REIMAGINING AQUACULTURE RISK MANAGEMENT BEYOND THE FARM

Mariska J.M. Bottema

Propositions

1. Aquaculture risks in space are intrinsically human.
   (this thesis)

2. Aggregating farm-level improvements will never lead to a sustainable aquaculture industry.
   (this thesis)

3. Conducting research in a foreign language should be compulsory in a social scientist's training.

4. The social science of shrimp farming can teach Dutch cities critical lessons in the mitigation of COVID-19.

5. Combined, and administered in the right doses, Metallica, Enya and Justin Bieber are conducive to effective PhD writing.

6. A PhD is an exercise in setting and protecting your own boundaries.

Propositions belonging to the thesis, entitled:

'Reimagining aquaculture risk management beyond the farm'

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Wageningen, 17 March 2021

Reimagining aquaculture risk management beyond the farm

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This research was conducted under the auspices of the Graduate School Wageningen School of Social Sciences

Reimagining aquaculture risk management beyond the farm

Mariska J.M. Bottema

Thesis

submitted in fulfilment of the requirements for the degree of doctor
at Wageningen University
by the authority of the Rector Magnificus,
Prof. Dr A.P.J. Mol,
in the presence of the
Thesis Committee appointed by the Academic Board
to be defended in public
on Wednesday 17 March 2021
at 4 p.m. in the Aula.

Mariska J.M. Bottema
Reimagining aquaculture risk management beyond the farm,
198 pages.

PhD thesis, Wageningen University, Wageningen, the Netherlands (2021)
With references, with summary in English

ISBN 978-94-6395-666-6
DOI https://doi.org/10.18174/537928

Acknowledgements

I was always fascinated by fish swimming in the sea, and this PhD introduced me to the wonderful world of fish that are farmed. Studying this exciting and hopeful industry brought me to remote and beautiful places, but most importantly introduced me to a large array of individuals that taught me a lot. I want to take this opportunity to thank a number of people who contributed to this experience.

First and foremost, I would like to extend my gratitude to all the aquaculture farmers and practitioners who took the time to speak with me and share their experiences. Without you, this thesis would not have been possible.

I want to thank Simon Bush and Peter Oosterveer for guiding me through my PhD journey for the past five years. Simon, my promotor – you brought me back to ENP after a few years away and are responsible for introducing me to the aquaculture industry, for which I am grateful. Writing with you has always been a great pleasure. Your relentless enthusiasm and ability to see opportunities everywhere gave me energy to aim high. Peter, my co-promotor – you were the calm voice of reason in our group. Your warmth and kindness brought me back to earth when I felt overwhelmed. Together, you helped me grow as a researcher and as a person.

Thank you to the individuals and their organizations in Thailand, Vietnam, China and Bangladesh that opened their arms to me and helped me organize my field work. In, Thailand, I would like to thank Kung Krabaen Bay Royal Development Study Centre for facilitating access to the communities in Chantaburi. Penchan Laongmanee, thank you for all your help in planning my stay there. Pornchai Buapradit, I'm grateful for your enormous hospitality and introductions in Chonburi. Pornpimon Chuaduangpui, thanks for your advice and supervision throughout all my field work in Thailand, and for the laughs during our SUPERSEAS workshops.

In Vietnam, I would like to thank the Kien Vang Forest Management Board, Ca Mau DARD, Blueyou and Minh Phu Seafood Corporation for facilitating access to the farmers. A special thank you goes out to the forest rangers that shared their field station with us. Vo Thi Thanh Loc and Dang Kieu Nhan, thanks for all your advice and supervision in Vietnam, and thank you to Truong Hong Vo Tuan Kiet for helping me plan my field work in Ngoc Hien. Tuan Hoang Nguyen, I am very thankful for all the time you took helping me prepare for my time in Vietnam.

In China, I would like to extend my gratitude to the Hainan Tilapia Sustainability Alliance and China Blue Sustainability Institute for facilitating access to the respondents. Han Han, thank you for all the support in Hainan, and for your advice throughout the past years. I really appreciate the way that Ray and the China Blue team welcomed me and made my stay on Hainan island unforgettable.

In Bangladesh, I would like to thank WorldFish for facilitating access to stakeholders during our scoping study. Mohan Chadag and Kabir Kazi, thanks for welcoming Lien, Sawitree and I to Bangladesh and introducing us to your beautiful country.

A very special thank you goes to the four people who assisted me during my field work: Tuanjit Sritongchuay, Duong Que Nhu, Amigo Xiao Zhimin and Pontip Vidyavrapat. Not only were you excellent translators, facilitators and organizers, we became friends. I learned a lot from you. I am grateful for our incredible adventures together and thank you from the bottom of my heart.

I also want to thank the SUPERSEAS consortium, inside and outside of the WUR. Lien and Sawitree – I will never forget our first and extremely eventful trip together; the beginning of a long friendship I hope. Lien, I admire your strength and incredible ability to combine your PhD with your responsibilities at CTU and at home. Sawitree, your ability to stay calm and see humor in little things is inspiring. Thanks for making me feel like I was part of a team during a sometimes lonely process, for letting me into your homes in Can Tho and Bangkok, and for all the fun and laughter which made this process so much more enjoyable. Miranda – your door was always open and I thank you for the chats we had.

Outside the WUR, the SUPERSEAS team reaches far. I want to thank all of our project partners who took the time to talk to me and to make countless introductions. It was really a treat to work within a big consortium and have access to such a large network. However, without the help of the individuals representing these organizations, I would not have been able to speak to so many people. A special thank you goes to Flavio Corsin, Lisa van Wageningen, Roy van Daatselaar and Olivier Joffre, for all the advice and help you gave me along the way. And of course Anton Immink – thank you for your mentorship, and for making me laugh in the process.

Luc and Emily, thank you for your help with designing the figures in my thesis and helping me figure out what I was trying to say!

A thank you also goes out to the ENP community. Corry, you made the office feel like home. Thanks for all the help throughout my PhD, but also for your "gezelligheid". Thanks to Eira, Hilde and Judith in the ENP marine team – you created a safe space to share research and are warm and supportive colleagues. Jan, you are a master in giving positive, constructive feedback and it was lovely to work with you. Gert and Kris, thanks for the advice you gave me along the way.

Thanks to all the ENP PhDs who I shared this adventure with. I was introduced to you during the 2016 PhD trip, which served as a grand and hilarious entrance to the weird world of PhD life. Joeri, Belay, Terrence, Harry, Karlijn, Martijn, Phatra, Tabitha, Trang, Anke, Sake, Nila, Frank, Ery and Robin – we didn't see much of each other this last year, but it was a pleasure sharing this venture with you. Linde, it was lovely to experience the first few years of my PhD with you down the corridor! Jillian, I really enjoyed our train sessions and we PhDers were so lucky to have someone like you bringing us together. Pamela, thanks for the many chats and for landing us tickets to that epic concert! Moises, in your own words: "bedankt voor de vriendschap". Last but not least: Mandy. What can I say my friend? You were my rock. Thanks for your thundering laughter, your shoulder to cry on. I quite literally could not have done this without you.

And now for my people outside of work. To all my friends, thank you for all your support. Sarah, thanks for convincing me that I was meant to go back to uni do this. Nichtje Laura - we both did it! I am proud of you. My lovely ladies: Eva, Sanne, Marit, Laura, Karlien, Hannah and Lidwien – thanks for the distractions, the talks, the wine. Despite most of you still thinking I study fish biology, your unwavering faith that I could pull this off gave me so much energy. Berenice, we've lived apart since high school but you are always there for me. Thanks for being a great friend, my sounding board, and for your positivity.

A final thank you goes to my family. Iuri, thank you for always opening your door to me when I needed a break. Jan, thanks for your professor's perspective and all your advice. Tamar – although it's been decades since we lived in the same country, you've always been my biggest cheerleader. You are the best big sister and friend anyone could ask for, thank you for being there. Dad, make room for a second Dr. Bottema. Your pride in me has given me confidence, and it has been a treat to be able to pick your brain in the process of writing these articles. Mom, you always say I live life with high highs and low lows, and this PhD was no exception. You have always been the constant factor, cheering me on and surrounding me with warmth – thank you.

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List of abbreviations

AIP	Aquaculture Improvement Project
ASC	Aquaculture Stewardship Council
BAAC	Bank for Agriculture and Agricultural Cooperatives
BAP	Best Aquaculture Practices
BAMS	Biosecurity Area Management Standard
BMP	Better Management Practice
CP	Charoen Pokphand Group
CoC	Code of Conduct
CoGP	Code of Good Practices
CPD	Cooperative Promotion Department
DARD	Department of Agriculture and Rural Development
DoAE	Department of Agricultural Extension
DoF	Department of Fisheries
DoI	Department of Irrigation
DoF	Department of Fisheries
EAA	Ecosystem Approach to Aquaculture
FIP	Fishery Improvement Project
FMB	Forest Management Board
IDH	Dutch Sustainable Trade Initiative
IMS	Integrated Mangrove Shrimp
ICS	Internal Control System
KPI	Key Performance Indicator
LDD	Land Development Department
MoU	Memorandum of Understanding
MoAC	Ministry of Agriculture and Cooperatives
PAM	Partnership Assurance Model
PPP	Public-Private Partnership
RMP	Risk Management Practice
SFP	Sustainable Fisheries Partnership
VSA	Verified Sourcing Area

CHAPTER 1

Introduction

1.1 The emergence of aquaculture risk management beyond the farm

Fish is an essential dietary component worldwide and the aquaculture sector provides more than half the fish available for human consumption (FAO, 2020). Fish is a rich source of amino acids, fatty acids, minerals and vitamins (HLPE, 2014). Whilst the production of capture fisheries has been rather static since the 1980s, aquaculture grows faster than any other major food production sector (FAO, 2018). As such, aquaculture is responsible for continued growth in the supply of fish for human consumption, highlighting the industry's critical role in addressing food security.

Aquaculture production is diverse in multiple ways, but production is geographically centered around Asia. There is an enormous diversity in species cultured (seaweeds, mollusks, crustaceans, fish and other aquatic species groups), environments (freshwater, brackish water and marine) and production systems (extensive, semi-intensive and intensive) (Arthur et al., 2009, Metian et al., 2020). Production takes place in more than 190 countries, but over the last 20 years Asia has accounted for about 90% of global production (FAO, 2020), demonstrating the region's leading role and justifying this thesis' focus on Asia.

As the sector continues to grow, so do the risks associated with production and these transcend farm boundaries. We commonly associate aquaculture production risks with the unit of production – the farm. However, like other agro-food industries (Sayer and Cassman, 2013, Sayer et al., 2013), aquaculture production is not isolated from the environment (Subasinghe et al., 2009). Production is associated with severe risks that move beyond farm boundaries. For example, production risks like water quality and disease are shared between multiple users that are impacted at an area-level (World Bank, 2014), and threaten sustainability of the environment and of the sector as a whole.

Reflecting a trend observed in other agro-food industries (Kissinger et al., 2013), approaches that address aquaculture risks beyond the unit of production are emerging. Traditionally applied risk management approaches, focused on farm-level strategies, appear unable to address area-level risks (Ha and Bush, 2010, Bush et al., 2019). Similarly, the ability of currently dominant assurance models in the aquaculture sector, also applied at farm-level, to foster the definition of and verification for claims about performance beyond the farm are being questioned (Resonance, 2019). In response to this, both public and private actors are experimenting with approaches that promote addressing aquaculture risks beyond the farm.

While modes of risk management and assurance beyond the farm are emerging as key approaches, we lack a fundamental understanding of how they address the sharing of production risks through collaboration between actors across landscapes. There are a plethora of different approaches, with various definitions for risk management beyond the farm. Some suggest that this comprises an aggregate of farm-level improvement approaches (Joffre et al., 2019, Ha et al., 2013b), whilst other insist that it is founded on addressing risks at a landscape level (Brugère et al., 2019, Sayer et al., 2013). Without comprehending how these approaches address management and assurance beyond the farm, we risk reproducing problems that have occurred in some farm-level forms of improvement, such as their tendency to exclude certain farmers (Bush et al., 2013) or their struggle to attain landscape-level impacts (Baumgartner et al., 2016, Baumgartner and Nguyen, 2017). Furthermore, the definition and implementation of regulation to facilitate risk management and assurance beyond the farm will remain unfounded.

The purpose of this thesis is therefore to explore what aquaculture risk management beyond the farm entails. This is realized by an investigation of the ways in which risk management beyond the farm is institutionalized in Asian aquaculture. Introducing a new social scientific approach to studying risk management beyond the farm, I analyze different approaches to risk management beyond the farm in Asian aquaculture using three analytical dimensions: space, risk and institutionalization. In doing so, this thesis presents a novel, dynamic and socio-spatial understanding of aquaculture risk management, reimagining what risk management beyond the farm means from a social perspective.

The introductory chapter is structured as follows. In the next section, I provide a background to area-level risks associated with aquaculture production, describe the management approaches that have emerged to address these, and outline the relevance of assurance in aquaculture value chains. Section three presents the socio-spatial and relational perspective I take to understanding risk management beyond the farm, and introduces the three analytical dimensions. This leads to the formulation of my research objective in section four. Finally, I present the research methodology and outline the overall structure of the thesis in sections five and six.

1.2 Managing aquaculture risks beyond the farm

To understand how risk management beyond the farm is addressed in emerging forms of management and assurance, it is essential to understand how area-level production risks manifest, to inventorize the different types of area management approaches that have been previously researched, and to understand the development of assurance models in aquaculture value chains.

1.2.1 Area-level production risks

Though the aquaculture industry represents part of the solution to food security issues facing the growing human population (Arthur et al., 2009, Subasinghe et al., 2009), it is concurrently faced with agricultural risks which are a primary source of food insecurity (World Bank Group, 2016). Agricultural risks are events that have the probability to cause losses (World Bank Group, 2016). These can be categorized into five risk types: production, market, financial, personal, and institutional risks (Meuwissen et al., 2001, Hardaker et al., 1997), each bringing with them uncertainty.

Though aquaculture, commonly referred to as 'risky business', involves all five risk types (Joffre et al., 2019), sustainability challenges and environmental degradation tend to be associated with production risks (Asche et al., 1999, Montanhini Neto et al., 2017, Gusmawati et al., 2016). Production risks affect the volume and quality of production, or disrupt the flow of goods and services (World Bank Group, 2016). The nature and severity of these production risks vary according to the region, species and production system (Alam et al., 2019, Joffre et al., 2019), highlighting the variability of the risks that contribute so significantly to sustainability issues.

Despite often being associated with the territory of the farm, production risks manifest both inside and outside the farm (Gentry et al., 2017b). Production risks can originate from external sources, such as from poor quality of inputs like feed, post-larvae and fingerlings, or nonextreme and catastrophic weather events (World Bank Group, 2016, Shameem et al., 2015, Le and Cheong, 2010). They can also originate from on-farm practices like overstocking, overfeeding and lack of biosecurity management, which can impact both on-farm production and the surrounding environment (Ahsan, 2011, Le and Cheong, 2010). A third category of production risks, like disease and water pollution, can be transmitted between resource users of a landscape (Montanhini Neto et al., 2017, Sanchez-Zazueta et al., 2017, Gusmawati et al., 2016, Piamsomboon et al., 2015). Thus, certain production risks move beyond the boundaries of individual farms. There is a progression throughout the thesis in terms of how I refer to these. In chapter two, which presents initial stages of my research, I refer to them as 'environmental risks'. Later, however, I refer to these risks as 'area-level production risks', to emphasize that they are a subset of production risks.

The shared nature of area-level production risks can be attributed to aquaculture production's close interaction with and dependency on the environment (Asche et al., 1999). Farms are permeable units and interconnected with other farms in a landscape (World Bank, 2014). An aquaculture farmers' own actions, if environmentally unfriendly, can affect other aquaculture operations and can have a cumulative impact on the surrounding environment (Singh et al., 2017, Montanhini Neto et al., 2017). These actions can also have an immediate or delayed impact on their own production through self-contamination (Asche et al., 1999, Cardoso-Mohedano et al., 2016). Thus, production risks are shared. However, the degree to which they are shared varies with production systems and species cultured.

The degree of shared area-level risks correlates to production systems. Production systems are commonly classified according to their level of intensity, which runs along a spectrum from extensive (less than 1 ton of fish per hectare per year), through semi-intensive (2-20 tons of fish per hectare per year), to intensive (20-200 tons of fish per hectare per year) (Waite, 2014). Intensive systems are characterized by high levels of control, relying entirely on off-farm inputs (Joffre et al., 2015). While intensive production can increase disease risk and environmental damage (Li et al., 2016, Rico et al., 2014, Hall, 2004), the level of control characterizing the production process makes it easier for farmers to prevent risk transmission (Asche et al., 1999, Alam et al., 2019). Extensive systems are characterized by a low level of control, minimal inputs and frequent physical interactions between farms and their environment (Joffre et al., 2015). The open nature of extensive systems causes them to be continuously exposed to diverse organisms and can contribute to a higher capacity to adapt to the stress caused by diseases (Bush et al., 2010, Bunting et al., 2013). However, their connectivity to ecosystems also increases their vulnerability to disease transmission and fluctuations in water quality and salinity (Bush et al., 2010, Joffre et al., 2018). Thus, while open systems tend to be more exposed to area-level production risks, they tend to be more resilient because the effect of these risks is less than seen in more closed systems.

Species also vary in their vulnerability to area-level production risks and this thesis focusses on penaeid shrimps and tilapia, which demonstrate different levels of vulnerability to production risks. Penaeid shrimp (*Litopenaeus vannamei* and *Peneaus monodon*), ranking first in total global aquaculture production in 2018 (FAO, 2020), are cultured in diverse production systems, ranging from closed systems to open systems (Bush et al., 2010). The expansion of shrimp farming has led to loss of biodiversity, farming effluents pollute land and water resources, and fresh water use leads to saltwater intrusion and ground subsidence (Lebel et al., 2010, Hall, 2004). At the same time, shrimp are highly vulnerable to upstream pollution and disease, and shrimp farming can actually undermine its own conditions of existence (Hall, 2004). Thus, shrimp is a highly sensitive species and production is associated with high environmental impacts.

Nile tilapia (*Oreochromis niloticus*) ranked fifth in total global aquaculture production in 2018 (FAO, 2020), and production techniques range from closed systems to open systems such as cage culture in rivers (Asche et al., 2009). Reported environmental impacts of tilapia production are escapees and untreated effluent discharge (Sustainable Fisheries Partnership, 2012). However, this species tolerates high densities so culture requires relatively little in terms of scarce land and water resources (Alam et al., 2019). Tilapia production is sensitive to climate-related risks like droughts and floods, and to changes in water temperature and oxygen concentration, which can lead to disease outbreaks (Lebel et al., 2015, Lebel et al., 2016, Belton et al., 2009). However, it grows well under a variety of conditions (Alam et al., 2019). Compared to shrimp, tilapia is a resilient species and impacts associated with tilapia production are low.

The variation of risks across production systems and species raises questions about how these risks can best be managed. The enormous variation in area-level production risks associated with the farming of different species and the application of different production systems paints a complex picture of diverse risk profiles (Ahsan and Roth, 2010, Ahsan, 2011, Bergfjord, 2009, Le and Cheong, 2009). One pre-defined risk management approach that is applicable to this variety of risk profiles is unlikely to exist. Thus, not only is there a variation in risks, this variation leads to management challenges. In this thesis, I study landscapes with both shrimp and tilapia production, thereby taking into account various risk profiles. I explore how shared risk management is governed across this variation, to determine whether there are commonalities.

1.2.2 From farm-level to area-level risk management

Traditionally, aquaculture risks have been addressed with on-farm management strategies, which can be grouped into three broad categories. First, states formulate and enforce regulations for farm management, specifying for example the use of water treatment facilities and effluent water quality systems, in order to control farm management (Vandergeest et al., 1999, Ha and Bush, 2010, Anh et al., 2011, Asche et al., 1999). Second, both governments, private companies and NGOs design Better Management Practices (BMPs) to standardize on-farm practices, to reduce production risks and to disseminate technical practices to farmers in a more structured and formalized fashion (Kusumawati and Bush, 2015, Anh et al., 2011, Padiyar et al., 2012). Third, market actors put forward private regulatory strategies such as certification standards to provide assurance over the social and environmental performance of aquaculture production (Bush, 2018, Anh et al., 2011). These three strategies set out a range of technical farm-level indicators that farmers can use as targets to improve their production practices.

The ability of farm-level risk management strategies to address area-level risks has been questioned. According to the World Bank (2014), management systems that are implemented at an area-level are essential to address issues that transcend the boundaries of individual farms. There is a considerable amount of literature questioning the landscape-level impact of farm-level measures like individual certification standards, specifically challenging the assertion that maintaining mangrove-to-pond ratios in an aggregate of individual farms creates landscape level effects (Baumgartner, Kell, & Nguyen, 2016; Baumgartner & Nguyen, 2017; Tran Thi Thu Ha, Bush, Mol, & van Dijk, 2012). This is supported by research illustrating that ecosystem functions are highly dynamic and change over time, suggesting that optimal solutions go beyond simply setting mangrove-to-pond ratios (Koch et al., 2009). This research provides an interesting backdrop to the now commonly held opinion – and premise upon which this thesis is founded – that aquaculture risk management requires holistic, integrated and area-based approaches.

Recognizing that farm-level risk management practices are limited in their ability to address area-level risks, a large scope of risk management strategies are being promoted to scale up risk management and environmental sustainability more generally. In initial chapters of this thesis, reflecting early stages of research, I refer to these collectively as 'off-farm risk management practices' and 'area-level risk management'. Later, from chapter five onward, I move to the term 'risk management beyond the farm', to encompass a larger scope of management and assurance approaches that attempt to scale up improvement, but are not necessarily able to address the management of area-level production risks. As outlined by Bush et al. (2019), a variety of concepts are used to describe different configurations for the organization of cooperation between aquaculture farmers and other actors within a certain geographical area. The multitude of approaches can loosely be grouped into economic approaches, ecosystem approaches, and landscape approaches. These vary in their consideration of area-level production risks.

Economic approaches to area-level collaboration in aquaculture are referred to as clusters. Clusters are geographic concentrations of interconnected companies in a particular field that compete but also cooperate (Porter, 2000), tying collective action to a specific geographical area. They are farmer organizations and can take on a number of forms such as informal unregistered farmer organizations, associations, and cooperatives (Kassam et al., 2011). Clusters consist of farmers in the same locality, which enables self-regulation for the implementation of standards or BMPs at the farm-level, and increases bargaining power for inputs or marketing purposes (Kassam et al., 2011, Umesh et al., 2010). Examples in Asia can be found in Vietnam, India and Indonesia.

Though some clusters may take on environmental goals to address area-level production risks, these goals tend to remain subordinate to economic goals of output efficiency and profitability (Bush et al., 2019). A long history of research demonstrates that farm clustering facilitates the adoption of farm-level production risk management strategies like water quality management and facilitates horizontal coordination between farmers to reduce market and financial risks (Ha et al., 2013b, Padiyar et al., 2012, Umesh et al., 2010, Ravikumar and Yamamoto, 2009, Joffre et al., 2019). More recently, Joffre et al. (2020) illustrate that clusters also increase trust and improve relationships between members. However, it is unknown whether clusters are able to facilitate shared production risk management strategies, either directly, through formal institutions, or indirectly, through informal communication.

The ecosystem approach to aquaculture (EAA) is a strategy for the integration of aquaculture in the wider ecosystem (Soto et al., 2008). It is part of a broader movement to incorporate a more holistic, integrative and cross-sectoral approach to sustainable development (Brugère et al., 2019). The EAA has been applied in the selection of production systems and spatial planning. It provides the backbone for a FAO/World Bank policy brief on aquaculture zoning, site selection and area-management (Aguilar-Manjarrez et al., 2017), and for zonal approaches promoted by various NGOs (Sustainable Fisheries Partnership, 2018c, The Nature Conservancy, 2017). Practical applications are (often industry-led) regional management areas for disease control in salmon farms (Gustafson et al., 2016, Werkman et al., 2011, Chang et al., 2014, Murray and Gubbins, 2016) and government-led spatial planning processes (Sanchez-Jerez et al., 2016, Brigolin et al., 2015, Vila et al., 2015). Furthermore, EAA has stimulated the development and wider use of a number of methodologies and tools for spatial planning (Lester et al., 2018, Gimpel et al., 2018).

Ecosystem approaches clearly aspire to address area-level production risks at scales beyond the farm, but in practice it appears to be difficult to balance addressing multiple goals. Brugère et al. (2019) outline how the implementation of the EAA is limited by several factors. First, it has been challenging to facilitate interaction with other resource users resources and realize cross-sectoral integration. Second, aquaculture production cuts across scales, which are not necessarily matched by legal and administrative frameworks. Third, there appears to be ambiguity in the perceived benefits of these approaches amongst farmers (Miao et al., 2013), which is likely to deter cooperation to minimize production risks. Fourth, the spatial and production focus of EAA constrains linking the approach to issues of trade and knowledge exchange along value chains. Thus, facilitating the shared management of production risks appears to be a challenge in ecosystem approaches.

Landscape approaches, in many ways similar to ecosystem approaches, focus the scale of management specifically to the landscape (Ros-Tonen et al., 2014). This is a popular paradigm in the international conservation and development community (Alexander et al., 2016, Huntington et al., 2010, Denier and Stam, 2015). It is aimed at achieving multiple objectives, through framing realistic objectives that recognize the need for tradeoffs to achieve multifunctionality of landscapes (Sayer et al., 2013, Freeman et al., 2015, Milder et al., 2014). Kissinger et al. (2013) specify that landscape approaches differ from scaling up efforts of individual interventions. These approaches are presented as a way to marry food production (including aquaculture) with biodiversity conservation, climate change adaptation and poverty alleviation (Sayer and Cassman, 2013, Milder et al., 2014, Minang and Catacutan, 2015, FAO, 2013), and NGOs are developing landscape approaches specifically for aquaculture (The Sustainable Trade Initiative, 2019a).

Similar to the EAA, landscape approaches face challenges associated with the broad engagement necessary for simultaneously framing development and conservation goals. This involves more objectives, tradeoffs and complexity, and implementation is challenged by governance issues and poor institutional capacity (Sayer et al., 2013). However, landscape approaches have more success in linking to value chains than the EAA. There is recognition that landscape approaches can offer sourcing solutions for buyers that purchase from areas faced with risks that cannot be addressed on the farm (Kissinger et al., 2013, The Sustainable Trade Initiative, 2019b). This has led to research exploring how to engage the private sector into landscape initiatives (Minang and Catacutan, 2015), and how to implement value chain collaboration beyond the chain (Ros-Tonen et al., 2015). According to Minang and Catacutan (2015), private sector application of landscape initiatives is increasing, but more assessment is needed of their landscape-level benefits and of how certification bodies are incorporating a landscape lens into criteria and indicators. Thus, though facilitating shared production risk management amongst multiple stakeholders is challenging in landscape approaches, there appears to be potential for sharing risk with other actors in the value chain.

These three management approaches illustrate that not only is there is large variation in the approaches taken to manage risks beyond the farm, the extent to which they actually address production risks beyond the farm is limited. Each of these approaches tend to be developed for very particular goals. Though some facilitate sharing market and financial risks between farmers or between farmers and other value chain actors, all lack a focus on addressing production risks beyond the farm. This raises questions about whether risk management beyond the farm actually involves production risk management at the landscape level, or whether in practice it entails an aggregate of farm-level strategies. Furthermore, these approaches do not appear to be well-aligned and it is unclear what commonalities exist in terms of dealing with area-level production risks. In order to further develop and innovate risk management beyond the farm, a better understanding of how different approaches address area-level production risks and what is common to these approaches is needed.

1.2.3 Assurance in aquaculture value chains

In globalizing seafood markets, trust that production is conducted sustainably becomes more crucial, and concurrently more challenging. Trust is the expectation that arises within a community of regular, honest and cooperative behavior, based on commonly shared norms (Fukuyama, 2010). Some of the major sustainability challenges faced by the industry involve relations of trust. For example, disease outbreaks threatening the sustainability of the sector can be in part attributed to the lack of trust and consequently lack of communication about diseases between farmers (World Bank, 2014). Furthermore, food safety concerns voiced by the media claiming unsustainable production practices have significantly decreased the trust that consumers have in seafood (Bush and Belton, 2011, Schlag, 2010). As more Asian seafood is sourced globally, geographical distances between those buying and consuming seafood and those producing it increase, making trust in the production process more critical (Mol, 2008). At the same time, value chains become more complex and consequently so do the different relations of trust associated with the production process.

There are multiple relations of trust associated with aquaculture production and I will highlight five that come back consistently throughout this thesis. First, trust between farmers. In both an economic and environmental sense, aquaculture farmers are competitors, competing for markets and resources. This inherently makes trusting each other difficult (Kassam et al., 2011). Second, trust between governments and farmers. The implementation of government regulation requires the government's trust in the responsible conduct of farmers, but also requires farmers to trust that governments are acting on behalf of their interests (Ha and Bush, 2010). Third, trust between farmers and their input suppliers. Input suppliers sell products and advise farmers about farm management, requiring trust from farmers. When input suppliers sell their product on credit, this in turn requires input suppliers to trust farmers (Ha et al., 2013a, Moahid and Maharjan, 2020, Jespersen et al., 2014). Fourth, trust between farmers and buyers (Handfield and Bechtel, 2002). Buyers must trust that farmers can supply a quality product on time (Trifković, 2014), and farmers have to trust buyers to pay a fair price and control quality in a transparent way (Ha and Bush, 2010, Ha et al., 2013a). Fifth, trust of consumers. For global consumers to buy sustainable seafood, they must have confidence in the sustainability of production (Bush and Belton, 2011, Trifković, 2014, Kjærnes, 2006). Managing these relations of trust therefore plays a substantial role in aquaculture production.

Sustainability issues in value chains have given rise to assurance models that institutionalize trust and concurrently generate more relations of trust. Assurance is demanded under circumstances in which resources are entrusted or exchanged (Power, 1997, Loconto, 2017). Assurance models signal credibility of the intent of actors in value chains to reach their sustainability claims (Mol, 2008, Gulbrandsen and Auld, 2016). In third party certification, currently the most dominant assurance model in the aquaculture industry (Bush et al., 2019), an actor assesses, verifies and certifies sustainability claims about a subject – for example a farmer or a processor – against a particular set of standards (Hatanaka and Busch, 2008). This introduces at least three new actors: standard-setters, auditors that verify whether standards are being met, and accreditors that assess the auditors' competence to conduct audits. As such, questions around the accountability, legitimacy and independence of actors involved in the process of assurance have also become central (Gulbrandsen and Auld, 2016, Auld and Gulbrandsen, 2010, Hatanaka and Busch, 2008, Amundsen and Osmundsen, 2019), as have questions around the reliability and verification of information (Mol, 2008). Hence, with the emergence of assurance models, trust becomes even more complex.

The two most dominant assurance models in the aquaculture sector have been questioned in terms of their ability to verify the management of area-level production risks. Like farm management approaches, certification standards tend to define farm-level indicators to measure conformity to standards and thus have been criticized for their focus on farm-level sustainability (Chaplin-Kramer et al., 2015). Seafood ratings programs, the second most dominant assurance models for aquaculture production, assess seafood production in regions (Seafood Certification & Ratings Collaboration, 2019). They provide non-voluntary assessments of seafood available in key markets and publicly share this information. As outlined by Resonance (2019), though ratings can describe performance at varying geographic scales, they are criticized for being limited in their granularity. Since assessments are often conducted at the country level, this results in an aggregated and generalized description that may not capture the nuances within a given industry. This raises questions about their ability to verify the management of area-level risks in a specific locality.

A big part of aquaculture production appears to be about managing trust that people are doing the right thing, and the emergence of area management approaches raises questions about what this means for the trust relations embedded in aquaculture production. First and foremost, managing risks beyond farm scale opens up new relations of trust and requires collaboration between farmers, which is likely to be challenging in an industry with limited success stories of collective action (Hall, 2004). Furthermore, if external actors (for example, the market, the government or assurers) are obliging or incentivizing farmers to collaboratively address shared production risks, this raises questions about what type of mechanisms must be applied to provide trust and confidence about performance in areas (Resonance, 2019). Ultimately, this also raises the question whether new claims about area-level sustainability will be developed to match these area-level risk management approaches. Hence, the emergence of risk management beyond the farm is not only about understanding risks and designing effective management approaches, it is also about the trust required to hold people together in the shared management of risk beyond the farm.

1.3 Analyzing risk management beyond the farm

As production risk moves beyond farm boundaries and affects multiple actors that share resources and land, questions arise about the space of aquaculture production and the institutions needed to address shared risk. This thesis takes a new socio-spatial and relational perspective to study the challenge of addressing production risk at a scale beyond the farm.

1.3.1 Aquaculture production space(s)

Traditional zoning approaches are based on an abstract concept of space. Abstract space is a singular, bounded and static space (Roth, 2008), in which space is separated from the meanings and matter within (Massey, 2005). As such, space is seen as a container for human activity (Murdoch, 1998). Zoning practices are used as a governance instrument to organize landscapes using abstract space, classifying land and ordering human-environmental relations (Roth, 2008, Rasmussen and Lund, 2018). This notion of space is used by planners and cartographers to delineate space with a fixed boundary (Roth, 2008, Rasmussen and Lund, 2018). These boundaries treat zones as ecologically and socially homogenous land units, applying homogenous access rules and facilitating centralized management at a distance (Roth, 2008). Thus, as posited by Bluwstein and Lund (2018), zones are put forward as objective representations of the real material world.

Human geography scholars have challenged this abstract notion of space, arguing instead that space is relational. They argue that abstract space eliminates the spatial complexity of the human-environmental dimensions that reside in space (Roth, 2008). Space is produced and reproduced by social interactions derived from processes and events, meaning that it cannot be considered as a neutral entity divorced from the material, social and ecological relations that shape it (Harvey, 1997, Massey, 2005, Roth, 2008). Furthermore, space does not only exist in social relations, but is produced through social relations (Lefebvre and Nicholson-Smith, 1991). Thus, different spaces can emerge from different sets of social relations (Roth, 2008). A key aspect of a relational perspective on space is recognizing that there is no one space (Murdoch, 1998, Massey, 2005). Instead, there are multiple co-existing spaces, which change over time.

Contemporary research in human geography applies this relational understanding of space and illustrates the multiplicity and diversity of spaces that emerge when studying governed landscapes. Accounts of conservation areas (Roth, 2008), certification processes (Vandergeest et al., 2015, Bear and Eden, 2008), technologies (Toonen and Bush, 2018), and other regulatory practices (Bear, 2013) demonstrate that a multiplicity of spaces emerge in conservation and production land- and seascapes. Bear and Eden (2008) suggest that cartographically bounded spaces are insufficient for understanding the processes that take place. Regulatory processes do not merely impose boundaries; boundaries are the result of heterogeneous relationships in hybrid networks (Bear and Eden, 2008). Different spaces with diverse characteristics emerge in combination with different sets of social, economic, and political processes (Roth, 2008). Consequently, different actors can have 'competing imaginaries' of what a landscape is and should be (Bluwstein and Lund, 2018). This means that the spatiality of aquaculture farmers, or the boundaries that they experience, may differ from the spaces that emerge from improvement initiatives or regulation led by for example buyers, NGOs, governments or assurers.

Materialities associated with the environment also 'shape' space. Bear and Eden (2008) illustrate that the materialities associated with aquatic environments have spatial implications. In fisheries, the fluidity of the ocean allows fish to swim freely, making the demarcation of boundaries problematic. In aquaculture, production is made up of production systems that are embedded within their surrounding environments and are permeable to varying extents (Vandergeest et al., 2015). The materiality of aquaculture production is manifested in inputs and outputs that move through production systems and interact with the ecological landscape. Thus, spatiality not only evolves in conjunction with socio-economic and political processes, but also with production processes and the associated ecological processes (Roth, 2008). This raises questions about how the materiality of aquaculture production, specifically the production risks that arise from interactions between the farmers and the environment, shape space and whether this extends beyond the farm.

Aquaculture farmers are part of (global) value chains, which connect production landscapes to global flows, further 'opening up' the space of aquaculture production. Aquaculture production takes place in rather sedentary production systems that are tied to a specific place. However, production inputs are part of flows of feed, seed and pharmaceutical products, and production outputs are part of flows of traded seafood (Vandergeest et al., 2015). Thus, farmers belong to value chains where input supply, production, trade and consumption or disposal are explicitly linked (Bolwig et al., 2010). As globalization frees the movement of commodities, capital and information, and enables the fragmentation of production across geographic space, cross-border production networks form, which shift spatial relationships (Gereffi et al., 2005, Kidd and Shaw, 2013). Furthermore, as food processors and retailers source food globally, global flows of food emerge (Oosterveer, 2009). Thus, the space of local aquaculture production becomes linked to the global spaces of distribution, processing and consumption (Castells, 2013), exploding the space of aquaculture into a complex set of production chains and networks.

Despite studies demonstrating the relational character of space, there still appears to be a spatial fix associated with regulation (Raycraft, 2018), which has been criticized for three reasons that are relevant for this research. First, political ecology scholars, dominated by accounts of conservation, highlight the disconnect between spatial planning imposed by external actors and the reality for and practices of people affected in rural areas, which are often constrained by management capacity, political complexities and resistance from local resource users (Bluwstein and Lund, 2018, Raycraft, 2019). Second, the measures and technologies designed to manage areas are frequently too rigid to manage the multiple spaces co-produced by the heterogeneity of actors and materialities, calling for more holistic approaches to manage fisheries (Bear, 2013). Third, Raycraft (2018) critiques regulators, with their focus on designating and enforcing areas, for fetishizing the power of space to shape social behavior. He argues that this obsession with the effect that space has on social behavior overlooks the social, political and economic contexts that shape resource use and fishing practices.

Building on political ecology and human geography scholars that problematize the spatial fix associated with regulation, I will use the concept of relational space to understand the ways in which aquaculture production space is produced and re-produced through risk management practices and social relations. However, instead of studying the ways in which public and private actors actively appropriate space in attempts to exert control over actors that inhabit this space (Corson, 2011, Rasmussen and Lund, 2018, Bluwstein and Lund, 2018, Raycraft, 2019), I examine how different risk management practices reconfigure the boundaries of aquaculture production space. As such, the spatiality of aquaculture production is contested in this thesis, exploring how risk management practices present active relational boundary-setting of actors. In doing so, I challenge structural top-down approaches to spatial management and test whether a more relational approach of studying the socio-spatial practices embedded within aquaculture risk management can improve our understanding of risk management beyond the farm.

1.3.2 Risks in space

Decision sciences traditionally define risk as the function of the likelihood and the value of some future event (Richard Eiser et al., 2012), and this rather objective understanding of risk has steered the majority of research into aquaculture production risk. This 'engineering' perspective enables the estimation of aquaculture risks based on this generic definition of risk (Sam et al., 2017). It makes a distinction between objective risks and subjective perceptions (Kjærnes, 2006). This implies that there is something 'out there' to be perceived, suggesting that there is a risk that we can identify and measure.

Risk research in aquaculture can be grouped into ecological risk assessments, economic approaches to quantify production risks and measurements of risk perception (Joffre et al., 2018). First, ecological risk assessments quantify the level of risk of a potential stressor, allowing the consideration of risks in a standardized manner (Moreau, 2014). They are used as management tools to assess potential risks associated with the development of new technology, the introduction of activities or the introduction of invasive species (Moreau, 2014, Tidbury et al., 2016). Second, economic approaches use risk factor analysis to identify significant risk factors that explain losses. These approaches allow individual farms to mitigate risks and losses from disease and weather events, and they can be instructive as to what measures might assist in mitigating disease impacts in a particular farming region (Clegg et al., 2014, Hanson et al., 2008, Piamsomboon et al., 2015). Third, risk perception research quantifies the perception and attitude that farmers have toward production risks, and how this impacts their adoption of risk management strategies (Barnett et al., 2016, Le Bihan et al., 2013, Ahsan and Roth, 2010, Le and Cheong, 2010, Joffre et al., 2018).

Though these approaches can generate valuable data to mitigate area-level risks, they are founded on individualistic understandings of risk and apply an abstract concept of space. Economic approaches and risk perception are rather instrumental approaches that quantify risks or risk perception at the individual, farm level. They do not explore the full array of production risks that farmers encounter, nor do they make spatiality of these risks explicit. Ecological risk assessments, on the other hand, when applied at the landscape level (Li et al., 2017), do take into account area-level production risks and even make their spatiality explicit. Nevertheless, they categorize landscapes based on an abstract concept of space, reinforcing the previously mentioned spatial fix associated with regulation. Hence, these three approaches do not correspond with how I have problematized space as relational.

The objective understanding of risk that unites these three approaches has been questioned, arguing for a more social understanding of risk. According to Beck (1986), risk is not reducible to the product of probability of occurrence multiplied with the intensity and scope of potential harm. It is a socially constructed phenomenon (Beck, 2009), and even the most 'objective' risk assessments involve politics, morality and ethics (Beck, 1986). It follows that, like space, risk is highly subjective and social relations influence how people understand risk. Combining definitions proposed by Richard Eiser et al. (2012) and Kjærnes (2006), I use the term risk interpretation to refer to how actors anticipate the outcomes of choices, made by themselves or by other decision-makers, and it represents judgements influenced by psychological, social, cultural, political and environmental factors.

Risk arises from the uncertainty surrounding a possible future and the quality of relations with other people influences how people understand and deal with this uncertainty (Richard Eiser et al., 2012). Social norms and networks can act as institutions and influence how both individuals and communities respond to risks like area-level production risks, which involve interactions between natural and human factors (Sam et al., 2017, Lo and Chan, 2017, Kerstholt et al., 2017, Giordano et al., 2017, Chatrchyan et al., 2017, Babcicky and Seebauer, 2017, Richard Eiser et al., 2012). As outlined by Lo and Chan (2017), networked relations enable the sharing of knowledge and information, they enable risk-sharing, and they can strengthen solidarity and allow claims for reciprocity in times of crisis. Consequently, production risks are both material and social, informed by context and thus ever-changing.

Risk is relational in different dimensions. Shared risks beyond the farm scale involve multiple actors that share risks and resources, and this opens up new relations of, and networks around, risk. There are various types of connections between individuals and groups that can influence the way that risk is understood and addressed (Pretty and Ward, 2001), and I will list five that are examined in this thesis. First, ties between individual farmers based on family kinship, friendship or locality (Adger, 2003). Second, ties within farmer groups such as clusters (Pretty and Ward, 2001). Third, ties between farmers and government actors. Fourth, economic ties between farmers and market actors with whom they exchange resources (Adger, 2003, Pretty and Ward, 2001). Fifth, ties between farmers and different actors involved in the process of assurance. Particularly these last two involve market actors that can be geographically distant, further complicating matters.

This research explores the ways in which risks beyond the farm are understood by different social actors and ultimately how this shapes action, spatially and socially. Current ways in which risk is researched in aquaculture do not capture the relational nature of risks, nor do they recognize how space can be socially constructed through risks. This research contributes to aquaculture risk research in two main ways. First, it opens up the question how far we are in understanding risk as a relational phenomenon. Rather than solely understanding risk management as something that is exerted top-down, this research explores how the shared nature of risks steers management. Second, it focusses on the management of risks that extend beyond the farm, bringing in the spatiality of risks and exploring how area-level production risks are interpreted.

1.3.3 Institutionalizing risk management in space

Institutionalization is understood to be an on-going process of construction and deconstruction whereby patterns arise in people's actions, fluid behavior gradually solidifies into structures and these in turn structure behavior (Arts et al., 2006). Through their actions, people produce and continually reproduce structures that hold them to account and pattern the way they act (Giddens, 1984). If we want anything to emerge and persist as a patterned form of behavior, we need to understand the active and ongoing process of that patterning. In this thesis, I am interested in what constitutes farmers' patterned behavior to collaborate to manage shared risks beyond the farm. This requires understanding what structures hold farmers to account and pattern their risk management behavior, and what specific risk management behavior actually emerges.

A dynamic and relational understanding of space and a social understanding of risk leads to contestation on what the institutionalization of risk management beyond the farm actually entails and explains the diversity of institutional arrangements that exist. Economic approaches, ecosystem approaches and landscape approaches highlight the myriad of ways in which risk and space are incorporated in various institutional arrangements aimed at environmental improvement beyond farm scale. Within these different approaches, there are local, market, state and civil society actors experimenting and addressing the same phenomenon in different ways. The two previous sections have illustrated the multiplicity of spaces and relations of risk associated with aquaculture production, reinforcing the idea that there are multiple ways in which behavior of actors can be patterned to deal with risk in spaces beyond the farm. As yet, there is no clear road to take. This calls for an exploration of a number of different ways that beyond farm risk management is institutionalized, starting with the local level.

As highlighted by Hardin (1968) many years ago, there is a tension between the individual and collective interests of natural resource users, which lies at the heart of the challenge of managing aquaculture risks beyond the farm (Lebel et al., 2014). Marine and terrestrial ecosystems used for aquaculture production are associated with common pool resources, which are shared by a group of people (Galappaththi and Berkes, 2014, Galappaththi et al., 2016, Beitl, 2014, Werthmann, 2015, Huong and Berkes, 2011, Galappaththi and Berkes, 2015b) and create collective action problems (Ostrom et al., 1999). Area-based forms of management are based on the premise that whilst on-farm concerns often require an individual and physical intervention, shared concerns require cooperation between farmers. There appears to be a strong assumption that risks that are perceived as common threats favor new coalitions and alliances which surpass narrowly defined geographical territories (Glin, 2014). This raises the question whether this assumption actually holds for Asian aquaculture farmers at the local level and whether and if so how farmers develop local institutions for risk management beyond the farm.

At the same time there are external, state and non-state, actors that strive for aquaculture improvement. Responsibility for public issues, such as sustainability or managing common resources, has traditionally often been relegated to the state (Glasbergen, 2011, Ostrom et al., 1999). In response to perceived state failure (Huber, 1991), we see a shift to hybrid governance arrangements with other societal actors, illustrating an increasing role for private, and also global, actors, representing the market and civil society, to bring about societal change and take responsibility for public issues (Mol and Janicke, 2009, Glasbergen, 2011). The shift has been observed in all kinds of institutional arrangements in which external actors engage with farmers, intervening themselves within existing relations or creating new relations with those actors. For example, partnerships aimed at certifying aquaculture farmers or multi-stakeholder initiatives that use networking as the lever toward change (Wijaya et al., 2018, Glasbergen, 2011). Though there is abundance of literature studying how state, market and civil society actors steer aquaculture improvement through farm-level management, little is known about how risk management beyond the farm is institutionalized in initiatives steered by these actors.

The manner in which external actors can govern or steer risk management beyond the farm is likely to differ from the way that this happens in local institutions. Understanding this requires exploring the strategies used to steer risk management behavior beyond the farm. This entails understanding the structures that shape farmers' risk management behavior and how these hold farmers accountable for their behavior. For example, farmers at the local level may be driven to cooperate by personalized trust (Joffre et al., 2020), which is trust that builds on moral obligations between individuals and is produced and reproduced through social practices in networks in which farmers interact (Zhang et al., 2016, Giddens, 1990). However, as distant or even global actors become involved, the institutionalization of risk management beyond the farm becomes more complex and is likely to require other instruments.

In complex food systems, organizational efforts with the aim of predictability are designed to foster trust of actors further up the value chain, or outside the value chain (Kjærnes, 2006). Instead of relying on personal relations, trust must be institutionalized. Institutionalized trust is abstract and established through interactions between representatives of formal institutions (Zhang et al., 2016). Institutionalization in these models tends to be built on rather formalized forms of organization, such as BMPs or certification standards (Kjærnes, 2006). These forms of organization involve three processes that will be examined in this thesis. First, the organization of farmers into groups. Second, the abstraction of sustainability – in this case specifically the translation of risk – into institutions that pattern behavior, such as third party certification (Ha et al., 2012a) and national standards (Vandergeest, 2007). Third, the development and implementation of instruments to incentivize (i.e. price premiums, see Tolentino-Zondervan et al., 2016a) or enable (i.e. training or guidance, see Wijaya et al., 2017) risk management behavior.

This research explores the ways in which risk management beyond the farm is institutionalized in various arrangements, to understand what constitutes this patterned behavior in both local and global conditions. I study how collaborative risk management behavior emerges in local institutions and how risk management beyond the farm is institutionalized in improvement initiatives and assurance models led by external actors. In doing so, I build up a dynamic understanding of the institutionalization of risk management beyond the farm, exploring how a multiplicity of actors, representing local farmers, governments, NGOs and local and global markets, contribute to this. Ultimately, this will feed into learning how best to organize risk management beyond the farm.

1.4 Research objective

The overall goal of this PhD thesis is to contribute to a better understanding of aquaculture risk management beyond the farm, both empirically and theoretically. This thesis empirically examines the institutionalization of risk management beyond the farm in the aquaculture sector to understand in what ways different types of actors involved with the production and governance of aquaculture address production risks beyond the farm, and the scale at which this takes place. The primary research question of this thesis is:

What is aquaculture risk management beyond the farm and in what ways is this institutionalized in the Asian aquaculture sector?

This overarching research question has been broken down into the following three research questions:

1. *In what ways are aquaculture production spaces (re)produced through risk and social relations?*

2. *What is the variation in the manner in which social actors understand aquaculture production risk beyond the farm?*

3. *In what forms is the collaborative management of aquaculture production risk beyond the farm institutionalized?*

To respond to these questions, I study a sample of management and assurance initiatives that represent variation in the manner in which risk management beyond the farm is institutionalized. Four types of institutional arrangements have been selected to function as the scientific sample upon which I wish to draw higher level observations about risk management beyond the farm. These are not necessarily designed specifically to manage production risks beyond the farm, but they take up risks beyond the farm in some shape or form. I study individual farmers and their local networks (Chapter two), market-led improvement projects that sit within global value chains (Chapter three), a government-led extension program (Chapter four) and assurance models (Chapter five). As such, these arrangements involve the actors classically involved in governing sustainability: local resource users, markets, civil society and state. Ultimately, the goal is to characterize the common attributes of these different approaches, and distill generic lessons that can be taken beyond the cases, which will feed into ideas about how to best organize risk management beyond the farm.

In studying these four arrangements I also wish to contribute to the conceptualization of risk management beyond the farm. Using a novel and relational analytical framework, I unpack risk management beyond the farm, to deliver a clear understanding of how space, risk and institutionalization come together in various ways. This thesis illustrates how space is produced and reproduced through socio-environmental interactions associated with aquaculture risk management, and the resulting socio-spatial boundaries of an aquaculture production landscape. I use this to present a new way of understanding and governing risk management beyond the farm.

1.5 Methodology

This research is abductive as it concurrently deductive and inductive (Morgan, 2007). It is deductive as I am testing pre-conceived, normative notions about risk management beyond the farm using the three analytical dimensions of space, risk and institutionalization, to orient my inquiry (Lund, 2014). However, it is also inductive as I explore how these three dimensions come together in different area management and assurance initiatives. Detailed field research allowed me to investigate the concrete dynamics (Lund, 2014) associated with the union of these three dimensions. As there is no predefined theoretical approach to understand this, in the following four chapters I make selective use of existing theoretical frameworks that are deemed appropriate for their empirically-led research questions.

Though the way that I understand space, risk and institutionalization is relational, I do not associate with stronger social constructivist approaches that define environmental problems, specifically production risk, only in terms of social constructs and storylines. Though the three dimensions are studied as relational concepts, risks such as water pollution and disease are understood to have a real, quantifiable existence (Mol and Spaargaren, 2002). Production risks and ecological functions of the environment must also be analyzed and understood in terms of the language of natural and biological sciences (Mol and Spaargaren, 2000). This thesis aims to build on these quantified accounts of environmental risks and demonstrate the value of understanding risk from a social perspective when attempting to find alternative ways for addressing area-level production risks.

1.5.1 Research design: case study research

This thesis employs a case study research strategy to gain insight into risk management beyond the farm as case studies tend to generate rich and exploratory information (Yin, 1993). Since very little is known about this emergent phenomenon, providing statistically valid generalizations beyond the cases is not a realistic objective and cases have not been selected with the intention to extrapolate (Lund, 2014). Instead, this thesis intends to find resonance between cases of area management in different localities and in different contexts (Lund, 2014). The intention is to, led by three guiding concepts, identify conditions and distil plausible general principles for risk management beyond the farm, which can be tested in future research. A key limitation of this research design is that, due to the relatively high amount of resources needed for case studies, a limited number of cases could be studied.

This PhD takes a multiple case study approach. In chapters two to five, I explore four types of institutional arrangements. Each chapter serves answering an empirically-led research question and does so through a comparison of multiple case studies. Thus, in themselves these comparisons offer only a partial understanding of risk management beyond the farm. However, the combination of these comparisons serve as triangulation across the thesis and will then be used to answer the core research question and its three sub-questions in the final chapter.

Comparative exceptional cases exhibiting high degrees of heterogeneity were selected. Since there is no commonly agreed upon definition of risk management beyond the farm to begin with, a variation of cases was needed to explore this phenomenon. Exceptional and different cases reveal rich information as they activate more actors and mechanisms in the situation studied (Flyvbjerg, 2006). The selection of cases enabled me to explore risk management beyond the farm in a limited but very informative collection of cases that represented contrasting conditions. Despite this diversity, running through these seemingly eclectic cases are a series of dependent and independent variables holding them together.

1.5.2 Case study selection

A scoping study to identify potential field sites in Thailand, Bangladesh and Vietnam in June 2016 strongly influenced the selection of the cases studied in chapters two to four. This thesis is part of the SUPERSEAS research program, short for Supermarket Supported Area-based Management of South East Asian Aquaculture. This research program is built upon three PhD projects that study area-based risk management from different perspectives: governance (this thesis), finance and risk transfer, and value chains. The objective of the scoping study was to identify potential case studies for the entire program, and to start identifying existing models of aquaculture area management in Asia. The primary criteria for visiting sites was that farmers in the same locality were collaboratively addressing risks, in line with the definition for aquaculture clusters (Kassam et al., 2011). Considering the governance focus of this thesis, when visiting sites, I paid particular attention to which type of actors were steering these initiatives. More than 14 sites were visited, and 20 potential case study sites were identified, featuring shrimp, tilapia and pangasius production.

The scoping study illuminated that one common form of area-based management does not exist and that instead, it is made up of a broad range of approaches. The sites visited presented a large variety of forms of area-based management and resulted in the identification of at least six existing models: (1) traditional cooperatives and informal farmer groups (Kassam et al., 2011), (2) farmer groups with a common irrigation system (Boonsong, 1997), (3) farm clusters formed by NGOs (Padiyar et al., 2012, Ravikumar and Yamamoto, 2009), (4) numerous contract farms controlled by one processing company (Ponte et al., 2014), (5) clusters involving collaboration between various value chain actors (Blueyou Ltd., 2016, The Sustainable Trade Initiative, 2019d), and (6) clusters formed for group certification (Aquaculture Stewardship Council, 2019c). Two notable observations were made, and influenced case selection for this thesis. First, the cases encountered largely presented examples of area management driven by state, market and civil society actors. None of the field sites visited were initiated by farmers. This does not mean that farmer-led initiatives of area management in Asia do not exist, but it did delineate the nature of cases available for this thesis. Second, the processor-led initiatives encountered during the scoping study did not present cases in which farmers collaborated in spatially delineated areas as member farmers were generally very dispersed.

The diversity in models encountered confirmed the value of exploring risk management beyond the farm across a variation of cases, to start understanding the way in which risk management beyond the farm occurs in practice. The scoping study, in combination with consultations with experts with knowledge about other parts of Asia and a review of current literature, drove the selection of the four cases studied in this thesis (Table 1.1). The variable held constant across these cases is that farmers in the same locality collaboratively addressed risks. However, the cases vary across two dimensions, species produced and the degree and type of external interventions. First, aquaculture farmers in the cases studied in chapters two to four either produce shrimp or tilapia, and therefore represent variation in area-level production risks. This variation is expected to influence the risk management strategies applied. Second, the cases in chapter two to four are interventions either led by private actors or by public actors. This variation enables exploring how risk management beyond the farm is institutionalized under different governance conditions.

Table 1.1 Case study sites

Chapters two to four:				
	Shrimp		Tilapia	
Private-led improvement	Case 1: Kien Vang Forest: Ngoc Hien district, Ca Mau, Vietnam (Chapter two and three)		Case 3: Hainan province, China (Chapter three)	
Public-led improvement	Case 2: Kung Krabaen Bay: Na Yai Am and Tha Mai districts, Chantaburi province, Thailand (Chapter two and four)		Case 4: Pan Thong and Phanat Nikhom districts, Chonburi province, Thailand (Chapter four)	
Chapter five:				
Beyond farm assurance models	Case 1: Group Certification	Case 2: Biosecurity Area Management Standard	Case 3: Partnership Assurance Model	Case 4: Verified Sourcing Areas

In chapter two, two cases featuring shrimp production are studied, one featuring closed systems and the other featuring open systems (Table 1.1). As described in section 1.2.1, production systems influence the vulnerability of farms to production risks and are thus expected to influence risk management strategies. The farmers in Kung Krabaen Bay, located in Na Yai Am and Tha Mai districts in Chantaburi province, Thailand, cultured *Litopenaeus vannamei* shrimp in semi-intensive, and thus relatively closed, systems. The farmers in Kien Vang Forest, located in Ngoc Hien district in Ca Mau province, Vietnam, practiced integrated mangrove shrimp farming, and cultured *Peneaus monodon* shrimp in extensive, integrated and thus relatively open production systems.

In chapter three, two initiatives steered by the private sector are compared, one featuring shrimp production in Vietnam and the other featuring tilapia production in China. These cases were selected as they presented contrasting approaches to private-led aquaculture improvement. Farmers in Kien Vang Forest were part of a public-private partnership designed to certify shrimp farmers to a sustainability standard. Tilapia farmers in Hainan province belonged to an alliance of actors in Hainan's tilapia value chain working toward sustainable development.

Chapter four studies a Thai, state-led, extension program through the comparison of two farmer groups, one featuring tilapia farmers and the other featuring shrimp production. These cases were selected to draw out commonalities between cases featuring the production of two different species, to learn about how the state facilitates risk management beyond the farm. One case involves tilapia farmers from Pan Thong and Phanat Nikhom districts in Chonburi province. The other case features shrimp farmers in Kung Krabaen Bay in Chantaburi province.

In chapter five, models of beyond farm assurance are compared. Unlike the cases selected for chapters two to four, which were field sites, the cases in chapter five are models that provide assurance for sustainable seafood production. These models are not species- or location-specific. The cases selected were Group Certification programs put in place by key third party certification standards, the Biosecurity Area Management Standard, the Partnership Assurance Model and Verified Sourcing Areas.

1.5.3 Study areas

Four cases were studied in three Asian countries: Thailand, Vietnam and China (Figure 1.1). The three countries fall within the world's top ten aquaculture producing countries (FAO, 2020), and within the top six fish exporters worldwide (FAO, 2020).

Figure 1.1 Location of case study sites
(Source: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors)

In 2018, Thailand produced 1% of total global production (FAO, 2020) and is recognized as a global leader in aquaculture innovation (Pongsri and Sukumasavin, 2005). The development of freshwater aquaculture started in the early 1920s and with the rapid development of shrimp culture in the 1980s, brackish water aquaculture became increasingly important (FAO, 2019a, Hall, 2004). Today, both coastal and freshwater aquaculture thrive. In 2018, 46% of aquaculture production was cultured in freshwater, 43% in brackish water and 11% in marine environments (FAO, 2019a). Freshwater species are mostly cultured for domestic consumption, and tilapia are the most important freshwater species group (Pongsri and Sukumasavin, 2005, Rico et al., 2014). Shrimp is the most predominant species farmed in brackish water (FAO, 2019a). Thailand was one of the top exporters of fish and fish products since the mid-1990s, but exports declined due to repeated disease problems impacting the shrimp sector, which are only gradually being overcome (Hall, 2004, FAO, 2020).

Vietnam produced 5% of global aquaculture production in 2018 (FAO, 2020) and pangasius and shrimp are the two most important aquaculture species. Aquaculture development started in the 1960s with small-scale extensive systems, and commercial production for export started in the early 1980s with the production of *Penaeus monodon* (Nguyen and Truong, 2005). In 2018, 67% of aquaculture production was cultured in freshwater, 25% in brackish water and 8% in marine environments (FAO, 2019c). Amongst freshwater species, pangasius production is highest and the sector continues to grow in the Mekong delta (FAO, 2020). Shrimp is the dominant brackish water species and most is produced in the coastal provinces of the South (Nguyen and Truong, 2005). Vietnam is the world's third largest fish exporter with most of its revenue coming from exports of farmed pangasius and shrimp (FAO, 2018).

In 2018, China produced 58% of global production (FAO, 2020), and has produced more than the rest of the world combined every year since 1991 (FAO, 2018). Records of aquaculture in China date back 2000 years, but large-scale production only began in the 1950s. Since the 1980s, the sector has grown dramatically (Shuping, 2005). In 2018, 62% of aquaculture production was cultured in freshwater, 3% in brackish water and 35% in marine environments. Unlike Thailand and Vietnam, marine aquaculture represents a relatively large portion of production (FAO, 2019b). China is the world's largest shrimp and tilapia producer (FAO, 2018), and since 2002 it has been the largest exporter of fish and fish products, although the rapid growth of the 1990s and 2000s has subsequently slowed (FAO, 2018).

1.5.4 Data collection and analysis

During field work in Thailand, Vietnam and China, data was collected together with local interpreters, as I did not master the languages spoken in these countries. Cross-language and cross-cultural research brings challenges with it. The ethnicity, gender and age of researchers and interpreters can influence the manner in which respondents answer (Temple, 2002). Other important concerns are assumptions about cultural similarities or community familiarity between interpreters and respondents, risks faced by interpreters, negotiation of power and authority in the process, and ambiguities of translated language (Berman and Tyyskä, 2011). To overcome some of these challenges and strengthen the rigor of this type of research, interpreters should be understood as active producers in research and incorporated as research partners (Berman and Tyyskä, 2011, Temple, 2002). In this research, the four interpreters I worked with played an active role in the collection and processing of data. I worked, and in most cases lived, with the interpreters for extended periods of time during field work, which enabled us to continually reflect on interviews and become aware of emerging themes as we collected data. We tried to transcribe the majority of these interviews during the field work. Field notes and recordings transcribed by myself were always checked by the interpreter to verify that I understood the meaning. Together, the interpreters and I applied four data collection methods.

First, semi-structured interviews were the primary tool for collecting data in this thesis. Interviews are a useful method when the perspective of the respondent is of focal interest (Bryman, 2016). As this thesis explores an emergent phenomenon little is known about, I aspired to get rich and detailed answers. The flexibility associated with interviews provided a way to thoroughly understand the respondent's point of view and if necessary depart from predefined plans in response to this. Since this is multiple case study research, some structure was needed to enable a degree of comparison (Bryman, 2016), which is why I chose to conduct semi-structured interviews. Interview lists were used to guide interviews and were tailored to the respondent. Interviews were generally between one or two hours. Respondents were provided with an explanation of the research and asked for informed consent. If given permission, interviews were recorded and later transcribed by myself, the interpreter, or a professional transcriber. When I was not given permission to record, as the use of a recorder can disconcert respondents (Bryman, 2016), I made field notes.

In total, 189 interviews were conducted between January 2017 and November 2019, in four countries and over skype (Appendix 1). The identity of respondents is kept anonymous, so these were given a code corresponding to their profession. Respondents included farmers, representatives of farmer groups, local, provincial and central government, NGOs, certification bodies, academics and a variety of private actors along the value chain. These included buyers, processors, collecting stations, middle men, hatcheries, feed companies, and pharmaceutical companies.

Second, semi-structured interviews with farmers to collect data for chapter two were combined with individual participatory mapping exercises. Maps can be useful when a topic has a spatial dimension and when you want to understand how spatial elements are connected to social interactions (Murchison, 2010). In chapter two, I explore how farmers' relations and risk management practices shape their production space, so participatory mapping, a method common to modified participatory rural appraisal (Sedogo, 2002, Trung et al., 2007), was used to unpack space. Printed maps were used as a tool to help clarify the location of risks, boundaries and actors. In Ca Mau I used cadastral maps of the farms and a land-use map of the commune. In Chantaburi, I used cadastral maps of the bay. Using the printed map as a starting point, the farmer instructed me or the interpreter where to draw topics of interest, such as actors with which they communicated. Transect walks were conducted to verify farm boundaries, to locate risks and risk management strategies in the vicinity of the farm and to verify information from the interviews.

Third, focus groups with farmer groups were conducted to collect data for chapter three and four. Focus groups generate data based on the synergy of group dynamics, so the type and range of data generated through the group's social interaction are often richer than those obtained from one-to-one interviews (Thomas et al., 1995). In this thesis, group dynamics were essential to understand how the farmer groups addressed certain risks collaboratively. Furthermore, the focus groups provided a way to triangulate data obtained in semi-structured interviews and to determine whether the perspectives of farmers emerging in a group-setting deviated from individual perspectives (Rabiee, 2004). The process of conducting focus groups required a great deal of preparation, flexibility, and team work between the interpreter and myself. The interpreter took on the role of moderator, which is very important for creating an environment in which the participants feel relaxed and encouraged to engage (Rabiee, 2004). Interview lists were prepared to guide the focus groups, including questions about the risks the farmers experienced and how the group responded to certain scenarios. Focus groups generally lasted one hour, depending on how easy it was to engage the participants.

In total, four focus groups were conducted. Participation varied between five to eight farmers per focus group. These groups differed in nature and included: (1) a farmer group formed for third party group certification, (2) a group piloting a Code of Good practice, (3) a group defined by the use of a government-led irrigation system, and (4) members of an informal tilapia club. I interviewed pre-existing groups because using established groups means that there is already an extent of trust amongst the members of the groups, encouraging the expression of views (Rabiee, 2004), and because I wanted to understand how the groups cooperated to address risk.

Fourth, secondary data were examined to verify information from the primary data sources. Secondary data are useful sources for corroborating and augmenting primary data (Yin, 1998). Data in the form of websites, brochures, standards, policy documents and reports were collected and reviewed during and after field work. Documents that were deemed essential for the research were included in the data analysis process.

Internal validity of the research was maximized through iteration and triangulation. Internal validity is the extent to which the structure of a research design enables the drawing of unambiguous conclusions from results (De Vaus, 2001). Data collected needs to provide the basis to be able to see patterns (Lund, 2014). Confidence in findings from interviews were established through iteration, until a certain degree of saturation was attained (Lund, 2014). To determine the validity of findings from one data source, these were cross-referenced with findings from other data sources in a process of triangulation, to determine internal consistency.

All transcribed interviews and focus groups, digitized participatory maps and documents from secondary data sources were coded and analyzed using content analysis in ATLAS.ti. The three analytical concepts that oriented this research were operationalized, which refers to the clarification of abstract concepts and translating these into observable measures (De Vaus, 2001), differently in chapters two to five. For each chapter, operationalization was guided by the chapter's research question and theoretical framework, and steered the formulation of codes used to analyze the data. In the process of coding the data, data segments were labeled and grouped by category, and examined and compared both within and between categories (Maxwell and Miller, 2008). This was a reflexive and iterative process, moving between data analysis and theory-building (Pearce, 2012), highlighting the abductive nature of this research.

1.6 Thesis outline

This thesis presents four empirical chapters in the format in which they have been published in or submitted to scientific journals and concludes with a final chapter that synthesizes findings from chapters two to five, and draws general conclusions. In Chapter two, I examine how individual aquaculture farmers interpret and manage environmental risks, based on a comparison of intensive shrimp farmers in Kung Krabaen Bay and extensive and integrated mangrove shrimp farmers in Kien Vang Forest. Chapter three explores the manner in which the management of production risks beyond farm scale is institutionalized in private-led improvement projects, through a comparison of a 'top-down basic' aquaculture improvement project in Ca Mau with a 'bottom-up comprehensive' aquaculture improvement project in Hainan, China. In chapter four, I investigate how shared risk management is institutionalized through Plang Yai, a state-led extension program in Thailand, by studying a tilapia farmer group in Chonburi and a shrimp farmer group in Chantaburi. Chapter five explores how assurance is organized in four emerging beyond farm assurance models with different designs and operating at a range of scales. The final chapter reflects on the findings of the preceding chapters, addressing the core research question and its sub-questions. It concludes with providing policy recommendations around risk management beyond the farm and identifying future avenues of research.

CHAPTER 2

Moving beyond the shrimp farm: Spaces of shared environmental risk?

This chapter has been published as:
Bottema, M. J. M., Bush, S. R. & Oosterveer, P. 2018. Moving beyond the shrimp farm: Spaces of shared environmental risk. *Geographical Journal*, 185, 168-179.

Abstract

Key environmental challenges faced by the aquaculture sector demonstrate that aquaculture production is not isolated from the surrounding environment and we see a policy shift toward area-based approaches. However, without an understanding of the farmer's perspective, there is a danger of misrepresenting how farm-level practices relate to area-based approaches to environmental risk management. This paper empirically examines how individual aquaculture farmers interpret and manage environmental risks and the extent to which they operate beyond the boundaries of their farms. The analysis is based on a comparison between intensive aquaculture farmers in Kung Krabaen Bay, Thailand, representing an area of closed production systems; and a mixture of integrated mangrove shrimp and extensive shrimp farmers in Kien Vang Forest, Vietnam, representing an area of open production systems. Data were collected through semi-structured interviews and participatory mapping. The spatial configuration of environmental risk management in both areas demonstrated a focus on the farm. Though farmers did recognise off-farm risks, this did not result in collectively practised risk management strategies at a broad landscape scale. These observations demonstrate the need to rethink the development of area-based approaches for both closed and open systems. Instead of the designation of aquaculture zones or all-encompassing integrated landscape models of area-based management, the findings suggest an alternative model. This third way of conceptualising spatial models of area-based aquaculture management is based on a nested set of areas within a landscape defined by the socio-spatial extent of farmer networks within which the interpretation of risk is homogeneous.

2.1 Introduction

The primary unit of aquaculture production has traditionally been understood as the territory of the farm. Consequently, environmental problems have also been largely dealt with by interventions targeting farm-scale production practices (Soto et al., 2008, Anh et al., 2011). However, key challenges faced by the sector, including disease and water quality, demonstrate that aquaculture production is not isolated from the surrounding environment (Subasinghe et al., 2009). Building on concepts such as agro-ecology (Tomich et al., 2011), landscape management (Freeman et al., 2015) and traditional spatial planning, NGOs and governments alike have shifted their attention to area-based forms of management to overcome a range of these risks (The Nature Conservancy, 2017, Aguilar-Manjarrez et al., 2017, Sustainable Fisheries Partnership, 2018c).

The degree to which a farm is integrated into a larger area depends on physical and social factors. First, the embeddedness of a farm within a landscape depends on the degree a farm is physically 'open' or 'closed' to the surrounding environment (Bush et al., 2010, Vandergeest et al., 2015). Intensive closed systems are characterized by high stocking densities and limited physical interactions between farms and surroundings. Extensive open systems are characterized by minimal inputs and frequent physical interactions between farms and surroundings (Joffre et al., 2015). All systems along this open-closed spectrum are, however, embedded in a set of environmental risks that force farmers to adopt both on- and off-farm management practices (Waite, 2014, Soto et al., 2008). Aquaculture farms can therefore be understood (to varying degrees) as environmentally permeable units. As such, boundaries delineating the farm as the unit of production and management become less clearly defined.

Second, a farm's embeddedness is also dependent on the degree to which social relations between farmers influence both on- and off-farm risk management decisions (Adger, 2003). It is assumed that the degree of collaboration to mitigate risks corresponds to how open or closed a system is. The more open a system, the more intense collaboration should be to reduce mutual impact (Bush et al., 2010). While the importance of collaboration has been observed, much of the existing literature explores risk in aquaculture production in quantified, farm-level measures of risk perception, attitude and management (Le Bihan et al., 2013, Ahsan, 2011, Joffre et al., 2018). However, these studies do not explore all the environmental risks that farmers encounter, nor do they make them spatiality explicit. Furthermore, these studies do not focus on whether farmers manage environmental risks individually, collectively or otherwise.

By ignoring the farmer's perspective, we argue there is a danger of misrepresenting how farm-level practices relate to area-based approaches to environmental risk management. This paper addresses this gap by empirically examining how individual aquaculture farmers interpret and manage environmental risks, and the extent to which they operate beyond the boundaries of their farms, using an interpretative and relational approach.

In taking this approach, we critically examine preconceived ideas about 'farm-level' production space. We do this by determining how production spaces are defined by farmers themselves and the extent to which social relations enable or constrain farmers to deal with environmental risks.

Our analysis is based on a comparison between intensive shrimp and grouper farmers in Kung Krabaen Bay, Thailand, and integrated mangrove shrimp (IMS) and extensive shrimp farmers in Kien Vang Forest, Vietnam. Kung Krabaen Bay represents an area with closed production systems, with clear delineation of farm boundaries and highly regulated water management. In contrast, Kien Vang Forest represents an area with open production systems, less clearly defined farm boundaries and less regulated water management. These differences are expected to result in two dissimilar situations in terms of the location of environmental risks in the landscape, the consequent activities farmers practise to manage these risks, and the social relations farmers pursue to deal with them.

The following section presents the analytical framework for understanding aquaculture production space. In section three we describe methods of data collection and analysis. We then elaborate on the spatial distribution of production systems and institutional setting in the two cases before presenting our findings on the spatial and relational configuration of environmental risk management in section five. Section six discusses how farmers set boundaries through risk management in open and closed systems, and we reflect on how this matches with what we expect to find in area-based approaches. The final section reflects on the contribution of our findings to contemporary debates around area-based approaches in aquaculture.

2.2 Aquaculture space, environmental risks and social relations

The dichotomy of open and closed farms implies two forms of area-based management. In its ideal state, integrated landscape management (which we take to include landscape and agro-ecological approaches), corresponding to open systems, engages all stakeholders and reconciles trade-offs between different land uses, thereby integrating agricultural and environmental priorities (Sayer et al., 2013). Actors organize themselves around consensual boundaries and risks are addressed through collaborative relations. Alternatively, conventional spatial planning, corresponding to closed systems, relies on models developed by experts to deliver optimal solutions and often segregates protected and productive areas, isolating production from vulnerable ecosystems (Sayer et al., 2013). The closed nature of systems diminishes the need for collaboration between farmers.

We use this dichotomy to examine whether assumptions about environmental risk management in closed and open systems hold. In doing so, we assume space and risk to be interpretative and relational. First, risks are concurrently material and social. Risk interpretation is how farmers anticipate the outcomes of choices made, by themselves or by other decision-makers, in the face of uncertain events (Richard Eiser et al., 2012, Kjærnes, 2006, Elliott and Pais, 2006). Second, there is no one space; there are multiple co-existing spaces that change over time (Murdoch, 1998, Massey, 2005). Each farmer has his or her own interpretation of space, which is dynamic and shaped by the material and social context. Third, this view of space presents alternative territorial units which go beyond rigid farm boundaries and lead to constantly shifting concerns (Vandergeest et al., 2015, Kidd and Shaw, 2013, Bear, 2013). Risks in aquaculture production are therefore no longer limited to individual on-farm issues. They include risks outside the farm which can involve multiple actors. Thus, changes in the understanding of aquaculture production space influences which risks are recognized, as well as the strategies applied and relations sought to address them.

To understand how environmental risk management is spatially organised in closed and open systems, we first group environmental risks into three spatial categories. We classify environmental risks as production risks, which affect the volume or quality of production (Hardaker et al., 1997, World Bank Group, 2016). Based on a review of literature and certification schemes we distinguish between three, sometimes overlapping, categories (Aquaculture Stewardship Council, 2014, GLOBAL G.A.P., 2012, Best Aquaculture Practices, 2014, Naturland, 2016, Arthur et al., 2009, Bostock et al., 2010). The first are environmental risks flowing into the farm from the surroundings and manifested on-farm; for example, poor quality or disease-carrying inputs and climate-related risks. The second are environmental risks caused by the farm, manifested as impacts outside the farm, such as waste and water disposal. Thirdly, there are environmental risks transferred between farms, such as disease.

The second step in understanding the spatial configuration of environmental risk management is determining where farmers intervene to address these three flows of risk: on-farm or off- farm. Lebel et al. (2016) distinguish between strategies applied at farm-scale and those applied at watershed-scale. Risk Management Practices (RMPs) may, however, also be carried out further away. In this investigation we distinguish between RMPs practised on-farm and those practised off-farm. We hypothesize that farms with open systems apply more RMPs outside the farm than farms with closed systems, since the effectiveness of their on-farm RMPs is inherently limited.

Thirdly, we distinguish between three risk management strategies: individually practised, externally practised and collectively practised RMPs. Individually practised RMPs, frequently applied in aquaculture management (Bergfjord, 2009), present the farm as the only unit of decision-making in mitigating risk. External RMPs are those practised or facilitated by external actors. Norms and sanctions set by external actors can act as institutions which shape farmers' responses to risk (Lo and Chan, 2017). Relations of reciprocity between a farmer and another actor may also result in RMPs carried out by this external actor. Collective RMPs are carried out collaboratively by multiple farmers. Networked relations, as exhibited by farmer groups or collectives, may facilitate the formulation of shared norms, information-sharing and collective management (Lo and Chan, 2017). Based on research by Bush et al. (2010), we hypothesize that farmers in open systems apply more collective strategies to mitigate environmental risks than farmers in closed systems, and we predict that the diversity of the landscape contributes to advancing their capacity for self-organization.

2.3 Methodology

Following a scoping study in search of illustrative examples of aquaculture area management in Vietnam, Thailand and Bangladesh carried out in June 2016, Kung Krabaen Bay and Kien Vang Forest were selected as two exceptional cases in which there were efforts to solve environmental problems at a spatial level beyond the farm. Kung Krabaen Bay represented an area dominated by closed production systems and Kien Vang Forest an area of open production systems.

Farmers were sampled and interviewed in two steps. First, government agencies responsible for area management, the Department of Fisheries (DoF) in Kung Krabaen Bay and the Forest Management Board (FMB) in Kien Vang Forest, were interviewed to understand the spatial distribution of farmers and environmental risks and to select farmer respondents. Government representatives in both areas claimed that there was no significant variation in terms of environmental risks throughout the areas. At the time of the research many of the farms in Kung Krabaen Bay were empty due to seasonality, so farmers were sampled from three of the eight user groups of the local irrigation system because there was a relatively large number of members present. Farmers in Kien Vang Forest were randomly sampled from three sub-areas of Kien Vang Forest. These sub-areas were selected because they contained both farmers who had Selva Shrimp certification, a form of organic group certification, and those who did not.

Second, 20 aquaculture farmers were interviewed at each study site between January and May 2017. In Kung Krabaen Bay 18 shrimp farmers and two grouper farmers were interviewed. In Kien Vang Forest 18 IMS farmers and two extensive shrimp farmers were interviewed. Semi-structured interviews with individual farmers based on prompting lists of environmental risks were used to understand the risks they experienced and the management practices they applied to mitigate them. Interviews included a participatory mapping exercise using cadastral, bay and commune level maps to clarify the location of risk management practices, actors in the landscape, and with whom farmers communicated about environmental risks. On the basis of these maps a walk in or around the farm was made with farmers where information from the interviews was verified. It was concluded after the 20 interviews that the variation in responses was no longer high enough to warrant additional interviews.

All interviews and digitized participatory maps were coded and analysed using ATLAS.ti software. The codes used correspond directly to the themes within the three parts of the analytical framework. Environmental risks were weighted and ranked according to the risk magnitudes assessed by the respondents, ranging from zero risk to very high risk, and to the number of respondents experiencing them. RMPs described in interviews were ranked according to the number of respondents applying them.

2.4 Contextualizing environmental risks in Kung Krabaen Bay and Kien Vang Forest

2.4.1 Kung Krabaen Bay: an area of closed systems

Kung Krabaen Bay represents an area of highly institutionalised, spatially bounded aquaculture production (Figure 2.1). In response to mangrove clearance and unplanned shrimp farming, the Kung Krabaen Bay Royal Development Study Centre was founded in 1981 to serve as a shrimp culture demonstration area. According to Boonsong (1997), in 1987, about 166 hectares of the bay's inland portion of deteriorated mangrove forest was allocated for a shrimp culture project managed by the DoF, whilst a fringe of bay side forest was maintained for conservation and restoration.

Figure 2.1 Image of characteristic aquaculture landscape in Kung Krabaen Bay, Chantaburi (left) and Kien Vang Forest, Ca Mau (right)
(Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN and the GIS User Community)

Despite a high level of oversight provided by the Centre and DoF, the lack of sound wastewater management led to deterioration of water quality, self-contamination and high disease incidence (Satumanatpan et al., 2011, Boonsong, 1997). In 2001, the Royal Thai Government built a seawater irrigation system. Offshore seawater is pumped to shore, tested by the DoF and distributed through an input canal. Effluent from farms is treated in a separate treatment canal (Satumanatpan et al., 2011). Farmers are grouped into eight user groups, pay a fee and follow waste management regulations, such as building sedimentation areas for sludge.

Kung Krabaen Bay is spatially bounded at two levels: bay- and farm-level. The 15 square kilometres of the bay, fringed with a mangrove forest, is entirely dedicated to fisheries and aquaculture (Tookwinas and Songsangjinda, 1999). There are 210 intensive shrimp and fish farms. Farm sizes amongst the respondents ranged from 0.4 hectares to 3.2 hectares. Each farmer must use water from the irrigation system, which eliminates water transfer between farms, thereby closing off farms.

2.4.2 Kien Vang Forest: an area of open systems

Kien Vang Forest is dominated by open, integrated production systems (Figure 2.1). The forest lies in a coastal zone dedicated mainly for IMS farming. The Vietnamese government assigned these areas to create livelihood opportunities through shrimp farming, whilst conserving mangrove forest (Ha et al., 2012b). In the study area, IMS farmers were required to protect mangroves on at least 60% of their land (Quoc Vo et al., 2015). Shrimp production on the remaining 40% was their primary income source.

The FMB manages forest in Tan An commune, Tam Giang Tay commune and Rach Goc town. IMS farmers are contracted by the FMB under 'Green Book' tenure, which stipulates the forest-to-pond area ratio, tree density and timber marketing conditions (Joffre et al., 2015). Extensive farmers produce on land owned by the People's Committee under 'Red Book' tenure, which stipulates less stringent regulations. All farming activities must also adhere to provincial regulations that seek to minimise production risk (Ha et al., 2014). For instance, the Ca Mau People's Committee stipulates that farmers must follow a seasonal calendar for dredging, and instructs farmers to arrange storage areas for sludge.

Kien Vang Forest features IMS farms and extensive shrimp farms, with a small number of intensive farmers, hatcheries and factories in designated zones. Like extensive shrimp farmers, the 866 IMS farms in Kien Vang Forest often combine shrimp culture with other aquatic species. Farms are established along brackish water estuaries. Farm sizes amongst respondents ranged from 2.5 to 13 hectares. These ponds connect to estuaries by gates which control water in- and outflow according to tides (Blueyou Ltd., 2016). Primary water sources for aquaculture farmers in the study area are several sea gates and Rach Goc river.

2.5 The spaces of environmental risk management

2.5.1 On-farm risk management practices

The location of environmental risks and RMPs described by farmers demonstrates that farmers are primarily focussed on the space inside their farm. In both areas over 70% of environmental risks described flow from the surroundings to the farm. In Kung Krabaen Bay 12% and in Kien Vang Forest only 3% of risks described flow from farm to environment. In terms of risk management, in Kung Krabaen Bay 88% and in Kien Vang Forest 74% of RMPs described were carried out on the farm.

In both cases, the majority of on-farm RMPs were carried out individually (Figure 2.2). These individually practised on-farm RMPs varied between the two areas due to the nature of production systems and risks experienced. This can be illustrated though a comparison of biosecurity and water management. Biosecurity RMPs were central in both cases, but were applied more frequently in Kung Krabaen Bay, since those farms had many options for preventing disease, such as nets and plastic linings (see Piamsomboon et al. (2015) for further detail). In contrast, RMPs to prevent disease in Kien Vang Forest mainly involved minimizing water exchange.

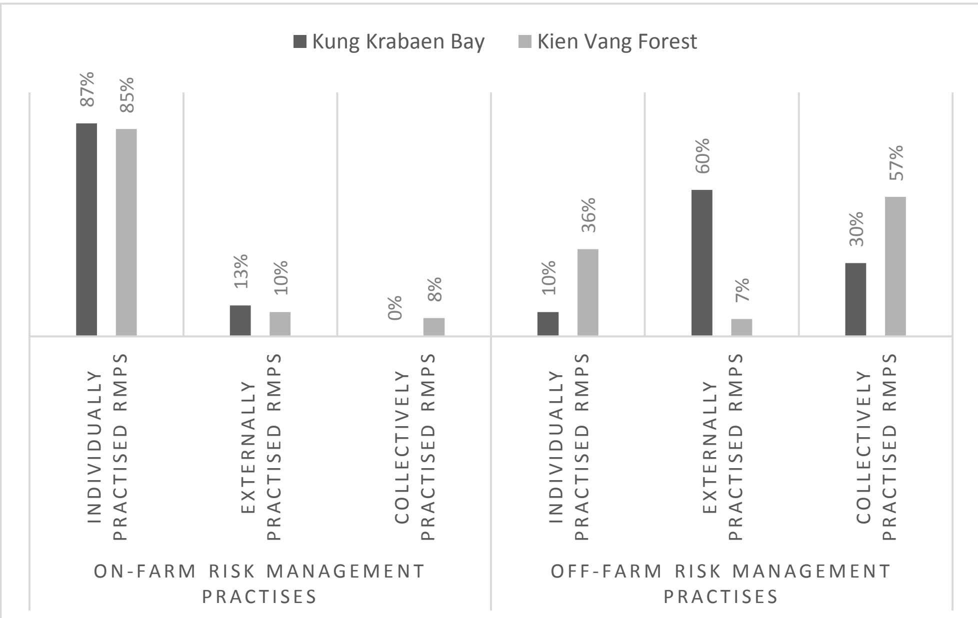

Figure 2.2 Distribution of on-farm and off-farm risk management practices in Kung Krabaen Bay and Kien Vang Forest

Farmers in Kien Vang Forest experienced higher risks from poor quality of input water than farmers in Kung Krabaen Bay, but due to the open nature of production systems controlling water quality was difficult. In Kung Krabaen Bay, 80% of respondents did not see poor quality of input water as a risk, and if they did, farmers filtered or treated input water. In contrast, farmers in Kien Vang Forest ranked poor water quality stemming from water disposal by intensive shrimp farms, hatcheries and factories as a high risk. However, due to the size and open nature of ponds, practices to improve water quality like those applied in Kung Krabaen Bay were inapplicable for respondents in Kien Vang Forest.

Farmers in both areas believed that physical location influenced their vulnerability to certain environmental risks. However, challenges related to physical location (for example, proximity to pollution sources such as sea gates) were more prominent and played a bigger role in determining RMPs in Kien Vang Forest than they did in Kung Krabaen Bay. This can be explained by the openness of production systems and dependency on the nature of the hydrological system in Kien Vang Forest, which led to more environmental interactions and consequentially greater vulnerability to off-farm risks.

External actors, particularly the government, also played a role in on-farm RMPs in both areas. In both cases the government formulated and enforced regulations for wastewater management, mangrove conservation and pond management. As such, formalised norms prescribed the way farmers should manage risks on-farm. However, in Kung Krabaen Bay, the role of government actors extended beyond these formalised norms. The DoF helped farmers manage the risk of poor quality post-larvae, which was the highest ranked risk. Farmers trusted the DoF, who played an active role in advising farms. In Kien Vang Forest, the local government did not support farmers in this way.

Processing companies also played a notable role in on-farm risk management in both cases. Though not described specifically as RMPs by farmers, processing companies stipulated rules for on-farm risk management. In Kung Krabaen Bay, farmers who were members of *Pracharat* (a public-private partnership amongst the DoF, the Centre, the Kung Krabaen Fisheries Cooperative and Charoen Pokphand Group (CP)) applied biosecurity RMPs stipulated by CP. The Cooperative also set on-farm biosecurity RMPs as conditions for loans. Similarly, in Kien Vang Forest, Minh Phu Seafood Corporation collaborated with Blueyou Consulting and the FMB to certify 387 farms to produce Selva Shrimp. Certified farms were grouped and applied on-farm RMPs, for example prohibiting chemical use, stipulated in the Selva Shrimp standard.

Feed suppliers played a role in on-farm risk management in Kung Krabaen Bay, but not in Kien Vang Forest, since IMS and extensive farms in this area depend on natural feed. In Kung Krabaen Bay feed suppliers tested water quality and shrimp health for free, as part of the service provided to farmers in exchange for buying feed, a role common to feed suppliers in the shrimp industry.

In Kung Krabaen Bay none of the on-farm RMPs were practised collectively, whilst in Kien Vang Forest 8% of on-farm RMPs were carried out collectively. Farmers in Kien Vang Forest coordinated dredging and water discharge. More than half of respondents in Kien Vang Forest who dredged claimed they coordinated the rental of dredging machines with others, to minimize costs and to deal with challenges related to spatial distribution of farms. Dredging machine transportation often required travelling through other farms, requiring coordination. About 60% of respondents claimed they coordinated water discharge with neighbours to address the risk of dykes breaking from water pressure differences caused by uncoordinated discharge. Half of these farmers stated this coordination took place through informal agreements between neighbours, whilst 50% stated coordination emerged naturally, since the tide prescribed discharge timing.

In Kien Vang Forest a number of informal and formal groups also set norms for collective or coordinated on-farm risk management, due to shared disease risks. For example, Dai Hiep Cooperative set rules for common water management to reduce disease transfer between farms and members were encouraged to coordinate stocking post-larvae. Similarly, some Selva Shrimp certified farmers stocked simultaneously with other farmers in their group, due to coordinated delivery of post-larvae from Minh Phu.

2.5.2 Off-farm risk management practices

Off-farm RMPs were more frequently applied in Kien Vang Forest than in Kung Krabaen Bay. In Kien Vang Forest 26% and in Kung Krabaen Bay 12% of RMPs were practised outside the farm. This difference can be explained by material characteristics of the production systems and the local contexts. Due to the open nature of farms, farmers in Kien Vang Forest could not apply some on-farm that RMPs intensive farms commonly apply to keep out environmental risks. Furthermore, farmers in Kien Vang Forest were faced with specific risks like produce theft and illegal wastewater disposal, which demanded action outside farm boundaries.

The social configuration of off-farm RMPs differed considerably from that of on-farm RMPs; the majority were practised collectively or by external actors (Figure 2.2). There was a notable difference between the two cases. In Kung Krabaen Bay, off-farm RMPs were mostly practised by external actors, followed by those practised collectively and individually. In Kien Vang Forest most off-farm RMPs were practised collectively, followed by those practised individually and externally.

There were more off-farm RMPs practised individually in Kien Vang Forest than in Kung Krabaen Bay. In Kien Vang Forest these were individual strategies for selecting post-larvae and individual reporting of problems regarding water pollution to the local government. These were not mentioned amongst respondents in Kung Krabaen Bay, where farmers talked more about the role post-larvae suppliers played in managing post-larvae quality outside the farm, and where farmers did not experience risks associated with water pollution in the same way as farmers in Kien Vang Forest.

External actors played a major role in off-farm RMPs in Kung Krabaen Bay, whilst they played a smaller role in Kien Vang Forest. In Kung Krabaen Bay, the government managed the irrigation system which arguably mitigated key risks. Farmers stated that the system supplies clean water, irrigation canals perform water catchment services and the treatment canal performs waste management services. Three of the four respondents who cultured shrimp before the irrigation system was built stated that disease transfer decreased after the irrigation system was constructed. Farmers in Kien Vang Forest, by contrast, expressed their lack of faith in the local government's capacity to address the poor quality of input water. Despite formal regulations for waste management and an Environmental Monitoring Group, assigned by the commune government to monitor wastewater management, farmers claimed that it was very difficult to enforce regulations. Consequentially, farmers searched for other ways to address this problem.

In both cases farmers described the role suppliers played in managing post-larvae quality. Trust in post-larvae suppliers was constant throughout respondents in Kung Krabaen Bay, but varied in Kien Vang Forest. Despite poor quality of post-larvae ranking as the highest risk in Kung Krabaen Bay, farmers had confidence that suppliers tested their product. Post-larvae suppliers were required to show farmers test results from the DoF. RMPs carried out by suppliers in Kien Vang Forest naturally differed due to the dissimilar nature of their production systems, and involved matching conditions of their nursery ponds to water conditions in the area. Trust in post-larvae suppliers varied amongst respondents; some farmers suspected suppliers of misleading them, whilst others trusted suppliers based on longstanding working relations, brand or relations of kinship.

Farmers in neither area reported the stipulation of rules for off-farm risk management or risk-sharing by processing companies. Though CP and Minh Phu provided training to teach farmers dredging techniques, hygienic farm management and appropriate stocking and harvesting schedules, they did not set conditions for off-farm risk management.

Instead of depending on external actors to manage risks outside the farm, farmers in Kien Vang Forest placed emphasis on the application of collective risk management. This can in part be explained by the perceived lack of capacity of the local government to address certain risks in Kien Vang Forest, but can also be attributed to the nature of the environmental risks experienced. The most important risk farmers in Kien Vang Forest addressed collectively is the poor quality of input water caused by discharging of wastewater by intensive shrimp farms, factories and hatcheries. Respondents described informal local systems of surveillance whereby IMS and extensive farmers warned each other when intensive shrimp farms were suspected of releasing water illegally. Farmers stated that they collectively approached local government when problems occurred by raising them at Farmer Association or village meetings. However, farmers reported the local government did not have the authority to take the necessary action and described how sometimes farmers took matters in their own hands, leading to serious conflicts between intensive shrimp farmers and IMS or extensive farmers.

The key similarity in off-farm RMPs in the two cases is that farmer groups collaborated in evaluating input quality, which suggests that this type of collaboration is common to farmers with both open and closed systems. In Kung Krabaen Bay, farmers with Thai GAP-7401 certification, a form of group certification run by the Thai government (see Samerwong et al., 2018), helped each other sample feed quality. In Kien Vang Forest selection of post-larvae was an activity shared between neighbours, relatives, Selva Shrimp certified farmers and Cooperative members. Farmers assessed quality together with others and bought post-larvae collectively, not only to save costs, but also to use the knowledge of other farmers and share risk information.

A notable difference in the nature of collectively practised RMPs in the two areas is that in Kien Vang Forest these were generally initiated by individual farmers, whilst in Kung Krabaen Bay, off-farm RMPs practised collectively were mostly requirements from membership of formal farmer groups. For example, the Centre initiated collective removal of seaweed from the irrigation canal, a mandatory activity for all irrigation system users.

2.5.3 The spaces between: communication about environmental risks

In both cases communication about risks between farmers appeared to be an important component of environmental risk management, particularly for managing disease. Farmers in both areas stated that it was important to share information about diseases with other farmers, presumably because a significant amount of environmental risks farmers faced were risks transferred between farms. In both areas roughly 16% of risks described were those transferred between farms.

In both cases neighbouring farmers communicated about disease and shared solutions, indicating a shared level of trust. Seven farmers in Kung Krabaen Bay mentioned that they communicated with neighbours when encountering disease. In Kien Vang Forest, half of the respondents said they communicated with other farmers about disease. A quarter of farmers described how they shared information regarding disease through daily communication with farmers who shared an input canal, thereby warning other farmers when water was unsuitable to take in. Farmers in both areas consulted each other about solutions.

Though there appeared to be an informal understanding of the value of communicating disease risks with neighbours, there was no formal structure for communication. In both areas, communication generally occurred between individuals connected through familial ties, common species cultivated, or vicinity of farms. However, in Kien Vang Forest there were also examples of farmers warning others in a collective context; through Farmer Association meetings, in Selva Shrimp certification groups, and in Dai Hiep Cooperative. Interestingly, in Kung Krabaen Bay the more formalised farmer groups, like irrigation system user groups and Kung Krabaen Bay Fisheries Cooperative, did not function as groups for risk communication.

In both areas, a number of spatial and scale aspects influenced communication structure and collaboration between farmers. More than half of respondents in Kung Krabaen Bay stated that the irrigation canal acted as a boundary for communication, with farmers only communicating with farms on the same side of the canal. Some farmers shared water inlets, reservoirs or sedimentation ponds with neighbours, which required collaboration.

Though the scale of farms in Kien Vang Forest is not comparable to Kung Krabaen Bay, the spatial structure of communication was in some ways similar. Farms were relatively large and far apart. More than 50% of respondents claimed they seldom or never communicated with farmers on the other side of their input canal, because they were too far away.

A key difference between the two areas was the interaction between aquaculture actors in the landscape. Though there was clear variation across farms in Kung Krabaen Bay in terms of success rate, species cultured, level of technology and management practices applied, the seawater irrigation system resulted in equal access to good quality water and the removal of cross-contamination of farms through water. Contrastingly, in Kien Vang, IMS and extensive farmers shared their landscape with intensive shrimp farms, hatcheries and factories, forming a hybrid landscape and creating, from the perspective of respondents, winners and losers. There was a high sense of hostility toward intensive shrimp farms. Intensive shrimp farmers were repeatedly accused of illegally dumping untreated wastewater. There was little communication between intensive farmers and interviewed farmers, and respondents perceived that intensive shrimp farms physically and socially closed themselves off from other farms.

2.6 Discussion

The open and closed systems compared in this research illustrate how social and spatial configurations of environmental risk management lead us to question some assumptions about open and closed systems, and in turn the formation of area-based management (cf. Bush et al., 2010, Joffre et al., 2015, Vandergeest et al., 2015). More specifically, the close association of closed systems with traditional spatial planning through zoning (A in Figure 2.3), which assumes the homogenization of risk in combination with strong (external) planning and control over shared infrastructure; and the association of open systems with landscape approaches (B in Figure 2.3), which assumes full integration and communication between land users at a broad and encompassing scale. We question this dichotomy based on three observations.

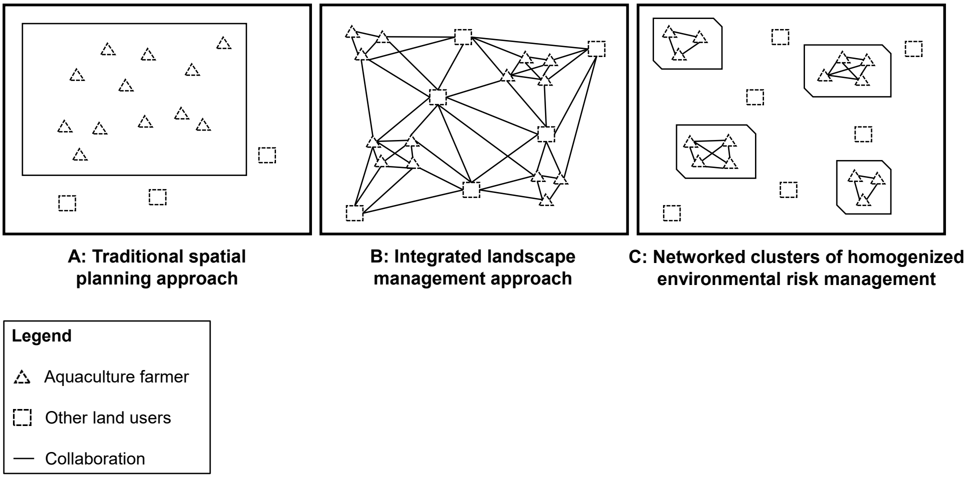

Figure 2.3 Models of area-based management in aquaculture

First, the spatial configuration of environmental risks and RMPs demonstrates a focus on the farm. In both cases the majority of environmental risks identified and therefore acted upon by farmers were those flowing from the environment to the farm. The urgency to address risks off-farm appears to increase the more open systems are, and, as hypothesized, off-farm risk management is applied more in open systems than in closed systems. However, the configuration of off-farm RMPs in open systems does not suggest that farmers with open systems proactively organise the mitigation of risks outside their farm. Instead, off-farm strategies are applied to protect farms from acute environmental risks that have a direct impact on production.

Second, while farmers do recognise off-farm risks, recognition alone does not result in collectively practised risk management strategies at an area-level. In the case of Kung Krabaen Bay, farmers were embedded within a wider irrigation system that was controlled by the government, which arguably removed the need for farmers to address key water quality risks. Reflecting research by Bush et al. (2010), the relatively high degree of control these farmers have over flows on and off their farms, coupled with the high degree of government oversight at the landscape level, means they have less need to negotiate with surrounding farmers about water management. In contrast, the open production systems in Kien Vang Forest, with weaker government oversight, did encourage the need to communicate about shared risks and at times these were addressed collaboratively at a very local scale. But in contradiction to our hypothesis and the expectations presented in Bush et al. (2010), this communication did not translate into proactively shared risk management at a broad landscape level.

Third, it appears that unlike the ideal notion of integrated landscape management (e.g. Tomich et al., 2011, Freeman et al., 2015), farmers do not appear able to build relations with surrounding land users. For example, IMS and extensive farmers in Kien Vang Forest did not communicate effectively with intensive shrimp farmers, who they believed to be responsible for water pollution. Instead, intensive shrimp farmers were described as 'closed' and communication with them often led to conflict. Hence, IMS and extensive farmers did not appear to create effective fora for negotiation with other land users in the absence of external actors and, in contradiction to our hypothesis, the landscape's diversity did not advance capacity for self-organization. The fragmented social networks involving different kinds of farmers across the landscape presumably interpret environmental risks differently, resulting in the existence of multiple spaces of risk and hindering the emergence of a landscape-scale approach.

These observations demonstrate the need to rethink the development and application of area-based approaches for both closed and open systems, taking into account: (1) the most effective socio-spatial scale of shared risk management; and (2) the coordinating role of external actors, such as the government, in managing shared infrastructure aimed at mitigating common risks. The consequence is that area-based management is unlikely to emerge, spontaneously or externally managed, at an all-encompassing landscape level, where there is maximum diversity of production systems, risks, and competition between farmers. Instead, the results indicate that risk homogenization, and therefore an effective scale of area-based management, is best realised at scales that reflect both the biophysical dimensions of risk *and* the shared experience of farmers to collectively mitigate these risks.

These observations open up the possibility of a third way of conceptualising spatial models of area-based aquaculture management for both closed and open systems. Instead of designation of aquaculture zones or all-encompassing integrated landscape models of area-based management (A and B in Figure 2.3), the results suggest an alternative model based on a nested set of areas or 'compartments' within a landscape defined by the socio-spatial extent of shared risks (C in Figure 2.3). These compartments do not as such meet the wider landscape level goals of area-based management by linking all risks and production activities in an area. Instead they are defined by scalar concordance of the biophysical extent of environmental risks, including shared infrastructures to mitigate these risks, and the social experience of these risks. Based on the above results, it is the social dimension that provides a starting point for the design of these compartments and is therefore key to their effectiveness. Once established, these compartments can be scaled up by establishing, with assistance from external institutions, networks that can proactively manage certain environmental risks shared across the landscapes.

2.7 Conclusion

The results confirm the basic premise of area management; aquaculture farms are undoubtedly embedded, physically and socially, into their surroundings. But while sharing environmental risks through collective risk management strategies is a worthy ambition in aquaculture management, it is not necessarily dealt with effectively through area-based approaches at a broad and holistic landscape scale. This leads us to two main conclusions on how research and practice on the development of area-based management should proceed.

First, 'areas' are best defined by the socio-spatial extent of farmer networks within which the interpretation of risk is homogenous. This does not mean that the biophysical dimensions of aquaculture landscapes are unimportant. What it stresses is that the actions of and cooperation between farmers to mitigate risks are driven by shared and therefore social interpretations and experiences. Recognising this offers an entirely new and fundamentally social starting point for the definition of area management units in the aquaculture sector, upon which management activities and risk assessments can be built.

Second, nested socio-spatial areas should be seen as building blocks for the management of wider landscapes. This research presents a socio-spatial approach to understanding risk management, which is fundamentally different from existing conceptualizations of area management. This approach appears as some kind of middle ground between, on the one hand, spatial planning approaches based on an understanding of the landscape's ecological functions and, on the other hand, utopian views of integrated approaches advocating the full integration of social and economic activities across landscapes. We argue that an understanding of the social connectivity between farmers is equally important as understanding the landscape's physical characteristics, as it is these social relations interacting with environmental risks which shape shared environmental risk management in space. As such, we propose networked clusters of farmers organized around homogenized environmental risks as an alternative starting point for understanding and scaling up area management in aquaculture.

Though we are confident that the manner in which farmers address environmental risks can be explained by the interpretation of shared environmental risks, differences in terms of culture, political history and institutional context may influence how environmental risks are managed. For example, the failure of collectivisation in Vietnam (see for detail Ha et al., 2013b, Ha and Bush, 2010) may very well influence farmer decisions to address environmental risks collectively. Further research into how such contextual factors influence shared environmental risk under conditions of area management would therefore be valuable.

More directly, further research is needed to provide better understanding of the extent to which external actors can stimulate collaboration between farmers to collectively manage environmental risks across landscapes. The public sector's inherent capacity to formalise institutions and delineate areas, the private sector's economic imperatives for risk management, and the moral authority of NGOs, appear to result in different approaches. Insight into how each of these actors can organise and facilitate risk management beyond the farm would help further our understanding of the potential of area-based management in aquaculture, and in other food sectors.

CHAPTER 3

Institutionalizing area-level risk management: Limitations faced by the private sector in aquaculture improvement projects

This chapter has been published as:
Bottema, M. J. M. 2019. Institutionalizing area-level risk management: Limitations faced by the private sector in aquaculture improvement projects. *Aquaculture*, 512, 734310.

Abstract

Aquaculture improvement projects (AIPs) have emerged as a novel form of market-based sustainability governance. Recognizing that aquaculture production is dependent on public resources, AIPs have been promoted as a mechanism for addressing shared or area-level production risk between farms. However, it remains unclear how different AIP models manage shared risk and at what scale. This article contributes an improved understanding of how AIPs led by NGOs and buyers address risk management at different scales by comparing a 'top-down basic' AIP in Vietnam and a 'bottom-up comprehensive' AIP in China. The results indicate that AIPs struggle with institutionalizing risk management at an area-level because of the difficulties both NGOs and buyers face in inducing horizontal cooperation to address shared risk between farmers. This is attributed to the poor capacity of these actors to align either top-down or bottom-up comprehensive AIPs with the social and environmental conditions of production. AIPs are more likely to be successful in institutionalizing shared area-level risk management if they build on the existing social networks of farmers. Such an approach means moving beyond dualistic top-down basic and bottom-up comprehensive models to more socially integrative area-based AIP models.

3.1 Introduction

Aquaculture improvement projects (AIPs) have emerged as a novel form of market-based sustainability governance in the aquaculture sector. Building on the more developed model of fishery improvement projects (FIPs), AIPs involve partnerships between private actors designed to engage and empower value chain actors to cooperatively address sustainability challenges related to aquaculture (Sustainable Fisheries Partnership, 2018b). As such, AIPs reflect the wider proliferation of market-based approaches employed by buyers and NGOs to foster sustainable and responsible food production (Bitzer and Glasbergen, 2015).

Recognizing that aquaculture production is dependent on public resources (Soto et al., 2008), the Sustainable Fisheries Partnership (2018b) has promoted AIPs as an approach for addressing shared social and environmental impacts of aquaculture production among farms. According to SFP, AIPs aim to reduce the cumulative and combined impacts of aquaculture practices, which can be realized through the combined efforts of multiple actors in a given zone or 'area'. This mirrors a more general move by private companies, often in partnership with NGOs, to mitigate production risk beyond the farm-level by coordinating improvement at a higher spatial scale (Kissinger et al., 2013).

Despite their ongoing implementation, there remains no generally recognized framework for AIPs (WWF, 2018, Sustainable Fisheries Partnership, 2018b, Global Aquaculture Alliance, 2018, The Sustainable Trade Initiative, 2018a). Inspiration has been predominantly drawn from FIPs, which define the unit of improvement through the type of vessels and gears used to harvest fish rather than a clearly defined spatial scale or area (Foley, 2012). The unit of improvement in aquaculture, by contrast, is delimited by farm boundaries and (most commonly) the input and output of public water resources. Whether the principles used to design FIPs are relevant for AIPs remains unclear.

FIPs have been characterized along two main dimensions. First, they are defined as having either 'comprehensive' or 'basic' strategies for improvement. Comprehensive improvement projects address a full range of environmental challenges over an extended time horizon, while basic improvement projects aim to address a specific set of environmental challenges through incremental improvements through time (California Environmental Associates, 2015, Tolentino-Zondervan et al., 2016b, Conservation Alliance for Seafood Solutions, 2018). Second, they are defined in terms of having 'top-down' or 'bottom-up' supply-chain engagement. Top-down improvement projects are led by buyers that directly leverage changes to the production practices of suppliers through price-signals or market access. Bottom-up improvement projects are, in contrast, often led by NGOs in the hope of eventually cultivating new markets by using fishery improvement as a competitive advantage (California Environmental Associates, 2015, Tolentino-Zondervan et al., 2016b). Whether and how these FIP-derived conditions can be translated to AIPs aimed at mitigating shared production risk across inland and coastal landscapes remains unexplored.

The lack of consensus around the scale and definition of AIPs raises questions about how private actors, like buyers and NGOs, institutionalize risk management beyond the farm scale. This paper explores the extent to which different improvement models enable farmers to address production risk and environmental concerns beyond the farm scale. Clarity on how different AIP models 'institutionalize' risk management, by setting rules and conditions for organizing shared risk management strategies beyond the farm, opens up a wider discussion on the role of the private sector in mitigating environmental impacts in the aquaculture sector.

Two illustrative case studies representing different approaches to aquaculture improvement are compared (Figure 3.1). First, the 'top-down basic' Selva Shrimp AIP in Ca Mau (Vietnam); a public-private partnership designed to certify groups of black tiger shrimp farmers to a sustainability standard. Second, the 'bottom-up comprehensive' Hainan Tilapia AIP in Hainan (China); an alliance of actors in Hainan's tilapia value chain, designed to contribute to the sustainable development of Hainan's tilapia industry. Both projects display high export orientation and export to EU and North American markets (Wei Lynn Tang, 2018, Blueyou Ltd., 2018).

The following section presents an analytical framework for understanding how private actors institutionalize environmental risk management beyond farm scale. Section three then describes the methods used for data collection and analysis. Findings on the institutionalization of risk management in the two AIPs are presented in section four. Section five discusses the differences and commonalities between the two models of private-led aquaculture improvement and reflects on the private sector's capacity to institutionalize area-level risk management. The concluding section reflects on what findings suggest about the role of the private sector in leading aquaculture improvement and managing public resources at an area-level.

Figure 3.1 Location and scale of two case study sites
(Source: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community)

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3.2 Private-led institutionalization of area-level risk management

AIPs are institutionalized forms of voluntary collaboration between leading actors from the market, state and civil society, to reach a sustainability goal, often serving a combination of private and public interests (Bitzer et al., 2012, Bitzer and Glasbergen, 2010). Utilizing complementary resources and capabilities of members enable collaborating actors to deal with risk that they struggle to address individually, such as water pollution and disease (Bitzer and Glasbergen, 2015, Bitzer et al., 2012, Glasbergen, 2011). The following paragraphs outline three dimensions that are used in the rest of the paper to understand how and in what ways AIPs institutionalize risk management at spatial scales that extend beyond farm boundaries.

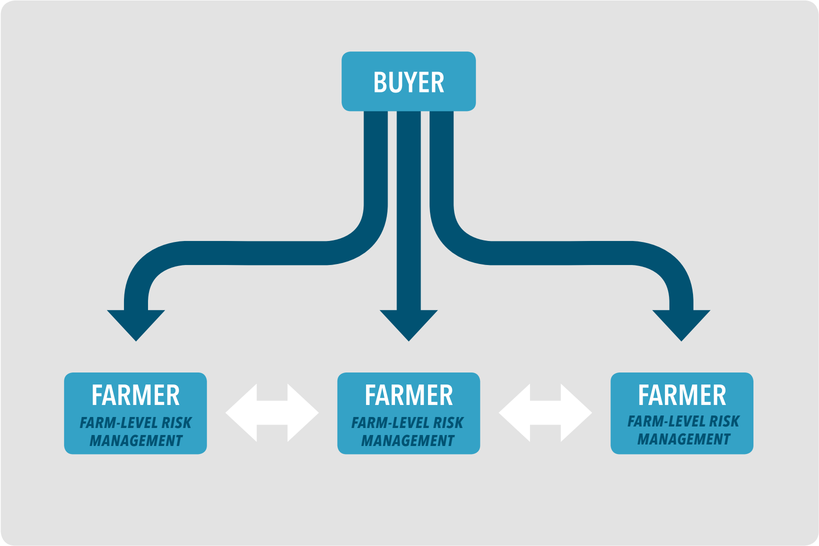
First, the roles of private actors in institutionalizing top-down basic and bottom-up comprehensive improvement projects are investigated. Top-down basic improvement projects are driven by buyers (California Environmental Associates, 2015, Wijaya et al., 2017) that assume a 'lead firm' role, and in doing so control the activities of producers (Ponte and Gibbon, 2005, Jespersen et al., 2014). Alternatively, bottom-up comprehensive improvement projects are often led by NGOs (Tolentino-Zondervan et al., 2016b), that take on the role of an 'intermediary' that fulfils a leadership role, bringing actors together and facilitating communication (Wijaya et al., 2017). It is expected that these different roles will influence how risk management objectives are defined, which mechanisms are used to coordinate relations between actors in AIPs, and ultimately the scale at which risk management takes place (Table 3.1).

Table 3.1 Assumed characteristics of two AIP models

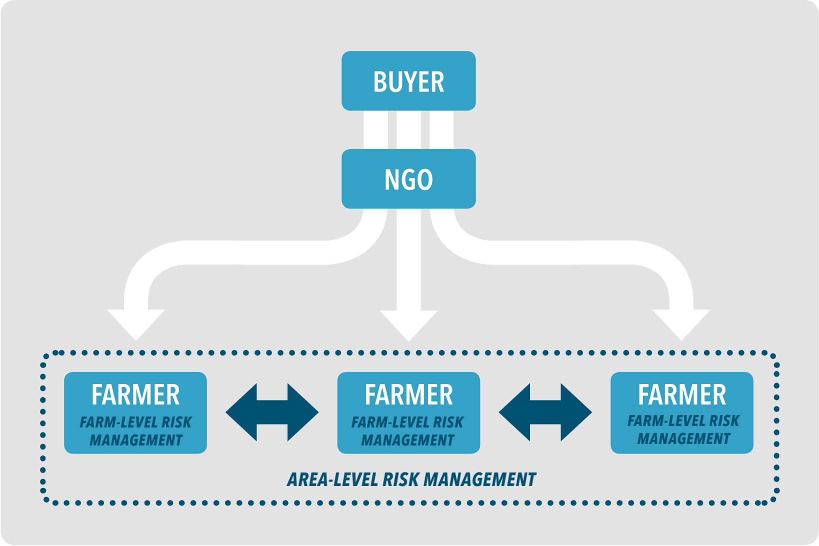
	Top-down basic	Bottom-up comprehensive
1. Leading actors	AIPs are led by buyers who assume a lead firm role.	AIPs are led by NGOs who assume an intermediary role.
2. Risk management objectives	AIPs are oriented toward addressing market risk and farm-level production risk.	AIPs are oriented toward addressing market risk and area-level production risk.
3. Coordination strategies	AIPs favor vertical coordination strategies that translate into farm-level production risk management.	AIPs favor horizontal coordination strategies that translate into area-level production risk management.

Second, the extent to which the risk management objectives set by leading actors address area-level production risk, as opposed to farm-level production and market risk, is investigated. In line with Bottema et al. (2018), farm-level production risk, such as input and water quality, are differentiated from area-level production risk, such as pollution or disease spread through a common water source. Market risk includes changes in price, failures in quality compliance, and poor access to production inputs and services (World Bank Group, 2016). Bottom-up comprehensive AIPs are assumed to be more concerned with area-level production risk given their focus on linking the practices and interests of farmers, government and civil society (Wijaya et al., 2018). In contrast, top-down basic approaches are assumed to focus on production and market risk that is managed at the farm-level. They are also assumed to be directly responsive to market incentives including both price and market access (Bitzer and Glasbergen, 2015) (Table 3.1).

Third, the coordination strategies applied in each AIP model to institutionalize their risk management goals are evaluated, reflecting on the extent to which these address area-level production risk. In doing so, a distinction is made between vertical and horizontal coordination strategies. Vertical coordination refers to the relations and agreements between two actors in different nodes of a value chain, whilst horizontal coordination refers to relations and agreements between actors in the same node of a value chain (Riisgaard et al., 2010). Top-down basic improvement projects are assumed to enable improved vertical coordination by buyers and, in doing so, enable farmers to reduce market risk by changing farm-level practices to comply with buyer requirements (Tolentino-Zondervan et al., 2016b). Alternatively, bottom-up comprehensive AIPs are assumed to focus more on horizontal coordination by building the capacity and organization of farmers (Tolentino-Zondervan et al., 2016b), to enable shared area-level management of production risk (Table 3.1 and Figure 3.2).



TOP-DOWN BASIC



BOTTOM-UP COMPREHENSIVE

Figure 3.2 Top-down basic and bottom-up comprehensive AIP models
Note: Model illustrates leading actors, favored coordination strategies and scale of risk management strategies. Arrows demonstrate vertical and coordination strategies; darker arrows indicate favored coordination strategy. (Designer: Luc Dinnissen, studio ds)

3.3 Methodology

The three analytical dimensions of institutionalizing risk management beyond farm boundaries outlined above are compared in the top-down basic Selva Shrimp AIP and the bottom-up comprehensive Hainan Tilapia AIP. These two AIPs represent exceptional cases in which contrasting attempts at introducing area-level risk management have been undertaken by buyers and NGOs. It is acknowledged that the wider contextual differences between the cases, including the different species farmed, geographical location and political context, may also explain variation in institutionalization. Nevertheless, the analysis is limited to a comparison of the three dimensions outlined above to provide a direct comparison of the two AIP models.

Field-work was conducted between April and May 2017. During this time 48 semi-structured interviews were carried out at the two study sites, followed by four follow-up interviews for further clarifications in April 2018. Interviews were conducted with NGOs, provincial and local government, researchers, farmer group representatives and value-chain actors including buyers, processors, collecting stations, middle men, hatcheries, feed companies and pharmaceutical companies. Interviews were structured using the three analytical dimensions outlined above. Access to the field sites and respondents was facilitated by Minh Phu Seafood Corporation and the Ca Mau Department of Agriculture and Rural Development (DARD) in Vietnam, and by the Hainan Tilapia Sustainability Alliance and China Blue Sustainability Institute in China.

Focus groups with farmers and secondary data collection complemented the interviews. Focus groups were conducted to understand farmers' perspectives on risk management and coordination strategies. In Ca Mau, six farmers were sampled from three Selva Shrimp certified farmer groups in Rach Goc town, located in Ngoc Hien district. In Hainan, eight Alliance member farmers in Wenchang county were sampled, all farms piloting the Code of Good Practices, a voluntary standard initiated by the Alliance. Secondary data in the form of websites, brochures, standards and reports were examined to verify information.

3.4 Results

3.4.1 Selva Shrimp: a top-down basic AIP

The Selva Shrimp AIP is led by two companies that cooperated in the application of the Selva Shrimp standard, designed to primarily manage farm-level production risk. In doing so the Selva Shrimp AIP set a price incentive for farmers to comply with farm-level requirements. As expected under a top-down basic AIP, very little coordination of farmers into coherent forms of horizontal collaboration to manage area-level production risk was observed. The following sections further characterize the Selva Shrimp AIP by explaining the role of the leading actors, risk orientation of private sector goals and the instruments used to foster coordination.

Leading actors

The Selva Shrimp AIP is a buyer-driven and processor-led AIP. It is a public-private partnership between Blueyou Consulting Ltd., Minh Phu Seafood Corporation and DARD Ca Mau. The dominant role of the two leading private sector actors has enabled them to condition contracts and relationships along the Selva Shrimp value chain.

Blueyou is an international consulting and services company that focusses on implementing sustainable fishery and aquaculture practices using market incentives (Blueyou Ltd., 2013). Minh Phu is Vietnam's largest seafood processor and DARD Ca Mau is a provincial office of the Ministry of Agriculture and Rural Development. The AIP combines zero-input shrimp farming with mangrove conservation, through the certification of approximately 400 integrated mangrove shrimp (IMS) farms. The project is located in Kien Vang forest in Ngoc Hien district, with groups of certified farmers located in Rach Goc town and Tan An commune.

Blueyou initiated the partnership and financed the project between June 2013 and December 2016 through support from the Dutch Sustainable Trade Initiative's (IDH) Farmers in Transition fund (The Sustainable Trade Initiative, 2018b). Blueyou developed the Selva Shrimp standard and trained farmers and a newly established Internal Control System (ICS) team. Minh Phu purchases and processes Selva Shrimp, which is sold to international buyers in the USA, Canada, China, Europe, Hong Kong and the Philippines through Blueyou (Blueyou Ltd., 2018). Minh Phu also runs the ICS team that trains, consults and inspects farmers. External audits for Selva Shrimp are carried out by Control Union, a third party auditor. Since IDH funding has stopped, Blueyou and Minh Phu continue to collaborate in this AIP, though roles have changed. Blueyou's current focus is brand development, marketing and sales of Selva Shrimp, whilst Minh Phu is fully responsible for implementation of the project.

The government's main role in the project is creating an enabling environment for execution of the project. A particularly important regulation in this project is Decision No. 111/QĐ-UBND, which encourages companies like Minh Phu and Blueyou to pilot a model for international certified aquaculture production in coastal forest areas. More specifically, the Decision stipulates the use of 'payments for environmental services', in which companies provide financial support to shrimp farmers protecting coastal mangrove forest on their land (Nguyen and Vuong, 2016). DARD is formally responsible for overseeing the Selva Shrimp AIP, but does not play a significant role in the implementation of the project. At a more local level, the Kien Vang Forest Management Board represents DARD by supervising the commitment between Minh Phu and project stakeholders and supports project implementation. Overall, however, the Selva shrimp AIP remains market-led, with strong control by both Minh Phu and Blueyou.

Risk orientation of private sector goals

The risk management objectives in the Selva Shrimp AIP reflect the priorities of Minh Phu and Blueyou, with a focus on farm-level mangrove conservation that addresses both farm-level production risk and market risk. The AIP does not appear to be inclusive of other area-level production risk that farmers claim to face, such as water pollution and flood risk.

The Selva Shrimp AIP combines aquaculture improvement with business-to-business services for sustainable shrimp sourcing and consumer marketing (Blueyou Ltd., 2016). By developing a shrimp standard and brand, and contractualizing actors along the value chain, both Blueyou and Minh Phu aim to reduce their supply risk and the overall reputational risk of shrimp aquaculture in Ca Mau. The production of shrimp for export - farmed, traded, and processed according to the Selva Shrimp standard - contributes to increased transparency, as well as secure access to and secure supply of black tiger shrimp for Minh Phu. Minh Phu additionally benefits from their collaboration with Blueyou through increased access to international buyers of shrimp.

Blueyou also states that Selva Shrimp creates economic incentives through the market to support more effective conservation of mangrove forests (Blueyou Ltd., 2016). In setting requirements for mangrove coverage in farms, Selva Shrimp aims to reduce the risk of sub-optimal yields prevalent in other extensive systems by contributing to the conservation of mangroves at both the farm and landscape level. Mangrove integrated shrimp aquaculture systems are considered more resilient to disease, as well as benefiting from more coastal protection and water quality afforded by mangrove forests (Lee et al., 2014, Joffre et al., 2015, Ha et al., 2012b, Bush et al., 2010). Questions persist over the landscape level benefits of farm-level mangrove conservation and production given healthy ecosystem function requires more than an optimal mangrove-to-pond ratio (Baumgartner et al., 2016, Baumgartner and Nguyen, 2017, Ha et al., 2012a, Koch et al., 2009). Nevertheless, the Selva Shrimp AIP's focus remains on the direct effects of protecting mangroves at the farm-level and on mitigating farm-level production risk for farmers.

Beyond mangrove coverage, no other shared area-level production risk is addressed by the Selva Shrimp AIP. Farmers meeting Selva Shrimp standards continue to experience shared production risk including disease, flooding and water pollution. The management of these types area-level production risk is not articulated in the objectives of the AIP. This suggests that the sustainability claims used to market shrimp from participating farmers are translated into a narrow focus on farm-level production risk management and mangrove conservation. This in turn leads to a mismatch between risk management objectives set by the two companies leading the AIP and the risk management priorities of farmers.

Instruments for coordination
Blueyou and Minh Phu apply a predominantly vertical form of contractualization to facilitate the group certification of farmers. The content and design of these contracts are aimed at managing farm-level production risk, with a focus on the conservation of mangroves. However, they do not move from the farm-level to address acute area-level production risk, like water pollution and flood risk, that farmers are concerned with, nor do they facilitate horizontal collaboration between farmers to address this type of risk.

The Selva Shrimp standard is made up of a Farming Operation standard, Farm Group Approval criteria and a Chain of Custody standard. The Farming standard is applied to farmers operating in Kien Vang Forest, though not every farmer in this area is certified. Selected farmers are divided into 11 farmer groups to ease communication with other farmers and organize training sessions. The Farm Group Approval criteria stipulates that group members must be in the same geographic proximity and have identical production systems. The group is the unit of approval, so the group as a whole is responsible for compliance. The criteria also stipulate that the group appoints a management body, which acts as the client for the external verification body (Blueyou Ltd., 2012b). In practice, this means the group appoints a leader that is responsible for disseminating information to farmers in their group, collecting harvest data, and supervising whether farmers produce according to the Selva Shrimp standard. As such, leaders are made responsible for supervising farm-level compliance.

The farm-level focus of the Selva Standard also means there is only weak facilitation of horizontal coordination between producers. The Farming Operation criteria mainly state requirements for on-farm management, including a clause requiring a minimum mangrove coverage of 40% (Blueyou Ltd., 2016). The only clauses specifically referring to managing area-level risk are those prohibiting the use of wild caught post-larvae and endangered species protection (Blueyou Ltd., 2015). The Farm Group Approval criteria states that a risk assessment must be carried out in order to identify possible threats with regards to any part of the Farming Operation Criteria, and states that procedures must be in place that address and mitigate the identified risk (Blueyou Ltd., 2012b). The Chain of Custody criteria focus on traceability of raw material collected (Blueyou Ltd., 2012a). Groups are free to choose how often they meet and there are no clauses that stipulate collaborative risk management among farmers in these groups.

Though collaborative risk management activities are not prescribed by the Selva Shrimp standard, group leaders claimed that farmers in their groups at times dredge collectively, buy and stock post-larvae collectively and communicate about disease. Though it remains ambiguous, findings imply that these forms of horizontal coordination are at least partially attributable to membership to Selva Shrimp groups. Industry and government respondents claimed that membership increased collaboration because farmers see each other more frequently due to training sessions. According to farmer respondents, dredging collectively takes place because a dredging calendar is stipulated by the government and pooling resources reduces costs. Buying and consequentially stocking post-larvae collectively is a form of horizontal coordination to increase access to high quality inputs, thereby addressing market and farm-level production risk. Thus, increased communication about disease appears to be the only form of horizontal coordination addressing area-level production risk that may be attributable to membership to Selva Shrimp groups.

The dominance of vertical, farm-level coordination of the Selva Shrimp AIP is reinforced through contracts between Minh Phu collecting stations, middle men and farmers. Farmers receive a price premium and the environmental service fee for maintaining 40% mangrove coverage on their farm. Collecting stations and middlemen receive instructions and training on product handling and transportation, and receive direct compensation for selling their products to Minh Phu. In addition, Minh Phu has expanded control over Selva Shrimp by assigning several recognized hatcheries from which certified farmers must buy post-larvae. Collectively, these various forms of vertical contractualization are attempts to incentivize greater transparency, quality improvements and secure supply, all of which are oriented to mitigating the market risk of Minh Phu and farm-level production risk of farmers.

3.4.2 Hainan Tilapia: a bottom-up comprehensive AIP

The Hainan Tilapia AIP is led by an NGO that plays an intermediary role in coordinating risk management through a multi-stakeholder alliance and by improving tilapia production quality through a Code of Good Practices (CoGP). The risk management objectives of the AIP are to manage both farm-level and area-level production risk. Though the AIP has improved relations between value chain actors, it has not linked improved production of Hainanese tilapia with a pricing arrangement or a long-term commitment from a buyer. Given the broad geographical distribution of farmers in the AIP, limited horizontal cooperation between farmers has been achieved. The following sections characterize the Hainan Tilapia AIP by analyzing the role of the NGO intermediaries, their ability to coordinate the risk orientation of farmers and buyers, and the extent to which they foster both vertical and horizontal coordination.

Leading actors

The Hainan Tilapia AIP is based on the multi-stakeholder Hainan Tilapia Sustainability Alliance that aims to strengthen relations between actors in the value chain, provide a common voice for the industry and to develop a CoGP for Hainan's tilapia industry. The Alliance is a Chinese registered NGO with membership comprised of 90 farmers and nine companies - including hatcheries, feed agents (that often play a dual role as collectors), pharmaceutical agents, processors and one U.S. buyer. The AIP operates at the provincial scale with farmers spread over five counties on Hainan.

The AIP was initiated by SFP in 2011 recognizing that, given 95% of Hainan's tilapia is exported to the United States and Europe (Wei Lynn Tang, 2018), a market-driven approach to improvement could prove effective. SFP also played a central role in the design of the AIP after an initial round of scoping studies to map out the Chinese tilapia supply chain and field studies on Hainan to assess disease risk and the environmental impact of tilapia farming (Sustainable Fisheries Partnership, 2016). Based on these studies, SFP organized a first Aquaculture Policy Roundtable in 2012 to engage key tilapia processors, farmers, hatcheries and feed suppliers in Hainan (Sustainable Fisheries Partnership, 2018a).

Following a number of local roundtables, five key tilapia stakeholders in Hainan signed an MoU with SFP in 2013 to launch the Alliance with support from IDH's Farmers in Transition fund (Sustainable Fisheries Partnership, 2016, The Sustainable Trade Initiative, 2019d). SFP continued to play an ongoing intermediary role after initiating the AIP by organizing roundtables with suppliers in North America and by building trust among stakeholders in Hainan (Sustainable Fisheries Partnership, 2016). In 2016, SFP took a step back and the Alliance now leads the AIP, with the China Blue Sustainability Institute, a Chinese NGO, as an ongoing advisor.

The Alliance currently plays the role of leader and intermediary in the Hainan Tilapia AIP. It unifies private sector actors in Hainan, acting as an intermediary between farmers, hatcheries, feed agents, processors and buyers. Furthermore, the Alliance represents the industry as a whole in dialogue with the government and in efforts to promote Hainan's tilapia internationally. The Alliance also funds a group of technicians that train and collect data from member farmers. Though local government is involved during capacity building activities with farmers, the provincial government has not been actively involved during development of the Alliance. However, the Alliance regularly communicates with the provincial government about the Alliance's progress and to receive information about industry development.

Risk orientation of private sector goals

As leading NGOs, the Alliance and SFP defined risk management objectives with a clear focus on managing area-level production risk. SFP were particularly influential in setting an agenda for area-level risk management building on their wider program of 'zonal' management (Sustainable Fisheries Partnership, 2016). By piloting a zonal management approach in Hainan they aimed to address area-level production risk, such as discharged farm effluents and escaped tilapia (Sustainable Fisheries Partnership, 2012, Sustainable Fisheries Partnership, 2016).

Like SFP, the Alliance also exhibits a clear focus on managing area-level production risk through their four main goals (Hainan Tilapia Sustainability Alliance, 2014). The first, to minimize negative environmental impacts caused by tilapia aquaculture in order to reduce regional disease outbreaks, is clearly directed toward minimizing area-level production risk. The second goal, to enhance transparency, traceability and production efficiency within the supply-chain, demonstrates that the Alliance aims to minimize market and farm-level production risk. The third goal, to build up buyers' and customers' recognition and trust in

Hainanese tilapia, is also aimed at reducing market risk, particularly reputational risk and price risk caused by changing demand. The fourth goal, to obtain governmental support for the sustainable development of Hainan's tilapia industry, focusses on influencing the regulatory environment. This last goal emphasizes an increasing recognition for the importance of government support in overcoming institutional challenges.

Aligned with the market-oriented goals of AIPs, the reduction of market risk, particularly price and reputational risk, also appears to have been an important motivator for involvement of local actors. Interviews with NGOs demonstrated that conflicts in the supply chain, resulting from a combination of market and area-level production risk, provided impetus for the development of the Alliance. In 2012, the initial president of the Alliance, a large feed agent in Hainan, started speaking publicly about the volatility of tilapia prices, partially caused by a serious incidence of streptococcal related disease outbreaks. Low fish supply caused prices to peak, leading to increased competition between feed agents that play a dual role as collectors. This led to a strike among the feed agents and caused friction between farmers, feed agents and processing factories. This illustrates that this AIP emerged from a combination of area-level production risk, price risk and supply risk. However, as expected from bottom-up improvement projects, market access appears to be more of a secondary goal.

Instruments for coordination

Both vertical and horizontal coordination strategies are used to facilitate communication between value chain actors and to realize the adoption of the CoGP standards. Despite the inclusion of area-level production risk in the design of the CoGP, and capacity building efforts, the leading NGO struggles to successfully facilitate horizontal collaboration between farmers. Furthermore, vertical coordination strategies have failed to result in permanent pricing arrangements between farmers and buyers.

The CoGP, developed in consultation with a large amount of local stakeholders and experts, contains clauses specifically aimed at managing area-level production risk. The first version was drafted in 2015 and tested on ten pilot farms. A group of technicians collected data on pilot farms and trained farmers in sessions that were also open to non-members. The CoGP was revised in 2016 and applied in 35 farms (Hainan Tilapia Sustainability Alliance, 2015, Hainan Tilapia Sustainability Alliance, 2016). By 2017, 41 farms applied the CoGP standard, with technicians measuring water quality at monitoring stations in pilot farms and providing farmers with ongoing technical support.

The CoGP standard was inspired by the Code of Good Practice for Scottish Finfish Aquaculture of the Scottish Salmon Producer's Organization, an industry association that applies area-based management principles (Scottish Salmon Producers Organisation, 2015). Next to standards for farm-level management, the Hainan CoGP contains several risk management strategies specifically aimed at preventing impacts to the environment, such as waste water management and prevention of escapees. More notably, and distinguishing it from other standards in aquaculture, the CoGP features several clauses for collaborative risk management, including communication about diseases and community collaboration (Hainan Tilapia Sustainability Alliance, 2016).

However, despite CoGP clauses aimed at encouraging collaboration between farms, the Alliance has not yet been successful in facilitating horizontal collaboration between farmers. Alliance farmer members were organized into five zones according to county, several of which have sub-areas. Membership is scattered, so neighboring farmers are not necessarily Alliance members. Furthermore, even if they are members, they may sell to different buyers and thus belong to different value chains. Attempts to encourage collaboration between farmers sharing a reservoir have also not been successful because of competition between farmers and trust issues resulting from a landscape shared by local and immigrant farmers. Though the training sessions and ongoing technical support have increased linkages between farmers to some degree and the Alliance encourages information-sharing, the majority of farmer respondents argued that the Alliance has not enabled stronger communication on shared risk management between farmers. The 'individualistic nature' of farmers, competition for markets and the lack of financial incentive for Alliance membership were stated as possible reasons. The latter indicates that financial incentives are important to farmers, which is difficult in AIPs where market access appears to be more of a secondary objective. However, as seen in Ca Mau, farmers in Hainan did collaborate with neighbors, relatives and friends outside the AIP to manage area-level production risk and market risk. They manage area-level production risk through building and maintaining canals and providing mutual assistance after weather events like storms and floods, and manage market risk by collectively bargaining prices with processing companies and collectively buying feed and fingerlings.

The Alliance appears to have been more successful at facilitating communication between its members in other ways; on the one hand improving communication among non-farmer members and on the other hand improving communication between farmers and feed agents, hatcheries, processors and buyers. This improved relations in the industry and arguably contributed to the reduction of market risk through increased transparency and information-sharing. The Alliance acts as a communication platform for actors in Hainan's supply chain and respondents claim it has enabled improved communication between members through an annual meeting, regular Board meetings and improved direct communication between members.

The Alliance also facilitated vertical coordination between several farmer groups and companies, in attempts to decrease market risk. The Alliance linked farmer groups to companies, such as processors, feed agents and pharmaceutical providers, in short-term initiatives to encourage the collective marketing of fish, collective purchase of inputs and increase capacity for farm-level certification. For example, in a project sponsored by a processor, the project rewarded farmers with a financial prize for reaching their sales target whilst producing according to the standard defined by the processor. However, none of these initiatives were reported by respondents as having resulted in increased collaboration between farmers aimed at area-level risk management. Likewise, no partnerships emerged which resulted in permanent price agreements between buyers and farmers.

3.5 Discussion

The Selva Shrimp AIP and Hainan Tilapia AIP present contrasting models of organizing and scaling private-led aquaculture improvement. By combining an analysis of the role of the leading actors, the risk orientation of private sector goals and the instruments used to foster coordination, the results demonstrate the extent to which different AIP models can foster improved collaborative management of shared and public risk in the aquaculture sector.

The results confirmed many of the expected differences between top-down basic and bottom-up comprehensive AIPs (as summarized in Table 3.1). However, the two cases also raise questions around the capacity of private sector actors to institutionalize area-level production risk management and the scale at which this should take place. Building on existing research into area-based aquaculture management highlighting the need for collective action to address environmental risk (Soto et al., 2008, Aguilar-Manjarrez et al., 2017, Kassam et al., 2011, World Bank, 2014), this research demonstrates that horizontal collaboration between farmers to manage area-level risk is necessary for the management of production risk outside the private boundaries of individual farms. In both cases leading actors struggled to induce horizontal collaboration between farmers to manage area-level risk. The results indicate three 'misalignments' between the institutionalization of AIPs and the social and environmental conditions of farmers that explain the limited extent of area-level risk management.

First, the results reveal a mismatch between the manner in which leading actors in top-down basic and bottom-up comprehensive AIPs institutionalize risk management and the manner in which production risk is experienced by farmers. Confirming the hypothesis outlined in section two of the paper, the findings indicate that bottom-up comprehensive AIPs tend to be more inclusive of area-level production risk, whilst those designed by buyers in top-down basic AIPs tend to have a stronger farm-level orientation and do not take into consideration the area-level risk experienced by farmers. The Selva Shrimp AIP narrowed down risk management goals to a number of standardized issues which tended to facilitate vertical coordination strategies designed to control private farm-level production risk and contribute to mangrove conservation. These findings suggest that prioritizing vertical coordination strategies that exclude the type of local area-level risk that binds farmers together limits the capacity of leading actors to induce horizontal collaboration between farmers. In contrast, the intermediary role played by NGOs in the bottom-up comprehensive AIP in Hainan enabled them to induce dialogue between value chain actors and facilitated research into area-level risk. As a result, the AIP took into account the risk priorities of farmers, including those outside the farm. However, despite this, and contrary to the hypothesis, this bottom-up comprehensive AIP did not enable the creation of strong horizontal coordination between farmers, limiting the extent to which area-level risk management was institutionalized.

Second, the capacity of leading actors to make a clear claim in the market and link this to a price incentive is key for binding farmers to an improvement project, but this capacity appears to be higher when risk is defined at farm rather than area-level. Reflecting research by Tolentino-Zondervan et al. (2016b), the findings illustrate that lead firms in top-down basic AIPs demonstrate a higher capacity to make marketable claims and deliver price-related incentives to farmers than NGOs leading bottom-up comprehensive AIPs. The Selva Shrimp AIP focused on a limited amount of issues, enabling leading actors to make claims on the market, based on zero-input production and mangrove conservation, and link this with price incentives. In contrast, the leading actors in the Hainan Tilapia AIP were unable to create a long-term pricing arrangement for Alliance farmers producing tilapia according to the CoGP standard. Though this may be in part attributed to the quality and price of tilapia, it may also be attributable to the wide range of risks the AIP intended to address. This would suggest that the more diverse and amorphous claims are, the more difficult it is to link to a price incentive, proposing that markets perhaps struggle to deal with multiple (area-level) claims.

Third, there appears to be a discordance between the scale at which production risk management is institutionalized by the private sector and the scale at which this is organized by farmers. Farmers in both cases collaborated with family and friends to manage production risk that has a direct impact on production at a local level. Although farmer's interests were included in the design of the bottom-up comprehensive AIP in Hainan, farmer membership was often dispersed and farmers were engaged in different value chains. As a result, membership to the Alliance did not resemble the scale at which farmers have long-standing collaborations. Though the Selva Shrimp standard in the top-down basic AIP in Ca Mau less accurately reflected the risk priorities of farmers, the spatial scale of Selva Shrimp group certification is arguably more likely to lead to collaboration, because the farmer groups more closely resembled the social networks in which farmers were already collaboratively managing risk. Building on Joffre et al. (2019) and in line with Bottema et al. (2018), the results presented above suggest that taking existing social networks as a spatial and institutional unit may be a more appropriate scale for managing shared area-level risk. If external actors wish to intervene, they should then better align themselves to the spatial and social characteristics of how farmers are already interacting with each other to manage risk.

Based on the above observations three scenarios provide a basis for thinking further about future AIP designs taking into account area-level risk management.

In a first 'business-as-usual' scenario, AIPs will continue to be defined as top-down basic improvement projects or bottom-up comprehensive improvement projects. Maintaining these two separate approaches will likely mean that top-down basic AIPs will continue to be led by farm-level logics, focusing on the management of farm-level production risk and failing to address area-level production risk, while bottom-up comprehensive AIPs will continue to struggle to link claims in the market for area-level improvements to price incentives. This dichotomous way of understanding the institutionalization of risk management through AIPs does not appear to lead to long-term and effective risk management at an area-level. As illustrated in this paper, there are elements of both top-down basic and bottom-up comprehensive AIPs that should be taken into consideration to achieve area-level production risk management. Thus, a second and third scenario include features of top-down basic and bottom-up comprehensive AIPs to build toward more integrative approaches.

In a second scenario, the top-down basic AIP model focusing primarily at the farm-level can be made more effective in managing shared risk by better integrating farmer perceptions of risk and the scale at which they currently organize risk management into its design (Figure 3.3). Reflecting farmers' risk priorities, including locally experienced area-level risk, in the design of assurance models (for example, those using standards) potentially facilitates the recognition, stimulation and incentivization of shared production risk management. Additionally, when organizing farmers into groups, top-down AIPs should not simply group farmers according to their geographical location or proximity to a water source, but instead build on existing social networks within which farmers already collaboratively manage production risk, thereby building on existing cooperative social relations (see Bottema et al. (2018)). This scenario can as such enhance existing forms of collaborative risk management, and presents a far more inclusive and scalable approach to risk management than an aggregate of farm-level certification.

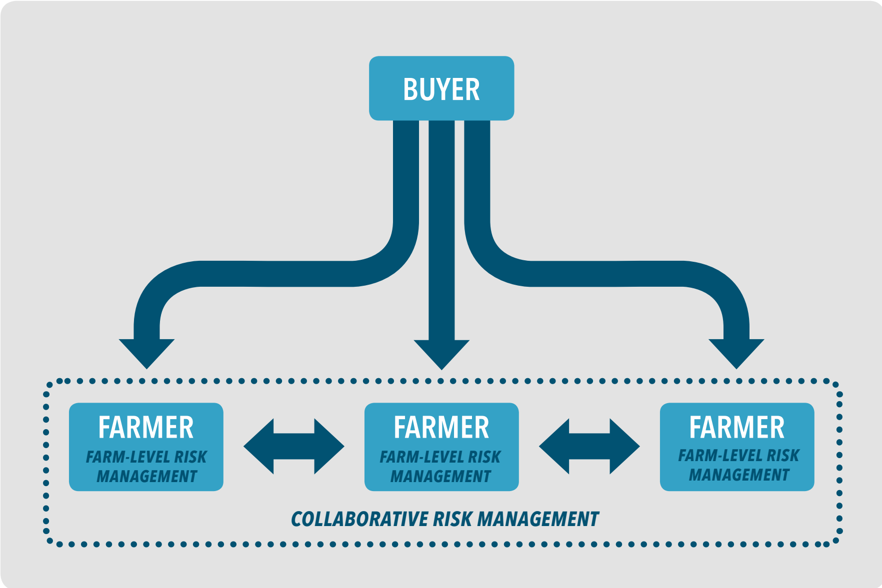


Figure 3.3 Scenario for top-down basic AIPs incorporating collaborative risk management
Note: Model illustrates leading actors, favored coordination strategies and scale of risk management strategies. Arrows demonstrate vertical and horizontal coordination; darker arrows indicate favored coordination strategies. (Designer: Luc Dinnissen, studio ds)

In a third scenario, bottom-up comprehensive and top-down basic AIPs develop a more synergistic stepwise approach to improvement, building on their respective strengths (Figure 3.4). To enable a positively reinforcing relationship between these two concepts, a two-phase model is envisaged. In the first phase, a bottom-up comprehensive AIP sets the stage for later top-down engagement. A landscape is selected within which leading actors work on building farmer's capacity and awareness for shared risk management, until a basic level of improvement or area-level production risk management is reached. In the second phase, more top-down basic approaches to improvement are taken in which buyers link with farmer groups and make more specific claims within this broader landscape, possibly linked to an adapted group or landscape certification (Aquaculture Stewardship Council, 2019c, Kramer, 2017).

Understanding top-down basic and bottom-up comprehensive models for improvement in the aquaculture sector as complementary to each other reflects similar findings on improvement projects in the fisheries sector (Tolentino-Zondervan et al., 2016b). Taking such a integrative approach also goes beyond the dualistic either/or thinking associated with these models and instead focuses on where and how top-down basic and bottom-up comprehensive models can reinforce each other, based on their relative strengths.

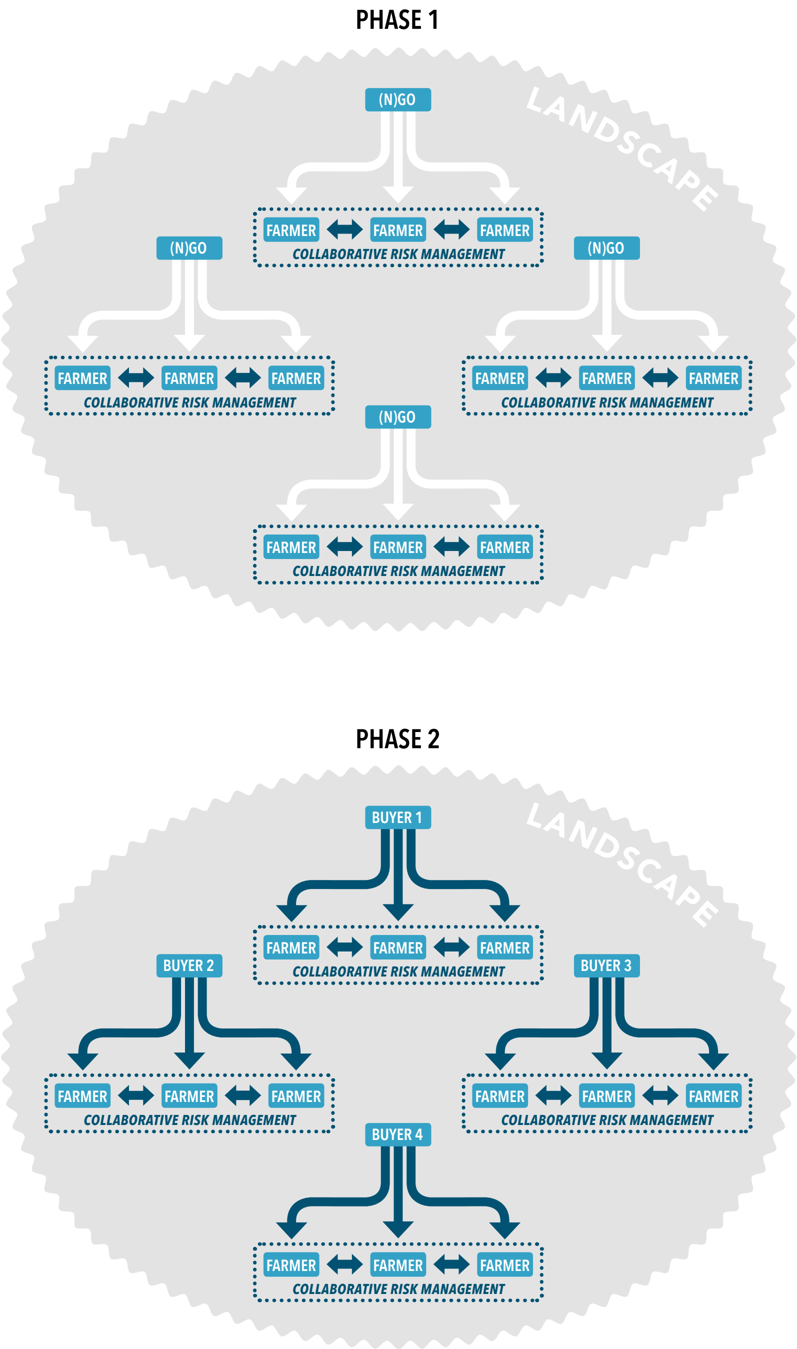


Figure 3.4 Scenario for AIPs using an integrated stepwise approach to landscape scale improvement
Note: Model illustrates leading actors, favored coordination strategies and scale of risk management strategies. Arrows demonstrate vertical and horizontal coordination strategies; darker arrows indicate favored coordination strategies. (Designer: Luc Dinnissen, studio ds)

3.6 Conclusion

Current AIP models struggle with institutionalizing risk management at an area-level because of the limitations they face when attempting to induce horizontal collaboration between farmers to collectively manage shared production risk. As demonstrated in this paper, this can be attributed to the private sector's lack of capacity to effectively align the institutions they design with the social and environmental conditions of farmers, which impacts the degree to which they can foster area-level approaches to risk management.

Moving forward, those designing and implementing AIPs with ambitions of area- or landscape-level improvement need to better define the scale at which risk management can be institutionalized. As also seen in the application of FIPs in the fisheries sector, large-scale improvement in aquaculture cannot be attained by only certifying or improving individual units of production. At a minimum this will involve breaking down the pre-occupation of risk management at the level of individual aquaculture farms and build on existing social relations between farmers. In doing so, adjusted (potentially integrated) models of top-down basic and bottom-up comprehensive AIPs can be implemented that more effectively foster risk management linked to public resources at spatial scales that better reflect the goals of landscape or ecosystem governance.

For AIPs to make a contribution to area-level risk management, a fundamentally social approach for organizing collective production risk management is needed. As this paper demonstrates, any AIP intervention would benefit from an improved understanding of the social networks through which farmers manage locally shared production risk. Building on the framework developed here, attention should be given to role of the leading actors, the risk orientation of different actors and the instruments used to foster both vertical and horizontal coordination. Based on this framework, further research into the scale and design of institutionalized area-level risk management is recommended to investigate the most effective way to induce horizontal collaboration between farmers and encourage collective risk management beyond farm boundaries.

Finally, any attempt to move to area-level risk management will require transcending dualistic categories of 'top-down basic' and 'bottom-up comprehensive' and designing more integrative AIP models. For such models to succeed, however, long-term obligations and investment by private actors are needed. This raises the question of whether it is in the interest of private actors to make such commitments in order to manage fundamentally public interests, and calls for attention to the role of the public sector. Moving forward, therefore, a deeper understanding of the capacity of both private *and* public actors to overcome challenges associated with institutionalizing risk management at an area-level is needed, both in and outside AIPs, in order to determine the most appropriate approach to shared risk and public resource management for the aquaculture sector.

CHAPTER 4

Territories of state-led aquaculture risk management: Thailand's Plang Yai program

This chapter has been published as:
Bottema, M. J. M., Bush, S. R. & Oosterveer, P. 2020. Territories of state-led aquaculture risk management: Thailand's Plang Yai program. *Environment and Planning C: Politics and Space*, 0(0), 1-21.

Abstract

The Thai aquaculture sector faces a range of production, market and financial risks that extend beyond the private space of farms to include public spaces and shared resources. The Thai state has attempted to manage these shared risks through its Plang Yai (or 'Big Area') agricultural extension program. Using the lens of territorialization, this paper investigates how, through the Plang Yai program, risk management is institutionalized through spatially explicit forms of collaboration amongst farmers and between farmers and (non-)state actors. We focus on how four key policy instruments brought together under Plang Yai delimited multiple territories of risk management over shrimp and tilapia production in Chantaburi and Chonburi provinces. Our findings demonstrate how these policy instruments address risks through dissimilar but overlapping territories that are selectively biased toward facilitating the individual management of production risks, whilst enabling both the individual and collective management of market and financial risks. This raises questions about the suitability of addressing aquaculture risks by controlling farmer behavior through state-led designation of singular, spatially explicit areas. The findings also indicate the multiple roles of the state in territorializing risk management, providing a high degree of flexibility, which is especially valuable in landscapes shared by many users, connected to (global) value chains and facing diverse risks. In doing so we demonstrate that understanding the territorialization of production landscapes in a globalizing world requires a dynamic approach recognizing the multiplicity of territories that emerge in risk management processes.

4.1 Introduction

The production risks that aquaculture farmers located in diverse landscapes are faced with are varied and complex (Joffre et al., 2019, Alam et al., 2019). Many risks are not restricted to individual farmers nor bound within the territory of a farm. For example, area-level production risks like disease and water quality affect multiple farmers and the surrounding landscape in shared spaces (World Bank, 2014). In turn, responses aimed at mitigating these shared risks have emerged that fall under the broad headings of 'beyond-farm' or 'area-based' aquaculture management (Bush et al., 2019, Aguilar-Manjarrez et al., 2017). While considerable attention has been given to private forms of area-based aquaculture management, including farmer collectives and market-driven initiatives (Kassam et al., 2011, Ha et al., 2012a), less attention has been given to public, state-led, approaches involving spatially explicit programs and instruments. It therefore remains unclear whether state-led beyond-farm aquaculture governance can overcome individualistic behavior and foster the collective management of risks linked to the management of public resources such as land and water (Beitl, 2014, Galappaththi and Berkes, 2014).

An exceptional case of state-led governance of shared aquaculture risks is the Thai government's 'Plang Yai' program; an explicitly spatial agricultural extension program initiated in 2015 by the Ministry of Agriculture and Cooperatives (MoAC). Plang Yai applies an area-based approach that encourages cooperation between farmers in specific areas. The program, chaired by the Department of Agricultural Extension (DoAE), aims to improve farm management to reduce production costs and increase productivity, and to improve product quality to enable access to new markets. It is applied for more than 70 agricultural species, and in 2018 there were 70 Plang Yai projects with aquaculture species. While Plang Yai is spatially explicit, translating as 'Big Area', it is unclear as to whether the program promotes the collective management of risks in public areas, or whether Plang Yai projects represent areas within which numerous individuals manage risks within the boundaries of their own farm.

Plang Yai projects are implemented using four main policy instruments. First, farmers, generally in sub-districts, are grouped on a voluntary basis. Second, these groups are encouraged to form formal cooperatives. Third, every aquaculture farmer in Plang Yai is encouraged to get Thai GAP certification. Fourth, as part of Thailand's modern agricultural approach stimulating public-private sector engagement, farmers are matched with private companies to form small Public-Private Partnerships (PPPs), referred to as 'Pracharat'. Plang Yai distinguishes itself from preceding programs, such as One Tambon One Product, that focused on marketing local products (Dressler and Roth, 2011), by addressing risks throughout both the marketing and production process.

The spatially explicit nature of risk management through Plang Yai can be understood as a process of territorialization. Territorialization is commonly understood as a top-down state-led process, creating territories through the delineation of boundaries within which claims of authority and control are enacted (Vandergeest and Peluso, 1995). Territorialization has been used to examine the consequences of spatial forms of conservation, like national parks, on people and ecosystems (Adams, 2020, Raycraft, 2019, Bluwstein and Lund, 2018). Attention has only recently been given to the territorialities of more diffuse environmental phenomenon such as aquaculture production risks across more 'fluid' (i.e. less clearly bounded) coastal and marine spaces. Vandergeest and Unno (2012), for instance, demonstrate how the transnational eco-certification of Thai aquaculture farmers creates territories in which global certification agencies claim extra-territorial rule-making and -enforcement authority in ways that pre-empt state territorial control. Building on that, Vandergeest et al. (2015) also investigate how eco-certification remakes territory, redefining territorial sovereignty but also potentially leading to positive environmental outcomes. Together, these authors raise questions about how states engage with global markets in maintaining territories of sovereign control, as well as highlight both processes of marginalization and opportunities for addressing environmental risks within these territories.

In this paper we examine how the Thai state shapes the management of shared and spatially diffuse aquaculture risks through Plang Yai and how this is manifested through the creation of layered 'risk-territories'. In particular, we examine the coordinating role of the state in spatially delimiting risk management through Plang Yai's four overlapping policy instruments. By doing so we extend an understanding of how state-led territorialization of an industry like aquaculture can contribute to the collaborative management of shared risks and the public resources upon which the industry depends.

The following section presents an analytical framework for understanding the institutionalization of risk management through a territorialization lens. We then describe the methods and introduce our two study sites, before presenting the results and discussing how multiple territories of risk management are shaped through the Plang Yai program. The final section reflects on the spatial management of aquaculture risks and the state's role in institutionalizing the management of shared aquaculture risks.

4.2 State-led territorialization of aquaculture risk management

Vandergeest and Peluso's (1995) seminal analysis of territorialization focused on strategies by the Thai state to control natural resource users' actions through mapping land boundaries, allocating land-use rights and designating resource use. Their work has been subsequently used to further an understanding of the powers of the state to include and exclude people under a range of resource use and conservation arrangements in Thailand and beyond (Roth, 2008, Raycraft, 2019). Others have challenged notions of territorialization that, they argue, overemphasize the structural power of the state, and examine how territorial control is resisted or shaped by resource users (Bluwstein and Lund, 2018, Rasmussen and Lund, 2018). Thus, contemporary notions of territorialization increasingly ascribe agency to local resource users (Raycraft, 2020), and to non-human actants such as fish and wildlife (Bear, 2013), to continuously negotiate and renegotiate spatial boundaries.

A dynamic and co-produced notion of territories is useful, we argue, for understanding how spatially explicit approaches for risk management are negotiated between the state and local farmers in an industry that concurrently feeds and responds to (global) market demand. Under such conditions, the state is unable to have complete control in responding to the diversity of risks facing the industry. Therefore, we suggest a more dynamic understanding of territorialization is needed that draws attention to the continual (re)negotiation and (re)production of boundaries by local, private and public actors with different objectives (Bear, 2013). This dynamic understanding also extends beyond a unilateral focus on the state to include negotiation and implementation of multiple territorial boundaries by public and private rules, standards and policies dealing with different risks simultaneously (Vandergeest and Unno, 2012, Foley and Havice, 2016). In such cases, we argue, multiple territories of risk management may emerge that contribute to the enactment of (public or private) authority and control.

Drawing on Vandergeest et al. (2015), we analyze the formation of multiple territories of risk management through four policy instruments as an active 'governing' process of boundary-formation that 'assembles' four elements – subjects, expertise, objects of concern and space. This approach also builds on a recognition of the decentered nature of boundary-formation (see Bear 2013), to reveal the agency of both state and non-state actors to assemble heterogenous elements and in doing so co-shape these territorial boundaries. By focusing on how such instruments actively assemble subjects, expertise, objects of concern and space, we determine how they shape new territories of risk management which contribute to wider goals of 'improved' aquaculture production.

First, we focus on the identification, inclusion, exclusion and control over *subjects* of risk management (Bear and Eden, 2008). Vandergeest et al. (2015) define subjects as actors who are allocated use rights and the authority to manage objects of concern within rules set by (non-)state authorities. In this study, subjects are understood to be human actors and the institutions that guide risk management. As such, we focus on the manner in which aquaculture farmers and other actors involved in Plang Yai projects are enrolled and organized into networks, and how they react and interact to negotiate (new) forms of collaborative risk management. Our analysis also extends to the manner in which actors collaborate to manage risks at a local level and the informal institutions that may facilitate or deter collaborative risk management.

Second, we study the manner in which *expertise* defines boundaries. Expertise, inherently interactional (Carr, 2010), is understood as the way that knowledge is applied and transferred to produce rules that define the risks addressed (Vandergeest et al., 2015). Though studies have predominantly focused on the role of state expertise in territorialization processes

(Vandergeest and Peluso, 2015, Vandergeest and Peluso, 1995), the scope of literature on territorialization has gradually broadened to understanding the interplay of state and non-state actors (Foley, 2017, Corson, 2011). Lund (2015) highlights tendencies to rely on approaches and information systems that privilege 'professional' forms of knowledge over local resource users' knowledge. Hence, we acknowledge that both state and non-state expertise, for example that of farmers and processing companies, plays a role in shaping boundaries.

Third, we examine the *objects* of concern, translated as the risks targeted by these instruments. This focus on risk as the focal object of concern differentiates this research from previous studies applying the same framework (Vandergeest et al., 2015, Toonen and Bush, 2018). There are multiple risks associated with aquaculture, and this research focusses on production, market and financial risks (Meuwissen et al., 2001). In line with Bottema et al. (2018), this study further differentiates between individual and shared risks, as we are interested in whether and how Plang Yai addresses management of public risks. For example, water quality and input quality are individual production risks, but disease and water pollution are shared production risks, manifested at an area-level. These socially mediated risks (Beck, 2009) are influenced by the subjects (and their institutions), and the expertise used to define and mitigate them. We therefore focus on the type of risks that each policy instrument aims to manage, how farmers understand these and how farmers act (individually and collectively) through the risk mitigation strategies they apply.

Finally, we analyze the manner in which *space* is designated through these policy instruments. Recognizing that there are multiple co-existing spaces and interpretations of space (Massey, 2005, Murdoch, 1998), spaces emerging through processes of state-led territorialization may not match how spaces are created in response to policy instruments at the local level. We study the manner in which boundaries are defined through the policy instruments, with specific attention for whether they address public areas within which risks are shared. Furthermore, we explore the manner in which aquaculture farmers are spatially organized, to determine what state-defined spatially delimited areas actually mean to farmers.

4.3 Methodology and study sites

4.3.1 Methods

Plang Yai's four key policy instruments are analyzed using the four analytical dimensions of boundary-formation. We focus on the intended objectives of these instruments from the state's perspective and how local actors enrolled in two Plang Yai projects contribute to the processes of boundary-formation, thereby recognizing that these actors are not simply responding to state-led territorialization, but are actively involved in this process. The first project features shrimp production in Kung Krabaen Bay, Chantaburi province. The second project features tilapia production in Chonburi province. The comparison of these projects aims to draw out commonalities from case studies that are dissimilar thanks to the different risks represented by farmed species and production systems, and the different ways in which local actors collaborated before Plang Yai.

Fieldwork took place between January and March 2017, with follow-up interviews in September 2018. In total, 67 semi-structured interviews were conducted at national, provincial and local levels. Eighteen government officers at national and provincial level were interviewed; officers from the DoAE, Department of Fisheries (DoF), Department of Irrigation (DoI), Land Development Department (LDD) and Cooperative Promotion Department (CPD). Seven non-governmental actors were interviewed in Bangkok, representing NGOs, researchers and processing companies.

To investigate how Plang Yai shaped farmers' conduct in managing risks at a local level, 12 government officers and 30 local stakeholders were interviewed at the two project sites. Local stakeholders included farmer leaders, researchers, and value chain actors, including input suppliers, middle men, and processing companies. In Kung Krabaen Bay, a focus group with five, male and female, farmers was held. In Chonburi, a focus group with seven male farmers was held. In both sites, one key informant introduced the researcher to initial participants, and snowball sampling was used to find additional participants. Though the farmer leaders were to a certain extent able to present the perspective of 'typical' farmers, other individual farmers were not interviewed for this research paper, which poses a limitation to this study. Secondary data in the form of policy documents and websites were examined to validate the primary data collected on the objectives of the policy instruments.

4.3.2 Kung Krabaen Bay Shrimp Plang Yai

The Kung Krabaen Bay Shrimp Plang Yai project was initiated in 2016. The site is located in a small bay lying on the border of Na Yai Am and Tha Mai districts in Chantaburi province (Figure 4.1). The bay hosts 210 adjacent intensive shrimp and fish farms, located along a shared irrigation canal (Satumanatpan et al., 2011). The farmed shrimp was sold to domestic and export markets. The Plang Yai project was initiated with the Kung Krabaen Bay Fisheries Cooperative, which was in serious debt due to disease outbreaks in the 1990s. This project differs from many other Plang Yai projects because the cooperative was formed long before the implementation of Plang Yai. Furthermore, Kung Krabaen Bay was already a national example of integrated landscape management as it hosts the Kung Krabaen Bay Royal Development Study Centre, founded in 1981 to serve as a shrimp culture demonstration area (Boonsong, 1997). In 2018, 193 farmers were enrolled in the project, which covered an area of 574 rai[1] (92 ha).

1 A rai is a unit of area commonly used in Thailand, equal to 1,600 square metres

4.3.3 Chonburi Tilapia Plang Yai

The Chonburi Plang Yai project was also initiated in 2016. The project involves tilapia farmers from Pan Thong and Phanat Nikhom districts in Chonburi province (Figure 4.2). The central government recognized Chonburi as a potential location for a Plang Yai project as there was a high number of registered tilapia farmers in the province and because of the presence of an informal farmer group with strong leadership in Pan Thong district. Though a small number of farmers sold to export markets in the past, at the time of data collection, tilapia produced was sold domestically. The two districts were chosen as appropriate areas to start the Plang Yai project because tilapia farmers in these districts were relatively close together, making it easier to organize them. The Chonburi Aquaculture Farmer Cooperative was registered parallel to the initiation of the project. In the first year, 120 farmers were enrolled in the Plang Yai project. In the second year, 300 farmers were registered and in the third year about 530 farmers were enrolled, covering an area of roughly 4000 rai (640 ha).

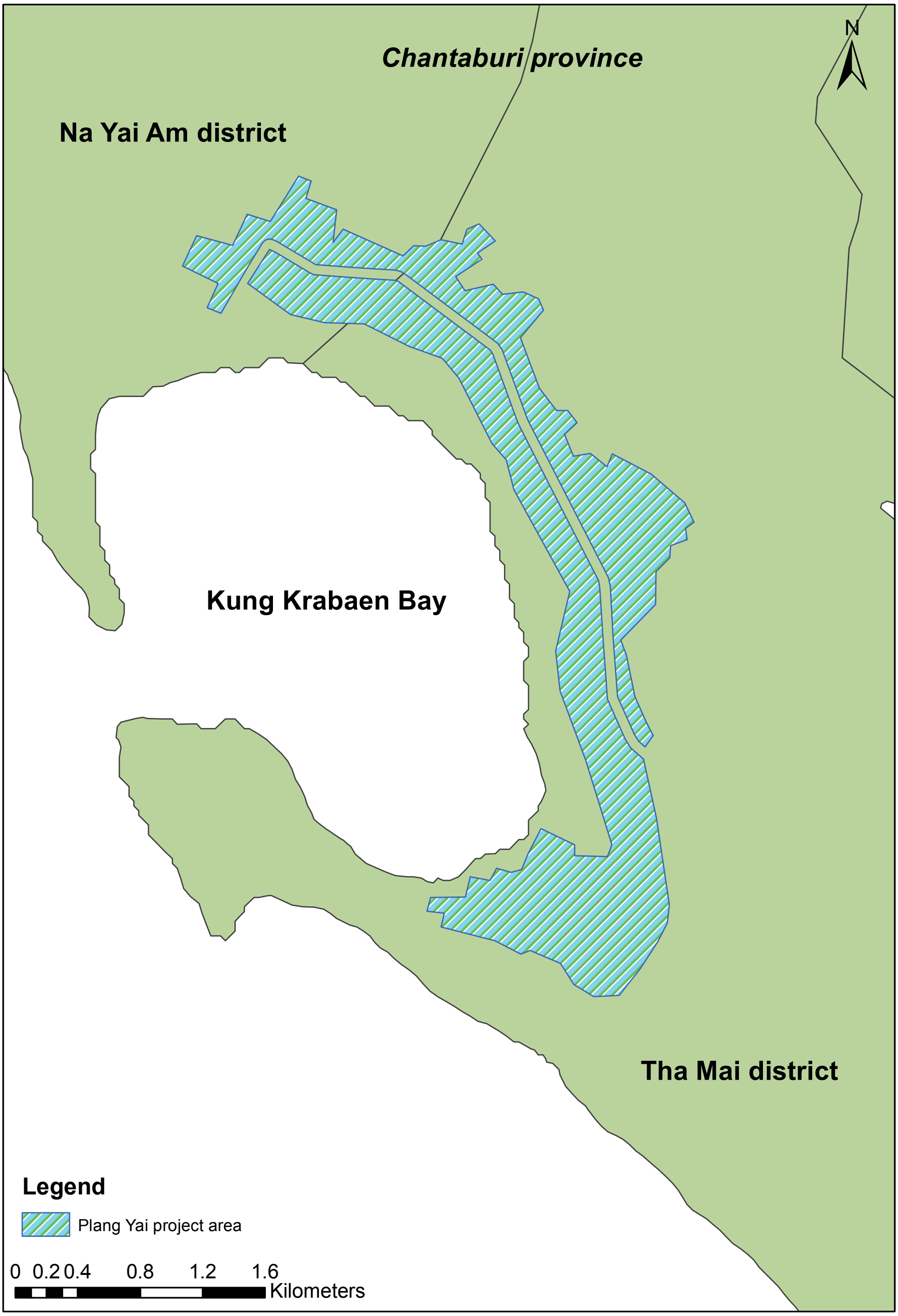


Figure 4.1 Map of Kung Krabaen Bay Shrimp Plang Yai
(Source: GADM database version 2.8, November 2015 (www.gadm.org); OpenStreetMap contributors (https://www.openstreetmap.org); extracts created by BBBike (http://extract.bbbike.org); osmium2shape-1.0 by Geofabrik (http://geofabrik.de))

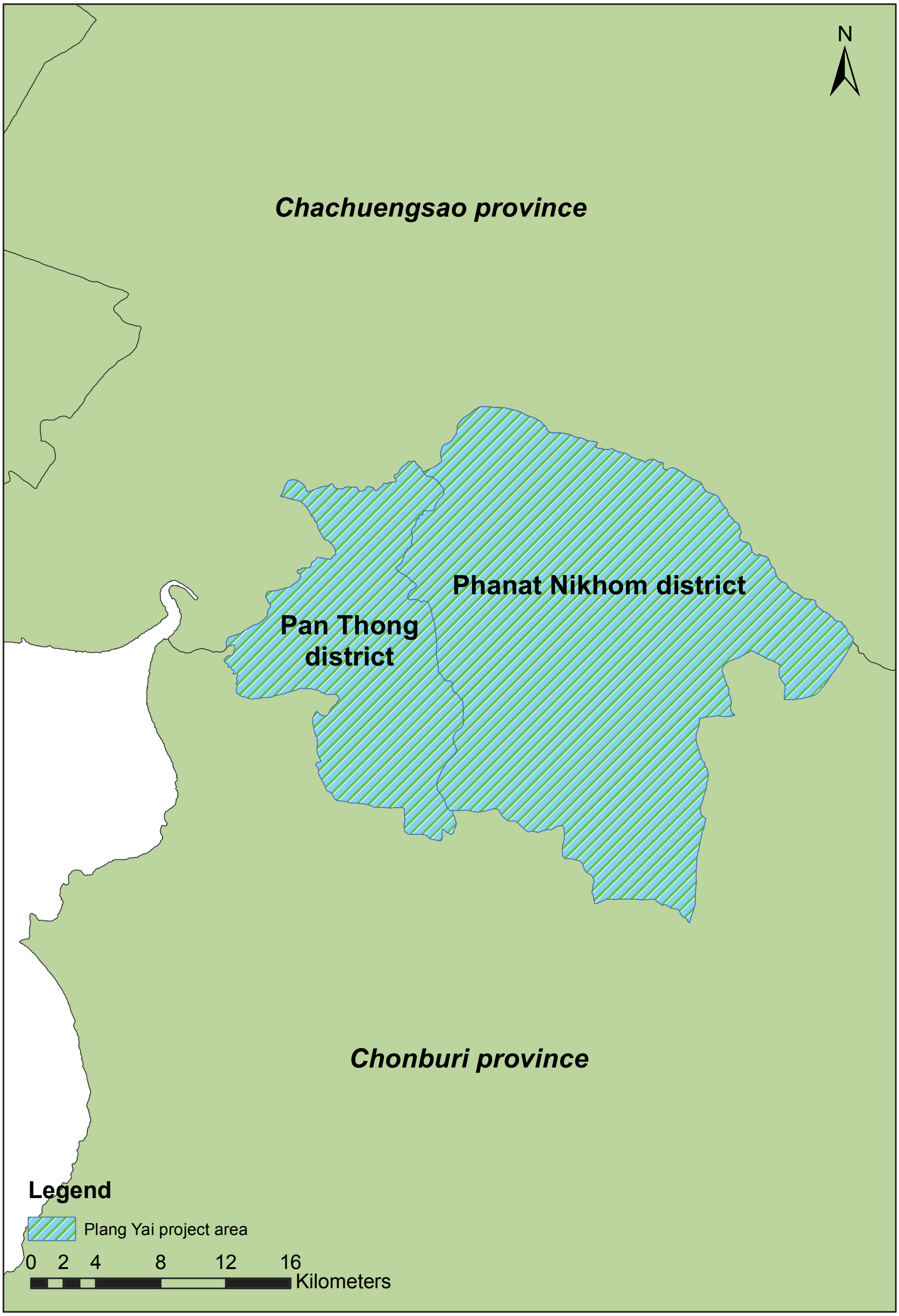


Figure 4.2 Map of Chonburi Tilapia Plang Yai
(Source: GADM database version 2.8, November 2015 (www.gadm.org); OpenStreetMap contributors (https://www.openstreetmap.org); extracts created by BBBike (http://extract.bbbike.org); osmium2shape-1.0 by Geofabrik (http://geofabrik.de))

4.4 Territories of risk management in Plang Yai's four policy instruments

4.4.1 Farmer groups

Farmer groups were spatially defined by the government, which was informed by 'AgriMap', a 160-layer Geographical Information System that classifies land in terms of suitably for cultivating particular species. The groups of, often spatially dispersed, farmers were trained primarily to improve individual production and market risk management (Figure 4.3 A). However, these state-defined territories overlapped with existing social networks through which farmers collectively addressed farm-level and area-level production risks and shared market risks (Figure 4.3 E). The following paragraphs further characterize how farmers were included within these territories through the assemblage of subjects, expertise, objects and space.

Farmers cultivating the same species were the *subjects* of these groups, brought together in order to build their capacity for improving production efficiency and farm management. Grouping was seen as an instrument to reach large numbers of farmers for capacity building, hoping these groups would eventually create more formalized institutions for shared risk management. A minimum of 30 farmers were enrolled in Plang Yai projects by local government for an initial period of three years to create the necessary capabilities for farmers to manage the groups themselves. To facilitate this, a government officer coached a farmer representative to become the group's leader and to collect and store performance data in a centralized online database (Department of Agricultural Extension, 2019).

The farmers in the Plang Yai groups in Kung Krabaen Bay and Chonburi were concurrently a member of several existing local (in)formal institutions within which farmers had already organized collective risk management (Figure 4.3 E). First, neighboring farmers in both sites communicated informally about shared and individual risks and mitigation approaches. Second, semi-formal water management institutions were already in place. In Kung Krabaen Bay, farmers were grouped into user groups for a government-built seawater irrigation system, requiring farmers to follow waste management regulations. Though these user groups did not function as groups for pro-active disease communication, farmers were required to report disease events because this entitled them to discounted membership fees. In Chonburi, a system of 'water guards' was in place for reservoirs in every sub-district, monitoring water levels in canals and corresponding with the DoI about water shortages. Third, there were informal groups of entrepreneurial farmers, who collaborated to learn from each other, access alternative markets and avoid middle men. For instance, farmers in Pan Thong (Chonburi), started the Bang Hak Aquaculture Farmers Club in 2003 to improve bargaining power for water with the DoI, improve market access, and share information about input quality and farm management. There were also groups in Chonburi which developed the capacity for collectively processing and selling tilapia.

4

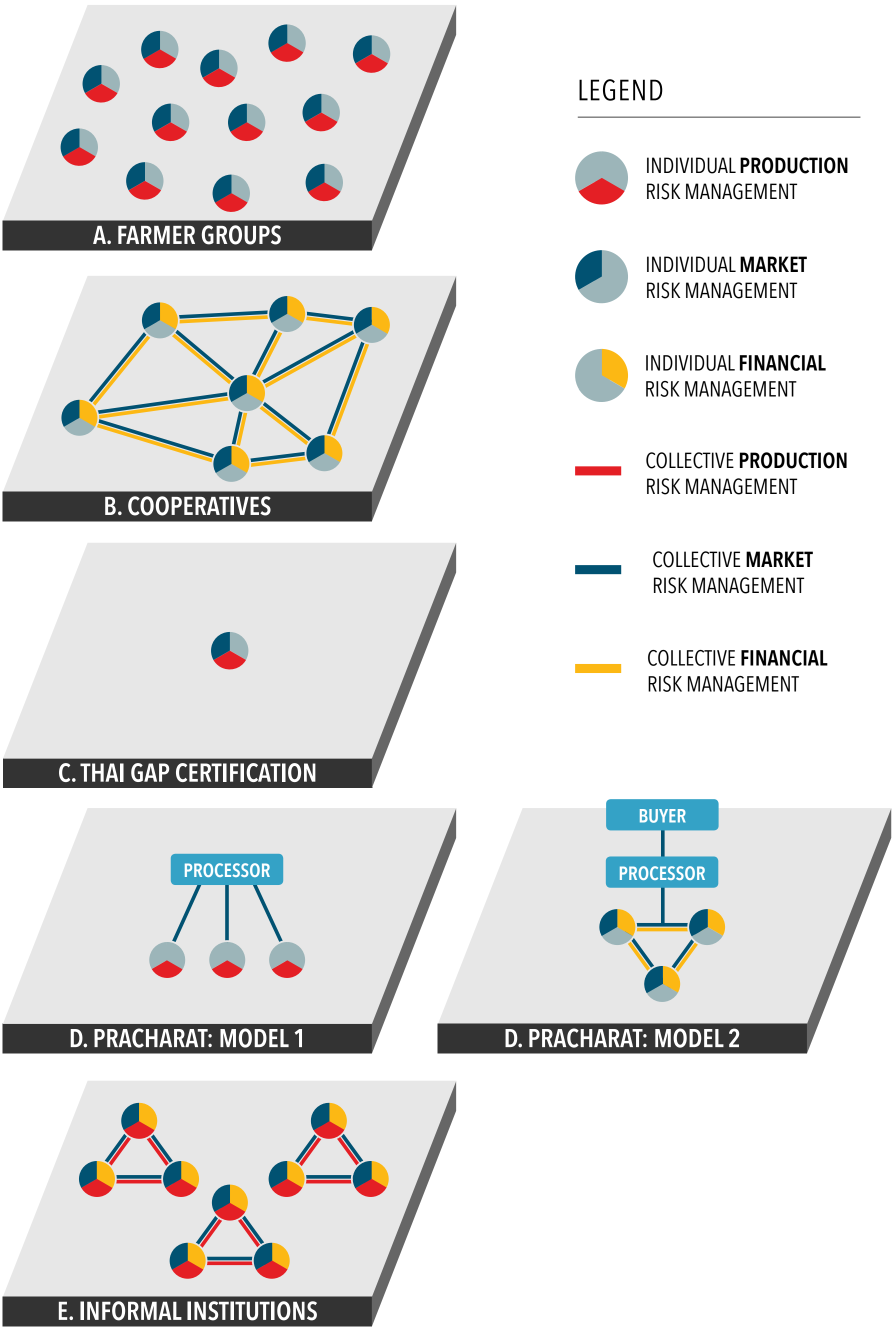


Figure 4.3 Territories of risk management shaped by Plang Yai's four policy instruments and informal institutions
(Designer: Luc Dinnissen, studio ds)

The *expertise* to determine the suitability of an area for a Plang Yai project was informed by AgriMap. This national land-use planning tool combines soil, environmental and irrigation data to map land-use in Thailand. It classifies the suitability of land for different agricultural products, serving as a recommendation from the government. Plang Yai encourages the most efficient land-use in the hope that eventually all agricultural land is covered by Plang Yai projects. Hence, only land classified as suitable for aquaculture was suggested for new Plang Yai projects. However, AgriMap was not yet used to its full potential as data from AgriMap were not used to inform collaboration between Plang Yai projects, or for predictive disease management.

Multiple departments from the MoAC were involved in supporting the Plang Yai groups with capacity building activities, such as the DoAE, DoI, LDD, DoI, CPD and the Department of Agriculture (DoA). In aquaculture Plang Yai projects, the DoF usually played a focal role, providing farmers with inputs and knowledge about recording data, reducing costs, and managing farms and diseases. Often government officers from different departments visited farmers together, demonstrating an integrated extension approach. According to government respondents, this was quite unique since these departments tended to work independently in prior extension programs.

The central *objects* of concern targeted through the farmers groups were individual production risks and market risks. Farmer respondents in Chonburi confirmed that grouping improved their production practices, through it is unclear whether these improvements were attributable to grouping in Plang Yai projects or to grouping in existing collaborations. Farmer respondents in Kung Krabaen Bay appeared to be unaware of their participation in the Plang Yai project, presumably because they already received a lot of support from the DoF due to membership to the irrigation system and their participation in the Kung Krabaen Bay Royal Development Study Centre (for details, see Bottema et al., 2018). Grouping farmers in Plang Yai projects appeared to indirectly increase the capacity of farmers to address shared, area-level, production risks. Respondents from Chonburi suggested that their power to negotiate for water access had increased thanks to their status as a Plang Yai project and significantly sped up the process of water release by the DoI. More speculatively, one farmer suggested that their status in the Plang Yai project was likely to protect them from potential consequences of the development of an industrial complex in Chonburi, which involved the re-zoning of land.

The *space* occupied by Plang Yai projects must cover at least 300 rai (48 ha) of farms, but farms do not have to be adjacent to each other. Initially, the government aspired to only group farmers that were close to each other and shared a water source, like in Kung Krabaen Bay. According to a government respondent, this was because managing groups is easier when farmers share a water source and consequentially share risks. In practice, however, aquaculture farms were often more dispersed, like in the Chonburi Tilapia Plang Yai, where farms were located in two districts. The group was further divided by sub-district when organizing capacity building activities. Government respondents recognized that there were 'free-riding' non-member farmers in the districts, benefiting from Plang Yai projects, but this was not seen as a problem. Instead, the hope was that they would observe the benefits of membership and join over time.

In conclusion, the assemblage of subjects, expertise, objects of concern and spaces through the formation of farmer groups translated into territories characterized by multiple, individual farmers addressing production and market risks within the boundaries of their own farm. It did not illustrate collective efforts to addressing risks in public areas outside of farms. However, these territories overlapped existing social networks within which farmers did address shared production risks collectively.

4.4.2 Cooperatives

The territories of risk management shaped by cooperatives, determined by a number of membership conditions defined by the cooperatives themselves, formed a subset of Plang Yai project member farmers. These institutions facilitated collective strategies for financial and market risk management (Figure 4.3 B). The conditions for borrowing money from cooperatives required members to address farm-level production risks which indirectly contributed to reducing area-level production risks such as disease.

The formation of cooperatives by farmers, as *subjects*, is one of the key performance indicators of Plang Yai projects. In Chonburi, 61 out of 530 Plang Yai farmers were cooperative members in 2018. Since the project in Kung Krabaen Bay was founded with an established cooperative, all 193 Plang Yai farmers in Chantaburi were cooperative members. As put forward by a government respondent, it is not possible to force farmers to join a cooperative. Instead, the cooperatives must demonstrate benefits in order to encourage membership. For instance, cooperatives facilitated access to low-interest loans and cheaper, better quality inputs. However, a number of conditions for membership potentially excluded certain farmers. First, farmers were required to pay registration fees and buy shares in the cooperative. Although not high, farmers reported these costs encouraged them to carefully consider the benefits of membership. Second, cooperatives formulated their own conditions for borrowing money and these conditions required investments, excluding farmers who could not afford this. For example, in Kung Krabaen Bay farms were required to construct ponds according to certain rules, to apply certain biosecurity measures, farm with a maximum stocking density and buy feed from the cooperative.

Communication between subjects in cooperatives focused on finances. At both sites, yearly meetings were held to discuss finances and cooperatives were further sub-divided according to administrative unit. In Kung Krabaen Bay, these subgroups met twice a year to discuss membership, monitor loans and savings, and choose leaders. These subgroup leaders made up the cooperative's board that generally met monthly to report on profits, stocking and harvesting, and to discuss problems and solutions associated with farm management. In Chonburi, additional monthly meetings were held, which were open to non-cooperative members. This is presumably because the cooperative was still relatively small and located at the farm of one of the initial Bang Hak Aquaculture Farmer Club members. Cooperatives at both sites did not define formalized rules on how members should communicate or collaborate for disease risk management. As such, cooperatives did not appear to function as pro-active channels for collective disease risk management.

In terms of *expertise*, the CPD provided farmers with the capacity to develop cooperatives. This department had three main responsibilities. First, they were responsible for legal registration of farmer cooperatives and building capacity for cooperative management. They trained farmers about formal group management, accounting, buying inputs and selling outputs collectively. Second, the CPD was responsible for building capacity for financial management. They trained farmers to organize loans within cooperatives and to access funding, like loans from the Bank for Agriculture and Agricultural Cooperatives (BAAC). Third, the CPD functioned as an intermediary between farmers and buyers, to help them access new marketing channels. They linked farmers with local buyers, helped them with price negotiations and encouraged farmers to consider organizing planned production.

The central *objects* of concern in the cooperatives were addressing market and financial risks through collective strategies to share risk. Farmers confirmed that cooperatives facilitated market risk management and borrowing money. Farmers also said that joining a cooperative increased their bargaining power with input suppliers – although some respondents in Kung Krabaen Bay claimed that feed from the cooperative was not always cheaper than from other suppliers. At both sites, the cooperatives were not collectively selling output and negotiating prices with buyers. However, farmers in Chonburi's cooperative planned to develop a system to sell products collectively, in which the cooperative would function as a middle man. Though the cooperatives provided an opportunity for farmers to borrow from the cooperatives, access to loans from external sources was difficult to obtain. Borrowing from the BAAC appeared to be challenging due to local conditions and risks associated with certain species. In Chonburi, tilapia farmers were unable to borrow from the government because loans had to be paid back within two years, which was deemed unrealistic for a newly established cooperative. According to an industry respondent, it is near impossible for shrimp farmers to get a loan from the BAAC because the required collateral is so high, and the common practice of using a cooperative's leader as the guarantor for loans is deemed as too risky. Finally, an indirect consequence of cooperative membership in Kung Krabaen Bay was the contribution to reducing area-level disease risks though biosecurity measures set as conditions for taking out loans.

The *space* of cooperatives can be seen as a subset of Plang Yai project members that collectively address financial and market risks. Thus, cooperative membership was not concentrated in one spatial area. In both case studies, the cooperatives had a demonstration farm that acted as a place to showcase best practices promoted by the cooperative to external actors and non-members. It also functioned as an important place for sharing knowledge within the cooperative. In Chonburi, the cooperative was located at the farm of one of the initial Bang Hak Aquaculture Farmer Club members, so it was also used as a place for non-members to convene.

In sum, the territories emerging through cooperative formation resembled networks of farmers collectively addressing market and financial risks that were common to individual farmers in these areas. In some cases, these networks indirectly addressed shared production risks such as disease due to the conditions set for borrowing money.

4.4.3 Thai GAP certification

Thai GAP certification, a farm-level standard, created territories of scattered and individual production and market risk management. This government-defined standard addressed farm-level production risk management and did not include clauses stipulating collective management (Figure 4.3 C). Though not promoted through Plang Yai, group certification provided an opportunity to foster collaboration and risk-sharing, and created overlapping territories of shared risk management. The following paragraphs further illustrate the assemblage of subjects, expertise, objects and space through Thai GAP certification.

All farmer *subjects* in a Plang Yai projects were required to obtain certification. Though there are three national aquaculture certification standards in Thailand – Thai GAP, Thai GAP-7401 and Code of Conduct (CoC) – Thai GAP is the focal instrument within the Plang Yai program. Thai GAP, developed by the DoF, sets minimum criteria for food hygiene, food safety and prevention of chemical residues (Samerwong et al., 2018, Prompoj et al., 2011). Thai GAP is compulsory for exported shrimp, so many shrimp farmers were already certified. Since most Thai tilapia is sold domestically (Pongsri and Sukumasavin, 2005), for which certification is not compulsory, it is arguably a larger challenge to demonstrate the value of certification to tilapia farmers. However, this is not reflected in the number of certified farmers at the two sites: in Kung Krabaen Bay, 101 out of the 211 farmers are Thai GAP certified and in Chonburi, 300 out of 530 farmers are Thai GAP certified. The DoF's CoC, based on international environmental, aquaculture and food safety guidelines, is perceived as difficult to obtain (Samerwong et al., 2018). In the two cases, only the demonstration farm at the Kung Krabaen Bay Royal Development Study Centre was CoC certified. Thai GAP-7401, developed by the National Bureau of Agricultural Commodity and Food Standards, combines CoC and Thai GAP principles, to meet demands for worker welfare, social responsibility and environmental conservation (Samerwong et al., 2018). In the two cases, only a group of 19 farmers in Kung Krabaen Bay were Thai GAP-7401 certified.

Though group certification appeared to facilitate risk-sharing, Plang Yai projects encouraged individual certification. In both project sites, farmer groups had piloted group certification, part of a collaboration between the DoF and the FAO Technical Cooperation Program on Certification for Small-scale Aquaculture (Yamamoto, 2013).

Group certification requires a quality management system that specifies production rules and controls compliance (Kersting and Wollni, 2012). These institutions facilitate sharing and adaptive learning. In Kung Krabaen Bay, where the FAO pilot group still functioned, the group met once a month to discuss farm management, input use and record-keeping activities. Farmer respondents claimed being a member of this group was beneficial because meeting each other enabled them to learn about managing risks. Nevertheless, Plang Yai projects appeared to promote individual certification for three reasons. First, certification was free at the time of the research, so lower certification costs, a frequently cited benefit of group certification (Yamamoto, 2013, Petersen et al., 2014), was not (yet) a reason for promoting group certification. Second, group certification requires internal audits and record-keeping, which creates extra workload. Third, group certification requires trust and cooperation, which, according to a government respondent, is specifically challenging for aquaculture farmers because their farms are often dispersed.

With regard to *expertise*, the DoF was primarily responsible for providing farmers with knowledge about obtaining certification. The DoF provided workshops about Thai GAP certification, to illustrate how this can increase farm management standards. The district DoF prepared farmers for certification. In Chonburi, the Chonburi Centre for Research and Development for Freshwater Aquaculture audited the farmers for Thai GAP. In Kung Krabaen Bay, an officer from the DoF audited for Thai GAP while auditing for Thai GAP-7401 was outsourced to an external company (for details, see Prompoj et al., 2011).

The *objects* of concern addressed through Thai GAP certification were farm-level production risk management and quality improvement, to eventually increase market access. However, industry and government respondents both claimed that certification inherently also addressed area-level environmental concerns. Thai GAP-7401 and group certification presented opportunities to do so, in different ways. Thai GAP-7401 addressed a number of area-level production risks, but did not promote collaborative risk management. Environmental criteria included management of escapees, routine monitoring of on-farm and off-farm environmental quality indicators and managing impact to surrounding habitat (National Bureau of Agricultural Commodity and Food Standards, 2014). Group certification, on the other hand, did appear to contribute to risk-sharing, even though no standards contained specific clauses stipulating collaborative risk management. It is interesting to note that farmer respondents at both sites believed that Thai GAP certification improved farm management, but their expectations in terms of benefits from market access differed. A farm respondent in Chonburi suggested that the financial benefits resulting from Thai GAP only applied to farmers exporting products, because they had yet to find a local buyer willing to pay a higher price for Thai GAP certified tilapia. Farmer respondents in Kung Krabaen Bay with Thai GAP-7401 certification recognized that their certification was closer to international standards than Thai GAP, but claimed that this did not result in higher price of shrimp.

The *space* of risk management associated with all three standards remained the farm. Though Thai GAP-7401 contained clauses that addressed certain area-level production risks, the territory of certification remained limited to the farm. Group certification, however, did move beyond farm scale. Though farmers in these groups still applied the farm-level standards, they were certified as a group and the sharing of information about risks in these groups enabled them to learn from each other.

In conclusion, the assemblage of subjects, expertise and objects of concern through the promotion of Thai GAP translated into territories of individual production and market risk management within which farmers addressed risks within the boundaries of their own farm. However, group certification created social linkages between individual farmers and could perhaps potentially foster the management of risks in shared spaces outside the farm.

4.4.4 Pracharat

The territories of risk management emerging from Pracharat projects took the form of PPPs which, while facilitated by the government, enabled private sector actors to define the terms of risk management. The territories emerging from these partnerships varied from territories of individual production risk management through the application of farm management technology promoted by a private actor, to territories of shared market risk management through value chain collaborations between farmer groups and private actors (Figure 4.3 D).

Pracharat projects were partnerships between three *subjects*; cooperatives, the government and companies. The MoAC found potential companies for cooperatives to collaborate with and cooperatives were free to decide whether they wanted to do so. The project in Chonburi illustrated challenges associated with matching demands from farmers with those of a buyer. At the time of data collection, the government had not yet been successful in making a match between farmers and buyers. Farmers wanted higher tilapia prices and access to new markets. While local retailers showed interest in working with the cooperative, their payment conditions and demands in terms of fish size did not match those of the farmers. Government respondents suggested several other reasons why farmers in general hesitated to participate in Pracharat projects. Some farmers simply prefer to work independently. Others distrust private companies because they fear that companies increase their control through programs like Pracharat. Farmers may also perceive strategies promoted by the private sector as too difficult to implement. Often companies in Pracharat projects started by working with pilot farms, to demonstrate the value of their approaches. This enabled them to present success stories to build the trust necessary for larger-scale adoption of these projects.

Charoen Pokphand Group (CP) and Thai Union Group, the two companies currently involved in aquaculture Pracharat projects, took different approaches to collaboration. In Kung Krabaen Bay, the government introduced the cooperative to CP in 2015. CP presented their Three-Clean farm management approach for addressing the Early Mortality Syndrome epidemic. CP supplied a pilot farmer with inputs on credit and helped the farmer reconstruct his farm with CP's technology. Several other farmers followed suit after the success of the initial farmer and at the time of the research about 20 farmers were enrolled in the program. Due to the high costs associated with the technology, only a fraction of cooperative members were able to do so. In contrast, Thai Union worked with farmer groups in collaborative arrangements in which they offered discounted feed prices or guaranteed a minimum price for fish they bought for processing.

In terms of *expertise*, the government was responsible for making connections between cooperatives and companies. Government managers helped farmers in negotiations with companies. Though the role of the private companies in CP and Thai Union projects differed, strategically, both CP and Thai Union saw Pracharat projects as a form of corporate social responsibility, supporting smallholder farmers' livelihoods and contributing to the sustainable development of the industry. Though margins made on these projects were minimal and projects were considered opportunities to demonstrate the value of company approaches, in the long run companies also saw these projects as opportunities to expand markets. In the field, the roles of CP and Thai Union differed. CP provided expertise in the form of technology and technicians to train farmers and monitor technology use. They also sold feed and post-larvae. Thai Union's role was helping farmer groups address market risks by guaranteeing minimum prices for fish they processed, or connecting farmers with other value chain actors. For example, in a Plang Yai project in Chachoengsao province, Thai Union linked a group of seabass farmers with a buyer, Thai Airways.

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The *objects* of concern addressed in Pracharat projects were reducing farm-level production risks and reducing market risks. The CP projects were aimed at reducing production risks such as disease, which had the potential to reduce area-level disease risks. However, the high costs associated with joining the Pracharat project in Kung Krabaen Bay deterred the large-scale adoption of the technology and consequentially the potential to address area-level production risks like disease. Thai Union projects demonstrated how Pracharat projects can reduce costs and increase market access for farmers, by offering inputs at discounted price, acting as a middle man buying up and processing fish, or guaranteeing a minimum price for fish.

The *space* of these PPPs also varied between CP and Thai Union projects. In all projects, Pracharat members could be seen as a subset of cooperative members, as cooperative membership was a condition for joining a Pracharat project. CP projects were centered around the application of CP's Three Clean approach, which addressed individual farm management. In Kung Krabaen Bay, Pracharat members were dispersed throughout the landscape and the project did not foster linkages between farmers. Thai Union projects, on the other hand, were value chain collaboration arrangements, so they included non-farmer value chain actors and facilitated risk-sharing between farmer groups and other value chain actors.

In sum, the territories emerging through Pracharat projects were different for CP projects and Thai Union projects. In CP projects territories were characterized by independent farms within which individual farmers were addressing production risks. Alternatively, Thai Union projects led to networks of farmers and value chain actors sharing market risks.

4.5 Discussion

The results demonstrate how aquaculture Plang Yai projects led by the Thai government institutionalize individual and collective risk management through multiple and overlapping territories of risk management. Furthermore, reflecting the active nature of boundary-formation (Vandergeest et al., 2015), the results also illustrate the state's role in assembling these territories of risk management, bringing together public and private subjects, objects of concern related to aquaculture, and expertise, in different territories. The Thai state does not exert territorial control as a means of gaining absolute authority and control over predefined subjects (Vandergeest and Peluso, 1995). Our results instead illustrate territorialization as a social and dynamic process that involves the negotiated enrolment of subjects, determines objects of concern, includes or excludes different forms of expertise and delimits the spatial extent of authority and control over risk management (building on Bear, 2013, Vandergeest et al., 2015, Foley and Havice, 2016). In 'making' these territories, we argue the state demonstrates the ability to foster spatially explicit collaborative risk management in the aquaculture sector that goes beyond the farm-level and traditional jurisdictions of districts or provinces.

More specifically, the results demonstrate how Plang Yai's different policy instruments enclose aquaculture risks through dissimilar, overlapping territories of risk management. Plang Yai is therefore different to traditional extension programs that are commonly bound to state jurisdictions (Uppanunchai et al., 2018, Chanaseni and Kongngoen, 1992), or based on a priori assumptions of aquaculture zoning that commonly delineate physical boundaries based on administrative or ecological factors (see for e.g. Aguilar-Manjarrez et al., 2017, Sanchez-Jerez et al., 2016). Instead, the Thai state, under the remit of Plang Yai, institutionalizes risk management through multiple policy instruments that assemble actors (farmers, private sector and state) and risks into what could be considered a layered set of risk-territories (Figure 4.3 A to D). Furthermore, these territories overlap existing social relations between farmers used to manage shared risks independently of Plang Yai and hence the state (Figure 4.3 E). As such, the process of boundary-formation in response to risk as a central object of concern is a dynamic and relational process that can lead to the formation of multiple overlapping territories of control, which challenges the spatial fix often associated with regulation (Raycraft, 2018) and suggests cartographically bounded spaces are insufficient for understanding the processes that take place (Bear and Eden, 2008). Instead of designating exclusive areas where particular activities are controlled, state-led area management seems to allow for establishing a system of multiple relational spaces that are dynamically co-constructed or 'assembled' (Bear, 2013) by local (farmers) and extra-local (state and private) actors.

The results also show, however, that the policy instruments applied under Plang Yai are biased in terms of the type and scale of risks they address. Though the instruments present varying territories of risk management, they facilitated the individual management of production risks, but facilitated both the individual and collective management of market and financial risks. Hence, not unlike in economic forms of clustering, there is a tendency toward territorializing production risks individually and at the farm-level, but market and financial risks collectively (see Ha et al., 2013b, Joffre et al., 2019). We question whether focusing on production risks only at a farm-level is the most effective means of ensuring effective stewardship of public resources such as water, shared risks like disease, and broader goals of landscape or ecosystem-based governance that "promotes sustainable development, equity, and resilience of interlinked social and ecological systems" (Soto et al., 2008). These wider goals appear to require more direct intervention around shared production risks between farmers, either starting from existing collaboration between farmers (Bottema et al., 2018, Bottema, 2019), or as Joffre et al. (2019) suggest, more effectively (and explicitly) coordinating individual farm-level risk management activities between farms.

The results also reveal two characteristics of the role of the state in risk management. First, the state plays a supportive role, strengthening the capacity of farmers in dealing with risks in the, often globally integrated, landscapes within which they operate. In line with the national political agenda, which has long promoted decentralization and privatization (Turner, 2002, Dressler and Roth, 2011), the Thai state promotes collaboration with large multinational companies that take on roles perhaps previously carried out by the state. This focus largely explains the bias towards addressing both individual and collective market risks and only individual production risks under Plang Yai. This could also be interpreted as the reason why shared production risks aimed at the collective management of public resources are less well embedded in Plang Yai. However, the results also suggest that it would be misleading to interpret Plang Yai as an instrument to regulate farmer behavior in an attempt to strengthen capitalist markets in rural areas, because farmers in the program were granted autonomy with respect to participation and the formulation of the terms and conditions for membership to cooperatives and collaboration with private sector. We do not deny that Plang Yai exerts control over people and resources, but we have not explored the specific outcomes in these terms. Nevertheless, we argue that there are multiple drivers behind this program which move beyond control and subjugation. The government has environmental and developmental ambitions (echoing Evans, 1989) to maintain an industry important for the Thai economy. In this sense, the government maintains its policy of strengthening the position of farmers in not only the complex landscape in which they cope with multitude production risks, but also in the global market in which they are firmly embedded.

Second, the state takes up multiple and flexible roles in territorializing risk management, as evidenced by the different institutions of risk management. For example, the government builds capacity of farmer groups and facilitates Thai GAP certification to empower farmers to address risks and improve quality on their farm. However, they also promote cooperatives to stimulate the devolution of shared market and financial risk management to farmer groups, match farmers with companies and coach them to negotiate contracts. This variety of roles addresses multiple configurations of risk, which provides a high degree of flexibility in the management of risk, especially valuable in highly diverse contexts.

Widening the impact of the Plang Yai program and incorporating collective production risk management, however, requires rethinking the use of the four existing policy instruments to better orchestrate the layered risk-territories. Based on our analysis, greater attention could be given to combining these risk-territories to go beyond fostering shared financial and market risk management, to more directly address shared area-level production risks. This could be done in two steps. First, government agencies could organize Plang Yai groups based on the existing collaborative relations farmers have, thereby benefitting from local expertise for dealing with collective risks embodied in these relations (for further detail, see Bottema et al., 2018). Such an approach is already seen in the Chonburi case, given the Plang Yai project was inspired by an existing farmer group. Second, the management of area-level production risks could be incorporated into existing capacity building initiatives. By fostering more knowledge-sharing between government and farmers, co-produced risk-territories that integrate the expertise of multiple actors can be developed to address shared production risks and the management of public resources.

4.6 Conclusion

Using a dynamic lens to understand territorialization, we demonstrate that state-led institutionalization of risk management in Thailand's Plang Yai program has led to a layering of risk-territories, each with varying assemblages of actors, risks and expertise. The Thai state institutionalizes individual production risk management, and both individual and collective market and financial risk management through aquaculture Plang Yai projects. Addressing shared production risks is at this stage, however, not a focal strategy. This leads to two main conclusions around the spatial management of aquaculture risks and the current and potential role of the Thai state in fostering collaborative aquaculture risk management.

First, the multiplicity of overlapping risk management territories that emerge from the Plang Yai program raise fundamental questions on the value of designating specific spatial areas for aquaculture risk management. Risk-based boundary-formation does not depend solely on physical boundaries. Despite translating to 'Big Area', the Plang Yai program does not appear to embody a process of state-led centralized control and management over one spatially defined area. Instead, and contrary to existing ecosystem approaches to area management that start from the delineation of spatial boundaries, this case of state-led institutionalization of risk management illustrates how an explicitly spatial extension program actually institutionalizes risks through multiple territories, with varying configurations of risks and actors.

Second, the results indicate an alternative role for the state in the creation of differentiated territories of risk management across landscapes. We recognize that Plang Yai builds on a long tradition of state control in Thailand (Walker, 2012, Vandergeest and Peluso, 2015). However, this research demonstrates the multiple and supportive roles of the Thai state through the Plang Yai program. This illustrates a potentially flexible approach to managing risks in landscapes shared by many users, connected to (global) value chains and facing a multitude of risks. Furthermore, though Plang Yai embodies a primarily economic approach to area management of aquaculture risks and does not incorporate the management of area-level production risks, it does appear to have the potential to adapt and incorporate these particularly complex risks.

Together, these two conclusions show a need for further debate on shaping farmer risk behavior through state-led designation of singular, spatially explicit areas. Instead, alternative, multiple and flexible roles for the state in the creation of differentiated territories of risk management across landscapes appear necessary. If states take up a relational perspective, they may be able to better cope with highly variable and globally connected landscapes of smallholder aquaculture production, by focusing on adaptability and flexibility to manage multiple land uses and complex risks. Further research should explore whether similar roles could be observed in countries other than Thailand.

This research demonstrates that understanding territorialization of production landscapes in a globalizing world requires a dynamic approach that recognizes the multiplicity of territories that emerge in processes geared toward managing risks. Traditional notions of territorialization as a rather singular strategy of state-led control do not capture what is actually happening in efforts to manage the diverse risks associated with the production of globally traded commodities like seafood. Considering the urgency to address shared food production risks in and beyond aquaculture, further research is recommended to better understand this multi-actor and dynamic process of territorializing risk management.

CHAPTER 5

Assuring sustainability beyond the fish farm

This chapter has been submitted to Marine Policy in October 2020 as:
Bottema, M. J. M., Bush, S. R. & Oosterveer, P. *Assuring sustainability beyond the fish farm.*

Abstract

This paper explores the emergence of forms of 'beyond farm' assurance in the aquaculture sector, designed to increase the inclusion of smallholders and scale up environmental sustainability. The analysis reveals a 'spectrum of assurance', representing contrasting levels of trust in sustainable production and consumption. At one end of this spectrum attempts emerge to foster self-determined assurance models with internal verification that represent growing trust in the ability of subjects to organize area-level sustainability improvements. The other, more dominant end of this spectrum, however, is populated with prescriptively and externally verified assurance models that demand high levels of control-driven assurance, demonstrating inherent distrust of area-level sustainability practices. The paper concludes that, to scale up sustainability, beyond farm assurance models must overcome the limitations of prescriptive assurance, by finding fundamentally new ways of trusting farmers and their local counterparts in the global agro-food system.

5.1 Introduction

Sustainability challenges in aquaculture production are not limited to the farm space (Bottema et al., 2018, Arthur et al., 2009, Jayanthi et al., 2018). This has resulted in the proliferation of public and private attempts to foster area-level or landscape management to address shared risks like water pollution and disease (Bush et al., 2019). These approaches exhibit considerable variation. For instance, some are motivated by increasing economic efficiency through collective action (Kassam et al., 2011, Ha et al., 2013b), while others are geared more toward managing public resources and promoting ecosystem-based approaches (Aguilar-Manjarrez et al., 2017, The Nature Conservancy, 2017). They all, however, hold in common the goal of coordinating action between farmers, and in some cases with other adjacent actors, to address area-level risks.

Managing area-level risks requires new forms of assurance, defined as institutionalized trust and verification (Loconto, 2017, Power, 1997). Markets for sustainable products demand assurance that products have been sustainably produced (Mol, 2008, Gulbrandsen and Auld, 2016). Farm-level assurance is now well established through certification (Bush and Oosterveer, 2019). To be certified, individual farmers must demonstrate compliance to a set of credible standardized criteria. Products sold from their farm then carry a label that conveys assurance to buyers that they meet a predefined level of sustainability (Loconto, 2017). Area-level management approaches have emerged in response to the limited effectiveness of farm-level standards in addressing shared and cumulative environmental risks (Bush et al., 2019, Resonance, 2019). Not only new standards are required, but also new forms of assurance that the multiple actors involved in managing shared risks and resources are accountable for setting, measuring and controlling sustainability outcomes.

The attention practitioners give to novel 'beyond farm' assurance models has not been matched by any systematic academic reflection on their design and capacity to foster confidence that sustainability claims made at a scale beyond the farm are indeed verifiable. This paper fills this gap by exploring how assurance is organized in four emerging beyond farm assurance models with different designs and operating at a range of scales. It examines the organization of these assurance models by reviewing (1) the scale at which the claims are made and to which audiences, (2) how these claims are defined and (3) what approaches are used to verify these claims. The results provide insights into how these models can effectively scale up sustainability impacts in area management. 5

The analysis is based on a structured comparison of four exemplary models of beyond farm assurance. First, Group Certification programs put in place by key third party certification standards - including Best Aquaculture Practices (BAP), Aquaculture Stewardship Council (ASC) and GLOBAL Good Agricultural Practices (GLOBALG.A.P.) - designed to overcome constraints in farm-level certification of smallholders (Potts, 2016). Second, BAP's Biosecurity Area Management Standard (BAMS); the only third party certification standard that certifies 'areas' in the aquaculture sector (Best Aquaculture Practices, 2018a). Third, the

Partnership Assurance Model (PAM); a collaborative model for aquaculture improvement and assurance that brings together local stakeholders to design, implement and verify improvements in a 'region' (Resonance, 2019, Monterey Bay Aquarium Foundation, 2019). Fourth, Verified Sourcing Areas (VSAs); a new area-based mechanism designed to verify sustainability production and trade from a spatially defined 'jurisdiction' (The Sustainable Trade Initiative, 2019e).

The following section outlines the analytical framework used to understand how these four assurance models organize the definition and verification of credible sustainability claims beyond the farm. The methods used for data collection and analysis are then described, before comparing the four assurance models in section four. Section five reflects on this comparison and presents a new conceptual model for understanding the possibilities and constraints for assurance models to foster greater trust in, and therefore greater impact through, shared risk management. The paper concludes on the implications of beyond farm assurance for scaling up sustainability across the agro-food sector.

5.2 Organizing assurance beyond the farm

Variation in assurance models can be understood in two dimensions. First, they can be classified in terms of whether the sustainability claims they assure are 'externally' prescribed or self-determined by actors involved directly in the practice and governance of production (Kalfagianni and Pattberg, 2013a, Havice and Iles, 2015). Second, they can be classified in terms of whether these sustainability claims are externally verified by, for instance, third-party auditors, or internally, through internal monitoring systems (Loconto, 2017, Loconto and Hatanaka, 2018, Havice and Iles, 2015). These two dimensions together create four quadrants (see Figure 5.1) that characterize the form of assurance buyers and regulators are willing to accept over the risk that 'sustainability risks' are not effectively managed by subjects involved in food production.

Assurance models that fall under Type A (Figure 5.1) typically exhibit weak trust in their target subjects as they focus on external verification of externally prescribed claims. Third-party sustainability certification, that is highly prevalent in the global agro-food sector, falls into this quadrant. As Auld et al.(2015) argue, these models are based on a 'logic of control' that assumes activities necessary for advancing sustainability require institutions for controlling behavior to ensure compliance. Without prescriptive rules and external audits, these assurance models assume subjects will subscribe to sustainability claims but not change their behavior (Auld et al., 2015). As such, mistrust and correspondingly high levels of external control are inherent to their design.

Figure 5.1 Heuristic model for classifying types of assurance based on claim-making and verification (Designer: Luc Dinnissen, studio ds)

The imposition of prescriptive rules and external verification has several limitations. They can be exclusionary when subjects cannot carry the organizational, administrative and financial burden of assurance (Bush et al., 2013). Subjects are also commonly excluded from defining the sustainability criteria upon which claims are made and designing the verification methodologies, both resulting in assurance models that do not reflect local conditions or interests (Kalfagianni and Pattberg, 2013b, Havice and Iles, 2015). Furthermore, externally verified models have been questioned in terms of their accountability, legitimacy and independence (Auld and Gulbrandsen, 2010, Gulbrandsen and Auld, 2016, Hatanaka and Busch, 2008, Amundsen and Osmundsen, 2019).

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In response to these limitations, alternative models have emerged that tend towards self-determined and internally verified assurance over sustainability claims (Type D). Examples vary in their specific design, but include participatory guarantee systems in organic agriculture and community supported agriculture and fisheries (Loconto and Hatanaka, 2018, Shi et al., 2011). These assurance models are associated with stronger levels of trust in subjects by buyers and regulators. They are, as such, steered by what Auld et al. (2015) refer to as a 'logic of empowerment'; promoting the participation of subjects, advocating a relational approach to addressing problems and questioning the value of assessment by external actors. This alternative logic then promotes monitoring methods that are accountable to those that are involved in the process and governance of production.

Figure 5.1 offers two further alternatives for this logic of empowerment. First, assurance models in which claims are self-determined, but still verified by external actors (Type B). For example, the codification for organic agriculture in the U.S. was initiated by private growers that had an interest in creating uniform definitions and standards for organic agriculture (Guthman, 1998). However, external verification was deemed desirable to inspire confidence in consumers that the produce was separated from conventional produce and protected from contact with prohibited substances. Second, assurance in which claims are prescribed, but internally verified (Type C). For example, industry association codes of conduct that leave verification to their members and do not engage outside stakeholders (Auld et al., 2008), or first party certification where the subjects themselves declare conformity (Loconto, 2017). These three models demonstrate different degrees of letting go of external control.

To determine where different assurance models fall among the assurance types outlined above, characterized by prescribed or self-determined claim-making, and internal or external verification, three analytical dimensions are applied.

First, the scale at which claims are made and the audience that needs to be assured that these claims are met, are examined. Claims can be made about the mitigation of sustainability related risks at the farm-level (Osmundsen et al., 2020), or at the area-level (World Bank, 2014, World Bank Group, 2016). The combination of the scale of these claims and their audience are central to determining what form of verification and claim-making is acceptable for building trust amongst an 'assurance audience', which can include buyers, regulators, civil society actors and/or adjacent actors in a given landscape (Mol, 2015). Thus, the audience of these assurance models and the way that conformity to the criteria used to support these claims is communicated to this audience, are identified.

Second, the extent to which the sustainability claims being assured are prescribed by external actors or self-determined by the subjects is examined. This entails identifying the actor that is defining sustainability claims, and how subjects are organized as a result of these claims. For instance, are sustainability criteria prescribed by external actors like standard owners (e.g. the ASC or Seafood Watch), or are local actors empowered to define their own sustainability criteria (Kusumawati and Bush, 2015, Hatanaka, 2010, Kruk, 2017)? The manner in which local actors are organized in response to these claims (whether prescribed or self-determined), to foster credibility of the assurance process for the different audiences being addressed (Gulbrandsen and Auld, 2016), is also examined. This includes decisions about who is included in the assurance process, how trust between subjects is institutionalized and how accountability between subjects and assurance audiences is organized.

Third, the organization of verification is examined, identifying whether this is organized by external actors or internally, by assurance subjects. This entails determining who verifies non-conformity and how this is organized, who is responsible for addressing non-conformity, and at what level (farm or area) information is collected for verification. For example, verification of farm-level third party certification involves independent external audits on either metrics of sustainability performance or on information systems a farm has in place to monitor sustainability performance (Hatanaka, 2010, Power, 1997). Farmers are then left with a prescribed workplan on how to deal with any non-conformities. In contrast, internal systems of control enable subjects, for example farmer groups, to measure and assess sustainability performance, and in some instances identify and address non-conformities (Loconto and Hatanaka, 2018, Kersting and Wollni, 2012, Power, 1997). The manner in which information collected pertains to performance of individual farmers against farm-level indicators, or to performance at an area-level against area-level indicators (Osmundsen et al., 2020, Chaplin-Kramer et al., 2015), is also identified. Finally, the manner in which this information is organized for the purpose of verification is determined.

5.3 Methods

Data was collected from July to November 2019. Seven scoping interviews with experts informed the identification of several emerging initiatives that appeared to provide beyond farm assurance. Twenty semi-structured interviews were then conducted with respondents responsible for initiating or managing these, to understand the scale of claims, the audience, how claims were defined and how verification was organized. Secondary data in the form of websites, standards and reports were examined to verify information from interviews.

The interviews identified fourteen potential initiatives. From these, six initiatives were selected as relevant cases of beyond farm assurance, and eight were excluded (Global Sustainable Seafood Initiative, 2020, Global Seafood Assurances, 2020, Sustainable Fisheries Partnership, 2019, Jala Tech, 2019, eFishery, 2019, XpertSea, 2019, Farmforce, 2019, Verifik8, 2018). Primary criteria for case selection, to demonstrate that initiatives could indeed be classified as assurance models, was that they both defined *and* verified claims. Secondary criteria was that initiatives that were already implemented or piloted (see Appendix 2 for details about case selection process). From the six selected cases, four assurance models were then identified inductively. These models and their implementation status are described in Table 5.1.

Table 5.1 Status of implementation of four cases of assurance beyond the farm

Case	Status of implementation
Group certification	GLOBALG.A.P. certified their first farmer group, which produced non-aquaculture commodities, in 2001 (GLOBALG.A.P., 2017a). BAP issued their Farm and Hatchery Group Certification program in 2018 (Best Aquaculture Practices, 2018b) and ASC issued their Group Certification program in 2019 (Aquaculture Stewardship Council, 2019a).
Biosecurity Area Management Standard	The Global Aquaculture Alliance issued the BAP Biosecurity Area Management Standard in 2019. Co-initiators included other third party certification standards and NGOs. After several pilots, the first certification was announced in 2019 for Clew Bay in Ireland (Chase, 2019).
Partnership Assurance Model	A group of experts, including ASIC, IDH, Monterey Bay Aquarium, Resonance, SGS, Seagreen Research, TCS and Thai Union are collaborating to develop the Partnership Assurance Model. The first pilots to test this approach were announced in 2018 and 2019, both located in the Mekong Delta, Vietnam (Monterey Bay Aquarium Foundation, 2019).
Verified Sourcing Areas	Verified Sourcing Areas were initiated by IDH. The first pilot was launched in 2018 in Mato Grosso, Brazil, with beef as the lead commodity. There were six VSA pilots at the time of data collection, all applied with non-aquaculture commodities (The Sustainable Trade Initiative, 2019e).

The design of the four models is described using the three analytical dimensions outlined in Section 5.2. Since this is a phenomenon that has not been studied before, this research asks first order social science questions around the audience, definition of claims and verification. The design of these initiatives was studied, not their implementation or effectiveness. This was because the initiatives studied were either still being piloted or recently established, with the exception of GLOBALG.A.P.'s program for certifying farmer groups. A study of their actual implementation might provide additional insights, but is beyond the scope of this research.

5.4 Variation of assurance models

5.4.1 Group Certification

Group certification programs represent prescriptive and externally verified assurance models (Type A, see Figure 5.2). Individual farmers must comply to farm-level certification standards but are certified collectively with other farmers to reduce auditing costs. Like farm-level certification, group certification claims are communicated to buyers through a single certification code and/or eco-label. These programs were established to increase the overall accessibility, compliance and impact of farm-level certification standards. Because of their continued farm-level focus, however, no explicit claims are made pertaining to the management of shared area-level risks.

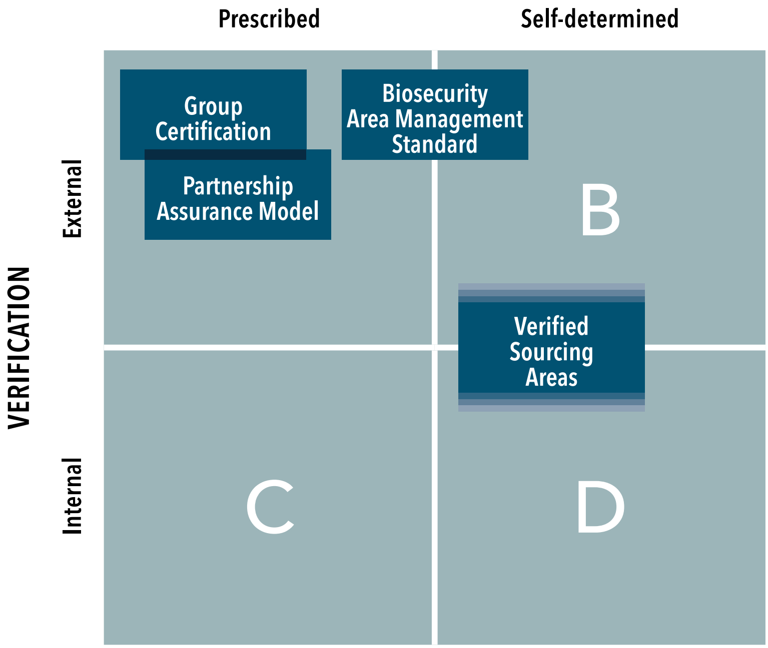

Figure 5.2 Classification of four case study assurance models based on claim-making and verification (Designer: Luc Dinnissen, studio ds)

Sustainability claims made through group certification are prescribed by the standard owner and these claims are codified through the standard's criteria. In all the group certification models reviewed, standards remain focused on individual farm-level performance (GLOBALG.A.P., 2019, Aquaculture Stewardship Council, 2019a, Best Aquaculture Practices, 2018b). All of the group certification models also prescribe an Internal Control System (ICS), or Quality Management System (GLOBALG.A.P., 2019), to enable the collective capability of farmers in these groups to demonstrate standard compliance. Farmers have no influence on the standards or claims made.

Membership to certified groups across all three programs is selective. In some cases buyers funding group certification screen individuals on the basis of their capacity to successfully comply (Pauwelussen, 2020). In other cases, membership is based on a farmer's own technical and organizational capabilities to join a group and comply to the individual farm standards. If farmers do not conform to the certification standards and/or refrain from taking the necessary corrective action in the manner prescribed by the audit, they can be removed from the unit of certification (GLOBALG.A.P., 2019, Aquaculture Stewardship Council, 2019a, Best Aquaculture Practices, 2018b). In all instances groups are made up of spatially non-contiguous members and are located in areas interspersed with non-members.

Accountability of group members is prescribed through three types of written agreements designed to formalize trust through binding commitments, with the 'group' as the unit of certification. First, individual farmers sign a written agreement to conform to the farm-level standards. Second, the 'group' signs a written agreement with the standard owner (ASC, GAA or GLOBALG.A.P.). Third, the 'group' signs a written agreement with the certification body, responsible for conducting the conformity assessments (GLOBALG.A.P., 2019, Aquaculture Stewardship Council, 2019a, Best Aquaculture Practices, 2018b). The 'group' then has the authority to exercise control, to ensure compliance, and is accountable for the collective performance of its members toward the standard owner.

Verification in the programs reviewed is organized through both internal and external conformity assessment. First, internal verification is conducted through an audit of the ICS and inspection of farms by qualified inspectors officially appointed by the group (GLOBALG.A.P., 2019, Aquaculture Stewardship Council, 2019a, Best Aquaculture Practices, 2018b). External verification consists of an IMS audit, an on-site assessment of the group management office and farm inspections, all carried out by a third-party certification auditor. For the internal verification process, all members are audited annually. However, for the external verification process, only a sample of farmers is audited. For BAP and GLOBALG.A.P., the square root of all farmers in the group plus one must be inspected, so that 100% of the farms are externally inspected over a period of five years (GLOBALG.A.P., 2019, Best Aquaculture Practices, 2018b). For ASC, the auditor scores groups on the maturity of their ICS, which feeds into the calculation of the audits sample size (Aquaculture Stewardship Council, 2019a).

All the programs reviewed include guidelines and checklists for operating and auditing the ICS, as well as for imposing sanctions on farmers for non-conformity (Best Aquaculture Practices, 2018b, Aquaculture Stewardship Council, 2019a, GLOBALG.A.P., 2019). By prescribing these guidelines, the ultimate control over the non-conformity is kept under the external control of the standard holder. This also reinforces a rigid system of control over verification and indicates limited or no trust in farmers to organize verification themselves.

Verification takes place largely at farm-level, within a sample of farmers that are selected to represent the group. Only for the Biodiversity Environmental Impact Assessment and participatory Social Impact Assessments required for some ASC farm standards (Aquaculture Stewardship Council, 2019b), and the biodiversity-inclusive Environmental Impact Assessment and Environmental Risk Assessment for GLOBALG.A.P.'s farm standard (GLOBALG.A.P., 2017b), is data also collected at area-level.

5.4.2 BAP's Biosecurity Area Management Standard

The BAMS represents a partially self-determined but externally verified assurance model (bridging Types A and B, see Figure 5.2). It is a multi-species certification standard that verifies groups of farmers in a defined area collectively managing pathogenic organisms through the implementation of area-wide biosecurity measures (Best Aquaculture Practices, 2018a). The standard does not focus on management performance of individual farms and, unlike group certification programs, farmer members are not individually certified. BAMS certified groups use their certified status to demonstrate 'good practice' to institutional investors, government agencies and insurance bodies. While at an early stage of uptake, there is no plan to use a label or product-based claim.

Though the overall claim of biosecurity management is prescribed by the standard owner, a group applying for BAMS certification has the freedom to specify its own objectives (Best Aquaculture Practices, 2018a). The standard requires farmers to conduct an Area Risk Assessment that identifies potential internal and external biosecurity threats and rates their potential impact. Based on this assessment, an Area Plan is written outlining measures for coordinated disease prevention, treatment and mitigation. Because these risks are commonly context-specific, the standard is not highly prescriptive on the content of the assessment and the plan. Instead the standard requires negotiation over collective risk management practices amongst constituent farmers and the definition of specific risk management objectives and corresponding Key Performance Indicators (KPIs).

BAMS certification is dependent on inclusivity. Farmer groups, as the unit of certification, are defined geographically in a 'biosecurity area'. Within the area, the group must invite 'non-committed' aquaculture facilities to participate in the Area Plan and actively engage non-aquaculture parties that are affected by biosecurity issues (Best Aquaculture Practices, 2018a). Exclusion of any aquaculture facility must be explained and during the application, an associated risk assessment must be provided outlining the consequences of their non-participation (Best Aquaculture Practices, 2018a). Non-participation of any of these parties is problematic because they may not be part of the unit of certification, but they *are* part of the unit of assessment. It remains unclear how unassociated parties can be held accountable should their actions increase the biosecurity risk of an area.

The accountability of group members is formalized through non-binding agreements, under the assumption that they have an intrinsic motivation to manage shared biosecurity risks. Evidence of member commitment is given through a signed Memorandum of Understanding (MoU) (or equivalent) (Best Aquaculture Practices, 2018a). The MoU does not, however, hold individual farmers formally accountable. Instead, by stipulating the conditions of cooperation, BAMS attempts to foster trust between participants. The applicant must provide evidence that the disease management approach adopted is based on (1) a dialogue among all participant farmers, (2) a clear area communication protocol, and (3) a rapid information-sharing system among members in the event of a disease outbreak (Best Aquaculture Practices, 2018a).

While BAMS allows farmers to develop and monitor their own Area Plan, it still requires a mix of internal and external assessment procedures. First, the Area Plan sets performance targets (based on guidance from the BAMS standard) that are internally monitored at least annually (Best Aquaculture Practices, 2018a). Since disease is context-specific, the program leaves it up to the applicant to define biosecurity targets and indicators. However, the Risk Assessment and the Area Plan are externally monitored by public veterinary services. Second, an external auditor assesses the Area Plan in consultation with the group to determine how shared biosecurity risks are managed before certification is awarded. Third, surveillance audits evaluate ongoing consistency, implementation of improvements and major changes to the Area Plan.

The certified farmer group is free to define how they deal with non-conformity of individual farmers. Measures for disciplining a non-compliant participant have to be outlined in the Area Plan (Best Aquaculture Practices, 2018a). However, informal peer pressure is likely to be an important mechanism to deal with non-conformity; under the assumption that farmers are intrinsically motivated to organize themselves to manage disease.

Claims are verified through the collection of information about processes of collective disease management and performance at an area-level. The standard's criteria focus on aquatic health status and controls at an area-level, over and above those controls required as part of existing farm-level certification systems (Best Aquaculture Practices, 2018a). This means that the evidence of competent aquaculture husbandry at the individual farm-level is subordinate to that of the Area Plan.

5.4.3 Partnership Assurance Model

The PAM represents a prescriptive and internally verified assurance model (Type A in Figure 5.2). It brings together local stakeholders to design, implement and verify improvement in aquaculture production in a defined 'region' (Monterey Bay Aquarium Foundation, 2019). Improvement is defined in terms of Monterey Bay Aquarium's non-voluntary and publicly shared Seafood Watch traffic light ratings (Resonance, 2019). These ratings are based on a range of farm-level sustainability metrics which allow for claims about 'ideal' farm-level performance in an area.

The PAM enables direct rather than desk-based verification of the Seafood Watch standards. The PAM, as such, does not have a separate claim associated with it, and remains highly prescriptive. It allows Seafood Watch to adapt global sustainability goals to a local context, while at the same time providing greater assurance to buyers and consumers in the United States on their rating of targeted aquaculture species (Resonance, 2019).

The PAM membership is defined through partnerships between a sub-set of aquaculture farmers and processors in a given region, designed to mitigate cumulative environmental impacts from aquaculture production. In its first pilot project, the PAM fostered a partnership between Seafood Watch, an auditor, a Vietnamese processor and the Vietnamese government to improve the performance of that processor's shrimp suppliers. In the second pilot project, this partnership was extended to include scientific institutions, NGOs, credit institutions, banks, certification evaluation organizations, and organizations representing the entire supply chain to improve the environmental sustainability of the shrimp aquaculture sector across an entire province (Monterey Bay Aquarium Foundation, 2019).

Partners are held accountable through a non-binding MoU, based on the assumption they are intrinsically motivated to work toward their common goal of a yellow or green Seafood Watch rating which gives access to the US market. By signing the MoU, partners give their commitment to achieve shared sustainability improvement goals for the region. For example, to improve all shrimp production in a province to a level of performance equivalent to a yellow "Good Alternative" or green "Best Choice" rating by 2030 in addition to more tailored goals of prohibiting antibiotics use, implementing traceability and/or demonstrating social responsibility (Monterey Bay Aquarium Foundation, 2019). While these commitments are transparently documented, no formal accountability mechanism is in place for non-compliant partners.

National and local governments play a critical role in the development, implementation and enforcement of specific sustainability measures at an area-level, such as water pollution and disease management (Resonance, 2019). Their participation in the PAM is suggested to provide external oversight and legitimacy to projects, but is not a hard requirement. Additionally, the inclusion of NGOs is encouraged to further legitimize the verification process in addition to creating links in consumer markets and support the on the ground implementation (Resonance, 2019).

Verification is prescribed through direct assessment by one internal and two external actors. The PAM is testing a digital verification platform to verify compliance of sub-sets of shrimp farms in a region against the Seafood Watch standard. The goal of this platform is to reduce costs and increase credibility through three layers of verification; first, by the processing company, second, by a collaborating NGO, and third, by a third-party auditor. To incentivize compliance action by farmers and processors alike, the next layer of verification only commences when all farmers sampled are found to comply. All assessments are uploaded to the digital platform to increase efficiency and transparency and to eventually provide area-specific information, enhance the accuracy of the improvements and enhance transparency within the value chain, which is likely to increase the confidence of end buyers (Resonance, 2019).

By adopting a sampling regime, the PAM verifies the performance of the average farm in a given region. This means that the PAM does not yet enable the identification of cumulative environmental impacts of multiple farms across regions. Initially, every farmer in a group is assessed to determine the variance in groups and the sample needed to capture the non-conformities in an average farm. This will differ for varying production systems, species and regions.

5.4.4 Verified Sourcing Areas

VSAs are a self-determined assurance model (either Type B or D in Figure 5.2) that aim to accelerate the uptake of sustainability by bringing together local stakeholders to determine shared goals for an entire 'jurisdiction' (e.g. municipality, district or province). In addition, VSAs connect entire sectors in these jurisdictions to markets and, in contrast with farm-level assurance models, enable end-buyers to source volumes in line with their sustainability commitments (The Sustainable Trade Initiative, 2019b). By securing commitments from multiple buyers, landscape-level sustainability can be integrated into sourcing strategies. Farmers are, in response to these commitments, assumed to make pre-competitive decisions around shared risk management with both aquaculture and non-aquaculture related actors.

Sustainability objectives are formulated in VSAs through a public private partnership, referred to as a 'Compact'. These specify sustainability topics and goals as well as the actions and monitoring needed to attain them (The Sustainable Trade Initiative, 2018c). IDH has developed a Compact Transparency Tool, that specifies the themes within which these goals must be set. This tool is subsequently used to score progress towards these goals using global references to sustainability (The Sustainable Trade Initiative, 2018c). Although minimum requirements for the themes are prescribed in this tool, partners still identify and prioritize the interventions needed to achieve these goals in their given jurisdiction (The Sustainable Trade Initiative, 2018c).

VSA membership aims to include multiple users across different sectors in a given jurisdiction. The Compact must include local government, private sector actors with strong local presence like farmers and traders, indigenous communities and civil society organizations (The Sustainable Trade Initiative, 2018c). VSAs have a single 'lead commodity' which brings together partners within a supply chain. However, given the diversity of products sourced from any given jurisdiction, VSAs also aspire to allow for Compacts to cover multiple commodities.

Distinct from the other assurance models, the role of government is seen as crucial to the effectiveness of VSAs. The participation and oversight of government provides legitimacy to the Compact given that the state, strengthened by the Compact, can enforce local regulations. NGOs are engaged because their recognition and acceptance provides legitimacy to the VSA model as they represent civil society. Currently, there are a number of large NGOs in the VSA Global Steering Committee (Resonance, 2019), where there are discussions about how to engage NGOs in the consultation process for the development of VSAs.

The accountability of partners in a VSA is formalized through the Compact in non-binding agreements, under the assumption that partners receive intrinsic benefits by fulfilling their commitments towards the shared goals and are thus motivated to do so. The Compact is used to institutionalize and strengthen local collaboration by providing transparency and building trust. It is also used to stimulate the involvement and contribution of end-buyers, though they are not required to sign the Compact (The Sustainable Trade Initiative, 2019c). The commitments these buyers make to support the Compact by sourcing product from a jurisdiction is assumed to create direct incentives for partners to fulfill their commitments.

There is currently no prescribed framework for verification available for VSAs, although it is clear that VSAs will verify the progress of an entire jurisdiction against the goals set out in the Compact (The Sustainable Trade Initiative, 2019b). There are ongoing discussions about whether IDH will prescribe a generic verification tool for all VSAs. A generic tool would suggest monitoring methods and indicators for the pre-defined themes in the Compact and perhaps even define different levels of assurance for each issue. However, it is also possible that the verification method will remain unique for each VSA, given the specific nature of initiatives designed to reach the goals set out for each Compact.

5.5 Discussion and conclusion

This comparison reveals an apparent tension around the degree of trust that beyond farm assurance models place in farmers to define and verify shared sustainability claims. Two contrasting observations can be drawn from the analysis, in support of Auld et al. (2015), that illustrate this tension. On the one hand, there is a tendency for beyond farm aquaculture assurance models to move toward a greater degree of empowerment through self-determination. They do so by devolving claim-making and verification to collaborations of farmers and other actors in a given area, based on the recognition that prescribed standards do not match specific local conditions of area-level risks. On the other hand, there appears to be a persistent tendency to retain external control over claims and verification. As illustrated in Figure 5.3, while new assurance models aspire to empower assurance subjects by allowing increased self-determined claim-making and verification, they continue to be pulled towards prescribed and externally verified forms of assurance.

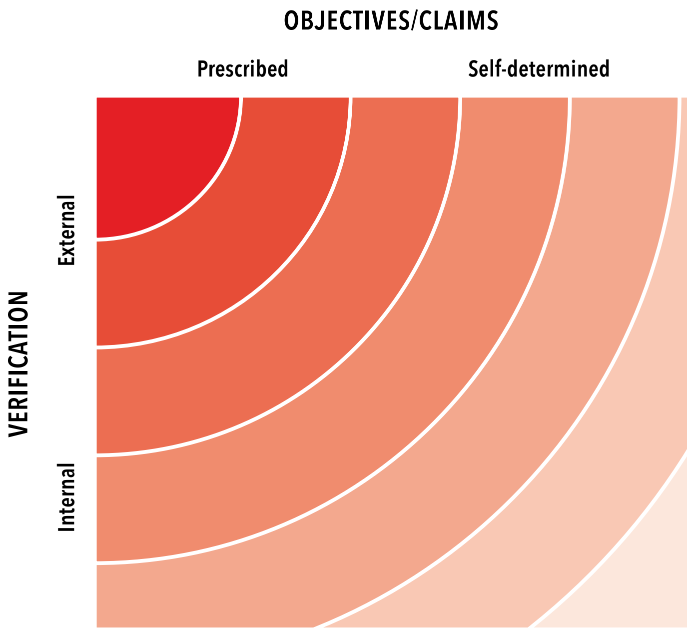

Figure 5.3 A spectrum of assurance models that define and verify claims about aquaculture performance beyond the farm
(Designer: Luc Dinnissen, studio ds)

The identification of this tension between empowerment and control is based on three key challenges synthesized from the assurance models reviewed. First, it remains unclear to what extent assurance audiences will accept the self-determination of claims and verification. The results demonstrate that while attempts are being made to innovate away from Type A assurance models, with prescribed claims and external verification, none of the models reviewed can be classified yet as Type D – i.e. with self-determined claims and verification. The cases that represent the greatest shift away from Type A, the BAMS and VSA models, are both based on a core assumption that when subjects demonstrate intrinsic motivation to cooperatively address risks, both control over sustainability criteria and the organization of internal verification can be devolved. However, even in these two 'extreme' models, such devolution remains only partial. Both continue to maintain a degree of control over how criteria are identified and the methodologies used to verify them, in order to satisfy the degree of assurance considered to be demanded by their target market audiences.

Second, the more actors involved in area-level assurance, the more difficult it becomes to create effective accountability and therefore trust between them. For example, the BAMS, PAM and VSA models all rely on non-binding agreements between subjects to work towards the management of shared sustainability risks and abide by the conditions of either internal or external verification. However, as seen in other governance contexts (Schleifer et al., 2019), it remains unclear who among the different actors can be held accountable for performance of the area as a whole. The cases present contrasting approaches to address accountability issues, which have varied implications for moving toward a Type D assurance model. If we assume that transparency leads to greater accountability, recognizing that many scholars remain skeptical about the ability of transparency to foster accountability and therefore improved performance (Schleifer et al., 2019, Gupta, 2010, Gupta and Mason, 2014), the promotion of informational transparency in the case of BAMS aligns with principles behind a Type D approach. In contrast, increased surveillance by external state and NGO actors in the case of the PAM and VSAs, constrains these models to move further towards a fully devolved Type D assurance model.

Third, despite attempting to move beyond the farm, the more prescriptive an assurance model is, the greater the tendency to focus on farm-level verification. This challenge was especially observed in the Group Certification programs and the PAM model, given they both verify claims at farm-level. While also being focused on the structure of farmers and partners, and scaling up their respective impact of certification standards and ratings, they both place emphasis on prescriptive, farm-level and performance-based criteria. The effect of this is again a constraint on moving away from a Type A assurance model. The effect, in contrast to other assurance types enabling greater self-determined and group-based assurance (as seen in both the VSA and BAMS models), is that they risk being less responsive to the variation within areas and among farms (Chaplin-Kramer et al., 2015), and may fail to stimulate collaborative management of shared risks.

The overall tendency to favor control over empowerment holds consequences for the design of beyond farm assurance models aimed at scaling up sustainability improvements through collaboration between often disparate actors. While new assurance models aspire to empower assurance subjects by allowing increased self-determined claim-making and/or self-verification, they continue to be pulled towards prescribed and externally verified forms of assurance (Figure 5.3). In doing so they risk reinforcing rather than overcoming assumptions of distrust and weak tolerance of uncertainty that underlie sustainability assurance in the global agro-food system (Auld et al., 2015, Power, 1997, Kjærnes, 2006). This distrust, and the desire for control that it fosters, risks reifying the same limitations faced by farm-level assurance – including high levels of surveillance, requiring high reporting capabilities and high associated costs. The ultimate consequence is that the ability of new assurance models to fulfil their ambitions to enroll a larger number of farmers in order to manage shared aquaculture risks (Aguilar-Manjarrez et al., 2017, Kassam et al., 2011, Soto et al., 2008, World Bank, 2014) and scale up sustainability improvements beyond the farm scale, may be undermined.

There appears to be a trade-off between the continued use of prescriptive assurance models stemming from distrust and attaining large-scale improvement. Thus, to scale up sustainability, we need to think beyond the currently dominant models of assurance in the agro-food sector. Moving forward, further research is needed to better understand the trade-offs and implications associated with opening up claims and verification involving stakeholders. Furthermore, a deeper understanding of what the audiences of assurance models really demand and the conditions they require in order to trust, is imperative to develop alternative approaches that facilitate new ways of trusting within a globalized market.

CHAPTER 6

Conclusion

6.1 Introduction

Area-based approaches to risk management in the agro-food industry are underlined by the premise that a sustainable society cannot be built on the aggregation of individual preferences (Goldblatt, 1996). In both the global South and North, agricultural policy and practice has historically been preoccupied with changing the behavior of individual farmers rather than of groups or communities (Pretty and Ward, 2001). However, the severity and frequency of risks that are transmittable between farms and can impact entire areas has led to the need for risk management approaches that confront challenges than transcend traditional environmental and agricultural boundaries (Sayer et al., 2013). These approaches recognize that, as proposed by Röling (2002), a sustainable society emerges from interaction, requires recognition of interdependence and should be capable of concerted action to address shared risks that move beyond the farm.

This thesis sets out to determine what aquaculture risk management beyond the farm is and in what ways this is institutionalized in the Asian aquaculture sector. In doing so, I seek to define conditions for risk management beyond the farm in the aquaculture sector, an industry for which production is associated with serious risks that move beyond farm boundaries (World Bank, 2014). Zooming in on Asia, which hosts the vast majority of aquaculture production worldwide (FAO, 2018), this thesis serves as a first step in exploring the institutionalization of beyond farm risk management in the aquaculture sector.

In this thesis I demonstrate the inherently social nature of aquaculture risk management beyond the farm. This thesis contributes novel ways of both understanding and governing risk management beyond the farm. Building on relational and dynamic perspectives on space (Massey, 2005, Roth, 2008, Bear, 2013), risk (Beck, 1986, Richard Eiser et al., 2012) and institutionalization (Giddens, 1984, Arts et al., 2006), I developed a socio-spatial and relational perspective to study the challenge of addressing production risks at a scale beyond the farm. Having presented empirical accounts of various cases of risk management beyond the farm in the preceding four chapters, this chapter further unpacks the geographies and institutional dynamics of aquaculture risk management beyond the farm. I offer a series of social insights that underpin a fundamentally new way of understanding beyond farm risk management, conceptualizing it as the intersection between space, risk and institutionalization. Based on these insights I classify existing approaches to area management. I then present a novel way of governing risks across landscapes, which enables the scaling up of sustainable food production across landscapes and in markets.

In this chapter I will reflect on the key research findings. The next section reflects on the main findings through answering the three sub-questions, which are guided by the three analytical dimensions. In section three, I present a new perspective to governing risk management beyond the farm, built upon the findings from this research. Section four looks ahead and outlines the policy recommendations that emerge from this research and concludes the thesis with suggestions for future avenues of research.

6.2 Key research findings

The primary theoretical innovation in this research is the reimagination of aquaculture production in terms of space, risk and institutionalization. This innovation is derived from answers to the three sub-questions. Using findings from chapters two to five, I answer these questions in the following three sections, revealing a fundamentally new way of understanding what the 'area' in area management actually means.

6.2.1 The multiple spaces of risk

To address the first sub-question, in this section I describe the ways in which aquaculture production spaces are produced and reproduced through risk and social relations. Using the concept of relational space to study the socio-spatial practices involved with risk management beyond the farm in several case studies, involving both shrimp and tilapia production, has illuminated a new way of understanding the spaces of aquaculture production.

The findings show there are multiple, dynamic and overlapping spaces of risk beyond the farm. Aquaculture production space is not something fixed. Building on Bear (2013), who studied the geographies of fisheries management practices in the sea, this research illustrates the similarly 'lively geographies' of aquaculture production. Through the interpretation and management of production risks, social relations and production risks are actively contributing to the (re)creation of spaces of risk. Therefore, in addition to relations between social actors, the materialities associated with production, specifically in the form of production risks, shape space. As such, this research demonstrates both the agency of social actors and that of production risks to shape aquaculture production spaces.

Various spaces of risk management emerge across and even within the four institutional arrangements studied. Chapter two's exploration of how individual farmers interpret and manage area-level production risks demonstrates that Asian shrimp farmers manage these risks in two spatial configurations. First, in contrast to what is suggested in normative notions of area management (World Bank, 2014), farmers to a large extent managed risk individually, within the boundaries of their own farm. This resembles production risk management in economic approaches to area-level collaboration like clusters, which typically facilitate the adoption of farm-level management practices (Joffre et al., 2019), and depicts the space of risk management across landscapes as an aggregate of individual, farm spaces. Second, when farmers did address production risks collectively, they did so in social networks within which their interpretation of risk was homogenous, which tends to happen at a very local scale. Consequently, unlike in ecosystem and landscape approaches in which risk management takes place at a large scale (Soto et al., 2008, Sayer et al., 2013), this depicts risk management space as a patchwork of local networks within which risks are homogenous and area-level production risks are addressed collectively.

Two spaces emerge from externally-led improvement initiatives and assurance models; the spaces of risk management defined in their regulatory instruments and the spatial organization of farmers. The scale at which external actors facilitate the management of production risk through their governance instruments tends to be at the farm-level. Like in clusters (Kassam et al., 2011, Joffre et al., 2020), the two private-led improvement projects studied in chapter three facilitated horizontal coordination to share market risks, but farmers managed production risks individually, within the boundaries of the farm. Similarly, and contrary to what we might expect from governments, with a traditional responsibility for managing public resources (Ostrom et al., 1999), the government-led projects studied in chapter four facilitated the management of production risks individually, whilst enabling the sharing of financial and market risks. The findings from chapter five demonstrate that, though there are exceptions, assurance models, too, have a strong tendency to set standards and measure individual performance within the boundaries of the farm. Overall, therefore, institutions imposed by external actors create an aggregate of farm-level risk management spaces.

The scale at which external actors organize farmers does move beyond the farm. The findings from chapters two to five demonstrate variation in the scale at which external actors spatially organize farmers. This suggests that there is not one commonly agreed upon way to organize farmers in area management initiatives, which is not surprising given the plethora of area management approaches identified in chapter one and supports the premise that different spaces emerge from different relations (Roth, 2008). In my analysis of private-led improvement projects in chapter three, like in clusters (Kassam et al., 2011), private actors organized shrimp farmers according to farmers' proximity to each other. However, private actors organized tilapia farmers according to administrative unit, resembling zonal approaches that organize people and their activities based on an abstract concept of space (Bluwstein and Lund, 2018). Similarly, and like in traditional extension programs (Uppanunchai et al., 2018, Chanaseni and Kongngoen, 1992), chapter four demonstrates how the Thai government organized both shrimp and tilapia farmers according to administrative unit. My analysis of assurance models in chapter five highlights various scales at which farmers were organized, ranging from proximity to each other, to landscapes. The latter resemble landscape approaches in that the scale of management was defined at the landscape level, thereby starting from the area. What is common to all of the management and assurance initiatives studied, however, is that though in some cases farmers collectively addressed market and financial risks in groups, farmers did not collectively address production risk management beyond the farm. This suggests that the spatial organization of farmers by external actors creates spaces of collective market and financial risk management, but that these do not represent spaces of shared production risk management.

These findings have three important implications for our understanding of risk management beyond the farm.

First, the spaces of aquaculture production – whether seen from the perspective of shrimp farmers or by studying initiatives governed by external actors – are far closer to the farm space than normative notions of area management suggest (Aguilar-Manjarrez et al., 2017). Though external actors do contribute to shaping spaces of shared market and financial risk management, these top-down approaches do not contribute to shaping spaces of shared production risk management outside individual farms. Spaces of shared production risks do, however, emerge bottom-up, from local networks. Nevertheless, these are relatively close to the farm, in spaces where the interpretation of risk is homogenous.

Second, there is a discordance between the spaces of risk management emerging from top-down externally-led initiatives and those emerging from risk management in local networks. The scale at which external actors define production risk management practices and at which they organize farmers are based on their assumptions around sustainable production practices. This does not coincide with the scale at which local Asian farmers are collaborating to manage risk. Consequently, similar to conservation processes (Bluwstein and Lund, 2018, Raycraft, 2019, Raycraft, 2018), in aquaculture governance, there appears to be a disconnect between the spaces of regulatory processes imposed by external actors and the risk management practices of local farmers, and these different constructions of space are in negotiation with each other. In line with Belton and Bush (2014), this suggests a disconnect between conditions of local production in Asia and assumptions that lie behind national and global spaces of aquaculture governance.

Third, the multiplicity of spaces that emerge suggest the need to re-think what areas actually mean in the context of risk management beyond the farm. Externally-led area management initiatives studied in this thesis demonstrate that there continues to be a spatial fix associated with aquaculture regulation, in the sense that this does not reflect the spaces of local production risk management. However, this thesis demonstrates that, like conservation landscapes (Roth, 2008), aquaculture production landscapes are not comprised of fixed, singular boundaries. 'Areas', in fact, emerge at the confluence of farmer, state and market relations of risk management. Instead of depicting a predefined zone, this results in an overlapping 'patchwork' of spaces (Bear and Eden, 2008, Roth, 2008), which reflect agency and are dynamic, changing as relations and risks develop. Building on Bear (2013), this raises the question whether measures designed to manage aquaculture risks based on a rather fixed understanding of space, namely the space of the farm, can deal with the diversity of spaces that emerge across aquaculture production landscapes.

6.2.2 Risks on and beyond the farm

To answer the second sub-question, in this section I explore the variation in the manner in which social actors understand aquaculture production risk beyond the farm. Applying a relational understanding of risk to study risk management beyond the farm in several case studies within which farmers were faced with a diversity of risks has revealed various interpretations of risk beyond the farm.

Investigating risk beyond the farm in several different institutional arrangements demonstrates that risks beyond the farm are interpreted in diverse ways. This confirms the highly subjective and relational character of risk (Beck, 2009), and suggests that there is no unified understanding of what risk beyond the farm actually means in aquaculture. Furthermore, this research demonstrates that not only are risks socially constructed, they actually appear to have the power to bind farmers and encourage collaborative risk management behavior.

A key finding from this thesis is that farmers collectively manage production risks in local networks and at a scale in which risks are understood to be homogenous. Chapter two demonstrates that shrimp farmers collectively address area-level production risks at a scale within which they experience similar risks that have a direct impact on production. These local networks of shared risks, overlapping the institutions imposed by external actors in chapters three and four, come back as a red thread throughout the thesis. They existed in all the shrimp and tilapia production landscapes studied in Thailand, Vietnam and China, which collectively represent a diversity of risks. This finding confirms that ties between individual farmers (Adger, 2003), and ties within (in)formal farmer groups (Lo and Chan, 2017, Pretty and Ward, 2001), influence the way in which resource users interpret and respond to risk. It also suggests that a shared or common understanding of production risks has the power to bind farmers and creates an intrinsic motivation for farmers to share information, communicate with each other and help each other address risk.

Externally-driven area management initiatives tend to define production risks at the individual level. In the spatially explicit government-led program explored in chapter four, the government defined and enabled individual production risk management interventions. The program facilitated horizontal coordination to share market and financial risks, but did not enable collective production risk management. The top-down basic private-led improvement project in chapter three also prescribed farm-level production risk management, and did so through a certification standard. It did not include the local area-level production risks that farmers were faced with and managed in local (in)formal networks. The bottom-up comprehensive improvement project in chapter three, however, did attempt to include the area-level risks that farmers were faced with and even prescribed collaborative risk management through a Code of Good Practices (CoGP). Nonetheless, they were unsuccessful in actually institutionalizing collective risk management behavior beyond the farm. It follows that, ties between the farmers and external actors did not result in a shared understanding of risk.

The tendency to define production risks at the individual level also applies to assurance models. Findings from chapter five demonstrate that assurance models are inclined to make claims about performance at the farm-level, and consequentially verify this at the farm-level. Given the tendency for assurers in the food sector to strive for predictability and standardization (Kjærnes, 2006), which is a lot more simple to control with individual models, this is not surprising. The Biosecurity Area Management Standard (BAMS) and Verified Sourcing Areas (VSAs) represented two exceptions and encouraged subjects to self-determine risk management objectives and the necessary collective action, thereby reflecting risks as interpreted by farmers. In this respect, these two models appear to embody and directly apply the finding that farmers work together in local networks of homogenized risks. In general, however, assurance models reflect risks as understood by assurers, and not by the farmers.

These findings have three implications for how we understand risk management beyond the farm.

First, externally-led area management initiatives are much more focused on managing individual production risks on the farm than was expected. The externally-led initiatives studied in this thesis do not focus on addressing production risks beyond the farm. Therefore, despite the urgency to address risks that transcend the boundaries of farms (World Bank, 2014), external actors continue to prioritize individual improvement over area-level improvement. This suggests that the individualistic and objective understanding of risk not only dominates aquaculture research (Joffre et al., 2018, Tidbury et al., 2016, Piamsomboon et al., 2015), but also dominates top-down governance approaches to risk management.

Second, there is a mismatch between the way that risk is defined in externally steered initiatives and the way that farmers interpret and consequentially address area-level risks at a local level. The risks addressed by farmers in local networks appeared to be negotiated between individual farmers, or within farmer groups. However, like in many certification standards (Kalfagianni and Pattberg, 2013b, Havice and Iles, 2015), the external actors steering the initiatives and assurance models studied in this thesis in most cases did not negotiate risks with farmers, and failed to incorporate the risk priorities of farmers. Thus, in general, the externally-led initiatives did not reflect the very specific area-level risks that characterize Asian production landscapes.

Third, a common understanding of risks appears to drive shared risk management. The observation that these socially constructed and shared risks have the power to steer or guide the actions of people has enormous implications, but was only directly applied in two of the assurance models explored in this thesis, namely the BAMS and VSAs. If the reason that externally-led area management initiatives continue to focus on facilitating individual production risk management is because external actors struggle to induce cooperation, then applying this finding could provide a route toward more effective external steering of risk management. However, there are debates about the role external interventions should actually have in resource management (Galappaththi and Berkes, 2015a, Nurul Islam et al., 2014), conservation (Alexander et al., 2016), development (Williams, 2004, Campbell and Vainio-Mattila, 2003), but also in extension services (Klerkx et al., 2006, Leeuwis, 2004), agricultural innovations (Klerkx et al., 2009) and even in market-led approaches like certification (McDaniel, 2003, Auld et al., 2015). Reflecting these existing debates, this research raises questions about what role external actors should really have in governing risk management beyond the farm. Aquaculture production involves very local and context-specific risks, and is concurrently responding and feeding into local and global markets. The complexity and diversity of risks associated with farming and trade suggests the need to reconsider the directive role that external actors often take, and advocates a perhaps more facilitative role in the governance of risk management beyond the farm.

6.2.3 The institutionalization of collaborative risk management beyond the farm

To address the third and final sub-research question, in this section I examine in what forms the collaborative management of aquaculture production risk beyond the farm is institutionalized. Understanding institutionalization as a dynamic and emergent process, and exploring this in a number of diverse contexts has revealed several configurations of space and risk, which are not equal in their ability to pattern risk management behavior beyond the farm.

Exploring different institutional arrangements for risk management beyond the farm illustrates that there are numerous and diverse forms of socio-spatial organization around aquaculture production risks. These forms delineate multiple spaces and open up various understandings of risk. This research illustrates institutionalization as the continual (re)emergence of structures that reflect agency through space and risk. Whilst the institutionalization of risk beyond the farm in local networks resulted in some forms of collaborative management of production risks beyond the farm, institutionalization of risk management beyond the farm in externally-led initiatives did not lead to shared production risk management behavior.

6

Local institutions of collaborative risk management emerge that bind farmers based on social relations and a shared understanding of space and risk. Findings from chapters two, three and four demonstrate that farmers collaboratively manage area-level production risks in local networks and at a scale at which risks are homogenous. Building on previous research demonstrating the importance of informal networks in doing business in Asia (Tsang, 1998, Wattanapinyo and Mol, 2013, Wattanapinyo, 2006), farmers collaborated with other individual farmers with whom they had social ties based on kinship, locality, friendship or profession, or within local farmer groups such as cooperatives. Whilst business networks in the global North are generally formed through deliberative involvement from outside agencies, such as industrial associations, in most East and Southeast Asian countries, business networks tend to be developed more organically, through personal relations (Wattanapinyo, 2006). Vietnam and China's history with agricultural collectivization may also contribute to the formation of informal networks of cooperation, deliberately outside the official and formal structures that characterize their economic and political pasts (Fforde, 2008). This research demonstrates that farmers are not only tied to each other by personal relations, but also by a shared understanding of space and risk. Building on accounts of community-based collective action amongst shrimp farmers in Southern Thailand (Vandergeest, 2007, Hall, 2004, Flaherty and Vandergeest, 1998), farmers collaborated with each other at a geographical scale within which their understanding of risks was homogenous. At this scale, farmers exchanged information about input quality, communicated about disease outbreaks and helped each other in times of crisis.

Within these local institutions, social relations and a common understanding of space also structure collaborative risk management behavior. Farmers may functionally seek collaboration to address risks that they cannot address individually and within the boundaries of their own farm (Ostrom et al., 1999). For example, a farmer with a broken dam that borders with their neighbor's farm needs the cooperation of his or her neighbor to fix it, and thus will seek collaboration. However, these informal networks, characterized by trust, loyalty, exchange relationships and effective communication (Wattanapinyo and Mol, 2013), also pattern collective risk management behavior in two ways. First, social structures facilitate collaboration through creating opportunities for information-sharing, strengthening solidarity, allowing for claims of reciprocity and facilitating various forms of risk-sharing (Lo and Chan, 2017, Pretty and Ward, 2001). Second, these relations in and of themselves drive collaboration. For example, a farmer may be motivated to help another farmer fix broken equipment after a typhoon, simply because that other farmer is his cousin.

Personalized trust is one of the principal institutions that drives shared risk management within these local networks. Trust is a key element in collaborative relationships in which actors need to jointly manage risks for the effective performance of the group as a whole (Das and Teng, 2001). The reason that trust plays such an essential role in aquaculture management is that prevention of transmittable production risks like poor water quality and disease is often difficult to detect by individuals before it is too late, and depends entirely on farmers' mutual trust and the resulting moral conduct. Building on Joffre et al. (2020), that demonstrate that trust in farmer groups is instrumental in driving the adoption of farm-level risk management practices, findings from this thesis suggest that trust is also instrumental in driving collaborative risk management beyond the farm.

Whilst findings suggest that collaborative risk management behavior emerges through local networks, private actors struggle with steering shared risk management. Both private-led improvement initiatives studied in chapter three did not lead to collaborative risk management beyond the farm. Like in many existing private governance schemes (Auld et al., 2015), the top-down comprehensive buyer-led improvement project was highly prescriptive and based on farm-level certification. Though the grouping of farmers resembled the informal networks within which farmers were already collaborating – which could potentially encourage collaboration – the prescribed standards formulated and rewarded sustainability practices at farm-level and did not include area-level risk management priorities of farmers, thereby disincentivizing cooperation. The bottom-up comprehensive NGO-led approach was less prescriptive and based on a GoGP. Though the GoGP did to a certain extent reflect the risk priorities of farmers – which could potentially encourage collaboration – member farmers were located far away from each other and were not tied to each other through social relations or a common understanding of space and risk, which possibly disincentivized collaboration. Initiators also struggled to financially incentivize area-level collaboration. In both cases, the configuration of space and risk in these initiatives did not match the way that collaborative risk management was organized at the local level.

Public actors also struggle to steer risk management behavior beyond the farm. The government-led extension program explored in chapter four prescribed farm-level production risk management practices, and incentivized shared market and financial risk management. Though in one of the cases the government organized farmers into groups that resembled the networks within which they already managed risks collaboratively – which could potentially facilitate risk management beyond the farm – none of the policy instruments were inclusive of farmers' area-level risk priorities. Like in many traditional extension programs (Leeuwis, 2004), the configuration of space and risk in this initiative was based on assumptions and knowledge of external actors and did not match the way that collaborative risk management was organized at the local level.

Assurance models, too, tend to be prescriptive in their definition of risks and in their organization of farmers. Unlike in informal social networks, trust in assurance models cannot be built on personalized trust as it involves creating confidence amongst actors that are far away from production landscapes. Chapter five explores different arrangements of institutionalized trust, involving various institutions with different 'trust-building practices' (Zhang et al., 2016). In line with Kjærnes (2006), in most assurance models studied, trust was built on rather prescriptive forms of organization. The models prescribed production risks, generally at the farm-level, and required external verification, propagating the 'institutionalization of distrust' (Kjærnes, 2006) which characterizes the current food system. The BAMS and VSA presented an exception as they allowed farmers to define their own risk priorities, building on personalized trust at the local level. However, these models still required an external actor to verify this, which illustrates the difficulty associated with translating personalized trust to institutionalized trust, and with assuring distant actors such as buyers or even consumers that farmers at a local level are collaboratively addressing risk.

These findings indicate three common characteristics of institutional arrangements that actually appear to limit collaborative production risk management beyond the farm.

First, facilitating and rewarding farm-level improvements disincentivizes collaboration. Like in clusters (Kassam et al., 2011, Joffre et al., 2020), the majority of instruments used to structure risk management in the area management initiatives studied addressed management of production risks at the farm-level. This implies that the most commonly used instruments and tools by external actors actually disincentivize collaboration, which raises questions about why this is happening when there are such clearly formulated ambitions to address area-level risks. It also suggests the need for future research to explore mechanisms or instruments that private and public actors could use to incentivize or reward collaboration at an area-level.

Second, organizing farmers into groups within which they have no ties – either based on social relations or a shared understanding of space and risks – does not encourage collaboration. Most known area management initiatives are externally-led and thus involve external actors actively organizing farmers into groups. This research demonstrates that there is often a mismatch between the way that external actors organize farmers and the way that farmers are tied to each other in local institutions that emerge bottom-up. In the latter, farmers are not responding to external institutions. These local institutions build on a shared understanding of space and risk, which appears to create a good foundation for personalized trust and consequently a promising avenue toward collaborative management. This raises questions about how to translate the personalized trust that characterizes these local networks into formalized trust, in order to build institutions for effective collaborative risk management beyond the farm that are at the same time trusted by external actors.

Third, instruments that prescribe risks are incongruent with bottom-up approaches to collaborative risk management. The majority of initiatives explored in this thesis were prescriptive and did not reflect risk as it is understood by farmers. Prescriptive instruments tend to be rather static, standardized, and based on external assumptions about risks. These technical, externally constructed risks in turn lead to externally constructed, top-down forms of risk management which do not take into account the relational and emergent characteristics of space and risk. Reflecting risks of local farmers, on the other hand, is more likely to result in collaborative risk management.

6.3 A socio-spatial perspective to governing risk management beyond the farm

Through a combined process of deduction and induction, this thesis presents a dynamic, socio-spatial understanding of aquaculture risk management. It opens up a novel way for understanding risk management beyond the farm, which can be used to comprehend this phenomenon in Asia and beyond. I conceptualize shared production risk management as the intersection between a social understanding of space, risk and institutionalization. As these elements align in diverse and specific ways, various configurations of area management emerge. As such, there is not one single, fixed and all-encompassing understanding of the institutionalization of risk management beyond the farm. Instead, risk management beyond the farm is dynamic, and socially mediated through space and risk.

Studying the relationship between space, risk and institutionalization in various configurations of risk management beyond the farm demonstrates that these are not all equal in their ability to address area-level production risks. Instead, approaches to governing risk management beyond the farm are positioned along a spectrum ranging from individual approaches, starting from the farm-level, to more specifically defined area or landscape approaches, which start from the area-level. Both seek to scale up the sustainable management of aquaculture practices, but face several key limitations that deter the collaborative management of shared production risks beyond the farm, and therefore limit their ability to scale up sustainability in general.

On one side of the spectrum risk management beyond the farm constitutes the aggregate of individualistic approaches to risk management. Like the vast majority of management and assurance applied in the aquaculture sector (Potts, 2016, Seafood Certification & Ratings Collaboration, 2019), most of the approaches studied in this thesis fit within this side of the spectrum. In these approaches, space is fixed and defined within the boundaries of farms, and risks are defined at the individual level. Instruments used to institutionalize risk management behavior involve external prescription of production standards and external control through supervision and monitoring (Figure 6.1 A). Though in some cases these approaches successfully facilitate horizontal coordination to address shared market and financial risks, they do not lead to shared production risk management beyond the farm. They experience two crucial limitations in terms of their ability to address area-level production risks. First, they prescribe farm-level practices. They do not include the area-level production risks that farmers are faced with, so the risks they define do not 'bind' farmers nor create intrinsic motivation to cooperate. Second, they are prescriptive and thus inherently exclude farmers that are unable to attain these standards. If the majority of currently applied management and assurance approaches in the aquaculture remain exclusive in this manner, this paints a rather bleak picture for the future sustainability of the sector. If these approaches are to be used as routes toward large-scale sustainability, they need to become more inclusive.

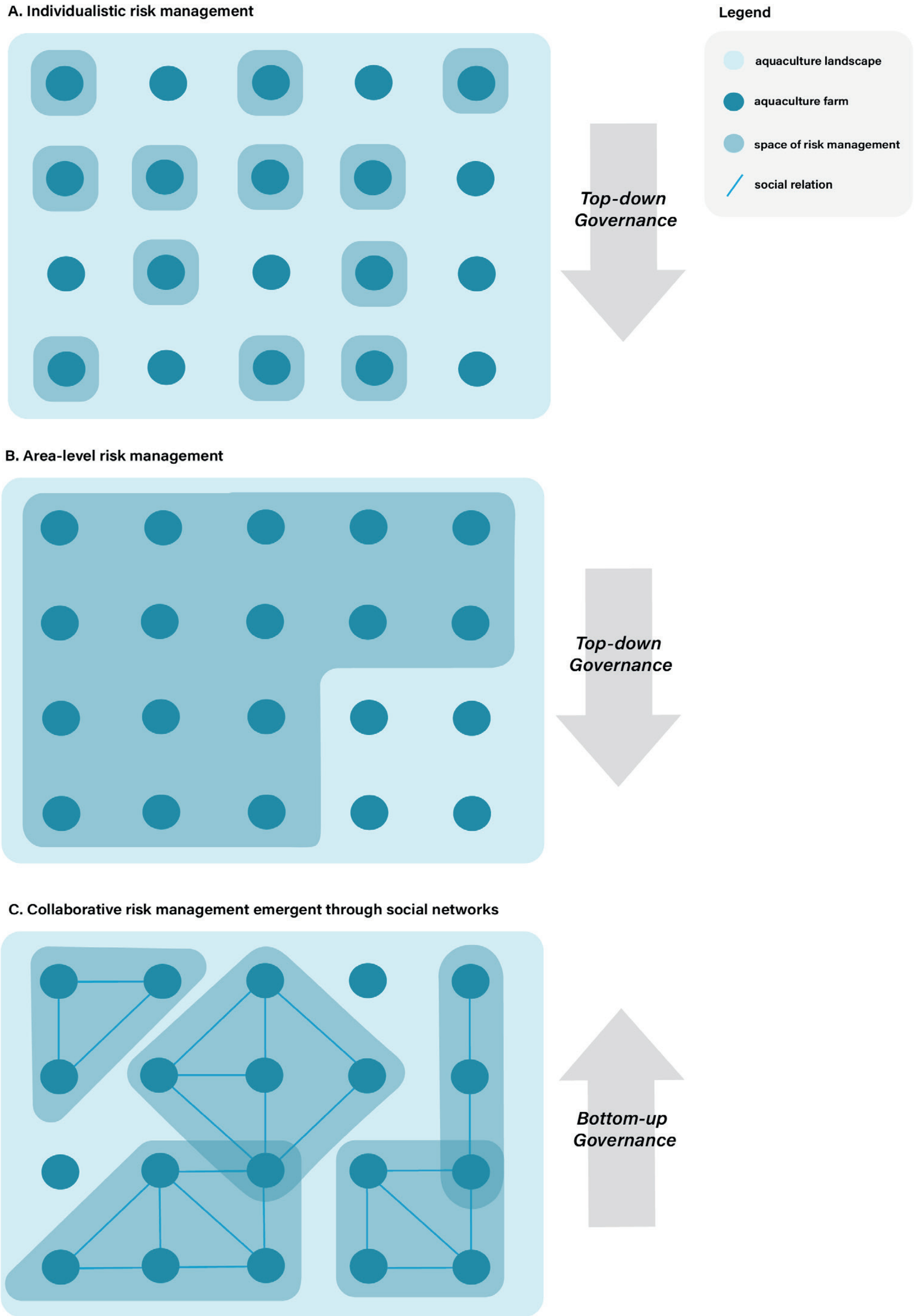

Figure 6.1 Three approaches to aquaculture risk management beyond the farm (Designer: Emily Liang)

On the other side of the spectrum are area-level approaches to risk management. Three initiatives studied in this thesis leaned more toward this side of the spectrum, which represents ecosystem or landscape approaches to management. These reflect the spatial turn taking place in the aquaculture sector, characterized by numerous efforts to plan in space for aquaculture (Gentry et al., 2017a, Gentry et al., 2017b, Lester et al., 2018). These approaches apply a rather structural ontology to understanding the environment, where the ability to define boundaries is a key prerequisite (Olsson et al., 2015). Boundaries are fixed and space is defined at an area-level, but, unlike in individualistic approaches to risk management, in many cases resource users participate in the definition of risks. Though these models are still experimenting with how best to incentivize and measure risk management behavior at the area-level, models studied still involved external control (Figure 6.1 B). These approaches, too, are limited in two ways. First, when areas for improvement are defined at large scales, but farmers are not 'tied' to each other across these scales – either through social relations or a shared understanding of space and risk – they are less likely to collaborate. Second, it appears to be difficult for external actors to develop incentives, financial or otherwise, for farmers to collaborate to address risks across a larger scale. These approaches do not recognize that there are people in space, that these people have the ability to organize themselves, and that the manner in which they do so does not always fall into fixed categories. Taking this into account could significantly contribute to finding more effective ways to govern risk management behavior over these larger scales.

Like global seafood governance more generally, externally-led aquaculture risk management beyond the farm appears to be based on specific assumptions around sustainability and this can actually deter the scaling up of sustainability. As globalization 'opens up' and further complicates the geographies of aquaculture production, standardization is the common route to sustainability governance (Power, 1997, Loconto and Busch, 2010). This thesis demonstrates that this standardization is, however, based on assumptions that are in many ways (too) exceptional and do not hold for local conditions of production in Asia. As outlined by Belton and Bush (2014), commonly used seafood sustainability governance instruments, applied in the majority of externally-led area management initiatives, are often based on the experience of Northern countries driven by post-productivist demands such as organic production, and demonstrate an export-oriented bias to industrialized production. Thus, applying these forms of standardization to the diversity of species cultured extensively, or for domestic consumption, is problematic. Building on this, this thesis demonstrates that the continued use of this type of standardization as the primary approach to sustainability will actually limit the ability to address area-level production risks.

This thesis reveals an area of innovation that suggests an alternative approach to understanding and ultimately governing risk management beyond the farm, in which space, risk and institutionalization are configured in a very specific manner. In this configuration, the space of risk management is that in which the interpretation of risk is homogenous, risks are shared and self-determined and the institutions of risk management are emergent through informal and local social networks (Figure 6.1 C). Though this does not address area-level production risks at a larger, ecosystem or landscape, scale, the intersection of space and risk in this configuration appears to be more promising in terms of institutionalizing shared risk management behavior than it is other approaches. Hence, this research illuminates the emergent and dynamic properties of institutionalization, presenting a stark contrast to very fixed and prescriptive understandings of what institutions are, which characterize the majority of existing externally-led area management initiatives. In line with Rigg (2007), this alternative approach demonstrates that it is essential to understand local material realities and risk management practices that characterize the diverse nature of aquaculture production.

This novel understanding of risk management beyond the farm can feed into designing more effective area management, in aquaculture and beyond. Most known area management initiatives are externally-driven, and this research demonstrates that it is challenging for external actors to steer Asian farmers to collaborate to manage production risks outside the boundaries of their farm. This thesis demonstrates that farmers collaboratively address area-level production risks at the scale in which they are tied to each other through social relations, and through a shared understanding of space and risks (Figure 6.2). On the one hand, this bottom-up approach to risk management can complement and reinforce existing approaches on the spectrum. On the other hand, these findings can be applied to fundamentally change the manner in which these existing approaches are carried out. Instead of prescribing space and often risks, the starting point or blueprint for new governance approaches becomes the way that farmers interact within their own existing understandings of space and risk.

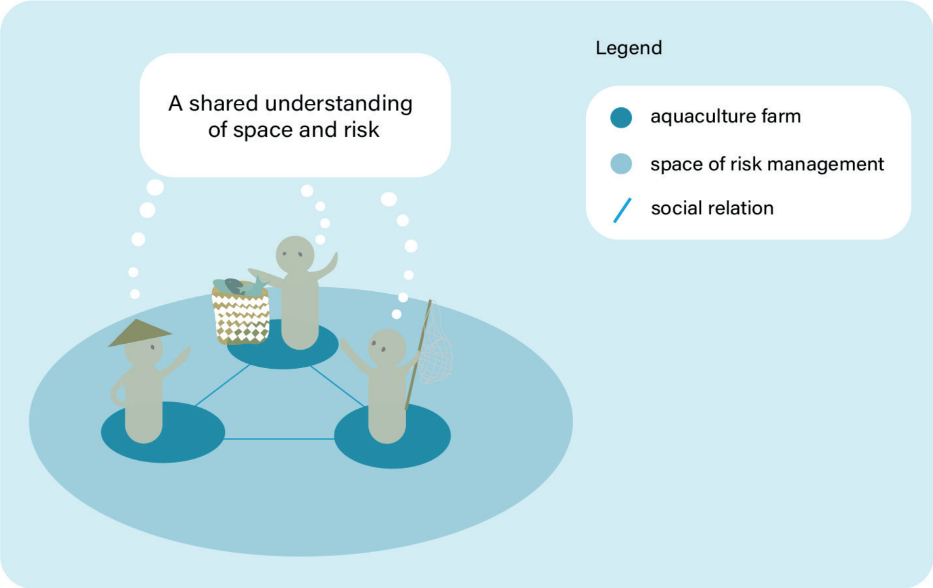

Figure 6.2 The scale of emergent risk management
(Designer: Emily Liang)

The currently dominant models of seafood assurance are incongruent with such a bottom-up approach to risk management beyond the farm. Starting from local networks of shared risk management requires empowering farmers to define risks and the scale of collaborative management, which is difficult for external actors to control. Building on Auld et al. (2015) and Kjærnes (2006), this research suggests that there are alternative ways to organize assurance, provided external actors are prepared to let go of a certain degree of control. Building on bottom-up shared risk management would require a radical move away from a starting point of distrust, to one of trust. One in which external actors trust that groups of farmers in very specific configurations collectively address shared production risks, opening up a space in which farmers are empowered to organize themselves based on a local understanding of space and risk. Though developing such an approach requires further investigation into how to extrapolate trust between local farmers to global actors, this approach would be more inclusive and accessible to a much broader range of farmers than current models are, and could structure a means by which sustainability can really be scaled up.

Exploring how social relations shape space and risk, and how these in turn shape the institutionalization of risk management beyond the farm has demonstrated the need to start thinking differently about how risks across landscapes should be governed. Though there is ample empirical evidence of management approaches that address risk beyond the farm in the aquaculture sector, the manifestation of risk management practices through space and their embeddedness in social relations is undertheorized. This thesis fills this gap, building a socio-spatial understanding of aquaculture risk management. This perspective does not replace quantitative risk assessments or maps delineating the ecological functions of landscapes, as these approaches remain imperative to understanding landscapes. However, this thesis demonstrates that to *fully* comprehend risk management behavior across landscapes and in markets, it essential to understand how people understand risks and relate to other people in space. Overcoming some of the limitations current approaches face, and developing new governance approaches for scaling up sustainability in Asia and beyond, requires reimagining risk in space, and starting from the social.

6.4 Policy and research recommendations

Having reflected on the main findings of this thesis and presenting a novel approach for governing risk management beyond the farm, this section translates results into policy recommendations applicable for various actors and outlines future avenues of research.

6.4.1 Policy recommendations

This thesis has demonstrated the importance of understanding space and risk from the perspective of farmers. Moving from theory to practice, a principle recommendation for both public and private actors who wish to design new mechanisms aimed at the management of production risks beyond the farm is to consider the dynamic and emergent characteristics of risk management beyond the farm, which cannot always be captured in fixed categories (see Figure 6.1 C). A socio-spatial understanding of how farmers understand and manage risks at a local level is integral for the governance of production risks beyond the farm and should provide the foundation for designing new or improving existing governance arrangements in three specific ways.

First, farm-level improvement models must be altered to increase their ability to address area-level production risks. Farm-level models such as regulation and certification are here to stay. However, this research demonstrates that integrating local actors' understanding of space and risk into the design of farm-level private-led or public-led governance arrangements can increase their potential to address area-level risks. This finding can be applied in two very practical ways. When external actors organize farmers in governance arrangements, they should base this on the local social networks within which farmers are already effectively sharing risks. When buyers form farmer groups for group certification, when NGOs and local government actors arrange farmers into groups in landscape-level PPPs, when local government actors organize farmers for training programs, or when defining how groups should be assembled in new assurance models, I recommend using these local networks as the starting point.

Another way to apply this finding is to include farmers' understanding of risk when defining claims or objectives in governance arrangements. Building on previous research demonstrating the value of empowering local actors to define their own sustainability criteria in third party certification standards (Kalfagianni and Pattberg, 2013a, Havice and Iles, 2015, Hatanaka, 2010, Auld et al., 2015), I recommend including farmers' risk priorities in governance arrangements. For example, standard bodies could include farmers' perspectives in the process of standard-setting or PPPs could empower farmer groups to self-determine risk management goals. I recognize that there are not simple or self-evident processes for doing this, there are difficulties associated with making stakeholders participants in rule-making, and processes of empowerment can also be associated with uncertain and uneven economic benefits (Auld et al., 2015). However, to address area-level impacts of aquaculture, these steps must be taken.

Second, spatial planning, too, must integrate local understandings of space and risk. Spatial planning plays an increasing role in aquaculture regulation. The FAO and World Bank promote spatial planning in aquaculture (Aguilar-Manjarrez et al., 2017), and national governments are increasingly facilitating spatial planning processes (Sanchez-Jerez et al., 2016, Vila et al., 2015, Brigolin et al., 2015, Gentry et al., 2017b, Lester et al., 2018). Despite contemporary research that demonstrates the importance of participatory processes in spatial planning (Fagerholm et al., 2016, Radil and Jiao, 2016), particularly when dealing with cumulative impacts (Huang and London, 2016), there is little evidence of spatial planning processes in the aquaculture sector that recognize the agency of actors to construct boundaries and risks. I recommend industry or government actors leading spatial planning processes to use more participatory processes in the definition of boundaries, allowing the ability of people to organize themselves and risk management to be more leading.

Third, to scale up sustainability, assurance must radically change. Sustainability issues continue to challenge the sector. At the same time, the demand for sustainable seafood continues to rise (Potts, 2016). This thesis demonstrates that current models of farm-level improvement and assurance are limited in their ability to scale up sustainability. Thus, to meet increasing demand for sustainable seafood, new models of improvement and assurance are needed. The development of new models requires support from and action by both private and public actors. This is already happening, as assurers, buyers and NGOs collaborate to think ahead and experiment with assurance approaches that are accessible to the large majority of non-certified aquaculture farmers (Global Sustainable Seafood Initiative, 2020, Monterey Bay Aquarium Foundation, 2019, Resonance, 2019). These initiatives do not only require continuous critical assessment of their accessibility to farmers and their inclusion of area-level risks, they also require thinking about mechanisms for incentivizing improvement, accountability for improvement and financing implementation in the long run. However, I recommend influential buyers, NGOs, assurers and governments to take this a step further and start experimenting with ways in which they can translate trust between farmers at a local scale into assurance models, which will enable distant actors to trust the production of sustainable seafood at the local level.

6.4.2 Future research

In my examination of four global assurance models and four area management initiatives, featuring three Asian countries and a narrow group of species, I focused on similarities between cases. This painted an initial picture of the institutionalization of risk management beyond the farm in aquaculture and builds a foundation for future research on this topic.

Given the prevalence of disease and other sustainability challenges associated with aquaculture production in other parts of the world, I recommend expanding this research both within Asia and beyond. Within Asia, it is beneficial to supplement this thesis with existing research on clusters in Vietnam, India and Indonesia (Ha et al., 2013b, Padiyar et al., 2012, Umesh et al., 2010, Ravikumar and Yamamoto, 2009, Joffre et al., 2019) and accounts of community-based collective action in Thailand (Vandergeest, 2007, Hall, 2004, Flaherty and Vandergeest, 1998), to paint a more complete picture of risk management beyond the farm in Asia. Beyond Asia, it would be interesting to explore accounts of aquaculture risk management beyond the farm in countries with entirely different political, environmental and cultural contexts like Scotland (Ellis et al., 2016, Murray, 2014, Murray and Gubbins, 2016, Scottish Salmon Producers Organisation, 2015), Chile (Gustafson et al., 2014, Gustafson et al., 2016, Vila et al., 2015), and Canada (Chang et al., 2014), to determine whether there are commonalities and whether there may be lessons to learn from other regions that have demonstrated effective risk management beyond the farm.

Since aquaculture is not just diverse in geography, but also in terms of species and production systems, I also recommend taking a closer look at particularities that apply to specific species and production systems. Species cultured and production systems applied influence the risks experienced by farmers, and findings from this research hint at possible resulting variations in forms of collaboration between farmers to address risks. For example, shrimp farming tends to be geographically concentrated and farmers share water sources, which suggests that these types of farmers have more incentive to collaborate. This would in turn affect the manner in which risk management is institutionalized by shrimp farmers versus farmers in areas in which farms are more spatially dispersed. Thus, it would be valuable to further explore whether there are notable differences in the manner in which risk management beyond the farm is institutionalized between species and production systems, as this could inform more effective governance of shared risk management.

Studying risk management beyond the farm in this thesis has concentrated on the perspective of actors either directly involved with production or with governing production, leaving the perspective of a number of other actors along the value chain unexplored. This research did not focus on the perspective of actors 'upstream' or 'downstream' along the value chain, such as input suppliers, importers, buyers or consumers, whilst these actors may have a role to play in the institutionalization of risk management beyond the farm. Though this thesis and previous research demonstrate a role for input suppliers in supporting farmers in the management of risks (Ginder, 1992, El-Sayed et al., 2015, Moahid and Maharjan, 2020), it remains unclear what their role is in the management of risks beyond the farm. Furthermore, though previous research demonstrates the important role of buyers and consumers in driving sustainable production (Bush and Belton, 2011, Trifković, 2014), it remains unclear whether buyers and consumers actually see value in addressing area-level risks, and, ultimately, whether they are willing to pay for this. These perspectives are important to understand, as they can inform designing new governance arrangements and provide insights into ways in which value chain actors can take or be given responsibility for furthering the agenda for risk management beyond the farm.

Considering the urgency to address risk beyond the farm in numerous agro-food industries, further research should compare the findings from this thesis to those from other agro-food sectors. Like the aquaculture industry, other sectors are experimenting with approaches for addressing risk beyond the farm (Sayer and Cassman, 2013, Milder et al., 2014, Minang and Catacutan, 2015, FAO, 2013). Between sectors, however, there is variation in the scale of farming, production risks, and relations between farmers, all which can influence the manner in which risk management beyond the farm is institutionalized. If farmers in other industries are found to share production risks in ways that are similar to how aquaculture farmers in this research do, this could have exciting implications for agriculture and addressing sustainability more broadly. Furthermore, it could provide a foundation for furthering knowledge on cross-sectoral collaboration to manage risk in landscapes, which currently challenges the implementation of ecosystem and landscape approaches (Brugère et al., 2019, Sayer et al., 2013), but is essential in order to address risk at a large scale.

A final recommended avenue of future research applies to both aquaculture and beyond. This thesis demonstrates that developing new models of assurance is critical to scale up sustainability in the global food sector, and I have touched upon several policy actions that should be taken. However, this necessitates a parallel effort in furthering our understanding of trust and assurance in the food sector. Findings from this research were based on a review of a number of emerging assurance models in the aquaculture sector. I recommend broadening this scope and exploring how far other sectors are with developing models that are both more accessible to farmers and more congruent with bottom-up approaches to risk management. In addition to this, I recommend investigating ways in which personalized trust has been and can be translated into institutionalized trust. This information can provide the foundation for designing new improvement and assurance models that are able to address area-level risks and structure a means by which the global food sector can scale up sustainability.

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Appendices

APPENDIX 1. List of interviews

Table A1.1 Interview details

Location	Respondent code	Date
Bangkok, Thailand	Central government	24.01.2017
	NGO	21.01.2017
	Central government	25.01.2017
Chantaburi, Thailand	Local government	30.01.2017
	Farmer	31.01.2017
	Farmer	31.01.2017
	Farmer	31.01.2017
	Farmer	31.01.2017
	Farmer	02.02.2017
	Farmer	02.02.2017
	Farmer	02.02.2017
	Farmer	03.02.2017
	Farmer	03.02.2017
	Farmer	03.02.2017
	Farmer leader	04.02.2017
	Local government	06.02.2017
	Farmer	06.02.2017
	Farmer	06.02.2017
	Farmer	07.02.2017
	Farmer	07.02.2017
	Local government	07.02.2017
	Farmer	08.02.2017
	Farmer	08.02.2017
	Farmer	08.02.2017
	Cooperative	09.02.2017
	Farmer	10.02.2017
	Farmer	10.02.2017
	Farmer	10.02.2017
	Academic	14.02.2017
	Farmer leader	14.02.2017
	Farmer leader	14.02.2017
	Cooperative	15.02.2017
	Value chain	15.02.2017
	Farmer leader	15.02.2017
	Value chain	16.02.2017
	Local government	16.02.2017
	Provincial government	20.02.2017
	Farmer* (focus group)	20.02.2017
	Farmer leader	20.02.2017
	Local government	21.02.2017
	Local government	21.02.2017

Location	Respondent code	Date
	Farmer leader	21.02.2017
	Farmer leader	21.02.2017
	Local government	22.02.2017
	Farmer leader	22.02.2017
	Local government	22.02.2017
Chonburi, Thailand	Cooperative	25.02.2017
	Farmer group leader	26.02.2017
	Value chain	27.02.2017
	Farmer leader	28.02.2017
	Farmer leader	28.02.2018
	Farmer leader	01.03.2017
	Local government	01.03.2017
	Cooperative	02.03.2017
	Value chain	03.03.2017
	Local government	03.03.2017
	Provincial government	04.03.2017
	Farmer leader	04.03.2017
	Provincial government	06.03.2017
	Farmer leader	06.03.2017
	Provincial government	07.03.2017
	Provincial government	07.03.2017
	Local government*	09.03.2017
	Value chain	09.03.2017
	Farmer leader*	10.03.2017
	Farmer* (focus group)	10.03.2017
	Academic	11.03.2017
	Cooperative	12.03.2017
	Value chain	14.03.2017
	Academic	17.03.2017
Ho Chi Minh, Vietnam	Value chain	03.04.2017
	NGO	03.04.2017
	Value chain	04.04.2017
	NGO	05.04.2017
Can Tho, Vietnam	Academic	05.04.2017
	Academic	06.04.2017
Ca Mau, Vietnam	NGO	10.04.2017
	Value chain	10.04.2017
	Provincial government*	11.04.2017
	Provincial government*	11.04.2017
	Central government	11.04.2017
	Local government	12.04.2017
	Local government	12.04.2017
	Local government	13.04.2017
	Local government	13.04.2017

Location	Respondent code	Date
	Local government	14.04.2017
	Value chain	14.04.2017
	Value chain	14.04.2017
	Farmer leader	14.04.2017
	Local government	14.04.2017
	Value chain	15.04.2017
	Value chain	15.04.2017
	Farmer leader	15.04.2017
	Farmer	17.04.2017
	Farmer	17.04.2017
	Farmer	17.04.2017
	Farmer	18.04.2017
	Farmer	18.04.2017
	Farmer	18.04.2017
	Farmer	19.04.2017
	Farmer	19.04.2017
	Farmer	19.04.2017
	Farmer	20.04.2017
	Farmer	20.04.2017
	Farmer	20.04.2017
	Farmer	21.04.2016
	Farmer	21.04.2016
	Farmer	23.04.2017
	Farmer	23.04.2017
	Farmer	23.04.2017
	Farmer	24.04.2017
	Farmer	24.04.2017
	Farmer	24.04.2017
	Local government	25.04.2017
	Farmer* (focus group)	26.04.2017
	Cooperative	26.04.2017
	Cooperative	27.04.2017
	Cooperative	27.04.2017
	Farmer	27.04.2017
	Value chain	28.04.2017
	Value chain	28.04.2017
Can Tho, Vietnam	Central government	01.05.2017
Ho Chi Minh, Vietnam	Academic	08.05.2017
Hainan, China	NGO	11.05.2017
	NGO	12.05.2017
	Value chain	15.05.2017
	Lead farmer	15.05.2017
	Lead farmer	16.05.2017
	NGO	16.05.2017

Location	Respondent code	Date
	NGO	16.05.2017
	Value chain	17.05.2017
	Value chain	19.05.2017
	Farmer* (focus group)	19.05.2017
	Value chain	22.05.2017
	Value chain	22.05.2017
	Value chain	22.05.2017
	Provincial government*	23.05.2017
	NGO	23.05.2017
	Value chain	24.05.2017
	Academic	25.05.2017
	Cooperative, farmer, NGO*	26.05.2017
	Local government*	26.05.2017
Skype	NGO	06.03.2018
Utrecht, The Netherlands	Assurance	13.03.2018
	NGO	16.03.2018
Ho Chi Minh City, Vietnam	Value chain	30.03.2018
Bangkok, Thailand	Central government	28.08.2018
	Central government	28.08.2018
E-mail	Local government	01.09.2017
Bangkok, Thailand	Central government	03.09.2018
	NGO	03.09.2018
	Academic	04.09.2018
	Central government	04.09.2018
	Central government	05.09.2018
	Central government*	06.09.2018
	Central government	07.09.2018
Chantaburi, Thailand	Provincial government	10.09.2018
	Provincial government	11.09.2019
	Provincial government*	11.09.2019
	Provincial government	12.09.2018
	Local government	13.09.2018
Bangkok, Thailand	Value chain*	17.09.2018
	Value chain*	18.09.2018
Skype	Digital management	12.07.2019
	Assurance	16.07.2019
Utrecht, The Netherlands	Assurance	17.07.2019
	NGO	17.07.2019
Skype	International expert	18.07.2019
Gelderland, The Netherlands	Assurance	18.07.2019
Skype	Assurance	1.08.2019
	International expert	9.08.2019
Utrecht, The Netherlands	NGO	12.08.2019
Skype	Assurance	15.08.2019

Location	Respondent code	Date
	Assurance	16.08.2019
	Digital management	20.08.2019
Phone	NGO	20.08.2019
Skype	Digital management	22.08.2019
	Assurance	26.08.2019
	Digital management	28.08.2019
Utrecht, The Netherlands	Assurance	29.08.2019
Skype	Digital management	4.09.2019
Utrecht, The Netherlands	NGO	4.09.2019
Skype	NGO	5.09.2019
	Assurance	9.09.2019
	Digital management	10.09.2019
	Digital management	10.09.2019
North Holland, The Netherlands	NGO	16.09.2019
Skype	NGO	17.09.2019
	Assurance	20.09.2019

*interviews with more than one respondent

Table A1.2 Respondent codes

Respondent code	Explanation
Farmer	Aquaculture farmer
Farmer leader	Leader of (in)formal farmer group
Cooperative	Representative of cooperative or cooperative group
Value chain	Non-farmer value chain actors: buyers, processors, input suppliers
Central government	Representative of central government
Provincial government	Representative of provincial government
Local government	Representative of district or sub-district government
Digital management	Digital management service provider
NGO	Representative of non-governmental organization, excluding assurers
Assurance	Representative of assurance organization: standard owner, certification body, accreditation body, seafood rating scheme
Academic	Employee of university
International expert	International aquaculture expert

APPENDIX 2. Case selection process

Scoping interviews identified fourteen potential initiatives providing beyond farm assurance. It became apparent that not all these initiatives were assurance models. Based on the data collected, a selection process was conducted to identify actual cases of beyond farm assurance. Criteria for classification as an assurance model was an initiative that defines claims for an audience and verifies these claims. Secondary criteria for selecting cases for this research was initiatives that were already being implemented or piloted. As such, only initiatives one to six in the table below were classified as currently functioning assurance models. Consequently, these were then used to identify the four cases of beyond farm assurance presented in this research. Table A2.1 briefly describes the initiatives considered, and provides a rationale for why they were or were not included as cases of beyond farm assurance.

Table A2.1 Rationale for case selection

Initiative	Description	Included?	Rationale
ASC Group Certification	The Aquaculture Stewardship Council Group Certification collectively certifies groups of two or more small-scale aquaculture operations against an ASC standard, seeking to bring efficiency to the certification of organized groups of small farmers (Aquaculture Stewardship Council, 2019a).	Yes	Claims are made and verified about farm-level management of farmer groups.
BAP Farm and Hatchery Group Program	The Best Aquaculture Practices Farm and Hatchery Group Program collectively certifies six to fifty farms/hatcheries against a BAP standard, which allows BAP to accept a reduction in the number of onsite audits while preserving the integrity of the BAP scheme (Best Aquaculture Practices, 2018b).	Yes	Claims are made and verified about farm-level management of farmer groups.
GLOBAL G.A.P. Option 2 Producer Group Certification	GLOBALG.A.P Option 2 certification collectively certifies a group of farmers against a GLOBAL GAP standard, to reduce costs and inspection time of audits (GLOBALG.A.P., 2019).	Yes	Claims are made and verified about farm-level management of farmer groups.
BAP Biosecurity Area Management Standard	The Best Aquaculture Practices Biosecurity Area Management Standard certifies groups of cooperating farms that collectively manage biosecurity risks across a defined aquaculture area (Best Aquaculture Practices, 2018a).	Yes	Claims are made and verified about biosecurity management in an area.
Partnership Assurance Model	The Partnership Assurance Model is a collaborative model for aquaculture improvement and assurance that brings together local stakeholders to design, implement and verify improvements in a region (Resonance, 2019).	Yes	Claims are made and verified about farm-level management of average farmers in an area.
Verified Sourcing Areas	Verified Sourcing Areas are an area-based mechanism to accelerate the production and market uptake of sustainable commodities by helping companies verify the sustainability of an entire jurisdiction (The Sustainable Trade Initiative, 2019e).	Yes	Claims are made and verified about performance in a jurisdiction.
Global Seafood Assurances	Global Seafood Assurances aims to close risk gaps in the seafood supply chain and to provide complete assurance throughout the chain, by bringing together a portfolio of standards and working with existing standard-holders to develop new standards where they lack (Global Seafood Assurances, 2020).	No	This initiative brings together existing standards and develops new standards, but is not an assurance model in itself.
GSSI Seafood MAP	This initiative, led by Global Sustainable Seafood Initiative, aspires to support non-certified seafood farmers in becoming more sustainable, by – amongst other activities – developing a mechanism to assess the sustainability of production systems (Global Sustainable Seafood Initiative, 2020).	No	Though it will potentially be developed as a model to provide beyond farm assurance, it was still in concept phase during the time of the research and will be developed and tested in 2020.

Initiative	Description	Included?	Rationale
Aquascape Program	This program is an aquaculture improvement project led by a coalition of partners. It addresses disease risks and environmental impacts across a politically and ecologically relevant location, to attract insurance and investment, and to create a scalable model for improvement (The Sustainable Trade Initiative, 2019a, Sustainable Fisheries Partnership, 2019).	No	The project focusses on farm-level and area-level disease management, but providing assurance is not (yet) a fundamental part of the project.
eFishery	eFishery is an integrated feeding system for fish and shrimp farming, which feeds fish automatically. It collects a lot of data, which the company is using to provide additional end-to-end services, connecting farmers to various services in the value chain (eFishery, 2019).	No	It is a farm management technology that does not make or verify claims. However, the data that this tool collects could potentially be used to measure performance beyond the farm.
JALA	JALA is farm management tool that uses water quality monitoring and digital data analytics to achieve precision farming. A water quality monitoring device records water quality and cultivation data, which is analyzed to provide cultivation insights and farming predictions (Jala Tech, 2019).	No	It is a farm management technology that does not make or verify claims. However, the data that this tool collects could potentially be used to measure performance beyond the farm.
XpertSea	XpertSea is an AI-driven data management platform that offers real-time insights. Their XperCount automatically monitors animal growth and health. The AI-driven aquaculture management platform identifies deformities, coloring inconsistencies and feed-related issues (XpertSea, 2019).	No	It is a farm management technology that does not make or verify claims. However, the data that this tool collects could potentially be used to measure performance beyond the farm.
Farmforce	Farmforce is a mobile platform that manages relations with farmers, usually used to manage sourcing within a contract farming scheme. It can be applied to improve traceability, increase transparency and document compliance to standards (Farmforce, 2019).	No	It is used by standards to set up and operate management systems, but does not make or verify claims.
Verifik8	Verifik8 is a software tool used to monitor and verify social and environmental performances in the agribusiness supply chain through key performance indicators aligned with existing standards. It offers a unique tool for verification delivering real-time analytics (Verifik8, 2018).	No	This tool can be used to verify compliance to existing standards, but does not make claims.

Summary

Summary

As the aquaculture sector grows, so do the risks associated with production and these risks transcend farm boundaries. Traditionally applied risk management approaches, focused on farm-level strategies, are unable to address these area-level risks. Reflecting a trend observed in other agro-food industries, risk management and assurance approaches that address aquaculture risks beyond the unit of production are surfacing. While these are emerging as key approaches, we lack a fundamental understanding of how they address the sharing of production risks through the collaboration of actors across landscapes. Zooming in on Asia, a region that hosts the vast majority of global aquaculture production, the purpose of this thesis is to explore what aquaculture risk management beyond the farm entails and in what ways this is institutionalized in the Asian aquaculture sector.

Building on relational and dynamic perspectives on space, risk and institutionalization, I introduce a novel, socio-spatial and relational perspective to study the challenge of addressing production risks at a scale beyond the farm. Using this social scientific approach, I study a sample of Asian management initiatives and global assurance models that represent variation in the manner in which risk management beyond the farm is institutionalized. Four types of institutional arrangements were selected to function as the scientific sample upon which I draw higher level observations about risk management beyond the farm. I study individual farmers and their local networks (Chapter two), market-led improvement projects that sit within global value chains (Chapter three), a government-led extension program (Chapter four) and assurance models (Chapter five).

Chapter two empirically examines how individual aquaculture farmers interpret and manage area-level production risks and the extent to which they operate beyond the boundaries of their farms. The analysis is based on a comparison between intensive aquaculture farmers in Kung Krabaen Bay, Thailand, and a mixture of integrated mangrove shrimp and extensive shrimp farmers in Kien Vang Forest, Vietnam. The spatial configuration of production risk management in both areas demonstrated a focus on the farm. Though farmers did recognise area-level production risks, this did not result in collectively practised risk management strategies at a broad landscape scale, which demonstrates the need to rethink the development of area-based approaches. Findings suggest that spatial models of area-based aquaculture management should be based on a nested set of areas within a landscape, defined by the socio-spatial extent of farmer networks within which the interpretation of risk is homogeneous.

Chapter three explores the manner in which the management of production risks beyond farm scale is institutionalized in private-led improvement projects. This chapter analyses how aquaculture improvement projects led by NGOs and buyers address risk management at different scales by comparing a 'top-down basic' aquaculture improvement project in Vietnam and a 'bottom-up comprehensive' aquaculture improvement project in China. The results indicate that aquaculture improvement projects struggle with institutionalizing risk management at an area-level because of the difficulties both NGOs and buyers face in inducing horizontal cooperation to address shared risk between farmers. This is attributed to the poor capacity of these actors to align improvement projects with the social and environmental conditions of production. Aquaculture improvement projects are more likely to be successful in institutionalizing shared area-level risk management if they build on the existing social networks of farmers.

Chapter four investigates how shared risk management is institutionalized through Plang Yai, a spatially-explicit state-led extension program in Thailand. It focusses on how four key policy instruments brought together under Plang Yai delimit multiple territories of risk management over shrimp and tilapia production in Chantaburi and Chonburi provinces. The findings demonstrate how these policy instruments address risks through dissimilar but overlapping territories that are selectively biased toward facilitating the individual management of production risks, whilst enabling both the individual and collective management of market and financial risks. This raises questions about the suitability of addressing aquaculture risks by controlling farmer behavior through state-led designation of singular, spatially explicit areas. The findings also indicate the multiple roles of the state in territorializing risk management, providing a high degree of flexibility, which is especially valuable in landscapes shared by many users, connected to (global) value chains and facing diverse risks.

Chapter five explores the emergence of forms of 'beyond farm' assurance in the aquaculture sector, designed to increase the inclusion of smallholders and scale up environmental sustainability. The analysis reveals a 'spectrum of assurance', representing contrasting levels of trust in sustainable production and consumption. At one end of this spectrum attempts emerge to foster self-determined assurance models with internal verification that represent growing trust in the ability of subjects to organize area-level sustainability improvements. The other, more dominant end of this spectrum, however, is populated with prescriptively and externally verified assurance models that demand high levels of control-driven assurance, demonstrating inherent distrust of area-level sustainability practices. To scale up sustainability, beyond farm assurance models must overcome the limitations of prescriptive assurance, by finding fundamentally new ways of trusting farmers and their local counterparts in the global agro-food system.

Chapter six reflects on the findings of the preceding chapters and further unpacks the geographies and institutional dynamics of aquaculture risk management beyond the farm. The primary theoretical innovation in this research is the reimagination of aquaculture production in terms of space, risk and institutionalization. This thesis opens up a novel way for understanding risk management beyond the farm, which can be used to comprehend this phenomenon in Asia and beyond. I conceptualize shared production risk management as the intersection between a social understanding of space, risks and institutionalization. As these elements align in diverse and specific ways, various configurations of area management emerge. As such, there is not one single, fixed and

all-encompassing understanding of the institutionalization of risk management beyond the farm. Instead risk management beyond the farm is dynamic, and socially mediated through space and risk.

Studying the relationship between space, risk and institutionalization in various approaches to risk management beyond the farm demonstrates that these are not all equal in their ability to address area-level production risks. I position these approaches to governing area management along a spectrum ranging from individual approaches, starting from the farm-level, to more specifically defined area or landscape approaches, which start from the area-level. Both approaches seek to scale up the sustainable management of aquaculture practices, but face several key limitations that deter the collaborative management of shared production risks beyond the farm, and therefore limit their ability to scale up sustainability in general.

This thesis reveals an area of innovation that suggests an alternative approach to understanding and ultimately governing risk management beyond the farm, in which space, risk and institutionalization are configured in a very specific manner. In this configuration, the space of risk management is that in which the interpretation of risk is homogenous, risks are shared and self-determined and the institutions of risk management are emergent through informal and local social networks. Though this does not address area-level production risks at a larger, ecosystem or landscape, scale, the intersection of space and risk in this configuration appears to be more promising in terms of institutionalizing shared risk management behavior than it is other approaches.

Exploring how social relations shape space and risk, and how these in turn shape the institutionalization of risk management beyond the farm has demonstrated the need to start thinking differently about how risks across landscapes should be governed. This thesis reveals the inherently social nature of aquaculture risk management beyond the farm. To fully comprehend risk management behavior across landscapes and in markets, it essential to understand how people understand risks and relate to other people in space.

WASS Education certificate

Mariska Johanna Melati Bottema
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Writing PhD proposal	ENP, WUR	2016	6
Project management and communications SUPERSEAS	ENP, WUR	2016-2020	3
Spatial thinking in the social science	WASS	2016	4
Introduction to Coastal and Marine GIS	University of Southampton/ABP MER	2016	1
Field visit Hainan	Sustainable Fisheries Partnership	2016	1
B) General research related competences			
Introduction to WASS	WASS	2016	1
Qualitative Data Analysis	CERES	2016	1.5
Reviews: two research papers	Land Use Policy & Maritime Studies	2016	2
Organizing marine meetings	ENP, WUR	2016-2019	1
'Moving beyond the farm: territories of responsible aquaculture?'	MARE Conference (Centre for Maritime Research), Amsterdam	2017	1
Guest lecture at career day	Academy of Marine Sciences, Hainan University	2017	1
Co-authorship committee	ENP, WUR	2018	0.5
'Private aquaculture area stewardship: the case of two Asian Aquaculture Improvement Projects'	LANDac Conference (the Netherlands Land Academy), Utrecht	2018	1
'Moving beyond the shrimp farm: spaces of shared environmental risk?'	WASS PhD Day	2018	1
'State-led aquaculture area-based management: the case of Thailand's Plang Yai'	Aquaculture Conference (World Aquaculture Society), New Orleans	2019	1
C) Career related competences/personal development			
Scientific Writing Skills	Wageningen in'to Languages	2017	1.8
Presenting With Impact	Wageningen in'to Languages	2018	1
Writing retreat: 2018 and 2019	ENP/PAP/FNP, WUR	2018-2019	2
Career Assessment	The Graduate School VLAG	2019	0.3
Supervision tutorials for YEI 31306 Trends in Aquaculture	ENP, WUR	2016-2017	1
Second reader MSc thesis, MSc thesis intake interviews	ENP, WUR	2018-2019	0.2
Presentation/consultation at industry workshop: Scaling up improvement in non-certified seafood	Expert Consultative Workshop on non-certified seafood, GSSI/FAO, Rome	2019	1
Presentation/consultation at industry workshop: Moving beyond the farm: area-based approaches to managing aquaculture risk	InvestAqua and PAM workshop (IDH/Aquaspark), Utrecht	2019	1
Total			34.3

*One credit according to ECTS is on average equivalent to 28 hours of study load

About the author

Mariska J.M. Bottema was born in Bogor, Indonesia, where she lived until her teens. Fortunate to grow up within the exceptionally beautiful nature of the Indonesian archipelago, she developed a love for the sea and its inhabitants, which steered many of her educational and career choices. After graduating high school in The Hague, Mariska obtained her bachelor at Hotelschool the Hague, where she gained experience in the European, Caribbean and Indonesian tourism industry. She then went to Wageningen University where she studied Environmental Sciences, with a focus on marine and coastal governance. Her studies brought her back to Indonesia, where she spent time researching coral restoration projects in Bali and Lombok. In 2011, she started working as a marine advisor in the Oceans and Coasts unit at the World Wide Fund for Nature. She worked on global marine protected areas development, species conservation, and program development and management in the Caribbean. In 2015, Mariska made a move to the private sector. At ARCADIS, an engineering consultancy, she worked as a policy and governance advisor for international and Dutch clients in the field of marine and coastal policy, urban climate change adaptation and stakeholder management. Missing the tropics, she returned to the Environmental Policy Group at Wageningen University in 2016 to start PhD research into Asian aquaculture risk management beyond the farm. She did this research amidst a large international consortium of project partners, and conducted field work in Thailand, Vietnam and China. This period introduced her to the world of aquaculture, where she aspires to find her new professional challenge.

The research described in this thesis was financially supported by the Netherlands Organization for Scientific Research Science for Global Development (NWO-WOTRO), New Directions in Environmental Governance at the York Centre for Asian Research, the CGIAR Research Program on Fish Agrifood Systems, Sustainable Fisheries Partnership, and The Sustainable Trade Initiative's Farmers in Transition Fund.

Financial support from Wageningen University for printing this thesis is gratefully acknowledged.

Cover photograph by Hainan Tilapia Sustainability Alliance

Cover design by Emily Liang

Printed by ProefschriftMaken on FSC-certified paper