for sustenance, but they are also social forms that create relations between people in the process of exchange (Watts, 2005). Commodities are intrinsically geographic and identifying their movement casts light on places and relations that are "fixed" by commodity flows. This section presents an accounting of this particular flow (metabolism in the material flux sense), and identifies the actors, nodes and relations in the fish commodity chain (second sense). Two locations are important physical nodes: Laguna Lake, and the urban wholesale fish market in the coastal Metro Manila city of Navotas (Figure 6.1).

Figure 6.1. Location of Navotas Fish Port Complex or the urban fish market (Basemap source: World Topographic Map, Esri)

6.2.1 Material flows of fish

In 2011, Laguna Lake produced 60,788 MT of milkfish, bighead carp and tilapia through aquaculture. Eighty percent of this total was supplied by pens and 20% by cages. This figure excludes the 13,778 MT of these three species produced through capture fisheries. Several phenomena are apparent from Table 6.1, including the reliance of Laguna Lake species on the urban market, the specialization of Laguna Lake producers on certain species sold at Navotas, and the importance of the lake on the urban supply of bighead carp and milkfish. Pens supply most of the Laguna Lake species landed in the urban fish market, including all of milkfish and most of bighead carp.

Table 6.1 Fish production in Laguna Lake and Laguna Lake fish landings in Navotas Fish Port Complex, 2011

Species	Laguna Lake production (MT)[1]			Navotas fish port LL fish unloading (MT)[3]	% of LL fish landed in Navotas	% of fish landed in Navotas from LL
	Pen Aquaculture	Cage Aquaculture	Capture Fisheries[2]			
Milkfish	21,028	0	1,866	9,519	42%	52%
Bighead carp	15,182	1,746	354	12,168	70%	100%
Tilapia	12,284	10,548	11,558	467	1%	9%
Total	48,494	12,294	13,778	22,154	30%	62%

[1] BAS data 2011

[2] Milkfish and bighead carp captured by fisherfolk are often fish that escaped from pens or cages. These fish cannot reproduce in the lake.

[3] PFDA data 2012. Other fish landed in the fish market totaled 102,775 MT.

Of the 60,788 MT of fish produced in the lake through aquaculture, traders and pen operators brought 36% (22,154 MT) to the Navotas fish market. The other 64%

were consumed in the lakeshore municipalities or were directly procured by wholesalers in the two lakeshore municipal fish ports for distribution in Manila and other parts of Luzon[9]. By species, a significant percentage of bighead carp and milkfish, primarily produced by pens, make their way to the Navotas fishport more than tilapia. This suggests that cage production in Laguna Lake is primarily for lake (or non-Manila) consumption whereas pens produce more for the urban market. Almost all of bighead carp and more than half of milkfish landed in the Navotas fish market came from Laguna Lake. On the other hand, only 9% of total tilapia unloadings in Navotas were from the lake.

Other major suppliers to the Navotas fish market of milkfish were the Luzon provinces of Pangasinan (37%), Bulacan and Batangas (6% each), while those of tilapia were Pampanga (63%) and Batangas (27%) (from 2012 PFDA data). There are distinct price and quality differences associated with particular places. Laguna Lake produces milkfish and tilapia of more varying sizes. The production of smaller fish, along with the lack of feeding (Chapter IV) and perceived inferior quality (Chapter VII), results in typically lower prices for Laguna Lake fish.

No recent published data detail where fish from Navotas go. However, between 1978 and 1982, 57% of fish landed in Navotas circulated within Metro Manila, half of which in the two most populous cities of Manila and Quezon City (Chuaunsu & Mercado, 1985). A 1973 survey also found that 68% of Laguna Lake milkfish were

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[9] There were no data on how much were consumed locally in the lake and how much were transported elsewhere.

distributed in Metro Manila (Guzman, Torres, & Darrah, 1974) and a 1976 study indicated the fish market supplied 80% of the city's fish requirements (Sevilleja & McCoy, 1979; Tiambeng, 1992). It should be noted that not all fish from the lake (or elsewhere) consumed in the city pass through the Navotas fish market. Some producers may supply wholesalers and retailers directly (M02 Manila retailer 2012), or land through the lake fish ports.

The Navotas Fish Port Complex handles the biggest volumes of fish in the Philippines and in Southeast Asia. Between 1980 and 2012, total volumes of fish landed in the fish port averaged 200,000 MT (PFDA data 2012), a third of the volume of the world's largest fish market (Tokyo's Tsukiji). From a small fish market in the 1940s, it expanded to an urban fish landing port with the rise of the deep-sea industrial fishing industry centered in the coastal cities of Navotas and Malabon.

Completed by the state in 1976 and built on reclaimed land from the Manila Bay (Figure 6.2), the fish port complex housed the fish market that existed prior to its construction. Fish market transactions, therefore, became subject to state control and taxation through an agency that oversees fish port activities in the country. This agency, for instance, taxes a fixed rate per tub of fish that pass through the complex, and charges rents for licenses, stalls, and transportation, among others.

The Navotas Fish Port complex is comprised of five landing structures or "markets" with the longest (Market 1) extending 300 meters from end to end. Markets 1 and 2 are the nightly markets where 70% of total fish port unloadings are landed through large brokers. Markets 3, 4 and 5, on the other hand, are daytime markets handling smaller volumes of fish and involving smaller brokers and wholesalers. The fish market is also a fish port where deep-sea fishing vessels unload marine fish on the bay side (70% of total volume), and where trucks carrying freshwater fish unload on the inland side (30%).

Figure 6.2 Navotas Fish Port Complex and surrounding areas (Basemap source: World Imagery, Esri)

6.2.2 Aquaculture and fisheries in context

Almost two-thirds of freshwater fish and a fifth of total fish landed in the Navotas fish market in 2011 came from Laguna Lake (see Figure 6.3). This is significantly higher than the lake's measly 0.7% share in 1974 during the initial stages of pen aquaculture expansion (Alix, 1975; Guzman et al., 1974).

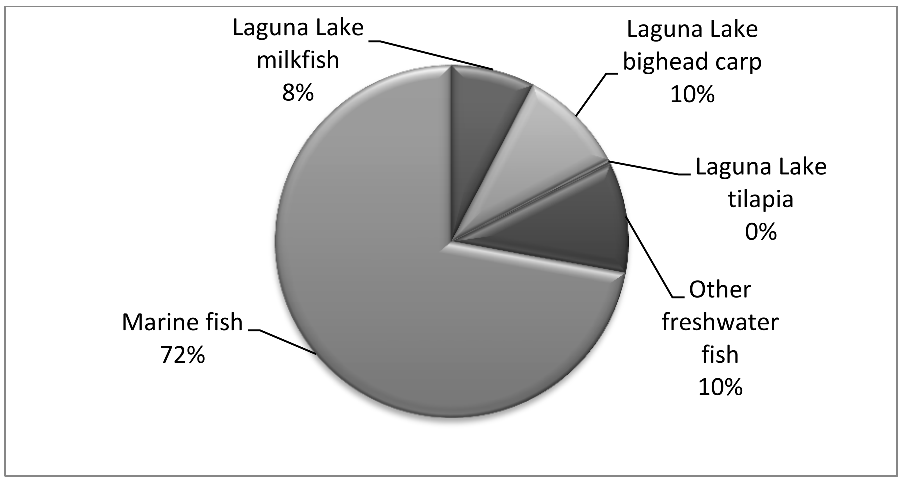

Figure 6.3 Composition of Navotas fish port unloading, 2011 (Source: PFDA data)

The increasing share of Laguna Lake fish in total landings reflects the broader shifts in Philippine fisheries toward aquaculture production. Supported by the state through subsidies and tax breaks, the country's industrial or commercial fisheries developed rapidly after the Second World War and became the 14th largest in the world in terms of fishing fleet tonnage (Green, White, Flores, Carreon, & Sia, 2003; Morgan & Staples, 2006; Spoehr, 1984). With decades of technological adoption, overcapitalization and spatial fixes, industrial fisheries experienced a drastic slowing of productivity beginning in the early 1990s (Green et al., 2003)(see Figure 6.4).

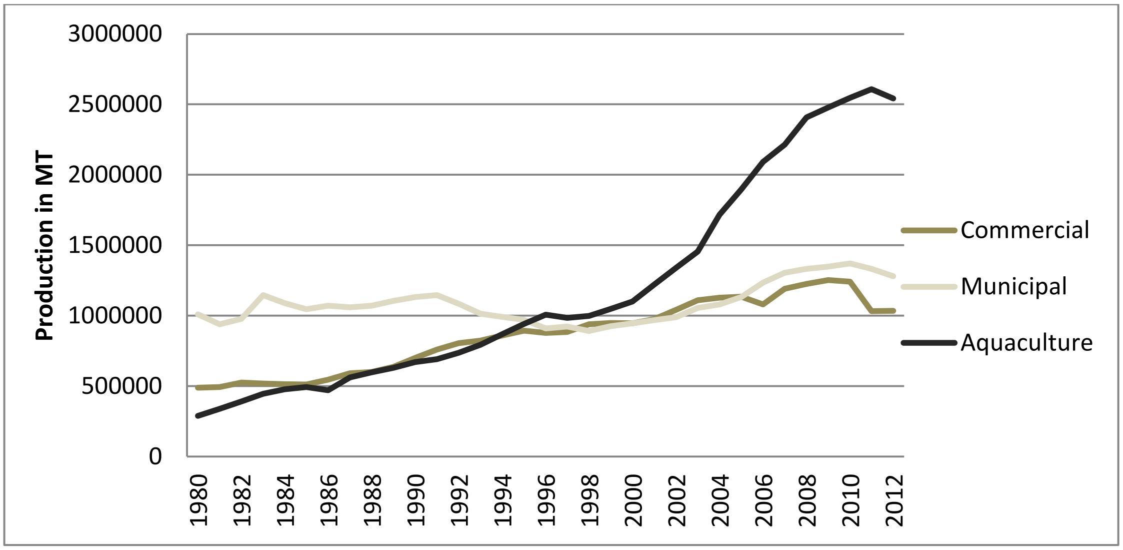

Figure 6.4 Philippine fisheries production by sector, 1980-2012 (Source: BAS data)[1]

[1] Aquaculture includes aquatic plants

The state continues to promote aquaculture as one of the ways to meet gaps in food fish demand and supply, and to relieve pressure on wild fisheries (BFAR, 2005). Laguna Lake production has played a significant role since the 1970s in supplying the city with fish (LLDA, 1999). In 2012, three of the four species with highest volumes landed in the Navotas fish port were freshwater fish that are also produced in Laguna Lake compared to none four decades earlier (Table 6.2).

Table 6.2 Species composition of Navotas fish unloadings, 1974 and 2012

1974			2012		
Species	Volume (MT) [1]	%	Species	Volume (MT) [2]	%
Roundscad	46,941	31.7	Roundscad	41,139	29.9
Sardines	20,169	13.6	**Milkfish**	**16,931**	**12.3**
Tuna	10,692	7.2	**Bighead carp**	**13,713**	**10.0**
Ponyfish	6,919	4.7	**Tilapia**	**6,029**	**4.4**
Caesio	6,637	4.5	Burot	5,376	3.9
Bigeyed scad	3,370	2.3	Caesio	5,336	3.9
Lizard fish	2,004	1.3	Threadfin bream	5,184	3.7
Milkfish	**1,799**	**1.2**	Skipjack tuna	4,764	3.5
Others	59,991	40.6	Others	39,165	28.5
Total fish	147,930	100	Total fish	137,637	100%

[1] (Alix, 1975)
[2] PFDA data 2013

As will be shown in Chapter 6.2.4, however, this shift from industrial deep-sea fisheries to aquaculture created opportunities for expansion for the same group of urban elites. A commodity chain approach to Laguna Lake fish reveals not only the degree of engagement and control by certain groups in circulating urban fish but also the mechanisms by which these are created and maintained.

6.2.3 Actors and organizations in the commodity chain

A simplified direction of flows within the commodity chain of Laguna Lake fish includes movement from producers to traders and wholesalers via brokers to retailers and consumers (Figure 6.5 provides a diagram of the chain based on my field research). Seed producers (through cages, tanks or ponds) supply pens and cages with fingerlings, which are stocked and reared until they reach harvest size. Pens harvest and transport these fish, sometimes through lake-based traders, to the urban fish market in Navotas. Trader laborers haul, handle, transfer, grade, weigh, ice and load the fish to trucks which will then be unloaded and re-iced by fishport laborers. After negotiating prices, often through bidding, wholesale buyer laborers would then load tubs of fish in trucks and distribute to retailers or supermarkets throughout the city and beyond.

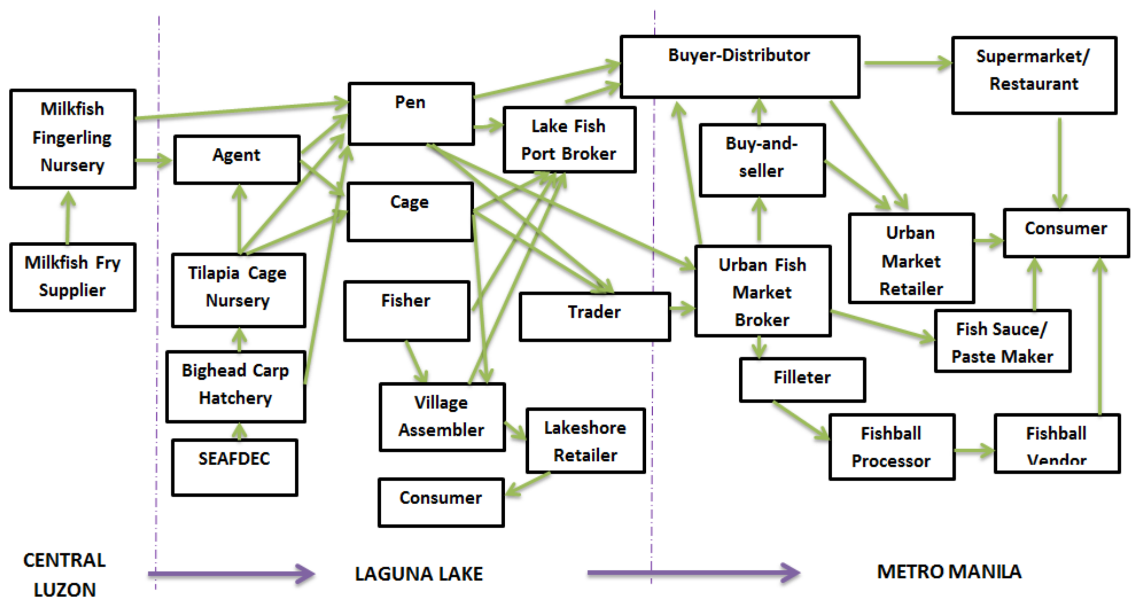

Figure 6.5 Commodity chain diagram of Laguna Lake fish

6.2.3.1 Laguna Lake nodes

Actors in Laguna Lake include pen and cage operators (as well as their caretakers and laborers), middlemen (e.g. traders and agents) and supplier of inputs (e.g. cage nurseries and inland hatcheries). In 2011, pens produced four times more fish by mass than cages. As Table 6.1 indicates, pens provide the urban fish market with a significant percentage of milkfish and bighead carp. These fish are sourced from fingerlings suppliers within the lake (e.g. bighead carp hatcheries via cage nurseries in Kalinawan village) or outside (milkfish fingerlings from Central Luzon ponds). Facilitating these flows are lake-based middlemen or agents. Agents of fingerlings buy fish from cage hatcheries (Figure 6.6.) and sell them with markup to pen or cage operators who are set to begin a new round of production.

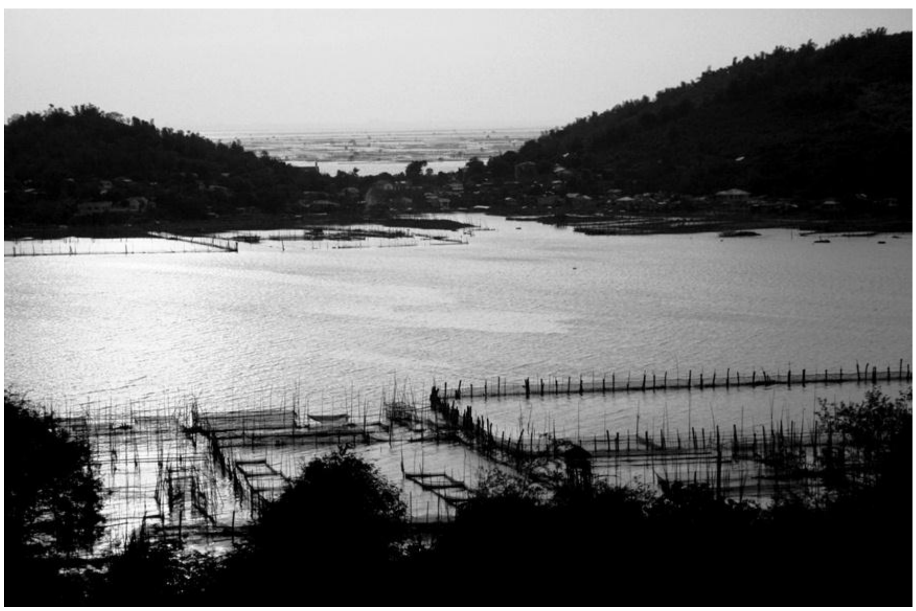

Figure 6.6 Laguna Lake cage nurseries (foreground and background) (Photo by author, 10 May 2012)

Some pens (and cages) ready for harvesting employ drag seiners and traders from the village to seine and harvest their fish, respectively. Some fish caught by capture fisherfolk using various gears also make their way to the urban market, albeit in much smaller volumes, as they have for decades, unloading their catch with village and municipal assemblers (Aldaba, 1931c; Mane & Villaluz, 1939). It is the recently emerged lake-based traders, however, who are able to transport Laguna Lake fish to the urban fish market. No reliable data exists on how much the traders bring to the city in comparison to pens but Appendix C estimates suggest that traders transport a third of the landed fish in Navotas. The remaining two-thirds are brought by pen operators themselves who have direct contacts with the urban fish market or brokers and wholesalers, or pen corporations who unload their fish with their own brokers.

6.2.3.2 Navotas fish market nodes

Brokers are the central actors in the urban fish market, mediating transactions between Laguna Lake traders or producers and wholesalers. There are around 70 brokers in the fish market, 21 of which are in Market 1, which is where the largest brokers operate (M04 fish market administrator 2012). Brokers get a 5-6% commission from total sales and serve as source of credit to wholesale buyers and traders.

Laguna Lake traders typically unload their fish to a small- or medium-sized broker (also called *consignacion*), who is responsible for selling the fish to wholesale buyers. An auction process (*bulungan* or whispered bidding) between wholesaler and broker takes place when several buyers are interested in the fish. When selling is slow, traders would move from market to market (and from night to day and night again) until all the fish they carried from the lake are bought by buyers. At the end of the trading night, unsellable fish (poor quality or low-demand bighead carp) and knife fish (not consumed in its fish form) are sold to filleters who will then sell white fish fillets to fishball processors (see Chapter VII). Poorer-quality fish (close to spoilage) are sold to fish sauce (*patis*) and fish paste (*bagoong*) makers, a traditional household industry in Malabon and Navotas (FAO, 1971; Satake, 2003).

There are different types of wholesale buyers, including buy-and-sellers and buyer-distributors (also *digaton*). Buy-and-sellers procure large volumes of fish from brokers, and sell them to other wholesalers and retailers. These wholesalers have a privileged access to the brokers that other wholesalers do not. They rent out space within or close to the broker’s landing space and would bid on the broker’s fish. Some buyer-distributors would have access to brokers, particularly the smaller ones, and can purchase fish directly through the brokers. The buyer-distributors would then distribute the fish to retail markets within the city or elsewhere in Luzon, and to supermarkets and restaurants, both of which require a constant supply of fish.

6.2.3.3 Metro Manila nodes

To save on high transport costs, it is common for retailers with their own market stalls to share a truck that would transport fish from Navotas (M09 retailer 2012). Urban fish consumers (see Chapter VII for further discussions) buy fish from these markets and supermarkets, as well as from ambulant vendors who peddle fish within neighborhoods. Table 6.3 provides data on prevailing prices and markup of four Laguna Lake fish species in the last quarter of 2012 as they move from the lake to the city.

Table 6.3 Prevailing prices and markups in the commodity chains of four Laguna Lake fish, 2012

	Milkfish		Tilapia		Bighead carp		Knife fish [8]	
	Price (P)	Markup (P and %)	Price (P)	Markup (P and %)	Price (P)	Markup (P and %)	Price (P)	Markup (P and %)
Producer to trader[1]	60	-	40	-	20	-	17	-
Trader to wholesaler via broker [2]	70	10 (17%)	50	10 (25%)	25	5 (25%)	20	3 (15%)
Broker [3]	-	4.2 (6%)	-	3 (6%)	-	1.5 (6%)	-	1.2 (6%)
Wholesaler to retailer/ supermarket [4, 5]	80	10 (15%)	70	20 (40%)	33	8 (32%)	28	8 (40%)
Retailer to consumer [4, 6]	105	25 (31%)	85	15 (21%)	100	67 (203%)	-	-
Supermarket to consumer [4, 7]	160	80 (100%)	120	50 (71%)	95	62 (187%)	-	-

[1] Interviews, Jun and Oct 2012
[2] Binangonan municipal fishport data, Sep 2012
[3] Interviews, Jul-Oct 2012 (brokers get 5-6% commission)
[4] Bureau of Agricultural Statistics or BAS (low-end prevailing prices of medium-sized milkfish and tilapia), Sep 2012
[5] Navotas fishport data of prevailing prices of medium-sized bighead carp and knife fish), Sep 2012
[6] Price checks in eight Metro Manila wet markets, Aug-Sep 2012 (Farmers, Q-Mart, Guadalupe, Balintawak. Blumentritt, Sangandaan, Malabon and Sauyo Wet Markets)
[7] Price checks in three Metro Manila supermarkets Oct 2012 (SM, Landmark and Eunilaine)
[8] Knife fish is not consumed as food fish in the city but is instead sold to filleters for fishball processing

6.2.4. Elites in the commodity chain

In 1992, the top five fishing corporations from Metro Manila accounted for 70% of capture fisheries haul in Navotas (Tiambeng, 1992). Similarly, 67% of fish in the fish market were handled by the eight largest brokers (Navera, 1976). The larger brokers in the Navotas fish market are also owners of large deep-sea industrial fishing vessels and large pen operations in Laguna Lake. Vertically integrated and diversifying, these fishing companies produce or capture their own fish via aquaculture and ocean fishing, and unload them with their own brokers. At least two of these corporations operate the largest pens in Laguna Lake, reportedly reaching hundreds, if not thousands, of hectares in total size (various interviews with Laguna Lake producers and fish market actors 2012).

These fishing corporations have expanded from their origins as the old elites of the adjacent northern Metro Manila cities of Malabon and Navotas to take advantage of changing fish economies. Post-war Malabon and Navotas saw rapid growth in their industrial and fishing sectors, attracting migrant laborers and transforming their land uses. Both cities were pioneers in fishpond aquaculture production, which was traditionally a rural elite venture (Villaluz, 1950). In Malabon, the *naturales* (native elites) and the *principalia* political class favored by the Spanish colonial government shifted from tobacco and sugar refining in 19th century to fishpond aquaculture at the turn of the 20th century. They were able to buy land from the huge tracts owned by the Augustinian friars who were forced to sell during American colonial rule (Magno, 1993).

With the opportunities opened up by Laguna Lake aquaculture and the Marcos' expropriation of many ponds in the late 1970s, several of these fishpond owners extended their investments to pen aquaculture in Laguna Lake to retain local economic power and take advantage of opportunities opened up by lake aquaculture (Chapter III). Building on their capital and prior knowledge base, Malabon-Navotas fishpond owners were among the first urban investors in Laguna Lake. It was common for their pen sizes to reach up to 800 hectares. One former pen operator from Malabon remarked:

> There are still many pen operators from Malabon in Laguna Lake but people with capital from other places have also copied and invested. Back then [late 1970s to early 1980s] the biggest fishpen operator in Laguna Lake was a Marcos crony from Malabon. (M07 former pen operator 2012)

Navotas (and other Malabon) elites, meanwhile, invested in industrial fishing ventures, taking over from the Japanese who controlled Philippine commercial fisheries in the first half of the 20th century (Morgan & Staples, 2006; Ofreneo, 1980). Through technological transfer from and joint ventures with Japan, the decades between 1950s and 1970s saw increased investments and expansion among Navotas-based fishing operations (Ofreneo, 1980; Spoehr, 1984). The largest fishing corporation in the Philippines started out with one Japanese deep-sea trawler in 1963 but has since diversified into other businesses including aquaculture, tuna fishing off Papua New Guinea, food processing and real estate (Frabelle, 2013). Consistently among the top 500 corporations in the Philippines, in 2011, it had total assets worth P1.5 billion (Securities and Exchange Commission data 2012). This figure is ten times that of the second largest industrial fishing corporation, which continues to be based in Malabon. Both corporations also have the largest pens currently in operation in Laguna Lake (Frabelle, 2013).

The example of the employment history of M06, now retired from the fishing industry, provides insight into these processes of change. He worked for one of the largest fishing corporations first as an engineer in the fishing vessels during the company's beginnings in the 1970s. After training in Japan and working in the deep-sea fishing vessels, he rose up in rank within the company. He was then made in-charge of the fishpen operations in Laguna Lake at the height of the fishpen sprawl in the early 1980s, when the corporation sought to expand its investment through freshwater aquaculture. His task was to oversee milkfish trading in one of the municipal fishports and manage pen operations. In the 1990s, he was transferred to Navotas fish market, where he worked as the company's broker-caretaker. He administered the nightly whispered auctions and managed the flows of fish from both deep-sea fishing and lake aquaculture. His career path mirrors the expanding reach of large fishing corporations throughout the commodity chains of all fish supplied to the city.

6.3 Relations, access and power in the commodity chain

This section examines who benefits from the fish commodity chains and how by employing access analysis to probe deeper into the relations and strategies that give certain actors more benefits and power over others. Due to the large number of actors in the chain, the discussion will be short and selective. While various forms of access can be identified and other types of benefits may be apparent (Ribot & Peluso, 2003), benefits in this section will be specifically framed in terms of implications on livelihoods, income and sustenance.

6.3.1 Producers, agents and traders in Laguna Lake

Chapters III to V detailed the nature of pen-fisher conflicts in Laguna Lake resulting from the introduction of aquaculture. Overcoming high barriers to entry through access to financial capital and past pond aquaculture experience, urban pen owners were able to claim large sections of lake waters for profitable production. Through access to national and local government officials (some operators were officials themselves), they were able to maintain and expand operations by circumventing (and influencing) regulations, and through individual political connections or through the collective power of the fishpen producer association. The association has bargained for, among others, deferment of payments, changes in payment schedules, prevention of fee increases and postponement of pen demolitions (L13 fishpen operator 2012; Jose, 1994a, 1994b).

Some displaced fishers, on the other hand, sought access to fish trapped within the pens through poaching and sabotage. Pen operators, through the labor they hired, were able to exclude fishers from their spaces with threats and exercise of violence. This exclusion extended beyond the actual borders of the pen and into surrounding spaces and waterways. Since the sheltered waters of the pens attract fish, they became the most attractive fishing grounds in the lake. Pen guards used various means to prohibit fishers from setting lines and nets close to the pens, and to construct passive gears such as fish corrals that could capture fish. During typhoons, however, when pens are partially damaged, fishers gain access for a few days to the flux of fugitive fish that escape from pens. This enables some fishers to accumulate enough income to invest in better boats or gears.

Pens, by virtue of the size of their production, enable large flows of fish as inputs (seeds) and outputs (harvest-ready fish) that influence other producers and traders. Through access to knowledge of technology (contacts with SEAFDEC staff) and starting capital (from cooperative, wealthy kin, urban wage work or urban financers), several Kalinawan village households, for example, were able to engage in cage nurseries that supplied pens and growout cages with fingerlings for stocking. Chapter V showed how engagement with this type of aquaculture transformed village relations and organization of production, and enabled certain households to accumulate more wealth than they would in capture fisheries. This is a major reason why cage nursery operators are less likely to support proposals to remove pens from the lake than fisherfolk (Chapter V).

While some cage nursery producers are in direct contact with pen or cage operators, most rely on agents (*ahente*) as intermediaries in transactions. Agents come from various lakeside villages, including some cage nursery producers themselves. This livelihood requires the building of more social rather than financial capital. Agents actively search for or are contacted by pens or cages looking for fingerlings. In turn, agents contact cage nursery producers in villages like Kalinawan to procure enough seeds to supply the demand. After agents and nursery producers negotiate a price for the fingerlings, the former will deliver the seeds to the pens with a markup and remit the earnings to the producer upon return. This system has caused mistrust and conflicts between the two actors, especially during delayed payments by pen producers. A cage nursery producer, for example, noted the following:

> A lot of people have become agents. It's beyond normal. Prices have dropped, so instead of earning, you just make enough. Even if they do not have nurseries, they would look for a buyer and promise lower prices to get the client. So what other cage nursery producers would do is to sell their fingerlings even at a low price just so someone would take it from them and that depresses the price of the fingerlings here. It is all the agent's fault. (K25 cage nursery producer 2012)

The rise of agents intermediating economic relations between seed suppliers and pens have caused points of conflict within the village in terms of the agents' power to bring fingerlings prices down, and to evade responsibility for prompt or complete remuneration of producers. Because there are plenty of nurseries in various villages and most transactions are paperless, agents may get away with non-payments. The agent is not a well-capitalized actor, but his mediating position and access to buyers in the seed commodity chain enables him/her to exercise power over nursery producers. As another cage producer remarked:

> There are some producers here who have not been paid for two and a half months. That is the problem with agents. They loan the money that is not theirs. It is not supposed to be like that, we need that money. There was a Korean pen owner who got fingerlings through an agent, the agent promised us a month. But two months have passed and we were still not paid. When you talk to the agent, they get angry and say they have not been paid yet. But of course we cannot know for sure since the agent might have loaned it to someone else. Some were paid by the pens but would tell you they have not. Of course, you cannot complain once they have taken the fish. You cannot bring them to the village hall to complain. When you do, nothing happens, the agent will just promise to pay you. (K21 cage nursery producer 2012)

Issues of trust and malfeasance (Granovetter, 1985) pervade transactions surrounding fish, emphasizing the importance of risk perception between actors as well as access to social ties. In the case of cage nursery producers, building a base of buyers is constrained by social ties and knowledge of pen or cage owners. This is not easy for many village-based producers given that pen and cage buyers are situated outside the village boundaries. Those who cannot or do not build ties with seed buyers are more dependent on agents. Two cage nursery producers noted the advantages of having direct ties with buyers:

> I can get better prices if I personally talk to the buyers, and they have personal experiences with many agents who are able to offer lower prices but with undercounting involved…If you are a new buyer of fingerlings, you are not aware that you are being cheated. You end up paying for something that you should not have paid for. Sometimes you pay for 40,000 more than you have to. (K25 cage nursery producer 2012)

> Like me, I know many pen owners because I used to run a passenger boat before. Many of those who own passenger boats here also have pens or cages. (K04 cage nursery producer 2012)

Apart from shaping the commodity chain of seeds, pen production also influences fluctuations in fish prices, with consequences on the incomes of traders, smaller producers, and even other pen operators. Gillnet fisherfolk primarily catch bighead carp and milkfish, two species that are also stocked by pens. Pen harvests, often staggered over many days, tend to depress prices of fish like bighead carp that fishers also unload in municipal fish ports. Large, vertically-integrated fishing corporations based in the urban fish market are also able to sell the fish at a cheaper price than traders who buy fish from pens who did not harvest or transport their own fish. Fishers and pen operators see these issues in different ways:

> When water is poor [i.e., turbid and unproductive], fishpens stock bighead carp. Then water gets better, they will harvest them and replace with milkfish. So that will affect the price of bighead that we catch through the gillnets. And they harvest a lot more than we catch, so we get affected (N17 gillnet fisher 2012).
>
> We control more or less, we have influence in the price of fish in the market, especially Metro Manila…. Sometimes we are willing to sell milkfish at P40 because we need to clear the pens and make them ready for the incoming fingerlings. When everyone does that, prices drop, P40 but that is okay, since harvest is good and you can increase stocking density (L07 pen operator and association president 2012).
>
> This big fishpen corporation would, for example, harvest 30 tons and sell them to the buyers at whatever price agreed through the broker because it needs to make space for the next set of fingerlings. If you, a smaller pen operator, harvest at the same time, your 10 tons will be affected. That is why I would call and ask brokers I know how much these big corporations are unloading, and what kinds of fish. If, for example, they are unloading bighead carp, then I would try and harvest milkfish instead (L13 fishpen operator 2012).

Traders, whose incomes rely on proper timing of unloading in the municipal and urban fish markets, are similarly vigilant on landings by large pen corporations who do their own harvesting and transporting (Figure 6.7).

> We monitor fishpen company unloading. But sometimes you think they will unload milkfish and it turned out they harvested bighead carp. So when you unload with them, you are disadvantaged, since they can unload their own fish at a much lower cost than you. So buyers will flock to them instead of you (N06 trader 2012)

Figure 6.7 A trader laborer moving tubs of bighead carp and tilapia for transport (Photo by author, 11 May 2012)

Access to brokers for information about prevailing market prices is important for traders. While freshwater fish prices remain relatively stable when compared with marine fish, a 2-peso change in prices due to unforeseen sudden landings by pen or deep-sea fishing corporations may be the difference between profit and loss. Forms of clientelism (*suki*) and patronage that pervades the whole commodity chains of fish also exist between traders and brokers. In return for information on prices, traders are expected to unload their fish to brokers.

> There are many brokers out there in the fish market. If you have, like my brother-in-law earlier, three trucks of fish and want to dispose of them quickly, then you unload with different brokers. But I don’t do that because I have a *suki* [preferred

client]. I will unload all of my fish only with him. He actually became my *kumpare* (compadre or co-parent). (N06 trader 2012)

Brokers are also sources of credit, especially for new traders. As one livelihood among many in Navotas village, trading requires the most starting capital. Like seed agents (and some traders use agents too), they also need to establish contacts with pen owners for harvesting.

6.3.2 Brokers, buyers and retailers in the urban fish market

Brokers have the responsibility of disposing of the fish once traders unload at the fish market. The 70 brokers in the fish market annually handle more than 100,000 metric tons of fish, and they are the only actors licensed to mediate between producers or traders and buyers. Licenses or rights are renewed for at least a million pesos every five years[10] (M06 broker 2012), making brokering a high-capital venture with risks that are different from those of producers. Most of the brokers are from the cities of Navotas and Malabon, and the largest have extensive linkages with traditional elite families who own deep-sea commercial fishing companies or large fishponds (M04 fish market administrator 2012; M01 broker 2012)

Organized into a broker association, brokers are oligopolistic actors that are able to influence other actors through control of credit, information, the fish consigned to them, and the auction process (various interviews 2012; Chuaunsu & Mercado, 1985;

[10] These are paid to the Philippine Fisheries Development Authority (PFDA), the state agency that manages fish ports throughout the country, including the Navotas Fish Port Complex

Navera, 1976). Eight of the largest brokers controlled two-thirds of the fish market transaction volumes (Navera, 1976). Since the large brokers operate under the same corporations that own the largest deep-sea vessels and pens, broker control of fish flows to the urban fish market is significant. Through their employed laborers, brokers are able to access information about total fish volumes in the urban fish market at a given time or in the immediate future. They are able to pass this knowledge to traders and producers so as to advise them on which nights it would be best to unload to maximize income from consignment through higher landing prices.

Brokers take a 5-6% commission and occupy roles beyond brokering fish transactions. Traders and wholesale buyers are tied to brokers through credit relations. At the end of a night's trading (usually late evening or early morning), brokers pay the traders the negotiated price for the fish and transfer fish ownership to the wholesale buyers and distributors via credit. Wholesalers are expected to pay the cost of the fish after selling the fish and when they return to the broker for another transaction (usually the day after or the next). This creates a situation wherein trust relations become one of the central considerations in the transaction.

Brokers only deal with established wholesalers, usually at high volumes. Retailers do not get access to brokers but rather to wholesale buy-and-sellers who purchase fish from brokers and sell them inside the market grounds to other wholesalers or to retailers. It takes a few years before new wholesale buyers can gain the trust and credit approval of brokers. Until then, transactions, when allowed, will be on cash basis.

Fish are sold to wholesale buyers through a secret auction system called *bulungan* (whispered bidding; see Figure 6.8), which has been in place since at least the 1940s (Hinkle, 1950). Fish would typically go to the highest bidder, but this is not always the case since brokers evaluate credit worthiness of the buyer, which is tied to established broker-buyer relations. It is possible for traders or producers to not know the actual price of the fish sold to buyers because of the secret auction. A fish market administrator described the process:

> Buyers would bid and whisper in the ear, you won't know how much, you're not sure if the price is really, say, P50. Of course, they would prefer to transact with buyers they know to avoid doubts. It's all credit there, maybe between buyers and brokers, 99% of the time is through credit. (M04 fish market administrator 2012)

Figure 6.8: Fish auction through whispered bidding (*bulungan*) at the Navotas fish market (Photo by author, 17 October 2012)

The whispered or secret auction is one of the ways that broker influence fish prices through control of knowledge. Brokers and deep-sea fishing companies also have extensive storage facilities both inland and ashore, and by staggering fish unloading, they are also able to take advantage of fluctuating fish arrivals in the market.

Wholesale buyer-distributors who are granted access by supermarkets to supply them regularly with fish gain an advantage over other distributors because supermarkets buy at fixed prices and fixed volumes. However, they are often strained by supermarkets' delayed payments, putting them at risk of losing credit-worthiness status with brokers who demand timely payments. Wholesalers who distribute to other regions of Luzon are typically able to control the fish markets elsewhere because of their limited numbers. One wholesaler explained the consequences of delayed payments:

> Sometimes it takes 30 days before we get paid. If they are stingy, it takes 60 days. What if you default today, let's say a holiday, no bank is open and they issued you a check? If you don't pay the broker before the due date, you'll lose standing with the broker, and you'll find it hard to get fish again. If you failed to bring fish to the restaurants and supermarkets, they'll find other suppliers and they'll hold on to your collectibles [i.e., money owed to the wholesaler] because you broke the deal of supplying them with fish regularly. (M07 former wholesaler 2012)

Delayed or nonpayment of debts is a risk that several commodity chain actors constantly encounter. Also, inaccurate fish counts or volumes through manipulated weighing scales are common throughout the commodity chain from seeds to end consumers. Retailers pass on the costs of such practices to consumers, who even with *suki* ties, are aware of such cheating. One retailer recounted the risks of selling fish through credit:

> I sold fish there in Coastal [southern part of Metro Manila]. I invested P60,000. Sometimes our customers buy fish in credit. People from hospitals, small restaurants, roadside eateries would get 20 kilos each. When they become your friends, they will ask for fish through credit, and would promise to repay you the next time. Until you notice that they have disappeared. Then you can't repay your credit with the buy-and-seller here. Good thing my brother is friends with one of the buy-and-seller's laborers. When they would load the fish that I bought, the laborers would add more fish in the tub, and you would just hand them P100, P50. That's how we earn from retailing. (M10 former retailer 2012)

This section identified the various ways that economic transactions and access to fish flows are constituted by different types of social relations. While competitive relations between actors are found throughout the commodity chain, urban fish flows are primarily controlled by fishing corporations who simultaneously operate deep-sea, pen aquaculture and brokerage ventures. Pens are not only able to exclude access by fishers in the lake, but they also influence seed exchange, trade and harvest processes. Brokers occupy a central role in the fish market through their relations with other traders and integration with producers.

6.3.3 The commodity chain in place: labor in the urban fish market

Commodity chains (or production networks) are always grounded in the specificities of place, an argument often overlooked by chain or network analyses that privilege inter-firm relations across abstracted space (Coe et al., 2008; Kelly, 2013; Selwyn, 2009). The Navotas fish market is situated in the densest city within Metro Manila, with relatively high rates of urban poverty (twice the average rate of Metro Manila in 2005), unemployment (20% average between 1999-2003), and highly insecure housing tenure, with close to a quarter of households living in informal settlements

(Navotas, 2010; Planades, 2011). In the country's "fishing capital," more than two-thirds of the city population of 250,000 are involved in fishing or are employed by the city's 90 fishing industry establishments. Close to 20,000 households reside around or within the grounds of the fish port complex (see Figure 6.2), supplying the fish market with abundant labor.

Despite the abundance of fish in the market, access to benefits from fish as food and as livelihood is limited for the surrounding urban poor communities. A 2009 survey among 75 urban poor households living near the fish market reported that close to half skipped eating for a full day at least once in the last month. Fish comprised about 90% of the animal protein in their diet. When they could not afford to buy fish they rely instead on cheaper fish products such as fish paste and dried fish (FIAN-Philippines, 2009).

Residents of Navotas engage in the fish commodity chain as a source of income by providing labor and small, often informal, ancillary services, such as distributing ice for wholesale buyers. Scavengers (*bakaw*), which include children from nearby shanties, gain access to fish by poaching fish or by picking up beheaded, crushed or partially damaged fish that fell by the wayside in the process of loading and unloading the fish. They sell stolen fish in the other markets, while some edible refuse fish are sold in the shanties, becoming a source of cheap fish accessible to poorer households (M06 former broker caretaker 2012; M11 fishport laborer 2012). Spoiled fish are collected by *durog* boys to sell to fish sauce or fish meal makers. Stealing by laborers and non-laborers alike is common in the fish market. Brokers employ armed guards and deploy surveillance cameras to watch over laborers and other people that pass through, restricting access to those they do not recognize.

Depending on their size and on fish landing volumes, brokers employ at any given time anywhere from 10 to 100 laborers (called *batilyo*). Excluding vessel laborers, these can be categorized into three based on security of tenure: regular, extra-regular, and extra. Regular workers (called "blueboys," after the color of their uniform shirts) are employed with first priority, are paid relatively fixed wages and receive health and housing benefits. Extra-regular laborers are picked by the broker's foreman on a nightly basis depending on amount of fish to be unloaded. They remain loyal to their broker employer and receive wages based on the night's work but get no benefits. Extra *batilyo*s meanwhile are only hired during times of high fish volumes and due to their highly irregular and unseasonal employment, they often offer their labor to any broker needing workers. Access to work is therefore stratified according to these categories, with extra laborers having the least chance of being hired during the lean season or days with few landings. These employer-worker ties are created and reinforced through patronage relations between laborers and brokers, passed on through generations of fish market work. Two fish market laborers narrated how they were employed by a large Market 1 broker:

> I first worked for this broker 8 years ago. I knew someone who worked there so I was able to get in as an extra-regular. They hire people from this area. If you have a hook, boots, you're in, as long as you know how to pull and drag tubs. (M11 fish market laborer 2012)
>
> We just work for one broker, because if we work for another, they might see us, they don't like that we work for another broker. Maybe you can work extra for

> those far from them, where they won't see. But if you work for a broker beside them and they saw you, they will ask you why. (M13 fish market laborer 2012)

The abundance of available labor tied by loyalty to a large broker makes the hiring process an important aspect of access to fish market work. Dressed in required plain white T-shirts and carrying hooked metal sticks used for dragging tubs of fish (Figure 6.9), extra-regular and regular workers would sit and wait in the fish port when they hear of carrier vessel dockings. The foreman would then decide who to hire for the evening based on degree of acquaintance (M14 fish market laborer 2012). He then assigns chosen workers an ID with a number. The number is important, since lower-ranked workers are more prone to being let go early when fish volumes inside vessels begin to dwindle. The laborers explained the process:

> For example, if the ID numbers are from 1 to 70, it would be good if you get numbers 40 and below because once there are few tubs left, in order for them to save from paying wages, the operators would ask those 41 and above to stop working and pay them P220, instead of P300. (M11 fish market laborer 2012)
>
> But what some brokers would do, we have our numbers already and the unloading is finished but we would get lower wages. Instead of earning P230, we would get P150. They should have let us go before the unloading finished instead of letting us finish the work. Who would not be angry at that? We worked the same amount, but receive lower pay just because of the ID. Just because our number is high they would ask us to queue in another line to receive less wages. We don't just work by standing there. (M12 fish market laborer 2012)

Figure 6.9. Broker laborers in Market 1 of the Navotas fish market (Photo by author, 17 October 2012)

Hiring is contractual for most and wages remain low, ranging from P130 to P350, all below the government's daily minimum wage rate for Metro Manila of P409. The working period is between six to eight hours in the middle of the night, and risks for accidents are high, especially when laborers are told to work faster so as to unload all fish in time for the trading hours and take advantage of fluctuating prices. Large brokers reinforce labor discipline through guards and surveillance, meant to assess a laborer's work ethic and to prevent occasional poaching. Guards are also hired, apart from those that brokers regularly employ (foreman and security guards), from the ranks of the laborers and are paid extra. Laborers experience surveillance in several ways.

> When they say faster, you have to go faster. They are very sensitive about time, especially when there are many fish to unload, like thousands of tubs. That is why when they tell you to go faster, you go faster. You cannot slow down

> because they will say, "You're not fit for this work," and replace you. (M13 fish market laborer 2012)
>
> You cannot get fish from the tubs for your own consumption. If they see you, you will be fired. They have cameras. They really watch over their fish. (M15 fish market laborer 2012)
>
> The foreman watches over us. Secondly, they hire watchers. They are like security guards. They will hire watchers to keep an eye on us. If someone, say, went back to his house during working time, they will tell the foreman. Or if someone is smoking while working, or took a fish. (M11 fish market laborer 2012)
>
> The guards get P30 more than what laborers get. They do nothing but stand. Every night. We're soaked in sweat but get the least pay (M17 fish market laborer 2012)

Wholesalers and smaller brokers, including some who deal with cultured fish brought by traders, employ fewer workers since loading/unloading of fish from trucks require less work. Some engage in a share system of dividing part of earnings among the workers (M10 former fish market laborer 2012). They also employ regular workers and hire extra ones during high-volume landings. Because fish supply through aquaculture is more stable and less seasonal than ocean fishing, regular workers in smaller brokers dealing with cultured fish are more assured of work and income. These brokers and wholesalers are also more lenient than the bigger brokers in providing laborers access to fish for take-home food. Their workers also become an informal means of access to fish as food for those laborers who are not given take-home fish by large brokers.

> If they add P30 to our wages, we are happy. That's a big deal to us. But they have become more strict. We used to be able to ask for fish that we can have fried. We have a break, 15-20 minutes, five people at a time starting at ten in the evening. So a laborer would rush to his break as soon as someone returned from his, because we cannot take a break all at the same time. Before, we can ask for

> fish for food, but now they won't give us one. It is prohibited to take fish, but after the operation, you may. You can ask for fish for your meal from the laborers of buy-and-sell wholesalers once the operations finish, say at 1:30 in the morning. You can have it cooked for a fee at a store nearby. (M11 fish market laborer Nov 2012)

Child labor is common. Around 400 children between 5 and 17 are estimated to work in the fish market through various tasks, including *batilyo* work, scavenging, poaching or prostituting in exchange for fish (Tolentino, 2010). Children are hired as *batilyo* laborers especially during peak season of fish landings (M11 fish market laborer 2012). Scavengers and poachers are often apprehended by guards, sometimes through violent means, whenever they are caught.

Fish market laborers and fishing corporations have a long history of conflicts surrounding casualization of labor and the nature of contractual relationships. In several rulings, the Supreme Court reaffirmed the regular employment status of fish port and vessel workers, arguing that their work meets the criteria of regular employment (i.e., laborers perform activities necessary and indispensable to the business). In *RJL Martinez Fishing Corporation vs National Labor Relations Commission (NLRC) et al.*, the Court dismissed the corporation's arguments that the laborers are not their regular employees because *batilyos* also work with other corporations in days when they have no dockings (RJL, 1984). The Court reiterated that regular employment is not determined by continuity or exclusivity of employment but by whether they perform tasks that are crucial and indispensable in the regular functioning of the employer's business. The Court ruled on a similar case for *Poseidon Fishing/Terry de Jesus vs. NLRC and Jimmy S. Estoquia*, stating that even casual employees became regular employees after one year, and that the process of re-hiring the same person for similar tasks over several years attests to the necessity of the laborer's work in the employer's business (Poseidon, 2006).

The persistence of casualization and contractualization of fish port work perhaps points to brokers' and fishing corporations' attempts to maintain profitability with fluctuating fish landings and manage the particular seasonality of fish unloading (Carnaje, 2007). It is common for fishing corporations, for example, to enforce fixed-term contracts (*por viaje*) for fishing vessel laborers, who are rehired on a per trip basis. The hiring of b*atilyos* is under even vaguer terms, and is not based on a fixed contract but subject to foreman decisions. The pool of labor from surrounding areas continues to be deep despite a slowing of population growth as a result of the relocation of informal settlements to make way for highway-widening project. Indeed, some of those relocated from the exurban town of Rodriguez make regular trips to the fish port to work as *batilyo*, even if this involves nearly two hours of commuting each way.

Increasing broker control over labor is compounded by (or resulted in) the weakening of a once strong trade union. The *Samahan ng Nagkakaisang Batilyo*-NFL (Association of United Fishport Workers-NFL) served as the bargaining organization against the Fish Brokers Association, particularly in the 1970s and 1980s (VDA, 1993). It held strikes when fishport work was threatened with lay-offs or casualization with the passage of the 1974 Labor Code, and with the construction of the Navotas Fish Port Complex in 1975. These events were seen as crucial moments in resistance against Marcos' Martial Law (CBBRC, EILER, & WAC, 2011; Lumbera, 2010) and provides an example of the agency of labor in commodity chains (Selwyn, 2009, 2012). However, laborers have noted the decreasing role of the labor organization and increasing casualization of work:

> The fishing company let several regular workers go. They paid the older ones to leave, those who have worked for a long time. They are shying from the responsibility of giving them benefits, social security, things like that. They paid them. So they hired new people, those extra ones that they can hire on a casual basis. They just give them something during Christmas as consolation. (M10 former fish market laborer 2012)
>
> Many of the laborers here are afraid to speak up because if you complain, they won't hire you anymore. If you ask for work, they won't give you one. So even those who would like to fight would just keep things to themselves. They just endure them. Whatever they give, we just accept. We just follow. We have yet to complain. (M11 fish market laborer 2012)

The largest capital investors in both production and exchange nodes in the commodity chain deploy labor in different ways. Pen operators hire willing rural migrant labor for tasks that Laguna Lake villagers are not willing to undertake. The materiality of nature and specificity of pen aquaculture required the deployment of migrant labor throughout the year but under conditions of low wages and that laborers should perform all-around pen work (see Chapter IV). On the other hand, brokers and other fish market actors employ local urban poor labor but on a primarily casual basis. Brokers respond to the unevenness and seasonality of fish landings though casualization of labor. This section supports the argument that there is a need to highlight local specificities in labor relations, as well as the place of labor in commodity circulation and exchange (Aguilar, 1989; Harriss, 1990; Mann, 1990).

6.4 Discussion and summary

Material flows of fish are socially structured through everyday transactions and relations involved in the movement from the lake to the city. A commodity chain approach enables the mapping of such dynamic flows fixed in particular sociospatial configurations that are historically constructed and shaped. More importantly, it allows making connections between various actors and identifying points of control and uneven access.

Access to the benefits of fish through income and sustenance is unevenly distributed along the commodity chain. It closely follows, however, the contours of size of capital of "firms" or actors. Discussions of social relations between different groups reveal mechanisms of access and control. While pens and brokers control large quantities of fish flows to the city, other commodity chain actors attempt to gain access to these flows by establishing social ties (e.g., through trust to gain knowledge and credit), direct physical access through licit or illicit means (e.g., poaching or scavenging), and employment (e.g., through fishport work).

Although subject to the lake's materiality (Chapter IV), large pens still derive most benefit from lake fish production. Through their size, political connections, market access and use of weapons, they are able to make most income from the lake (see Appendix C), exclude other actors from use of certain parts of the lake, and influence production practices and incomes of other producers. They shape the commodity chains of seeds through sheer demand and the commodity chains of food fish through high landing volumes and close links with brokers. Village-based cage nurseries are tied to the pen production cycles, and their relations are mediated by seed agents who are able to extract extra income from cage nurseries by depressing seed prices and delaying payments. The long history of pen-fisher conflicts illustrates dynamics of exclusion and resistance. By denying them access to fish, sometimes violently, fisherfolk take advantage of illicit means (poaching) and disasters (escaped fish) to gain income and sustenance benefits from fish reared in pens (Chapter V).

Large brokers control a majority of the flows of all fish in the urban fish market. As central actors in the urban exchange node of the commodity chain, their privileged position and established relations with other intermediaries provide them with means to gain benefits through influence over fish prices and volumes, including knowledge, secret auctions and access to storage. Casualization of abundant low-skilled laborers tied by loyalty to brokers manages labor costs and fluctuating fish landings. In turn, laborers and surrounding urban residents rely on a variety of everyday strategies to secure livelihoods and access to fish as food.

In some highly significant cases, brokers, pen producers and industrial deep-sea fishing companies are the same entities, as is the case with the country's largest fishing corporations. With roots in the old elite families in northern Metro Manila, these groups exploited the opportunities in commercial fisheries after the departure of Japanese fleets, and occupied spaces in Laguna Lake aquaculture when pen culture was introduced. Large fishing corporations exert the greatest control in the fish commodity chains that supply Manila with both wild and farmed fish. This has been achieved partly through greater integration of various activities in fishing and through control of access to benefits in several nodes of the chain, including labor.

After discussing the nature of the flows, actors and access mechanisms, an important question to pose is why such chains and relations are created and maintained. Indeed, it is easy to lose sight of processes that exist outside direct social relations between (or within) “firms” or actors in the commodity chain (Starosta, 2010; Taylor, 2007). The remainder of this section and the next chapter suggest that benefits can be understood in less direct ways than previously discussed. The Laguna Lake fish commodity chain is a “slice” (Bernstein, 1996b) in the broader whole of relations between aquaculture and industrial fisheries on the one hand, and the urban and rural on the other.

Orthodox economic explanations and certain state discourses interpret aquaculture as a viable substitute to address crises in industrial and municipal fisheries, whereas critical political economists argue that it is as a contradictory fix that results in other kinds of socioecological crises, such as undermining its own conditions of production and producing unhealthy fish (Mansfield, 2011). Elements of both predictions appear in the Laguna Lake fish commodity chains. The shift in species composition landed in the urban fish market suggests increased and steady production and consumption of cheaper farmed fish that seem to replace the role of dearer marine fish. Chapters III to V, however, showed that the introduction of aquaculture in Laguna Lake produced particular socionatures in the process of enabling commodity production, with uneven impacts on various lake producers. This chapter illustrated that aquaculture became a way for elites based in the capture fisheries sector to maintain control of the flows through expansion to other realms of fishery production, in addition to opening up livelihood and sustenance opportunities for cage nurseries, traders and agents. Chapter VII meanwhile argues that this process of aquaculture substitution is messy, incomplete and requires work by commodity chain actors.

As proposed in the first section of the chapter, the commodity chain approach provides a means to understand urban metabolism by linking spaces of and actors in (rural) production and (urban) consumption. Through efforts by various actors to access fish flows and gain benefit from these, they establish relations with other actors. Aquaculture production, primarily through large pens, enabled increased flows of fish to the city, sociospatially "fixing" the lake to the city through this process. As a result, urban-based actors (as pen producers and cage investors) and "urban" activities (waste generation, water extraction, industrialization) become more active producers of Laguna Lake socionatures in the same manner that Laguna Lake actors help sustain the city by producing fish.

By conceptualizing access to commodity flows as questions of access to socionatures, we can contribute to understanding natures in commodity chains beyond material substratum that is transformed primarily in sites of production (Bernstein & Campling, 2006b; Goodman, 1999). This also allows us to view labor and practical activity as the locus of production of socionatures. Strategies by various commodity chain actors to gain access to fish for sustenance and livelihoods reflect how society-nature relations are mediated through work and practices of metabolizing socionatures. It also points to the possibilities of political change and opening up of worldviews through everyday activities (Loftus, 2012). In this chapter, I focused on labor as a crucial component of fish production and exchange. In the next chapter, I seek to extend the notion of working to produce socionatures through practices by commodity chain actors to transform fish to enable consumption and sustenance.

In terms of consumption patterns in Metro Manila, percentage of fish consumed relative to other sources of animal protein aligns with income class. Thus, the flow of cheap Laguna Lake fish plays an important role in nourishing urban inhabitants, with consequences on the social reproduction, particularly of low-income city dwellers. The next chapter examines this point in greater detail through the example of the metabolism of Laguna Lake's bighead carp, the cheapest fresh fish sold in the city.

CHAPTER VII

METABOLIC FLOWS OF CHEAP FISH: BIOGRAPHIES OF BIGHEAD CARP

The urban metabolism of Laguna Lake fish involves the circulation of fish commodities as socionatures that flow from spaces of production to consumption. The previous chapter showed how these flows are constituted by various groups of actors who benefit differentially from fish. However, it stopped short of discussing who consumes the fish and the processes by which this consumption takes place.

This chapter follows the social biographies of the bighead carp, a Laguna Lake commodity recently introduced and currently widely available as a cheap fish in the city. The introduction of bighead carp and its metabolism through urban consumption are by no means components of a straightforward story. Pen producers stocked the bighead carp as a way to address the natural limits imposed by the lake's materiality, and thereby maintaining profitability in periods of less productive lake water conditions. However, while production increased, urban consumption of the fish as fresh food remained limited owing to consumer unfamiliarity with the fish and its bony and bland character. This chapter tells the story of how bighead carp has been and is being made amenable for urban consumption in Metro Manila. It concludes by considering how these flows of cheap fish reflect the complex and contradictory relations between aquaculture and capture fisheries, and the city and the lake.

The task of this chapter is two-fold. First, it examines the processes by which fish commodities acquire new meanings and are transformed materially as they circulate along the commodity networks. Bighead carp's importance at the site of production owes to pen producers' use of the fish as a socionatural solution to the problems with fluctuating quality of the conditions of production. In the lake, bighead carp is known through many names, including Imelda (after former First Lady and Manila governor Imelda Marcos), Taiwan (after the source of the first fingerlings) and *mamali* (a local Tagalog name). In the urban markets, however, once the fish is chopped and displayed in stalls, it acquires the new, if not misleading, name *maya-mayang tabang* (freshwater red snapper). Various agents in retail and consumption have converted the fish into a substitute for certain dishes through culinary transformations and also in making fishballs, a surimi-like food consumed in the streets of Manila. Practices of distancing from its freshwater lake nature and entanglements with more desirable and familiar marine characteristics were necessary for bighead carp to become acceptable to urban consumers. This chapter discusses these practices in terms of how they smoothen of frictions in commodity flows between the lake and the city through distancing and entanglement in wet market retailing, kitchen cooking and fish processing. These practices highlight the work that actors do to metabolize the fish and transform particular relations with urban socionatures. It also argues that the substitution of wild fish, such as marine red snapper, by farmed fish is an incomplete and messy process that reflects metabolic contradictions that the fish embodies.

Second, the chapter highlights how bighead carp, produced primarily in Laguna Lake's fishpens, became an affordable food important in the social reproduction of the urban poor. The stagnation in capture fisheries and the rising costs of catching wild marine fish have made fish dearer. The state promotes aquaculture as a solution to address this crisis by providing a steady supply of cheaper fresh fish to the lower income populations of an expanding megacity. Increasingly, the most affordable fish in Metro Manila are produced through aquaculture, and the cheapest among these originate from Laguna Lake, where pen producers enroll plankton and labor in the production process at little or no cost. The chapter argues that bighead carp, the lowest priced among the fresh fish sold in the city, reflects the production of Laguna Lake as a socionatural and sociospatial fix (Harvey, 2003, 2006) by fishing corporations to manage crises in fish production. This can be situated within abstract needs for capital to provide for the social reproduction of the urban population through the least cost. As with practices of transforming bighead carp in the city, this requires deployment of labor in the sphere of production.

7.1 Cheap fish for the megacity

Fish and seafood are an important source of sustenance in archipelagic Philippines. Fish comprises 57% of average daily protein intake in 2008 (Figure 7.1) or a figure of 36 kg per person annually, which is more than twice the global average. The proportion of fish consumption relative to other sources of protein has decreased due to several reasons, such as the changing diets in favor of other types of animal protein and the rising prices of traditional marine wild fish staples. The latter phenomenon results from the stagnant marine fish production in commercial and municipal fisheries, which increased aquaculture production seeks to address (BFAR, 2005; Dey & Ahmed, 2005). Chapter VI shows these changes in urban Manila, where three farmed fish species – milkfish, tilapia and bighead carp – have replaced marine species as the most unloaded fish in the urban wholesale market (Table 6.2) and, consequently, the species that fetched the lowest prices (Table 6.3).

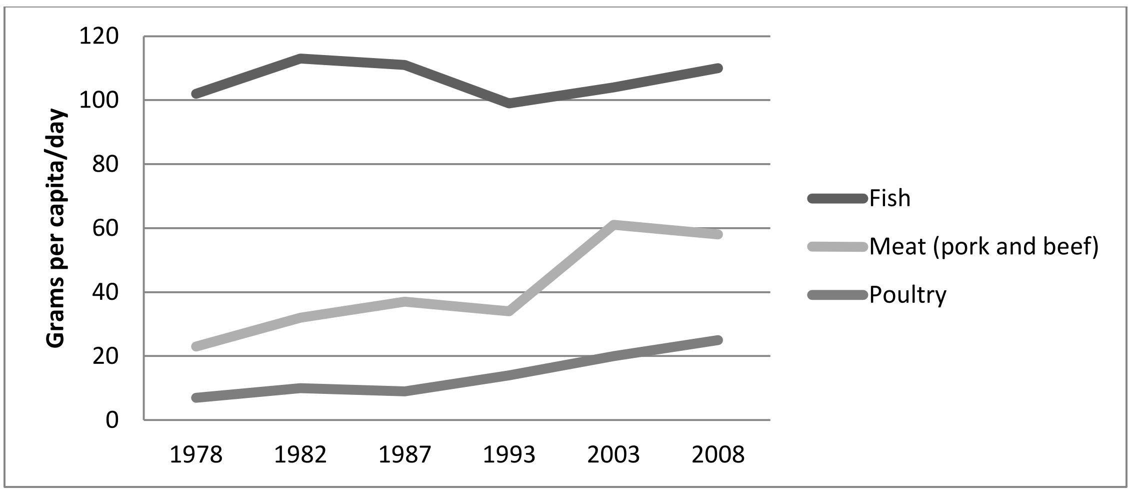

Figure 7.1 Trends in animal protein intake in the Philippines, 1978-2008 (Source: Food and Nutrition Research Institute 2008 national survey data)

Consumption of fish, considered as the "poor people's protein," follows socioeconomic class lines (Y. T. Garcia, Dey, & Navarez, 2005; Yosef, 2009). Figure 7.2 shows that in Metro Manila (as in other parts of the country) the lower and extremely lower income groups proportionally consume more fish than other meat, even if much less in total amounts. Fish account for approximately half the animal protein intake of the lower two-thirds of the metro Manila's urban population, by income.

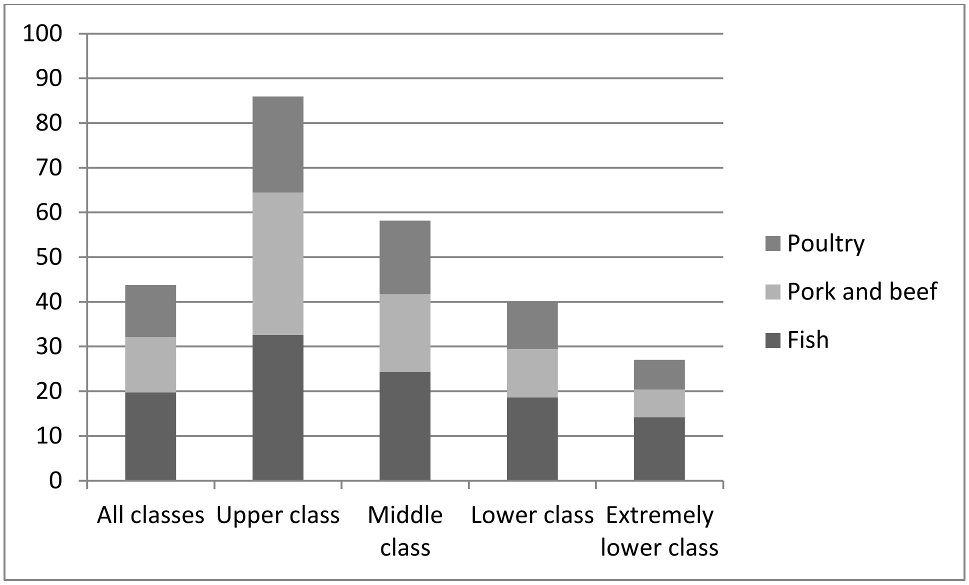

Figure 7.2 Annual average per capita intake of animal protein by income class in Metro Manila in kg, 2008-2009 [1,2] (Source: BAS data)

[1] Fish includes roundscad, milkfish and tilapia
[2] Distribution of households by socio-economic class in Metro Manila in 2008 according to National Statistical Coordinating Board (NSCB) and BAS data is as follows: Upper (A/B) classes - 4.7%; middle (C) class – 23.5%; lower (D) class – 45.1% and extremely lower (E) class – 26.7%

The type of fish consumed matters as well (Figure 7.3). Round scad or *galunggong* (*Decapterus* sp.), a marine wild fish, has long been considered a symbol and indicator of poverty. With escalating prices of this fish, however, other more common and previously middle-class fish, such as tilapia and milkfish, have become cheaper. In a symbolic move in 2003, president Gloria Macapagal-Arroyo proclaimed tilapia, a farmed fish, as the new national staple fish in place of round scad (Yosef, 2009). In 2012, round scad prevailing retail prices equaled or exceeded those of milkfish, tilapia and bighead carp.

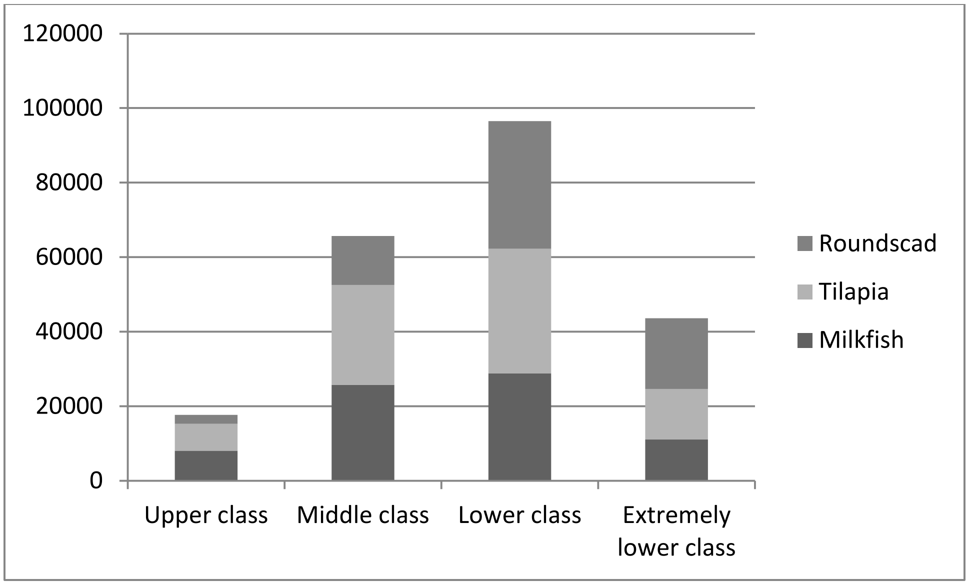

Figure 7.3. Total consumption by income class of three common fish species in Metro Manila in MT, 2008 [1]

[1] Calculated from BAS data and using the 2007 population census

In 2010, Metro Manila consumed more than 400,000 MT of fish, supplied from various bodies of water, including a significant percentage from Laguna Lake (see Table 6.1). Owing primarily to the presence of natural planktons and absence of feeding, the lake produces the cheapest of the fish species sold in the city that are accessible to the more than three-quarters of the city population that belong to the lower and extremely lower income groups (alternatively called the urban poor or the working class).

Fresh fish circulates throughout Metro Manila through wet markets (*palengke*), neighborhood markets (*talipapa*), peddlers (*naglalako*) and local supermarket chains. Scattered throughout the city, wet markets continue to be the preferred place to buy the freshest fish sourced from the wholesale fish market or from producers themselves.

Neighborhood markets and peddlers are particularly common in poorer sections of the city, and they serve as an accessible place to purchase fish, especially for households without refrigeration or means to preserve the freshness of the fish. Supermarkets are gaining more fish customers in the last decade (M26 supermarket chain administrator 2012) but still cater primarily to the middle and upper classes.

Large-scale Laguna Lake pen aquaculture not only produce lower-cost fish by avoiding feeds but also supply the urban market with varying sizes of fish because of the fluctuating water conditions of the lake (Chapter IV). In times of poor conditions, producers are forced to harvest fish even when they are smaller than regular market size to reduce non-production time and hasten the turnover cycle. These small fish sizes find a market among poorer urban households that are able to purchase more pieces of fish per kilo. In 2012, considered by pen and cage producers as a poor year in tilapia production, small tilapia sizes (less than 100 g) were abundant in the urban market. As a neighborhood market retailer noted:

> You won't find tilapia of that size from Batangas. Tilapia that size could only come from Laguna Lake. In Laguna Lake, they produce all sizes of tilapia. Of course, fish of smaller sizes are a lot cheaper, so I would buy them. I would double my investments, say I put out P1,000, I would earn P1,000. They would sell faster and the poorer families buy them from me. Because they have more household members, everyone gets a piece of fish. (M09 Manila fish retailer 2012)

The case of the small-sized tilapia reflects the role of Laguna Lake as a provisioning space that produces low-priced fish consumed largely by the urban poor. It is in this context that I will examine bighead carp, the cheapest fresh fish sold in the city.

Despite its low price, it has only slowly gained consumers in the city, in part due to efforts of commodity chain actors to enable consumption of the fish. These practices are discussed in the next section.

7.2. Social biographies of the bighead carp

Bighead carp acquires different meanings in sites of production and consumption. The following discussions narrate the social biographies (Kopytoff, 1986) of bighead carp in the lake and in the city.

7.2.1 The bighead carp as "Imelda": a socionatural fix to unpredictable lake production

While bighead carp is the fifth most commonly produced freshwater farmed fish in the world, it has escaped academic attention due primarily to its low prices and localized consumption patterns. Endemic to the waters of China, bighead carp has been introduced in 72 countries, mostly after 1960 and primarily for aquaculture purposes (Kolar et al., 2005). The fish, along with other kinds of carp, made its way to the Philippines from Taiwan in 1966 through the Fisheries Bureau, and to Laguna Lake in the mid-1970s through two pen producers (Baluyut, 1989). It has been stocked in other lakes and reservoirs to augment fish production, mainly during the Marcos presidency, and has thus acquired its colloquial name "Imelda" after the former First Lady (L04 bighead carp hatchery owner 2012). The lake environments and hydrology in the country could not support requirements of natural bighead carp reproduction, thus preventing the fish from becoming invasive. Because of this inability to reproduce naturally, SEAFDEC's research played an important role in artificially reproducing the fish through induced spawning technology (Chapter III; see Figure 7.4), which private hatcheries around Laguna Lake, usually owned by wealthier villagers, adopted beginning in 1986.

Figure 7.4 A step in the process of induced spawning of bighead carp - collecting sire sperm and mixing with dam eggs inside a recirculating tank (Photo by author, 16 June 2012)

An example of the processes of adoption of bighead carp is provided by L04, perhaps the country's longest operating and most successful bighead carp hatchery owner. He now lives in the mainland lakeshore town of Binangonan where he operates his bighead carp hatchery with modern facilities like recirculating tanks, incubators, and oxygen tanks. With 27 years of bighead carp breeding experience, he started out operations from the lake village of Kalinawan. Prior to aquaculture, his father owned one of the few motorized push net boats in the village, which he abandoned with the adoption of tilapia breeding by the villagers in the early 1980s (see Chapter V). From tilapia culture, he saw opportunities with the nascent bighead carp hatchery development and switched in 1985 to breeding the fish, a much higher-capital and knowledge-intensive venture. With trial-and-error experimenting and painstaking note-taking, he was able to perfect the processes of induced spawning (Figure 7.4) and fry rearing that avoided high mortalities.

In our interview and in his appearances in local television programs, he reiterated the importance of bighead carp in providing cheap and abundant fish for national food security. Furthermore, he narrated how important bighead carp was to pen production:

> Some fishpen operators tell me, "You know without you, many fishpens would have ceased operating, many of us would have left Laguna Lake. We cannot rely on milkfish and tilapia because when water conditions deteriorate, milkfish won't grow, sometimes they would even lose weight." But bighead carp does not mind water conditions. It grows well whether the water is turbid or clear, cold or warm, it is able to grow. That is the advantage of bighead carp. It is an all-weather type. So, many fishpen producers who stock milkfish also stock bighead carp. Even the biggest fishing corporations there stock bighead carp. (L04 bighead carp hatchery owner 2012)

For pens, stocking bighead carp is a way to manage the risks of lake materiality where fluctuating water conditions can prolong the production time of fish given its better tolerance for poorer water conditions (Chapter IV). As shown in Figure 7.5, this was most pronounced in 2001 when milkfish production dropped 70% and bighead carp production almost doubled from the previous year, continuing its ten-fold increase since the mid-1990s. Since then, pens produced bighead carp and milkfish in almost equal volumes, with dips in production in 2006 and 2009 due to devastating typhoons.

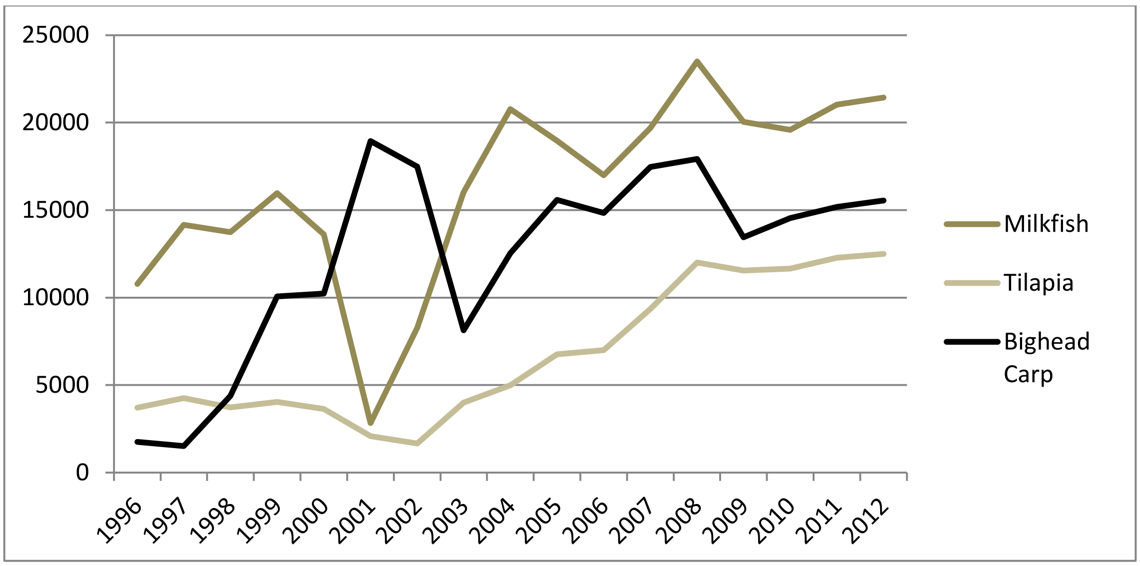

Figure 7.5 Pen production by species in Laguna Lake, 1996-2012 (Source: BAS data)

Bighead carp provides a “fix” for the long production time of milkfish in pens due to its better tolerance of poor (e.g., turbid) water conditions. Pens are able to circumvent the long gestation times of higher-priced species like milkfish by stocking bighead carp. This provides increased demand for fry from bighead carp hatcheries and fingerlings from cage nurseries, both primarily based in Kalinawan village (Chapter V). Owing to the high capital costs and risks of constructing and operating hatcheries, only a few hatchery operators exist. These are often the wealthiest families, who owned the boats and nets prior to the shift to small-scale aquaculture production. They benefit from increased demand from pens, especially in times of poor water conditions. One hatchery owner remarked:

> Large pen corporations and big-time operators get fry from me….For seven years I have supplied the largest fishpen corporation here…They get 3 million bighead carp fry from me (K06 bighead carp hatchery owner 2012)

Cage producers also see bighead carp as a means to earn income when tilapia fingerling demand is low, even if the fry is more expensive. While bighead carp is not consumed in the same amounts as other indigenous or introduced fish, lake fisherfolk see the fish as a source of income when escaped fish caught through gill nets or fish corrals are sold to assemblers for the urban market (Figure 7.6). Sustained flows of fish are also important to traders and brokers, who rely on higher volumes of fish unloading for income. In all these cases, various producers derive economic benefit from bighead carp, particularly as a socionatural fix to complexities of producing fish from the lake environment.

Figure 7.6 Lake villager weighing a 3-kilo bighead carp caught in a fish corral before sale (Photo by author, 15 May 2012)

However, despite successes in introducing the fish and improving production, bighead carp consumption has not been as widespread and common as the other well-established cultured lake fish. The next section details how bighead carp is consumed as food fish and as white meat for food processing in Metro Manila. These processes involve materially and symbolically transforming the fish through practices of distancing of the fish from its freshwater lake nature and entanglement with more desirable and familiar marine qualities (Cook & Crang, 1996; Mansfield, 2003b).

7.2.2 The bighead carp as "freshwater red snapper": practices of smoothening urban circulation

A 1989 paper by a development NGO-based fishery scientist that sought to assess the potentials of carps for food security claimed:

> The limited market acceptability has been attributed to two major objections to the fish: namely, it has too many bones and it does not taste good. While there may be some basis for these observations, it is felt that with efforts directed at information dissemination and marketing campaigns (including cooking demonstrations), bighead carp may eventually become an important food fish in the country in much the same manner that the perception for tilapia has changed from that of a trash fish to that of a highly desirable commodity (Baluyut, 1989, p. 112)

Neither the state nor fish producers embarked on efforts to encourage bighead carp consumption through marketing campaigns and cooking demonstrations; however, various practices of commodity chain actors in the spheres of exchange and consumption attempt to make the fish more acceptable to urban consumers, as a way of "smoothening" the frictions of bighead carp metabolic flows. The problems that "smoothening" had to overcome are revealed by a bighead carp hatchery owner:

> Consumers do not want to eat bighead carp. They say it has a strong fishy [*malansa*] taste. But that's not true anymore. Maybe the first strains introduced were, but the taste has improved due to cross-breeding and the quality of water. (L04 bighead carp hatchery owner 2012)

This section discusses these practices in the aspects of urban retail (wet markets), cooking (kitchens) and fish processing (small-scale manufacturers).

7.2.2.1 Chopping

Bighead carp is the only freshwater or marine fish commonly sold in the wet markets of Metro Manila that is displayed chopped, with the fish body sliced in thick cuts and the head priced separately (Figure 7.7). While several stalls that sell tilapia and milkfish mention the place where they originated (usually Batangas for the former and Pangasinan for the latter) as a way to indicate quality, the few stalls that display bighead carp only show fish prices, excluding origin. This is unsurprising given that almost all of the bighead carp sold in Metro Manila come from Laguna Lake, a place that is often associated with inferior quality in terms of fish taste – blander and sometimes earthy-muddy (Chapter IV). When selling milkfish and tilapia from the lake, for example, retailers do not specify where they come from, in contrast to those sourced from Batangas and Pangasinan. Bighead carp is often both nameless and placeless in wet market fish exchange.

Figure 7.7 Sliced bighead carp displayed in a stall (Photo by author, 30 October 2012)

Chopping and minimal labeling are also retail strategies not only to distance the fish from its lake origins but also to resemble red snapper, *Lutjanus sebae* or *maya-maya*, a more desirable and expensive marine fish. Labels in stalls where they name the fish would include *maya-maya* (red snapper) or *maya-mayang tabang* (freshwater red snapper), a term that originated in the wet markets of Manila only within the last decade. Both the "fake" and "real" red snapper have bright pinkish flesh and an elongated body of roughly the same size. The notable difference is the bighead carp's disproportionately large head, which is often sold separate from the fish body at a lower price. Commodity actors noted this practice and how it is easy to confuse the fish with something else:

> A lot more people are buying bighead carp now. In the wet market, people are not able to distinguish the fish. When sliced and filleted, its flesh resembles that of a red snapper. That is why when bighead carp is sold in the market, the head is displayed face down, not up, because one is not able to note the difference between bighead carp and red snapper. If you are not familiar with the fish, you would mistake it for the real thing. (M10 former fishport worker 2012)

> They [retailers] fake it, because in some wet markets consumers are not familiar with the fish, so whatever label they place there is okay. There in Sangandaan [wet market that is 3 km from Navotas fish market], when a fish is big, they display it and call it *maya-maya*. (M06 fish broker 2012)

> I was fooled one time, but I don't think the retailers had the intention to mislead me. For instance, they display *maya-maya* in their stalls but don't say what kind. I noticed that my *suki* [preferred retailer] sold *maya-maya* for P230 a kilo, but this other guy sold it for P100. So I bought from the other guy….and he admitted it was *maya-mayang tabang*. Consumers might easily confuse one for the other because both fish have a creamy taste and this melt-like texture. The other one, though, is bonier and if you are not careful, it can have a fishier taste. It takes more effort to get rid of the fishy taste. (M25 urban professional consumer 2012)

7.2.2.2 Cooking

Retailers encourage consumption through various culinary suggestions. These are sometimes indicated in the labels or are mentioned by retailers in the process of attracting customers. Unlike other fish, bighead carp requires a proper way of preparation to wash out the strong fishy taste and particular cooking methods suited to the blander flesh and larger head. This extra required work and access to knowledge have deterred some from consuming the fish despite its affordability. Making the fish more palatable through additional steps in cooking shifts the burden of metabolizing the fish to the spaces of homes, usually where work is often performed by women or household helpers who need knowledge of proper ways of cooking to be able to make the fish more palatable. This knowledge and work is one factor that determines those who will continue to consume the fish. Two retailers and a consumer explained the work necessary prior to fish consumption:

> *Maya-maya* has a fishy taste if uncooked properly but it tastes good when prepared well. What you should do before cooking is to wash the fish with salt then soak it in ginger and put pandan leaves so that it smells more fragrant. (M09 fish retailer 2012)

> We tried *maya-maya* before. But I found the fishy taste off-putting. And I had to go through several steps before we could eat it. I don't know how to properly cook it to get rid of the fishy taste. I just fry the fish or grill it or cook it in vinegar. (M20 neighborhood store owner 2012)

> Consumers here prefer tilapia and milkfish because only those who know how to cook Imelda buy it. It used to be hard to sell Imelda here [neighborhood with large informal settlement population], everyone ignored it. So you have to instruct consumers how to cook the fish so that they come back. Eventually, more people brought Imelda when people learned about specific ways to cook it. (M09 fish retailer 2012)

Parts of the fish are cooked in different ways, with the head used in *sinigang* (tamarind-flavored sour and savory soup) and the more versatile flesh in *sinigang*, frying, and *escabeche* (fried fish topped with sweet and sour sauce), among others (M02 fish retailer 2012). Another consumer explained the instances when her household cooks and consumes bighead carp:

> We got used to cooking *maya-maya* in *sinigang sa* miso. We only buy and use the head for cooking because we find the flesh not exciting to eat. The head though has different textures, some of it soft, and then you have the eyes….When we learned about Imelda, I would go back to where I first bought it and request more. Price is a factor too. Yellowfin tuna head is more expensive. One gets more *maya-maya* per kilo. (M24 urban professional consumer 2012)

In the example of *sinigang sa* miso (sour soup with a Japanese seasoning), a popular dish served at home as well as in restaurants and *carinderia* (sidewalk eateries), bighead carp head has served as a cheaper substitute to the more expensive tuna. In this sense, not only are retailers passing bighead carp for an altogether different marine fish (and thereby attaching with it its desirability and premium price), but consumers are using the fish a cheaper substitute to other kinds of marine fish.

Bighead carp consumption in Metro Manila is associated with class. The fish is popular in markets that cater to the urban poor, and this increased consumption partly accounts for the rise in wholesale prices from P8 to P33 per kilo (M06 fish broker 2012). M09, a fish retailer in Sauyo, an area in northern Metro Manila where a quarter of its 15,000 households live in informal settlements (Sauyo, 2010) notes that while bighead carp is not as popular as milkfish and tilapia, he is able to earn more from selling it because more people can afford it. He is also able to buy the fish at a much lower price in the wholesale fish market and sell it with a comfortable markup. While a kilo of bighead carp costs P33 in the wholesale market, its flesh retails at P70-100 and its head from P40-70. The mark-up gap is partly explained by the low fillet yield of the fish (given the large head) but also by the premium attached to its resemblance of a higher-priced fish. He noted:

> If you ask me, I earn a lot more if I sell Imelda. More people are able to buy it and you get it at a lower price in Navotas. Half a kilo of flesh can fetch P35 and P20 for the head. If you buy the fish at P35 from Navotas and you sell at P70 for a kilo of flesh, you can recover your costs. That's excluding the head, which is additional earning.

The deceptive retail practices, the amount of work of to make the fish taste good at home, and the class connotations associated with its consumption are three reasons that deter a young professional from further consuming the fish. His quote summarizes the problematic process of bighead carp substitution:

> I tried it once or twice. No offense but I am not too poor to buy this fish; it is really cheap. I also feel bad for my household help who prepares it in our house. It really takes a lot of work. Third, I don't like this feeling that I am being deceived, even if the retailer had told me it is not the real *maya-maya*. (M25 urban professional fish consumer 2012)

7.2.2.3 Processing

Prior to gaining greater urban consumer acceptability as food fish in the 2000s, bighead carp produced in Laguna Lake was primarily used for food processing as extenders and fish fillet substitutes (Baluyut, 1989). State-supported research also developed it as one of the first freshwater fish for surimi production (Fernandez, Mabesa, & Mabesa, 1998). Its most common use in processing, however, is in the production of fishballs, a common street food sold by hawkers in wooden carts where the fishballs are skewered, deep-fried and dipped in sauces. Fishballs as a street food are a cheap, quick and accessible *merienda* or snack for the urban working class and students usually consumed in the afternoons after work or school (Tinker, 1997). They are also popular snacks in urban poor neighborhoods where they are sold in neighborhood stores.

Fishballs are Cantonese in origin, and most manufacturing facilities, located in Manila, are owned by Filipino-Chinese families. Fishballs are made of white fish, flour and flavorings. The proportions of the ingredients determine its quality. To keep fishballs cheap, however, manufacturers use more flour than fish, and use the cheapest available white fish of lowest quality (i.e., unsold or near perishable) at the urban fish market. Prior to manufacturers' use of bighead carp in the 2000s, the low-priced marine fish *kalaso* or lizard fish (*Saurida elongata*) was traditionally used as the white fish for fishballs. The fish's increasing price, resulting from decreased wild stocks and increasing costs of commercial fisheries operations, has made freshwater bighead carp more attractive. The result is a change in the taste, volume and texture of fishballs. For example, a fish broker and a consumer interviewed about whether they noticed some changes in the taste or texture of fishballs observed:

> Fishballs were originally made from lizard fish. It is a marine fish. But it is more expensive now at P60 a kilo that is why it was replaced with bighead carp. The lizard fish fishball is round and fluffy when deep fried and are cooled. Fishballs now turn flat after frying…and they don't taste as good. (M06 broker 2012)

> I've noticed while eating fishballs once that the taste changed. It tasted like *maya-maya*… Fishballs have gone blander. (M25 urban professional consumer 2012)

The example of fishballs shows how processing is one practice to enable the urban consumption of bighead carp, primarily by the urban poor, by transforming the fish to an unidentifiable form, distancing it from its freshwater nature, and entangling it with other ingredients. It is also an example of the freshwater aquaculture substitution of marine fish. This process of substitution, however, had corresponding material effects in the taste and form of the fishballs.

7.3 Discussion: flows of carp, substitution and social reproduction

Following the metabolic flows of commodities from lake production to exchange and urban consumption reveals that such flows are constituted not only by actors deriving direct benefit from this movement, but also the practices of material transformations of commodities as they circulate within the city. These transformations reflect aquaculture-capture fisheries relations through the process of fish substitution on the one hand, and on urban-rural relations through the urban social reproduction on the other. In this section, I will examine the process of substitution as it reflects aquaculture-capture fisheries dynamics through the metaphors of friction and flows of socionatures in urban metabolism (Lawhon, 2013; Marvin & Medd, 2006), and distancing and entanglement in commodity circulation (Cook & Crang, 1996; Mansfield, 2003b). Furthermore, I will discuss the implications of cheap fish on urban social reproduction, and how these tie urbanization with productive processes in the lake sociospatially.

7.3.1 Bighead carp flows, substitution and aquaculture-capture fisheries relations

State officials and pen producers view Laguna Lake aquaculture as a solution both to the lake's stagnant production in the capture fisheries sector and to the national-level marine fish crisis in commercial fisheries. This discursive framing fits with broader global goals of establishing aquaculture as a solution or fix to the crisis in large-scale wild fisheries (Dey & Ahmed, 2005; FAO, 2006). But these efforts create new contradictions, such as increased volumes of cheaper farmed fish that undermine price premiums of wild fish, new forms of environmental degradation different from capture fisheries, and materially unhealthful fish (Mansfield, 2011). In the spaces of fish consumption, such as Manila, the substitution of wild fish by farmed ones is neither simple nor complete. The example of bighead carp is illustrative.

Introduced to augment fish production in Laguna Lake in 1966, bighead carp production did not take off until the development of artificial reproduction in the mid-1980s and widespread pen stocking beginning in the late 1990s. The latter emerged as a way for pen producers to circumvent the long production time of established aquaculture species in periods of unproductive water conditions, and thus speed up turnover rate and maintain profitability. Despite the proximity of a large urban population that pens supply with cheaper farmed fish, bighead carp did not become a common fixture in the plates of city-dwellers, even those of the poorest, until the 2000s. This was due to consumer unfamiliarity with the fish, and to the bony, bland and fishy character of its flesh, partly associated with its freshwater and lake origin. In this sense, bighead carp encountered socionatural frictions in its flows to the city.

The smoothening and lubricating of the frictions of bighead carp flow to the city involved practices aimed at encouraging fish consumption. Commodity chain actors in the exchange and consumption nodes, rather than producers, perform these practices in spaces such as wet markets, kitchens and fish processing sites. Distancing and entanglement are crucial in the process of smoothening or lubricating frictions in flows of bighead carp. In wet markets, through fish filleting and labeling of a new name, retailers distance bighead carp from its freshwater lake origin and entangle it with snapper, a higher-priced marine fish. Whether intentional or accidental, this practice relies on misleading consumers in an attempt to make the fish sellable. In kitchens, culinary suggestions made by retailers and others enable those who purchase fish to consume it more palatable. In this sense, cooking – the process of bringing the "natural" outside world to the internal domestic world where socionatures are ultimately metabolized (Chevalier, 1998) – transforms the fish to food through the distancing of the taste and character of its flesh, and entangling it with other more familiar and entrenched ways of consuming fish. But this process involves additional steps in the preparation and cooking of the fish. This extra work aligns with household division of labor that in some cases involves a gendered and classed transfer of the burden of metabolizing the fish to women or household helpers in these domestic spaces. In fish processing, the white meat character of the flesh allows it to be stripped of its freshwater lake origin and becomes entangled with generic white fish for fishball processing. The result is a cheap but slightly different final product, a flatter and blander fishball.

The practices of distancing and entanglement involved in the smoothening of bighead carp flows in the city reflect the incomplete and messy process of substitution of wild marine fish by farmed freshwater fish. Bighead carp has been used to substitute for more expensive marine fish in cooking (e.g. in place of tuna for dishes like *sinigang*) and in processing (in place of lizard fish for fishballs). However, this process requires extra work, sometimes gendered and classed, often performed by commodity chain actors in the process of everyday acts of buying, cooking and consuming fish. The freshwater origins of the fish persist despite attempts to make the fish resemble something else. The blander taste of the meat and the slight change in form of fishballs are material examples, as well as the seasonal earthy-muddy taste characteristic of Laguna Lake *Microcystis* blooms (Chapter IV) that occasionally appears with the fish. Less tangible but increasingly gaining attention is the bioaccumulation by fish produced in the lake of heavy metals from industrial activities and hormones from urban organic wastes that have corresponding public health impacts on regular fish consumers who are often the poorest (Molina, 2012; Molina et al., 2011; Paraso & Capitan, 2012).

These examples provide additional support for Mansfield's (2011) argument that despite relieving pressures on capture fisheries by producing greater volumes of fish, aquaculture produces a materially different fish that embodies a different set of socionatural contradictions tied to its production. However, the contradictions embodied by Laguna Lake fish are not only socionatural but also sociospatial in that they illustrate urban-rural relations.

7.3.2 Cheap fish flows, social reproduction and urban-rural relations

In terms of urban metabolism, bighead carp (and cheap fish) flows to the city from Laguna Lake provide a low-cost means of securing the social reproduction of urban labor power. Social reproduction pertains to the varied practices and processes by which labor power and the means of production are reproduced, often framed in relation to capitalism (I. Bakker & Gill, 2003; Katz, 2001; Mitchell, Marston, & Katz, 2004). Food, of course, is the material basis of social reproduction (Breitbach, 2007; Gertel & Kuppinger, 1994; McMichael, 2003; Shillington, 2013; Strauss, 2013) but less attention has been devoted to what food and its circulation tell us about urban-rural and production-reproduction relations. Bighead carp, consumed primarily by the urban poor, thus serves a dual role: one as a fix to the pen production problems associated with relying on planktons, and another as a low-priced commodity that reduces cost of social reproduction of labor.

Following Moore's (2011) world-historical observations, one could argue that the city-countryside dynamic is a necessarily ecological relation within the logics of capital. The city or town, site of accumulation, consumes surpluses produced by the countryside through the least cost and effort of appropriation of "untapped frontier zones" and "nature's free gifts" (pp. 401 and 404). The production of cheap food through reduced costs therefore kept the capital's costs of reproducing labor power low (de Janvry, 1981). In this sense, the fish cheaply produced from Laguna Lake, due to the "free gifts" of planktons and labor, can be regarded as a wage food of the urban working class, which has expanded in size due to migration of rural peoples, many of whom were displaced from their lands through parallel processes of primitive accumulation in the countryside (Ofreneo, 1980).

In his analysis of Latin American agriculture, de Janvry (1981) identified three ways that enable a steady supply of cheap food: cheap imports, state intervention in pricing, and state-led development of capitalist agriculture. In the Philippines, fish imports comprise a meager 4% of total fish production, and direct state intervention in fish prices is minimal to nonexistent (BFAR, 2011). It is in the third means where Laguna Lake production of cheap fish fits best, although what de Janvry did not observe with relation to agriculture was the ecological or socionatural basis of the process. The development of capitalist aquaculture (via pen production), set in motion by state programs, technological advances and exercise of political power, harnessed the "free gifts" tied to the lake's unique materiality and the cheap labor from migrants from central Philippines in order to continue to provide low-priced fish for the city. In this context, Laguna Lake aquaculture is not only an aquaculture-capture fisheries (socionatural) fix through substitution – as has been argued earlier in the chapter. It is also an urban-rural (sociospatial) fix. Seen from this angle, pens in Laguna Lake do not just contribute toward an abstract notion of food security, but also toward the social reproduction of urban labor in specific and the process of urban capitalist accumulation in general.

This discussion of cheap fish, urban consumption and social reproduction is far from complete, however. It does not account for the uneven access of food, even of the cheapest fresh fish among the lower income groups, nor for the prevalence of urban hunger amid abundance (Heynen, 2006; McMichael, 2007). Mechanisms that influence access to fish, such as those indicated in Chapter VI, need to be explored in the context of urban fish consumption. Furthermore, we can view the practices of fish transformation discussed earlier in the chapter as practical activities that produce particular socionatures. By doing so, we will be able to expand our analysis of labor (as understood in Chapter VI) toward broader notions of practical activities (as framed in this chapter) that mediate the processes of urban metabolism and the production of socionatures. Producing socionatures by laboring not only ensures material survival and livelihood security but also opens up potential avenues of political change centered on nature-society relations (Loftus, 2012).

7.4 Conclusion

Following the flows of Laguna Lake fish from sites of production to consumption allows us to weave stories of the metabolism of fish from the varied spaces and scales of bodies, kitchens, markets and cities. Introduced to augment fish volumes in the lake, the bighead carp became a "fix" for pen producers working with the lake's complex materiality. It required practices of commodity distancing and entanglement in order for it to be consumed in the city so as to overcome the frictions in its metabolism tied to its freshwater origins in the lake. These practices involved substitution of expensive wild marine fish with cheap freshwater farmed fish through chopping, cooking and processing. But these practices mirror the incomplete and messy substitution of capture fisheries by aquaculture. By tapping on planktons and migrant labor, Laguna Lake pen producers were able to produce fish at a much lower price that made them affordable to the urban poor consumers. Viewed through the lens of social reproduction and urban-rural relations, cheap fish are the means by which Laguna Lake aquaculture supports urban social reproduction.

CHAPTER VIII

CONCLUSION

This dissertation examined how state policies, livelihood activities and fish demands produce socionatures. Using an urban political ecology framework, I situated Laguna Lake transformations in relation to the development of aquaculture and its role in partly sustaining food demands of a metropolis. By framing Laguna Lake relations with Metro Manila through the urban metabolism framework, I identified how the state produced Laguna Lake as a resource to address both urban provisioning and the crises in commercial capture fisheries. By following commodity flows between the city and the lake, I showed which practices and relations constitute the urban metabolism of fish, and the mechanisms by which actors gain access to or influence these flows. I showed how material properties complicate commodity production and flows by highlighting nature's materiality in commodity production. In all of these processes, producers, traders, consumers and the state transform and produce socionatures.

8.1 Summary of research findings

In this section, I present a summary of the dissertation's findings. I organize these according to the three research questions and objectives I identified in Chapter I.

8.1.1 Objective 1: producing Laguna Lake through aquaculture

The dissertation's first objective aimed to describe the production of Laguna Lake as a resource through aquacultural technologies and practices. It identified the corresponding socioecological transformations associated with aquaculture introduction and expansion. In Chapter III, I provided a historical account of the rationale and context of aquaculture introduction in the lake. I argued that production for urban consumption was a primary consideration for state intervention in lake fisheries. The state perceived traditional capture fisheries, which sustained lake villagers for centuries, as incapable of provisioning the inhabitants along the lake and the expanding city of Manila. Set in the context of postwar developmental thrusts, the state through the LLDA aimed to tap the promise of aquaculture in producing a stable supply of fish and providing livelihoods, in addition to its potential as a multi-use resource.

The state embarked on projects aided by scientific institutions and foreign consultants and donors to enable aquaculture production. Environmental knowledge production about fish and the lake was a crucial element in these projects. Plans disaggregated and simplified the lake's socioecological complexities to identify problems and enforce solutions. LLDA's experimental fishpen proved the economic feasibility of rearing fish without feeds but failed to examine the social context of fisherfolk livelihoods, the economic and political power of urban elites, and the problem of regulating aquaculture activities in the lake. Urban elites and entrepreneurs led the resulting aquaculture boom, which displaced the producers for whom aquaculture was intended. The state also constructed a hydraulic control infrastructure (NHCS) designed to enable multiple uses of lake waters by regulating saltwater intrusion. The state framed the seasonal saline flux as a problem rather than as a spatially and temporally contradictory process in the lake with positive and negative consequences for various producers. The construction and short-term operation of the hydraulic control caused long-term ecological problems in fisheries production in the lake. The LLDA also introduced a fishpen development program to improve fisherfolk access and respond to the elite capture of aquaculture. The project failed, however, in part because large fishpens already occupied the most productive portions of the lake. To recreate Laguna Lake as a resource that would enable commodity production and multiple-use benefits required interventions not only through the objectification of nonhuman nature but also through the simplification of its dynamics.

Aquaculture expansion caused unprecedented social conflicts in Laguna Lake. As urban elites occupied most of the lake for fishpen production, it became more difficult for capture fisherfolk to secure a living due to reduced fishing grounds, the exercise of territorial power around pens, and recurring violent encounters with armed guards. I argued in Chapters III and V that the conflicts resulted from contradictory property rights between capture fisheries and aquaculture. While state-introduced aquaculture is fixed in space and fish are owned from stocking to harvest, mobile capture fisheries consider the whole lake as their fishing grounds and only own fish once they are harvested. The fishpen sprawl and production practices also resulted in ecological impacts on the lake that contributed to busts in aquaculture production.

I showed in Chapter V how fisherfolk and small-scale aquaculture producers experience and perceive lake transformations through aquaculture expansion. I described the processes by which a capture fisheries village became a small-scale aquaculture village. This transformation involved changes in social relations of production within villages and perceptions and relations with fishpens. However, the extent and scope of these transformations were not similar for all villages. Instead, transformations were tied to local village specificities and dynamics, personal connections with the scientific research station, and role of state-formed rural cooperatives. In some villages, aquaculture adoption de-centered wealth from a few households who owned fishing boats to several cage producers. In other villages, successful engagement with aquaculture was limited to households with enough financial and social capital to gain entry. In Chapters III and V, I illustrated the centrality of state intervention in reworking the lake as a resource to produce fish commodities for the city. These transformed lake socioecologies reconfigured how lake villagers produced from the lake.

8.1.2 Objective 2: materiality of nature in aquaculture production

The dissertation's second objective was to examine how the materiality of nature shaped aquaculture production. In Chapter IV, I described the dual trajectories of Laguna Lake aquaculture development, and discussed how pens, the more capitalist of the two production systems, encounter nature's materiality. I argued that water-based production creates constraints and opportunities for capitalist aquaculture expansion and intensification. Saltwater intrusion plays an important role in enabling productive water conditions, which speeds up production time and turnover cycles. However, intrusion is spatially and temporally uneven, and various state interventions and watershed activities have made this flux unpredictable. Planktons in the lake provide “free” food for reared fish, which allows pens to reduce production costs and sell fish at a cheaper price in the urban market. However, greater dependence on planktons increases reliance on saltwater intrusion, reduces the possibility of intensifying production and produces a seasonal presence of an earthy-muddy taste in fish that repels consumers.

Fish production also necessitates dealing with the fugitive and biological character of commodities. Pens require a large size to be more profitable, but this complicates monitoring of fish, which could easily escape or be stolen by villagers. Pens employ migrant labor, spread throughout hundreds of hectares of pen area, to ensure surveillance of fish. The proliferation of invasive fish has also shaped pen-fisherfolk relations from primarily adversarial to synergistic. Capitalist aquaculture overcomes these constraints and continues to produce most of Laguna Lake’s fish because of access to cheap migrant labor that enables flexibility in production, schemes that create shell or dummy corporations to take advantage of economies of scale, and socionatural fixes (e.g. stocking bighead carp) to reduce production time.

In Chapter V, I also examined the materiality of lake production through the perspective of lake villagers. Fluctuating water conditions, typhoons and invasive fish reconfigure production decisions and deployment of labor. Decisions about production and labor, however, depend on access to financial and social capital, which vary internally among villages. In Chapter VII, I illustrated how retailers and consumers remake a Laguna Lake fish by distancing its materiality from its ties with the lake. In sum, Chapters IV, V and VII showed that materiality of nature actively reworks and is reworked by producers and other commodity chain actors. This supports the argument that understandings of nature-society relations require analytical engagement with material natures and their place in making geographies and histories.

8.1.3 Objective 3: access to commodity flows

My third objective was to trace the commodity flows of fish to determine who benefits from the urban metabolism of fish. I framed "benefit" in terms of the mechanisms by which various actors gain access or exert influence within these flows. Employing economic and cultural economic commodity approaches, I argued that benefits are unevenly distributed within the flows. In Chapter VI, I claimed that pens and brokers exert influence in the production and exchange spheres, respectively, at the expense of other commodity chain actors. The largest pens and brokers operate under the same fishing corporations owned by a few urban elite families. Therefore, while many lake and urban actors base their livelihoods from the flows of farmed fish, the benefits are concentrated in these few actors.

In sites of production, pen owners are able to gain most benefits from flows of fish, in part by denying access to other lake producers. Their sheer size, political connections, market integration and use of weapons enable them to continue lake production despite opposition from fisherfolk, constant attempts by the state to limit their sizes, and materiality of lake natures. In sites of exchange, brokers handle most of the influx of fish that reaches the city. Owing to their central position as intermediaries between other exchange actors, brokers influence fish prices and volumes through secret auctions, integration with fish suppliers (aquaculture and deep-sea) and access to storage. Relations of trust and patronage, which that shape access to credit and knowledge by other exchange actors, reinforce this influence. Pens and brokers rely on migrant or casual labor and are embedded in the local contexts of lake villages and urban neighborhoods. In Chapter VI, I provided examples of how large brokers discipline fish market labor and how other city-dwellers attempt to gain access to the abundance of fish in the market through permitted and illicit means.

In Chapter VII, I deployed the notion of benefit as sustenance in the context of food security and social reproduction. I argued that Laguna Lake aquaculture, specifically through pen culture, produces the most affordable fish available for urban consumption. Fish is the most important source of animal protein for the urban population, and especially for lower income groups. Flows of cheap Laguna Lake fish, therefore, benefit urban consumers by providing an accessible source of nourishment in light of increasing marine fish prices. However, the case of the bighead carp shows that this process of provisioning is socioecologically contradictory. Production volumes of the fish increased when pens used bighead carp as a “fix” to decrease production time. However, particular fish characteristics and consumer unfamiliarity tempered its urban uptake. The fish required various practices by retail, processing and consumption actors to increase its urban consumption. As bighead carp is remade for substitution of more expensive marine fish, its freshwater lake origins and characteristics surface in tangible (e.g., bland or earthy-muddy taste) and intangible ways (e.g., fish bioaccumulation of heavy metals in the lake). Furthermore, the transformation of the fish for home consumption involves culinary work that is passed on to those who labor to prepare fish, a gendered and classed task often performed by women and household helpers.

8.2 Contributions to urban political ecology

It may seem idiosyncratic to begin a narrative about the urban political ecology of aquaculture with an account of socionatural transformations outside the built environment. But this dissertation speaks to a gap in urban political ecology by showing the linkages of transformations within and beyond the territorial bounds of what is traditionally considered the "urban." I employed the term co-production to capture the processes that produce both urban and nonurban socionatures. These transformations are constituted by a multitude of relations and practices by diverse actors situated in and beyond cities. I used urban political ecology's notion of urban metabolism and integrated it with approaches to commodities and materiality of nature to describe the metabolic transformations associated with commodity flows linking spaces of production and consumption.

I sought to expand UPE's notion of urban metabolism in four ways. First, I emphasized the need to extend the analytical focus of urban metabolism to sites beyond cities. Doing so identifies transformations, actors, relations and practices that transcend the urban-rural conceptual divide. Second, I proposed the usefulness of commodity analyses to frame the spatially-dynamic socionatural transformations. Urban metabolism is mediated by processes of commodity production, displacement and consumption. Third, I focused on activities and relations surrounding commodity flows to de-center urban metabolism from the scale of the city to those of individuals and groups who do the work of transforming socionatures. Finally, I presented a case of urban metabolic transformations associated with food. I emphasized how nature's materiality shapes trajectories of urban metabolism in food commodity production and displacement.

I illustrated how an urban metabolism approach centered on commodity flows can illuminate socionatural transformations in and beyond cities. I revisit the practices I described in Chapter VII of transforming bighead carp in urban markets and kitchens, and consider three ways to frame these acts as a socionatural production. First, these urban and nonurban practices bring attention to the importance of labor and practical activity in mediating metabolism. The process of working to gain access to the benefits of fish for livelihoods and sustenance is a metabolic act that transforms the fish, produces new socionatures, and smoothens the frictions of commodity flows. Second, these practices reflect broader socioecological processes and contradictions in food production. City dwellers encounter more bighead carp because of its central role in fixing the problems in capture fisheries and pen aquaculture. But to enable continued production of bighead carp, aquaculture required a reworking of the lake as a condition of production. Third, the practices point to the lively materiality of nonhuman nature that city dwellers confront, reconfigure and transform. Together, these processes comprise the various aspects of the urban metabolism of Laguna Lake aquaculture.

8.3 Laguna Lake's urban futures

In this dissertation, I aimed to tell the story of a particular metabolic flow by examining the case of fish production and its linkages to urban consumption. However, aquaculture development is situated within broader processes of urbanization of nature that continue to link the city and the lake. In 2012, Metro Manila experienced one of its worst floods in history. Two years earlier, the city was threatened with a severe water shortage. In both moments, the national government reiterated the untapped potentials of Laguna Lake in meeting the demand for potable water and addressing the need for flood control, recalling arguments made earlier in Chapter III. It proposed revisiting plans for water treatment plants, dikes, spillways and dredging projects in and around the lake through public-private partnerships and foreign funding. These projects remind one of state interventions that facilitated aquaculture introduction less than half a century ago. However, many fish producers in the lake, both fisherfolk and aquaculture operators, see these plans as conflicting with livelihoods that depend on particular configurations of the lake's water conditions.

The interactions among water demands, flood control and fish production highlight the multiple and contradicting flows and exchanges in the urbanization of nature. It emphasizes the continuing and active historical-geographical production of socionatures. Examining these production processes identifies the mechanisms through which particular political ecological relations emerge. However, it also points to the potentials of transforming these existing relations and creating better ones. "Societies make the natural environment they live in," Neil Smith (2006, p. xv) remarked, paraphrasing Marx, “although not of course under conditions of their own choosing. It is therefore a search too for political possibilities.” The production of socionatures does not imply that the fate of Laguna Lake is predetermined and inevitable. Rather, by working to produce socionatures, urban and nonurban actors have the capacity and agency to make better and more just lake futures possible.

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APPENDIX A

SAMPLE INTERVIEW SCHEDULE QUESTIONS

For Aquaculture Producers:

1. How long have you operated a fishcage/fishpen? How did you become a cage/pen operator? How did you learn the process of cage/pen culture? Before aquaculture, what was your primary source of livelihood? How is the work in aquaculture different from your previous work in terms of income or the type of tasks? How many individual cages/pens (in terms of nets or total hectarage) do you own?
2. How often do you visit your cage/pen and when? What is the process of maintaining or visiting your cage/pen? What are the seasonal differences in production? How do you pay and register with the LLDA? How did you secure a space in the lake?
3. How many laborers (permanent wage or seasonal hired) do you employ? Where do you get labor? How much are they paid and what tasks do they perform? Do any household members help you in operating the cage/pen? Are any of your children interested in operating cages/pens?
4. Which species do you rear and why? How much do you stock? Where do you get the fry/fingerlings and other inputs? Do you transact through agents? How do you engage with them?
5. When do you harvest (or sell fingerlings for cage nursery producers)? Where do you land your harvest? What is the process? How do you establish contact with buyers (for cage nursery producers) or traders (for pen operators)? How do you agree on prices? What qualities in fish do traders/buyers/brokers look for?
6. What are the production issues you encounter? What conditions allow fish to grow well? What conditions prevent them from growing well?
7. How are you affected by typhoons and floods? How do you prepare and recover?
8. What environmental changes you have noticed in the past years? How is the lake different from when you were younger?
9. How are you affected by knife fish invasives? How do you respond to them?
10. What are your thoughts on fishpen development in the lake (for non-fishpen producers)? What are your thoughts on recent proposals of removing fishpens from the lake?
11. What other livelihoods do you engage in? Have you worked in the city? If so, what was the nature of your employment and why did you return to the lake?
12. Where do you get credit for your operations?
13. What are your thoughts about the Napindan Hydraulic Control Structure? Does it affect your production? If so, how?
14. What are your thoughts about your future in lake production?

For Intermediaries:
1. How long have you been engaged in this livelihood? How did you become a trader/wholesaler/retailer? What was your major source of livelihood before? Where did you learn this trade?
2. What are the primary expenses in your operations? What conditions enable you to earn profits or to run at a loss?
3. How many laborers do you employ? What are their tasks? Where do you get them and how much are they paid?
4. Where do you get the fish and where do you bring them? How do you establish contacts? What kinds of fish do you trade? Do species matter in trading? If so, how? Is there seasonality in trading?
5. What is the process of fish exchange in the urban fish market? How do you agree on price? What aspects of fish quality do buyers/traders/consumers look for in fish? How does Laguna Lake fish differ with fish from other places?
6. How are you affected by typhoons and floods? How do you prepare and recover?
7. What environmental changes you have noticed in the past years? How is the lake different from when you were younger?
8. What are your thoughts about fishpen development in the lake (for non-fishpen producers)? What are your thoughts about recent proposals of removing fishpens from the lake? How is your livelihood affected by them?
9. What other livelihoods do you engage in? Have you worked in the city? If so, what was the nature of your employment and why did you return to the lake?
10. Where do you get credit for your operations?
11. What are your thoughts about the Napindan Hydraulic Control Structure? Does it affect your production? If so, how?
12. What are your thoughts about your future in lake production?

For Consumers:
1. What is your primary source of livelihood? How many members does your household have? What are their primary livelihoods? How long have you stayed in this neighborhood?
2. How much do you spend on food every day? How often do you eat fish in a week? Why do you choose fish over other types of meat? What types and sizes of fish do you often buy? Why?
3. How often do you go to the market to buy fish? Do you have a *suki* relation with retailers?
4. How often do you tilapia, milkfish and bighead carp? Why do you buy them? What characteristics do you look for in these species? Do you know where these fish come from? How do you cook these fish?
5. Have you noticed changes in quality and quantity of fish in the markets in the past 10 years?
6. Do you eat fishballs? Where, when and how often? What do you like about fishballs?

APPENDIX B

SELECTED EVENTS FOR PARTICIPANT OBSERVATION

Events	Location	Date	Notes
Lake visit	Laguna Lake	Jun 2010	During pre-fieldwork, I took a boat around Talim Island to see aquaculture and fisheries in the lake.
Purse seining of pen	Navotas	Apr 2012	I joined a group that purse-seined a large pen in southwestern Laguna Lake.
Corral harvest and selling of harvest	Navotas	Apr-May 2012	I accompanied my host family in harvesting and tending to their small fish corral offshore. I also observed how they weighed, graded and made the fish ready for selling.
Cage nursery visit	Navotas	Apr 2012	I accompanied an interviewee to his cage used for tilapia hatchery and nursery.
Fish drying	Navotas	May 2012	I observed the process of preparing fish (Manila catfish) for salting and drying.
Fishing (gill net)	Navotas	May 2012	I joined a gill net fishing group haul their set nets offshore.
Assembling fish	Navotas	May 2012	I observed how fishers bring fish to a village assembler who will bring all fish to the municipal fishport
Bighead carp hatchery breeding	Kalinawan	Jun 2012	I witnessed the process of induced spawning of bighead carp in tanks.
Cage harvest and cage nursery visit	Kalinawan	Jun 2012	I accompanied my host family as they fed the fingerlings at the nursery and then later harvested tilapia.
Lake fishport unloading/loadin g	Binangona n	Feb, May 2012	I observed the process of unloading of fish from large boats to the fishport and onto the trucks headed for Manila (Navotas/Malabon fishport).
Market observations, fish counts, price enumeration	Manila fish retail markets, neighborh ood markets and	Jul-Nov 2012	The following were visited: Nepa Q-Mart, Farmers Market, Guadalupe Market, Quinta Market, Blumentritt Market, Balintawak Market, Sangandaan Market, Malabon Market, Sauyo Neighborhood Market, SM Hyper/supermarkets, Eunilaine

	supermarkets		supermarket, Landmark supermarket
Market observations	Manila fish wholesale market (Navotas/ Malabon fishports)	Jul-Nov 2012	I went on several visits to the Navotas/Malabon fishports. Several of these were made on my own, and others were separately accompanied by a market administrator, a wholesaler, and a fishport laborer.
Flood control system	Office near the Manggahan floodway	Oct 2012	Engineers showed and explained to me how the flood control system works in relation to Manila and Laguna Lake hydrology.
Fish symposia	Bureau of Fisheries office	Oct 2012	I attended a public symposium where different sectoral speakers talked about topics from lake management and ecosystem-based fisheries management to feeds and organic aquaculture.

APPENDIX C

MARKUP MARGINS IN THE COMMODITY CHAIN OF LAGUNA LAKE AQUACULTURE FISH DISTRIBUTED IN METRO MANILA

Groups [1]	Total annual fish volume (MT/yr)[2]	Group size [3]	Average annual fish mass per firm (MT/yr) [4]	Annual revenue per firm (‘000 PhP) [5]	Annual expenses per firm (‘000 PhP) [6]	Annual net profit per firm (‘000 PhP) [7]	Markup margin per firm (%) [8]
Pen producers	48,494	410	118.28	7,096.7	4,278.9	2,817.8	40
Cage producers	12,294	2,806	4.38	153.3	118.5	34.8	23
Traders	7,000	50	140.0	1,400.0	1,050.0	350.0	25
Brokers	22,154	20	1,107.7	4,652.3	3,289.9	1,362.5	29
Wholesalers	15,065	80	188.3	941.5	608.2	333.3	35
Retailers	13,957	600	23.26	581.5	429.7	151.8	26

[1] Groups pertain to those involved in the commodity chains of Laguna Lake aquaculture fish distributed in Metro Manila. Traders may also bring fish from Laguna Lake by capture fisherfolk. Brokers, wholesalers and retailers may also handle freshwater fresh not from Laguna Lake as well as marine fish, but estimates in the table are limited to flows of Laguna Lake aquaculture fish. No data was available for supermarkets.

[2] Pen and cage producer volumes are based from 2011 BAS data. Trader volumes are drawn from estimates based on 2012 interviews (average of 5 MT per harvest multiplied by 28 harvests in a year). Broker volumes are based on Navotas Fish Port Complex 2011 data on fish unloadings from Laguna Lake and exclude fish sourced from other places. Wholesaler volumes are extrapolated from broker volumes multiplied with a percentage assuming that 68% of Laguna Lake fish remain in Metro Manila via the wholesalers and that 63% pass through the retailers (Guzman et al., 1974).

[3] Pen and cage producer group size is from 2011 LLDA registration data. The pen owners’ practice of creating paper or dummy corporations suggests the unreliability of LLDA pen registration data (Chapters 3 and 4). Trader size is an estimate based on 2012 interviews. Broker size is based on 2012 interviews, participant observation and personal counting at the Navotas Fish Port Complex of brokers who deal partially or exclusively with Laguna Lake fish out of an estimated total of 70 brokers. Wholesaler size is estimated based on 2012 interviews of wholesalers, fish port administrators and brokers. Retailer size is estimated based on 2012 observation and visits to eight markets throughout Metro Manila, and includes retailers who partially or exclusively sell Laguna Lake fish.

[4] Computed as the quotient of Column 2 (total annual fish volume) and Column 3 (group size)

[5] Computed as the product of Column 4 (average annual fish volume per person) and price markup from Table 6.3. Pen and cage producer incomes derived through this method were consistent with the 2006-2007 producer survey results (Israel et al., 2008). In the case of cage producers, polyculture of bighead carp (25%) and tilapia (75%) was assumed for the average markup prices. The P10/kg wholesaler markup was divided by two to account for the two wholesaler nodes.

[6] Pen and cage producer expenses are based on a 2006-2007 survey (Israel et al., 2008). Expenses for the pens were computed as the average of expenses between a 50-ha and a 5-ha pen producing milkfish. Expenses for the cages are based on a 1-ha cage producing tilapia and bighead carp. Trader expense computations are based on 2012 interviews with 5 Laguna Lake traders. An estimate of P35,000 total expenses per harvest trip was multiplied with the estimated annual number of harvest trips of 30. Broker, wholesaler and retailer expenses were extrapolated from a 2007 BAS survey of milkfish marketing costs in Metro Manila (BAS, 2007). Average expenses per kg of milkfish marketing were as follows: PhP2.97 for brokers, PhP3.23 for all wholesalers and P18.4735 for retailers.

[7] Difference between Column 5 (annual revenue per person) and Column 6 (annual expenses per person)

[8] Net markup margin was calculated as net profits divided by income and multiplied by 100.