Bridging the Gap between Planning & Implementation in Strategic Delta Planning

Structuring Implementation Programming

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Master Thesis

2018

Bridging the Gap between Planning & Implementation in Strategic Delta Planning

Structuring Implementation Programming

by

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in partial fulfilment of the requirements for the degree of

Master of Science
in Engineering and Policy Analysis,

Faculty of Technology, Policy and Management,
at the Delft University of Technology

to be defended publicly on August 24, 2018

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All the codes used in this thesis along with the documentation can be found at:
https://github.com/agurvinder/MasterThesis_Vietnam

Acknowledgements

After the hard work and struggle of 6 months to cope with the process, I have finally reached the conclusion of my thesis journey, marking the end of my scholarship at Delft University of Technology. On this special occasion, I would like to express my sincere and deep gratitude to everyone who has helped me in this wonderful journey of Engineering and Policy Analysis.

Firstly, I would like to thank Leon Hermans, for providing me this opportunity to work for the NWO UDW project on Strengthening Strategic Delta Planning. Not only did this open my perception towards the needs and development of delta regions of the member countries of Vietnam and Bangladesh, but also provided me opportunity to visit Vietnam and conduct field research. Leon has been a mentor in the entire process, from guiding, to providing healthy criticism. Haiko van der Voort, as my second supervisor always provided the balancing argument and a counter perspective to my thesis and helped ground my research into Institutional arrangements. And Bartel Van de Walle, for being the chair of my committee and providing the optimism to keep pushing forward in the entire process.

I cannot thank the local team at Centre for Water and Climate change (WACC), Vietnam enough for their support and collaboration during my field visit. I would like to thank Nguyen Hong Quan, as my external supervisor helping me to arrange interviews and having the patience to discuss my research proposal late into the evening. Luan for helping me conduct the interviews in Ben Tre and Dorien for helping in the interview process and discussions that would eventually enrich my thesis. I would furthermore, like to thank the project team UDW, University Funds and Delft Global initiative to provide me with funding and support to make the field research possible.

To my classmates at EPA, Rizky with whom I jointly developed the application algorithm to RDM, for all the collaborations with you. Alper and Quinn for being good roommates and all those fun evenings. Koen for showing me that anything is possible with dedication. All my project mates during the two years for the continuous learning curve. I hope we all keep in touch.

Lastly, I would like ot thank my family for believing in me and letting me pursue this opportunity. Your support is what made me push the last mile. Ksenia, for being there with me during the whole process and listening to me!

This one is for all of you!

Gurvinder Pal Singh Arora
August 2018

Executive Summary

Research Definition

In this research, an attempt was made to bridge the gap between the planning phase and the implementation phase in context of Strategic Delta Planning framework of Seijger et al. 2016). The Strategic Delta planning framework gives us an initial idea of implementation, suggesting that implementation can not be controlled and need to be an adaptive process as the project moves forward.

Other researchers have commented on the messiness of the implementation process pointing out that the outcome and plan may vary. While some suggest that the stakeholders in the implementation process may be different than the ones in planning and may not have similar positions on the plan. Therefore, this research provides a conceptualisation of implementation in strategic delta planning and proposes an approach which will help structure the implementation process and address some of its challenges.

Final Deliverables

A conceptual review of implementation in context of Strategic Delta Planning: Implementation in strategic delta planning is the extent to which the plan is put into practice while being adapted itself over the course of being "implemented". It has multiple aspects;

1. Implementation Classification matters
2. Uncertainty in Implementation should be managed
3. Preconditions of Successful implementation must be met
4. Implementation is a nested process
5. Implementation needs continuous monitoring and evaluation

A conceptual approach for implementation programming in Strategic Delta Planning: . Using the implementation concepts, a visual representation of the system as it moves forward with implementation was developed. The implementation programming approach was thus designed using this structure into a multi-step iterative process which needed to; review the strategic program, translate into operational objectives and create an adaptive plan. Then map the plan and current trajectory into the visualization, understand the position of stakeholders towards current direction and then evaluate the need for a coping action. This is designed as an iterative process which keeps updating the system plan as the uncertainties affect the adaptive space over time.

A case operationalization of the framework: The approach developed in the previous question was then applied to the Mekong delta region where the Mekong delta plan was translated for 2 coastal districts in the Ben Tre province. After the system trajectory was mapped, it produced interesting insights that showed that the current implementation trajectory of both the regions is moving towards maladaptive space. An integrated robust set of measures was proposed which can potentially fulfil the long-term objectives, however, the actors perceive the current direction to be beneficial for the area and have limited authority to bring about a bottom-up change in the implementation direction.

Based on the findings of the case it was noted that the implementation approach developed in this thesis is useful, but its effectiveness is limited by the institutional setting. Therefore, further works is required to build on the approach and incorporate stakeholder positions more explicitly.

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Part I – Introduction to Research

1 Introduction to the Research

Strengthening the Natural River Deltas

The natural river delta regions are some of the largest sedimentary deposits in the world. The mineral rich deposits make them fertile and attractive for economic activity and settlement. However, with the changing climate and relative rise of sea levels, (Ipcc, 2007), the regions around deltas are exposed to risks of potential population displacement, loss of fertile land and loss of economic activity (Van Driel et al., 2015). This increased vulnerability of the delta region may have global repercussions (Kuenzer & Renaud, 2012) posing serious threats to its inhabitants, which depend on the region for their livelihood (Birkmann, Garschagen, Kraas, & Quang, 2010).

The need for a comprehensive strategy to adapt to climate change and mitigate the long-term uncertainties therefore, becomes crucial for successful long-term management of the delta. The planning and implementation in delta management, without a deep understanding of the systemic uncertainties may have severe long-term ramifications. Most of these uncertainties evolve with time which makes it difficult to have fixed long-term plans for development of the region. Therefore, the plans need to adapt as the development of the region moves forward, as a means to manage the uncertainties (Zandvoort, van der Vlist, & van den Brink, 2017).

Acknowledging the need for adaptive delta management, the Netherlands has commissioned the delta program (Delta Committee, 2016). This has been benchmarked by Vietnam and Bangladesh, which are developing their own delta programs with advise and support of the Netherlands (Veerman, 2013). These programs lay forward the strategic goals for successful development of the delta over a longer time horizon. The delta planning and management process is seldom a straightforward process due to the presence of multiple interest groups representing competing public values to reach a decision (Veeneman, de Bruijne, & Dicke, 2009), in conjunction with multiple policy-making levels & rounds (Teisman, 2000).

In this research, we use the approach of (Seijger et al., 2016) to define explicitly the Strategic Delta planning process "*as a public-sector led process through which a long-term vision (the strategic delta plan), and actions and means for implementation are produced that shape and frame what a sustainable delta is and may become*" (p2). This definition puts forward a framework of adaptive delta management that outlines the strategic directions of the entire development process of a delta, without controlling the outcomes of the plan. The subsequent section discusses the Strategic Delta planning framework in detail, mapping it to the existing literature and try to introduce the problem that will be addressed in this thesis.

Strategic Delta Planning

The Strategic Delta planning framework as proposed by (Seijger et al., 2016) presents the delta management process as a strategic long term delta development process. It attempts to link the historical context of the delta region with the potential for future technological developments while aiming to facilitate the evolution of the delta plans up to implementation. Within this process, decision making, and plan formulation is embedded to resemble the classic policy cycle with multiple phases of decision making as the development moves forward. The phases do not have clear boundaries other than the decision moments which decide the beginning for plan formulation and the acceptance of the delta plan. Different stakeholders try to negotiate consent while gaining new information as the process moves forward. This makes possible to view the delta planning process not only as a rational process where pareto optimal solutions can be reached, but also a messy administrative process where public value are contested throughout the different phases (Veeneman et al., 2009). The Strategic Delta Planning process, therefore, does not attempt to control the course of action of the delta planning, but merely tries to facilitate it. The phases are; Agenda Setting, Plan Formulation and Implementation (Figure 2) and each phase along will be discussed in detail subsequently along with the challenges in future work and improvement.

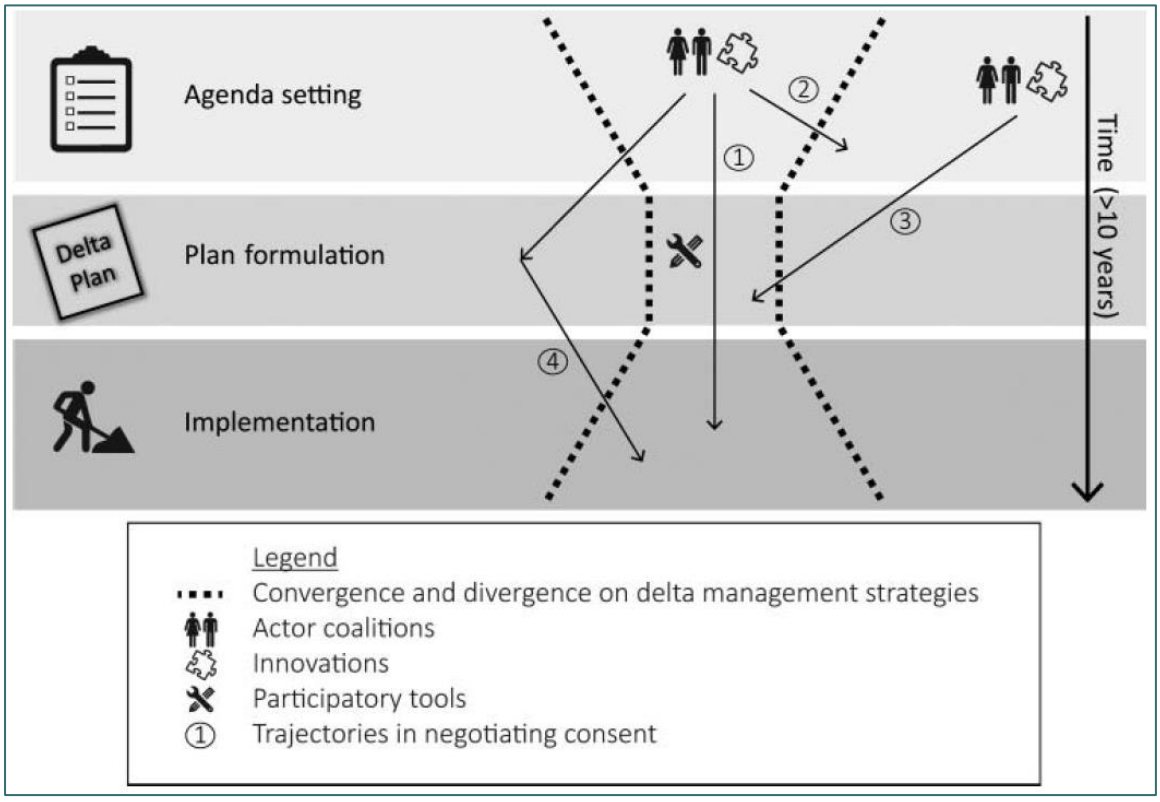


Figure 1 The hourglass analytical framework (Seijger et al., 2016)

Agenda Setting

The beginning of the Strategic Delta planning (SDP) is characterized by the agenda setting phase. A key part of the process consists of creating the space for the topic of Strategic Delta Planning on the political agenda. This may be supported by raising the awareness of the actors that an integrated approach is needed for successful delta development, which may involve moving away from conventional sectoral planning approaches (Seijger et al., 2016). The actors involved in this phase may be politicians or other societal actors who may influence the process through advocacy coalitions (Sabatier, 1998) or direct participation and attempt their definition of the problem be accepted as a legitimate basis of planning. This may lead to cooperation or

fallout of amongst actors as the process moves forward (Figure 1) and may take multiple years based on the priority of the issue on the government's agenda.

Researchers have attempted to characterize the agenda setting process through formation of different advocacy coalitions to influence the political process (Sabatier, 1998). Here, different public values may be presented as clouds of goodness with very little attention to the details of the project (Veeneman et al., 2009). The actual political decision making process has a vast literature behind it to describe the process as different political rounds, creation of a policy window, or a more evolutionary approach to steering the political discussion into a relevant direction such as Climate change (Cairney & Jones, 2016; Kingdon, 2003; Teisman, 2000). Being a complex process, there is ongoing research in problem framing, process management and providing strategic advice for negotiation between different advocacy coalitions (de Bruijn & Dicke, 2006; De Bruijn & Ten Heuvelhof, 2012; Druckman, 2004).

Being part of the political process, far from the actual implementation, the challenges in the agenda setting phase have been left out of scope of discussion of this thesis.

Plan Formulation

Once the need for a strategic plan for the delta management is acknowledged, the development of a delta plan may be commissioned that can be backed by the political support. This is described by the decision moment that marks the soft beginning of the plan formulation phase (between agenda setting and plan formulation in the figure 1). A clear timeline of a few years may be set based on the urgency and priority highlighted in the agenda setting (Seijger et al., 2016). Researchers and subject matter experts assist in designing of comprehensive delta plans by structurally narrowing down the broad discussion into strategic actions. The development of Strategic plans, as prescribed in SDP, depends on dealing with one or more forms of uncertainties (W.E. Walker et al., 2003) affecting the delta region. Therefore, the plans need to withstand the uncertainties for multiple plausible future (**robust**), while providing space to manoeuvre on alternate course of actions (**adaptive**) (Warren E. Walker, Rahman, & Cave, 2001).

A strategic plan must be agreeable by multiple actors involved in the plan formulation, while also accounting for preferences of implementation level actors (Phi, Hermans, Douven, Van Halsema, & Khan, 2015). The planning may be supported by quantitative methods or the decision makers may rely on past experiences, biases and expert interviews, and diplomacy to decide the relevant course of action. The resulting plans help policymakers to identify the vulnerabilities and adapt in time while ensuring provision for learning.

Challenges in Plan Formulation Phase

The plan formulation phase completion not only requires a plan that accounts for the complexity and uncertainties associated with the delta management, but it should also be agreeable by the political actors involved in the process. The research on plan formulation is currently focussing on methods and tools to incorporate robustness into the plans (R. Lempert, 2013), while the research on adaptive plan formulation is also being developed to account for adaptive strategies with multiple objectives (Haasnoot, Kwakkel, Walker, & ter Maat, 2013). Although these methods provide a starting point for uncertainty exploration, research on analysing stakeholder willingness and resources is exploring the dimension to negotiate consent within the stakeholders, such as the Motivations and Ability Framework[MOTA] (Phi et al., 2015). Both these research directions; on robust adaptive plans, and stakeholder consensus, are actively improving.

Implementation in Strategic Delta Planning

Implementation as a phase begins once the official strategic plan has been agreed upon by the decision-making authorities. The next logical step is to breakdown the problem per region and try to formulate an implementation level plan. There is a possibility that policies and regional initiatives might exist, in which case it is important to compare them, and adjust the plan or the programs accordingly, in-line with the strategic direction (Seijger et al., 2016). However, as each region may have different policy and program needs, the entire implementation phase may last a couple of years to decades based on the size and scale of the project implementation, process management roadblocks, and may face divergences from the strategic objectives. Furthermore, new and parallel hourglasses structured process, like SDP, may begin for other sectors that are related to delta management, as future unfolds.

Challenges in Implementation Phase

The implementation level may deal with a separate set of stakeholders who work, in conjunction with the planning stakeholders. These may be public servants at different ministries or private stakeholders. However, their willingness and ability to carry forward the plan, as is, cannot be guaranteed (Phi et al., 2015; Veeneman et al., 2009), as not all the actors involved in implementation have similar interests towards the project and may try to maximize their individual gain (Wilson, 1991). Additionally, the objectives decided in the strategic plan, when operationalized into sectoral plans, may lead to misallocation of responsibility and resources, if the ownership of objectives is unclear. This may lead to coordination issue between actors, leading to lack of agreements support and ultimately delay in the implementation process.

The implementation, therefore, often requires necessary modifications, and often fails to stick to the plans (Pressman & Wildavsky, 1973). The reason for the implementation to diverge from the initial plans can be partly due to the uncertainties and unpredictive information that adds as the implementation moves forward, or due to the evolution of actor dynamics (Pressman & Wildavsky, 1973; Seijger et al., 2016; Veeneman et al., 2009). The plans once developed are seldom revised making the final implementation unstructured, uncoordinated, and often with significant changes from the plans (Flyvbjerg, 2007).

It is important to note that implementation is context dependent and what may be seen as implementation at the national level needs further elaboration at the regional level, making it an input for agenda setting and plan formulation. This "nested" aspect of implementation can create a coordination issue among different hierarchical levels and what may seem unstructured at the national level may not seem so at the regional level, depending on the institutional setting.

Furthermore, in contrast to the research in planning phase, the research in implementation of the plans has focussed on identifying the limitations and mismatch in implementation rather than developing methods and approaches to support the process itself. With the Strategic Delta Plans in the Netherlands, Vietnam and Bangladesh, now entering into the implementation programming phase, it is important to address these challenges and help minimize resource misallocation and lock-ins.

For these reasons, the aim of the research is to structure the process of implementation context of Strategic Delta Planning. What is perceives as a good implementation plan may not remain good as the process moves forward. Therefore, it is important to identify the transition in implementation by keeping track of the objectives and the actions to support successful implementation of the plans. To facilitate the successful implementation, it is important to put the process under lens and bridge the gap between the strategic direction of delta and the regional implementation programs.

2 Research Definition

The focus of the research is to structure the implementation process to keep track of the strategic objectives. To achieve this, the research gap needs to be explicitly defined. The main research question and the corresponding sub-questions are then formulated in this chapter. Furthermore, the research methods applied to each question are highlighted in the subsequent section. Lastly, the research flow is highlighted which connects the chapters that will follow.

Research Gap

It is difficult to guide the implementation at a detailed level as a blueprint and can only be steered loosely. In practice, sectoral planning attempts to micro-manage implementation which may result in undesired lock-ins. The nature of Strategic Delta planning framework provides scope for adaptation which makes the implementation phase fluid and susceptible to changes. There is limited research till date, that attempts to translate the strategic plans into adaptive implementation frameworks, in context of Strategic Delta Planning. By reviewing the existing work in adaptive plan formulation and implementation, in context of Strategic Delta planning, the following research gaps have been observed;

Once the Strategic plan has been formulated, there is a lack of structure in the implementation process to operationalize, monitor and evaluate the strategic measures that are proposed for the development of the delta region.

One reason for this may be that due to the strategic nature of the national plans there may be ambiguity in what the decision makers seek to implement.

Research Question

Based on the research gap posed above the following Main Research Question is formulated;

How can the implementation process be structured to support operationalize, monitor and evaluate the strategic measures, in context of Strategic Delta Planning?

The research question defined above addresses the following aspects of implementation of strategies; operationalization, monitoring, and evaluation; to adapt the plans as delta development moves forward. The key element that differentiates the study from other studies is the attempt to structure implementation programming in context of Strategic Delta Planning.

Sub-Research Questions

To answer the main research question systematically, it is further subdivided into manageable sub-questions. To set the foundation for the research, it is important to develop an understanding of the implementation process in the light of Strategic Delta Planning. The first step then is to understand the meaning of implementation and the aspects of successful implementation when

Strategic Delta plans are used for regional programming. Therefore, the following research question is proposed;

Sub RQ 1: What is implementation, and how can it be conceptualized for Strategic Delta Planning?

After implementation has been conceptualized, the next step is to use these concepts to design an approach which can help in better implementation programming, or translating the plans in the plan formulation phase, into regional level programs. This may require creating conceptual linkages between various aspects of implementation. To address this, the following sub-question is proposed;

Sub RQ 2: *How can the aspects of implementation help to design an approach for implementation programming of Strategic Delta Planning?*

The approach designed for implementation programming must then be used to a real case application to prove its usefulness in structuring the implementation process, monitoring its course and providing useful measures for adjusting the implementation direction. Therefore, the following research question must be asked;

Sub RQ 3: *Is the approach useful and applicable for implementation programming in a real case?*

To answer this question, the entire implementation approach or a part of it needs to be executed where the steps are followed, and the outcomes are discussed. Based on the outcomes, it is then necessary to reflect on the usefulness of the approach to address implementation challenges in other Strategic Delta Planning cases.

Research Deliverables

Through answering of the above research questions, the following deliverables are provided;

1. **A conceptual review of implementation in context of Strategic Delta Planning:** With this deliverable, the concepts of implementation, as presented in classical and current research is studied to identify concepts and characteristics that are useful in the Strategic Delta Planning process. This deliverable is presented in the first part of Chapter 3.

2. **A conceptual approach for implementation programming in Strategic Delta Planning:** With this deliverable, a structure is provided for the implementation programming, with information on how the designed approach can be applied to a case to produce insights on the current implementation direction. For monitoring and evaluation of the system in implementation, a representation system is designed to map the system. This deliverable is presented in the second part of Chapter 3.

3. **A case operationalization of the framework:** To apply the conceptual framework proposed in the previous deliverable, will be applied to a real case step by step and methods to address each step are discussed. The output of the case application is then discussed with the usefulness of the approach. This deliverable is presented in Chapter 4 and subsequent chapters.

Research Approach and Method

In this section, the research approach used in the thesis is elaborated with its advantages and limitations. The next subsection lays down the methods used for answering the research questions and summarizes the entire thesis research flow in a diagram.

Research Approach

Before delving into these aspects, it is important to understand what is meant by implementation in context of Strategic Delta Planning. Due to the limited literature available on implementation in context of Strategic Delta planning, the available literature on general implementation in public planning processes was reviewed. Additionally, the concepts related to adaptation in water management process along with case study applications were reviewed. This part of the study was qualitative due to the lack of an overarching framework to support the literature review.

The implementation concepts were then summarized to develop a structured implementation programming framework where the steps to monitor and evaluate implementation were laid forward. The framework was then applied to a real case of implementation programming of the Mekong Delta Plan in Vietnam. This emphasized the need for a case-based research Approach. A field visit was conducted to Vietnam to have consultation sessions with the local experts and stakeholders and data collection. The insights gained from the literature review on implementation along with the plan and stakeholder data, was then be used to design, monitor and analyze program implementation strategies in the region. This part of the research was conducted using an exploratory design approach using computer assisted adaption planning method. This was followed by a qualitative analysis of the stakeholder positions on the implementation programs for the region. Hence, the mixed methods research approach was used to gain insights(Johnson & Anthony J. Onwuegbuzie Lisa A. Turner, 2007). To link the quantitative adaptation plan and qualitative analysis of stakeholder positions, a convergent parallel mixed method design was used to the research (Creswell & Plano Clark, 2007).

Advantages and Limitations

The choice of convergent parallel mixed method approach is a good fit for the proposed research as it is builds on both qualitative and quantitative analyses. This provides a good balance to the research as the insights gained may be complementary in nature.

The qualitative review of implementation literature is a good fit due to the limited literature on Strategic Delta Planning implementation. This makes the review of implementation concepts as exploratory in nature leaving the exhaustiveness of the review on the scoping of the fields to be reviewed. By a simple search in Scopus and Science direct repositories, it was observed that a large body of literature is available on spatial and water project implementation. However, a limitation may be related to the relevance of the research to Delta Planning. This uncertainty may be handled by widening the scope of implementation literature review, if a sufficient number of articles are not found in the demarcated field of studies.

For the quantitative part of the research, using an exploratory model helps to account for uncertainty and systemic feedbacks, without attempting to predict the future. However, the exploratory nature of the model may not define the causalities exhaustively, and within a limited scope may result in weak insights.

Research Methods

As discussed in the previous section, a mixed method approach will be used to reach the research objectives. The table 1 below shows the different methods as applied to different research questions along with the limitations of each method;

Table 1 Research Methods & Limitations

Research Question	Research Method	Limitation
RQ1	Desk Research and Literature review of existing literature and case application	Non-Exhaustive and Time Dependent. The quality of the research is proportional to the availability and analysis of literature
RQ2	Desk Research and consolidation of existing concepts in implementation	Non-Exhaustive and Time Dependent. The quality of the research is proportional to the availability and analysis of literature
RQ3	Case Study Method with primary and secondary data collection and analysis	The quality of the analysis is dependent on the quality of data collected, and the conceptualization of the system under study.

The first 2 sub-questions involve Desk research where the existing literature on implementation is reviewed and the concepts are synthesized into a structured approach. The literature review for this was carried in two stages; the first where a general idea was developed on the existing concepts and problems in implementation of plans while the second stage aimed in combining these ideas into a concrete implementation programming approach. The shortfall of the method, as indicated in the table is the time availability to conduct the review. The thesis research had a fixed duration of time, and there needs to be a scope for the study. This can affect the quality and exhaustiveness of the concepts reviewed, although attempt has been made to be exhaustive.

Sub Question 3 required significant amount of work since where the case needed to be established and understood before deep diving into the application of the designed approach. This required studying the existing available data and identifying the need for more data collection, if any. Based on the data collected, the system was conceptualized and analyzed to produce implementation direction of the region under study. The main shortfall in this step can be the quality of the data available and the system conceptualization However, it has been ensured that the data collection was done with the help of regional expert in the best possible ways.

Research Flow

In this research, an attempt is made to understand implementation concepts and synthesize them into a program implementation framework to bridge the gap between planning and implementation. Figure 2 below shows the research flow diagram, which summarizes the flow of this thesis as explained in the previous section. The methods and sub questions have been linked to the chapters for the clarity of the reader.

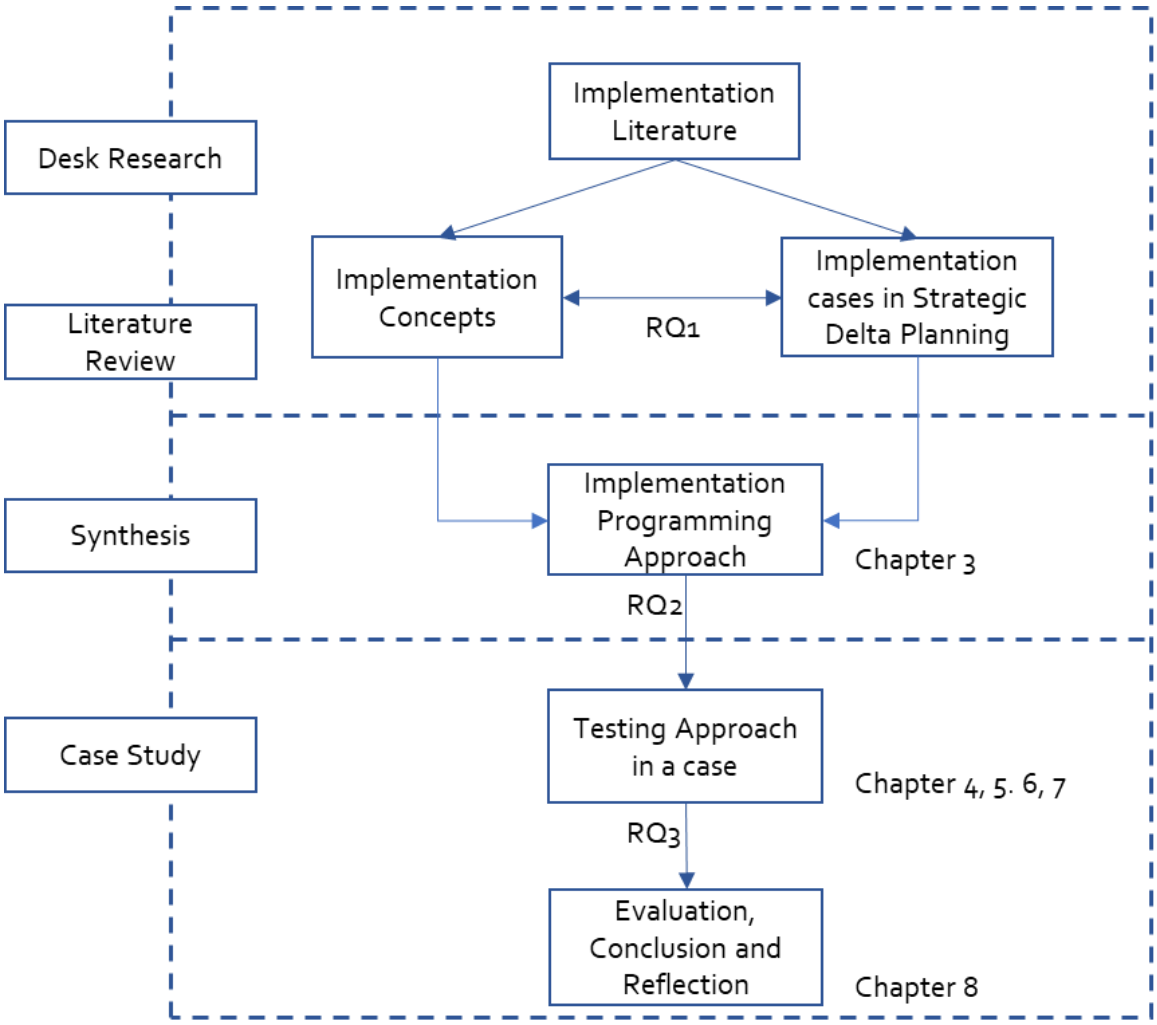


Figure 2 Research Flow Diagram

The subdivision of the subsequent chapter from Chapter 3 depends on the approach designed to answer the sub-research question number 2. Depending on the approach, the structure of the research steps further is elaborated in the first part of Chapter 4.

Part II – Structuring Implementation in Strategic Delta Planning

3 Implementation in Strategic Delta Planning

This chapter sets the foundation of this thesis, where the concepts of implementation are reviewed and discussed in context of Strategic Delta Planning. The concepts reviewed are then synthesized into the implementation programming framework in the subsequent sections. A step by step general approach is then presented to assist in the implementation programming for any case.

Implementation in Strategic Delta Planning

Implementation can be characterized by the extent to which a plan is put into practice which may change or modify from the existing plan over the course of being "implemented". This definition was given in context of policy implementation (Newig & Koontz, 2013) and will be used in context of Strategic Delta planning in this research. This definition itself puts forward an idea that there is potential for changes in implementation and it is seldom possible to have an "as-is" translation of plans. In context of Strategic Delta Planning as introduced by (Seijger et al., 2016), the implementation is introduced at a strategic level where various policies, programs and projects contribute towards the long-terms development of the delta.

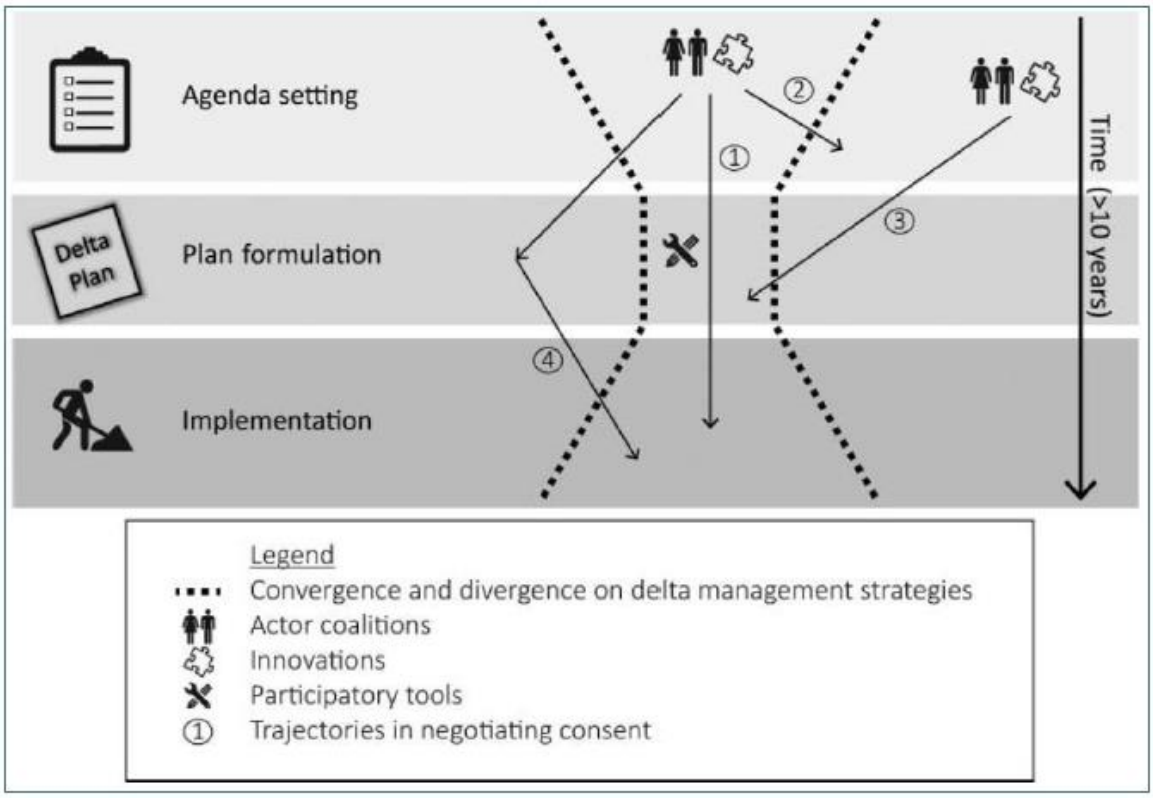


Figure 3 Strategic Delta Planning (Seijger et al. 2016)

To tackle implementation at an operational level, the strategic plans needs further elaboration and structure. Before diving into that, it is important to first introduce some aspects of implementation

Classification of Implementation

Over the years, researchers have categorized the process of implementation into different categories. In the section below, two categories are discussed as they are relevant to this research;

Top-Down and Bottom Up Implementation

From the direction of flow of decisions, implementation may be characterized as Top-Down Implementation or Bottom-up Implementation (Sabatier, 1986). In the Top-Down process, the process starts with the central decision maker creating a policy and moves all the way down to the lowest level of implementation actors. For the implementation to be successful, the outcomes of the actions are monitored over time and feedback is sent upwards to the decision makers for corrective measures. An example of the top-down process in context of SDP can be the formation of a statute at the central level setting the course of economic development of delta region.

On the other hand, Bottom-up implementation process starts from the lowest level, where street-level bureaucrats or influenced actors may start independent or joint initiatives. These initiatives interact with each other to create an emergent pattern where local actors may work for their own objectives without a mandate from an upper level. However, if the actions of the lower actors are deemed beneficial by the decision makers, the actions may be institutionalized converting them into Top-down actions. An example of Bottom-up implementation action in SDP may be a local initiative taken by a group of farmers to change the crop system in the area, due to changing soil conditions and more saline intrusion.

Hard and Soft Implementation

In terms of the nature of the measures, implementation more recently has been characterized as "hard implementation" and "soft implementation" (Seijger, Vo, van Halsema, Douven, & Wyatt, 2018). A hard implementation measures represents a physical measure or action taken to support the process of implementation. These measures are tangible in nature making easy to identify and keep track of the implementation process. An example of a hard implementation measure in context of SDP will be building a dike ring to manage the rising sea level.

Soft implementation measures on the other hand, are non-physical measures that facilitate the implementation of project. The intangible nature of these actions makes it harder to identify their success directly and need indirect observation to ascertain their success. An example of soft implementation may be of organizing a workshop to raise awareness about the effects of salinity intrusion on crops. The success of this measure ca be ascertained by the degree of incorporation of the learnings into the attendees' regular practices. Or it may be ascertained by the total number of workshops conducted within a prescribed time-period.

Managing Uncertainty in Implementation

Before attempting to structure the implementation process, it is important to address the meaning of uncertainty and why it is important in context of implementation. Uncertainty as defined by (W.E. Walker et al., 2003) as "*any departure from the unachievable ideal of complete determinism"* is used in this research. This signifies that when there is a lack of knowledge or inherent systemic uncertainties, they may lead the system to move away from the ideal course. In this research, the term "uncertainty" and "vulnerability" will be used interchangeably.

As discussed in Chapter 1, the strategic delta plans may be made through quantitative methods, stakeholder deliberation or expert workshops, to account for the uncertainties that may influence the system. However, once the implementation phase begins, the critical assumptions, on which the strategic plan was formulated, may not hold true due to the system evolution. This happens as the plans are built using critical assumptions about system, with the knowledge available at the time. However, when the reality unfolds, the trajectory of the system may take a completely different course, altering the notion of what is an acceptable condition for the system. Therefore, as implementation moves forward, the intended course of action may be realized as planned, or it may lead to an emergent state which was not intended but may be deemed acceptable or unacceptable (Mintzberg, 1978).

There has been a significant research in implementation, with more classic works of (Pressman & Wildavsky, 1973) who describe the policy implementation process and that the outcome may differ from the plan. The reason for the implementation to diverge from the initial plans can be partly due to the uncertainties and unpredictive information that adds as the implementation moves forward, as advocated by a large group of researchers (R. J. Lempert, Popper, & Bankes, 2003; Warren E. Walker, Haasnoot, & Kwakkel, 2013; Zandvoort et al., 2017). However, the evolution of actor dynamics, as the project moves forward needs to be considered for successful implementation. The positions of the actors might change as the project moves forward, which has also been highlighted in the hourglass framework (Madani, 2010; Madani & Hipel, 2011; Phi et al., 2015; Seijger et al., 2016). In the next section, these concepts, which are referred to as the preconditions for successful implementation are discussed in detail.

Preconditions for Successful Implementation

Adaptation and Robustness of Strategy

Strategies or plans must be capable of adaption, to cope with vulnerabilities affecting the system. Implementation is a complex process where the adaptive approaches might arguably be used to anticipate the changes and act in time. (Zandvoort et al., 2017). Once the implementation has moved forward, any divergence from the plan may be difficult, if not impossible, to correct as the social & financial costs of an alternative course may be impractical. Therefore, for an adaptive plan, it is crucial to monitor implementation to be able to identify the barriers and tipping points in due time and manage them. This highlights the need for some monitoring and evaluation arrangements, as that will facilitate in keeping track of the entire process for adaptation (L. M. Hermans, Haasnoot, ter Maat, & Kwakkel, 2017).

At the same time, robustness of individual strategies is deemed important to provide solutions that can withstand the uncertainties associated with complex systems (R. Lempert, 2013). However, even the robust strategy recommendations in the planning phase may become vulnerable as new information is uncovered and the system is exposed to unaccounted events (Wise et al., 2014). It is important to balance the robustness of the plans with the possibility to alter the adaptation trajectory, due to changes in the externalities to the system. Therefore, in actual implementation, the temporal uncertainty needs to be accounted.

Managing stakeholders' positions during implementation

In addition to the strategies being robust and adaptive, they need to be acceptable to the stakeholders involved in planning phase. The position of the stakeholders towards all the candidate strategies plays a role in ultimately selecting the strategy for implementation. The position might be understood through deliberation or negotiation amongst stakeholders to reach a decision (Islam & Susskind, 2012), or a result of computer assisted tools which try to find an agreeable solution by translating stakeholder requirements into objective functions (Herman, Zeff, Reed, & Characklis, 2014). However, the planners may be different from implementers and

may not correctly account for the actor intentions to implement. Moreover the intentions of the actors may evolve as the project moves forward and new information is uncovered (Phi et al., 2015). The interests and resource capacity of the stakeholders will influence the extent to which the plan is executed. Therefore, while making implementation plans, it is important to keep track of actors' motivations and abilities throughout the coping and adaptation processes.

Accounting for the possibility to develop a robust adaptation strategy and keeping track of stakeholders' position, a new framework for program implementation is introduced that can assist in bridging the gap between strategic adaptation and program level coping.

Implementation as a Nested Process

The Strategic Delta Planning framework proposed by (Seijger et al., 2016) attempts to map the process of Delta management as an hourglass. However, when we talk about the hourglass framework, the hourglass framework is dependent on the decision-making arena, where it is being used. This means that the stages of Strategic Delta planning may have a nested relationship with each other. At the national arena, once the strategic plan is developed, the implementation from their point of view is to monitor and facilitate the achievement of these strategic objectives. However, for the provincial level, this is the agenda setting phase and their implementation arrangement will drive the agenda setting for the districts, and so on. This nested relationship between different planning and implementation levels within the context of Strategic Delta Planning may be represented as a single hourglass at the national level being distributed into multiple streams as we move towards operational levels (Figure 4).

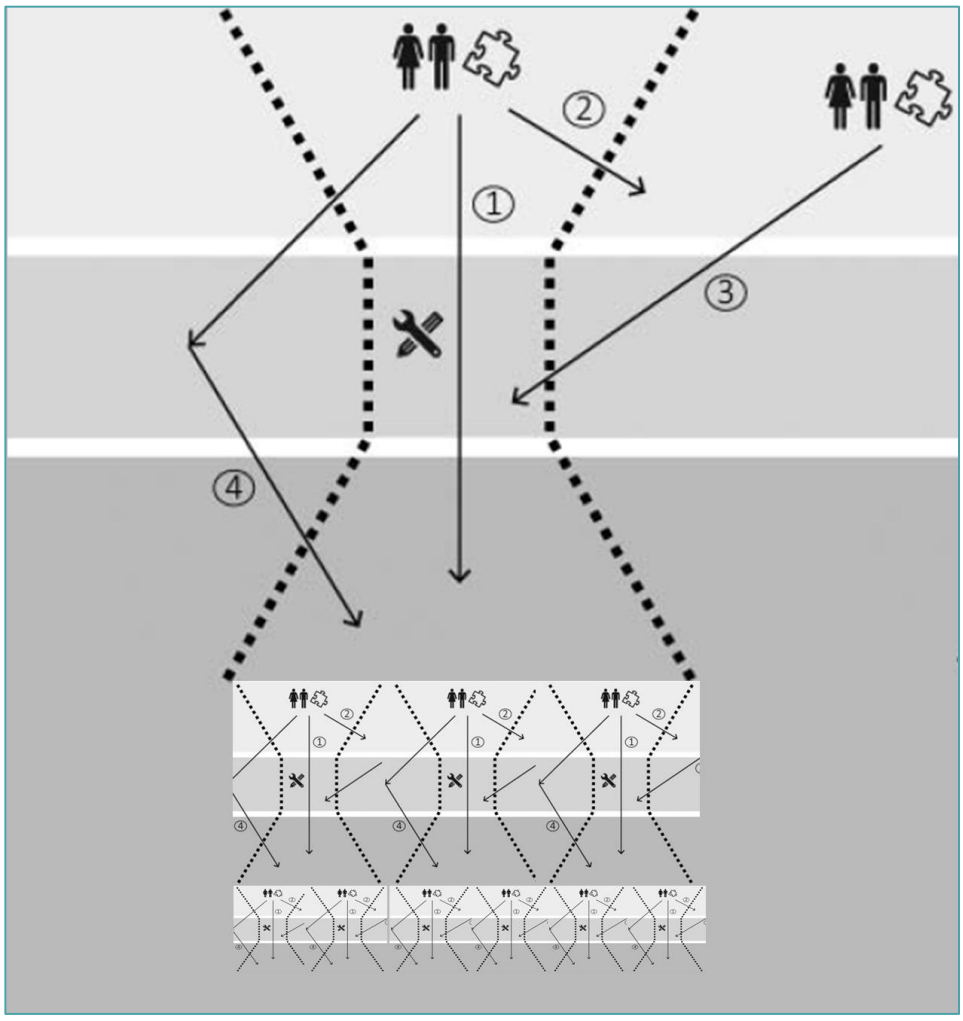


Figure 4 Nested Hourglass Structure

This observation is not unique for nested systems. A similar relationship has been described through multi-level governance (Ostrom & Janssen, 2004) where the governance scales are characterized as a nested, hierarchical structure, with processes and interactions at several scales. Another description has been provided by (Enserink et al., 2010) through a means-ends relationship between the multiple "aggregations". In this description, a certain action may be an end to a mean for one aggregation, or it may be a means for the lower aggregations which may operationalize it further. In both the descriptions, as one goes lower in the aggregation, the context becomes more operational. Therefore, it is extremely important to account for this difference of contexts while designing implementation level plans.

Monitoring and Evaluation in Implementation

As mentioned in the previous sections, for implementation process to adapt to uncertainties, there needs to be some arrangement to keep track of the process. At the same time, implementation needs to be in-line with the requirements of the plan. (L. M. Hermans et al., 2017). Monitoring and evaluation are objective based, i.e. some target objectives are required as a source of feedback. In Strategic Delta Planning, at the plan formulation level, this may be strategic objective, but for implementation at the operational level, the objectives need to be more operational. Therefore, the monitoring and evaluation need to be done for operational objectives without losing sight of the strategic goals.

For hard implementation measures, the policy objectives are tangible in nature, making monitoring explicit. However, in case of soft implementation, a direct measurement may not be possible and indirect objectives may be required. This has been discussed in the section of Hard and Soft implementation. This adds to the challenge in ensuring that implementation is on track, as the interpretation of successful implementation among actors may be contested.

From the above section, we have highlighted some aspects which make it necessary to devise a method to structure the implementation programming phase. In the subsequent section, all the ideas from these aspects are brought together in the form of Program Implementation Framework.

Conceptualizing Implementation Programming

From the above sections a clear implication is the need for more and better adaptive plans. At the same time, there is a need to keep track of implementation processes as multi-actor processes. Strategic Delta Planning introduces the idea of delta management process as a guiding process with scope for learning and adaptation as the implementation moves forward. However, it is observed from the initial literature review, from an epistemic perspective, agenda setting, plan formulation and implementation may have different meaning at different levels. Governance institutions and bureaucratic departments have nested structure that run from national level all the way to community level (Ostrom & Janssen, 2004). This implies that, at a strategic level, what may be implementation for a political actor by putting the legislation in place, may just be agenda setting for the national ministries. And the implementation for the them will lay down the strategic foundation for regional bureaucracies and departments for their form of implementation. Therefore, the hourglass framework must account for the different levels of implementation and the possibility for designing arrangements to monitor and adapt implementation.

To make a clear distinction between plan formulation at the national level and the plan formulation at a lower level of implementation is thus made within the scope of this research. In a nested structure, the planning at the national level, to set the direction of development is referred to as Strategic plan formulation. This is similar to plan formulation as referred by Seijger

et al. (2016). Translating the strategic plans to a more operational level to be able to extract manageable actions from it will be referred to as Implementation Programming.

A program structure is therefore introduced in this section, which can assist to bridge the gaps between strategic planning and operational levels of implementation programming, leading to final implementation. However, before the structure is introduced, it is importance to establish a difference between nature of adaptation dealing with long-term strategic directions, and short-term immediate responses.

Long-term and short-term Implementation

Due to the nested relationship between different levels of implementations, a distinction is needed between actions required to achieve long-term strategic goals and the immediate short-term actions that are an outcome of periodic monitoring. This is done by introducing a distinction between the concepts of long-term adaptation, and short-term coping. By making this distinction, between coping and adaptation it is easier to design an integrated approach which combines the strategic insights of top-down approach with the in-depth pragmatism of bottom up.

Coping

In the context of this research, coping is defined as, the actions and attempts to manage a system within shorter time span, under uncertainty. This can be characterized as short-term actions, where the monitoring and evaluations periods are closer in time. Coping is done at ground level of implementation, where the effects of the actions are observable. These actions may be in-line with the top down directives as provided through formal strategic direction. In this case, the coping action may be characterized as top-down. An example of top-down coping may be the controlling the operations of sluicegates to maintain the water discharge and salinity levels, as stipulated in regional water quality standard prescribed by provincial authorities.

Another form of coping may be a result of the emergent actions of individuals without any clear link to the directives, as a strategy to adjust to the changing environmental conditions. Due to its emergent characteristic, this is mostly bottom-up. This type of coping behavior may be observed by the local institutions as important to the entire region, formalized and added to the higher directives changing it to top-down. Depending on the leeway provided by the top-down directives and the governance system, a bottom-up coping action may be left without formalization. An example of this type of coping may be a farmer choosing to plant higher saline tolerant crops after learning a new technique.

Adaptation

In the context of this research, adaptation is defined as, the strategic directions and changes in the management direction of a system, under longer term uncertainties. This can be characterized as relatively longer time spans where the monitoring and evaluation is less frequent than coping. Adaptation is required to revise the strategic objectives based on the information consolidated through coping over time. Multiple coping actions, when observed over a longer duration of time, exhibit an adaptation trajectory. Adaptation is more top-down, as the strategic directions are mostly set at the highest levels of planning from a nested Strategic Planning context (figure 4). An example of adaptation may be a directive to change livelihoods based on the economic and environmental condition of an area or setting up a dike construction program.

As adaptation trajectory is an integrated image of short term coping actions, a maladaptive trajectory may be rectified through recommendation of top-down coping action, or by formalizing bottom up initiatives. Therefore, the effective interaction between top-down and

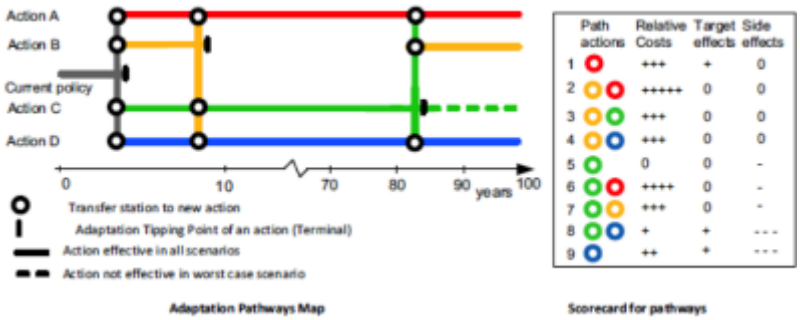
bottom-up processes to constantly maneuver in the adaptive space is a characteristic of a Robust Adaptation strategy and an important pre-condition of successful implementation.

Implementation Programming

In this section, the program implementation framework will be introduced. F**igure 5** below shows a metro map representation where each horizontal line represents a strategic measure. Suppose a strategy **A→ B** is chosen as strategic action/policy on a metro map representation with multiple strategic actions. In this metro map, if we proceed towards A, and due to system uncertainties, have to transition to **C** instead, it would be referred to as strategy adaption. This representation of strategies where adaptation is shown possible between multiple strategies is known as Dynamic Adaptive Policy Pathways (Haasnoot et al., 2013).

Dynamic Adaptive Policy Pathways (DAPP)

The Dynamic Adaptive Policy Pathways are a combination of the literature works on Planning under deep uncertainty; Adaptation Tipping points (Kwadijk et al., 2010), on adaptive policy making (Kwakkel et al., 2010) and policy Pathways (Haasnoot et al., 2012). It is an adaptive process where pathway maps, similar to a metro station map, are generated. Each of the line in the metro map represents a potential action and the time under which they can be pursued. Each action has a start and an end period after which a new action must be chosen. The circles on the map, similar to stations represent the opportunities to move over to a different course of action. Adaptation happens when different actions are linked with each other to create an adaptation trajectory over time.



Referring back to figure 5, if the strategy A → B is selected, from the strategic level, it might have a linear trajectory, moving from point A to point B. However, when the idea of nestedness is operationalized from an implementation perspective on this strategy, by zooming one level below, the apparent linear strategy is transformed.

Such a transformation, by zooming into a lower aggregation level, can be applied at any level of nestedness and is proposed to have the following characteristics;

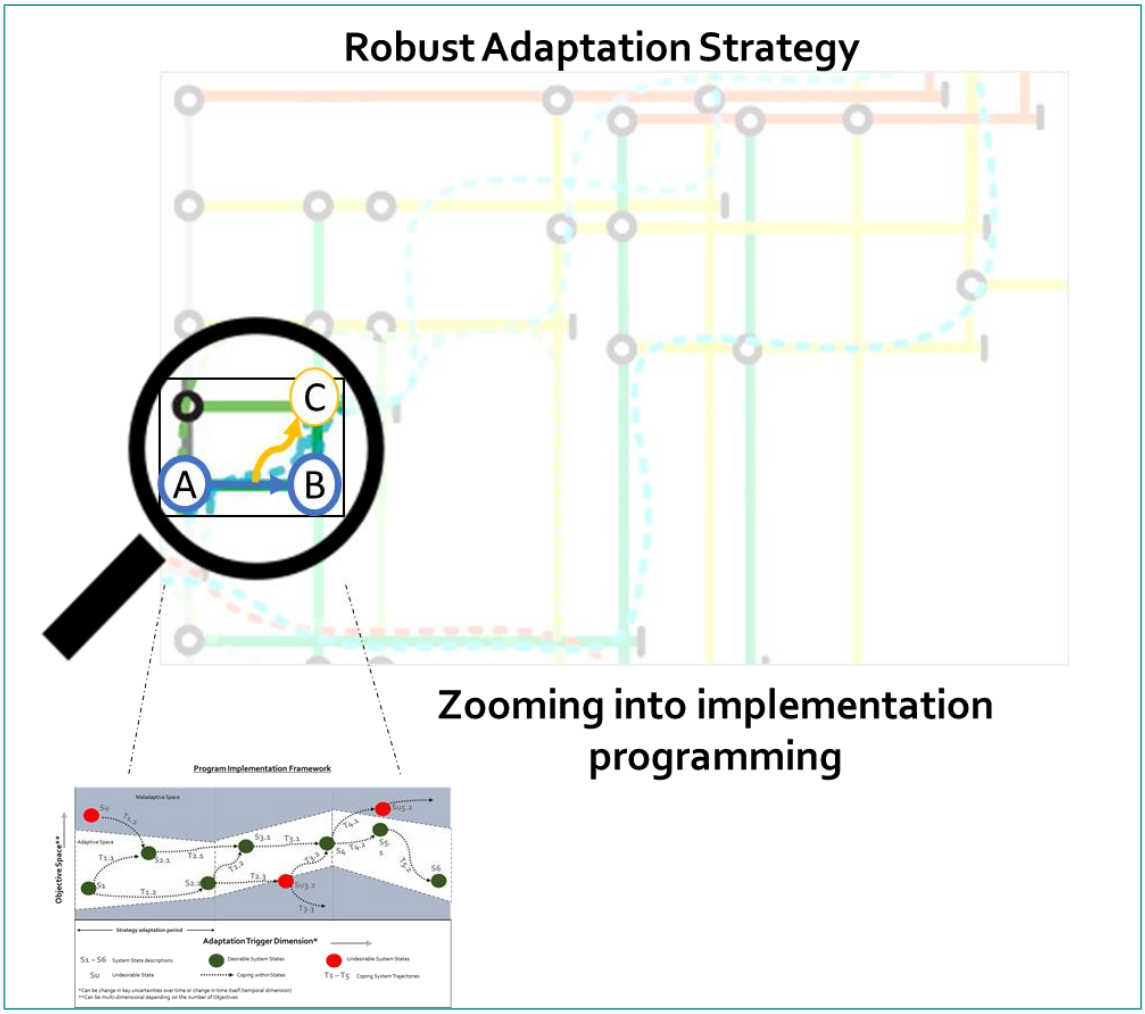


Figure 5 Conceptualizing Implementation Programming

System Trajectory Space

Adaptation strategies when viewed from an implementation perspective, can be conceptualised as a system trajectory space as shown below in figure 6. The Vertical axis of the figure is defined as the Objective Space, which is characterized by the acceptable and unacceptable ranges of the objectives. This characterization divides the space into Adaptive and Maladaptive space. The horizontal axis is defined as the adaptation trigger dimension, along which the strategy evolution/emergence takes place. In the most basic form, it can be the time axis, however, in most cases where a clearly recognized uncertainty affecting the system exists, the policy evolution may be described by that key uncertainties affecting the Objective space. The system trajectory space can be mono-objective, or it can be many-objective based on the nature of the problem. In case of many-objective system trajectory space, multiple diagrams are required to represent to provide the complete picture of the system. For instance, in case of changing farming practices, for the policy of changing from agriculture to animal husbandry, the objectives can be; the net economic position, and government spending. The evolution of economic position can then be mapped against temporal uncertainty (time) or against a known uncertainty, for instance, the market fluctuations, in the region.

System States

Within the system trajectory space conceptualised above and represented in the diagram below, the system under study is modelled as having states that are linked to each other through a path dependency. The state of the system changes when actions are taken. Since there is the presence of temporal movement, this is represented by the system (shown in figure 6 as coloured circles)

moving forward in the System Trajectory Space. The system can either be in a desirable state (green) or an undesirable state (red). As the system moves forwards based on actions, it can have the following possibilities;

- Change from an undesirable state to a desirable state
- Change from an undesirable state to undesirable state
- Change from a desirable state to a desirable state
- Change from a desirable state to a desirable state

When a system is in undesirable state, the action or strategy selected to bring its course back into desirable region is termed as a "transformative action". This type of coping Is termed as transformative as a change is required in the implementation actions to bring the system back to adaptive space. In case of "hard" transformative action, it is possible the strategy might adapt completely as seen in case of A → C instead of A → B in figure 5. However, in case of "soft" transformation action, the strategy might still stay consistent and not adapt.

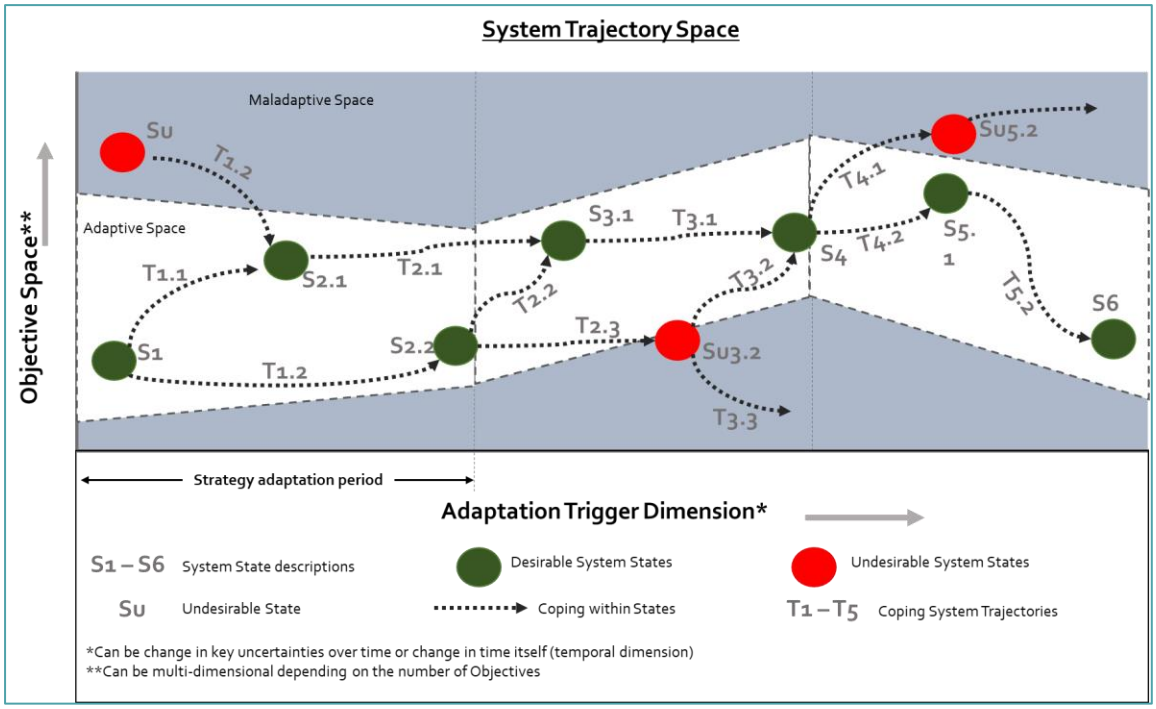


Figure 6 System Trajectory Space

System Trajectory

As the system copes with uncertainty, the future state of the system changes based on the coping action. This is represented by the dotted arrows connecting each state. Based on one of the above four possible system states, the system trajectory moves forward facilitating in designing the monitoring system. The system trajectory has a temporal element to distinguish between coping and adaptation trajectory between the states. The coping trajectory shown in the figure 6 is for representation purpose, and in context of mapping will represent the jump of the system from S1 to S2[1]. The system trajectory is dependent on the policy actions being taken, i.e. a set of coping actions will move the system from S1 to S2.1 based on the trajectory T1.1 or from S1 to S2.2 based on trajectory T1.2 as shown in figure 6. The system trajectory between S1 to S3.1 or S1 to S3.2, is the adaptation trajectory, as it represents the system movement over a longer time frame. In other words, the sum total of all coping actions between multiple coping states create

[1] Mapping the actual trajectory of the system movement within the coping states is extremely difficult, if not impossible, to map, and is in no way an intention of this research.

an adaptation trajectory. This also highlights the path dependency of the system trajectory based on the short-term actions performed.

Monitoring and Evaluation Mechanism

To create a link between the coping and the adaptation, it is important to define a monitoring and evaluation mechanism, where the system state is evaluated towards achieving the strategic directions and adapting thereafter. The mechanism may not necessarily be comprised of a hard measure, and instead be a soft measure. It should be agreeable by all responsible stakeholders in case the action requires multiple parties' intervention, manageable in terms of technical and financial position, from an installation and maintenance perspective and actable with ease. For instance, monitoring the salinity levels in river water every month (coping) and observing the rapid increase of salinity may lead to a proposal of control measure (dike) or a transformation measure (changing livelihood), both of which can be characterized as adaptation. This may require an agreeable monitoring standard, with portable measurement system or an on-site installation (or both), which may give real-time data through internet. The monitoring and evaluation needs to a frequent process, as it is required to decide the next relevant coping action in case of deviation from adaptive space.

Strategy Adaptation Period

Furthermore, as the system moves ahead, new information may be uncovered leading to changes in the adaptive space itself (Wise et al., 2014). In such a case, even though the coping trajectory may seem correct from a previous system state, the irreversible physical changes in the system may lead system into maladaptive space. Therefore, a strategy adaptation period needs to be defined that will facilitate the review of the system trajectory and make the relevant changes in the adaptation strategy while accounting for potential changes in the adaptive space. For instance, in the Vietnamese Mekong Delta, the livelihood transformation in the coastal areas was defined with a model of salinity increase, that stipulated a certain transformation direction. However, due to the El Nino event of 2016, the salinity increase was sudden and the strategy for adaptation needed to be completely revised. With the proposed linkage between short-term coping and long-term adaptation, as proposed in the model above, the possibilities to adapt may be visualised more clearly.

Each coping action may also have a lock-in period which may limit the possibility to act or rectify in case the adaptation trajectory is moving towards the maladaptive space. For instance, building a dyke in the region may reduce the uncertainty associated with salinity intrusion while it may permanently affect the water pollution levels of the river. Therefore, each coping action may need monitoring and evaluation procedures, which in turn may influence the review period definition.

Accounting for Stakeholder Dimension

Once the system has been mapped with the above framework, the relevant coping actions, monitoring and evaluation responsibilities may also be mapped to the relevant stakeholders. This mapping can be structured by using a framework to understand the local institutional arrangements (Korbee, Nguyen, Hermans, & Phi, 2018) or it may be applied directly based on the knowledge of the analyst. Once the mapping is complete, the framework can show institutional vacuum, where actions are without owners. Additionally, if the system is moving towards an undesirable state, a transformation of the system may be required.

Implementation Programming Approach

The Program Implementation approach has been conceptualised in the previous section in an abstract form and the individual components have been defined and explained. This section provides details on how the framework can be applied to any case of Strategic Delta Planning

where the implementation program process has not started yet or is in its nascent phase. The process of application of the framework has been highlighted in the figure 7.

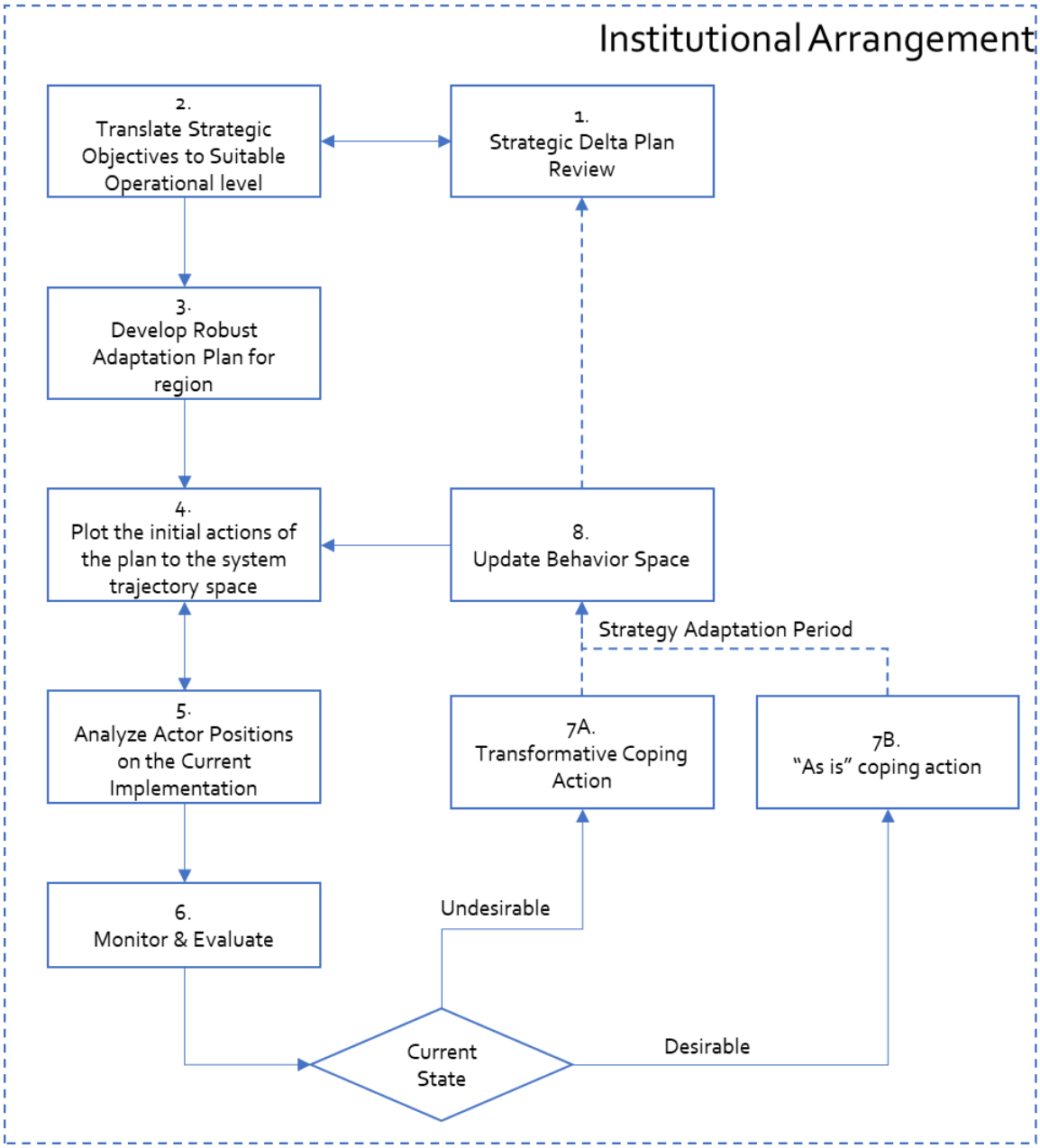


Figure 7 Implementation Programming Approach

Step 1

The process begins with the review of the Strategic Delta plan that has been formulated and formalized for the long-term development of the Delta Region. In this step it is important to understand the formal plan and the strategic objectives highlighted for the successful development of the region. Furthermore, it is crucial to look closely at the strategic measures defined to achieve the objectives. Before moving to the next step, it is important to understand the plan and the regions itself as the development of further steps is dependent on this step.

Step 2

After the plan has been reviewed, the next step is to move towards the operational level. Based on the formal division of the delta region, the strategic goals stated within the delta plan must

now be translated into operational objectives. A starting point for this may be provided within the plan itself, and it might be required to fall back to the Strategic Delta Plan, as shown in the diagram. Additionally, consultation of local experts, institutions and governmental departments within the region may be done, for more detailed information. This can be done through interviews or consultation sessions with groups or at individual level. Secondary data in government reports, journal articles, newspapers, etc. may also be referred for this information.

Step 3

Once the objectives have been operationalized into regional Key Performance Indicators (KPIs), the next step is to develop an adaptive program implementation plan for the region through detailed system understanding. Although this is represented by one block within the process, this step is extremely crucial and can be elaborated on its own. Referring to the nested aspect of SDP, this step is like the Plan formulation method used for developing the Strategic Plan and may have similar requirements; to be **robust** and **adaptive**.

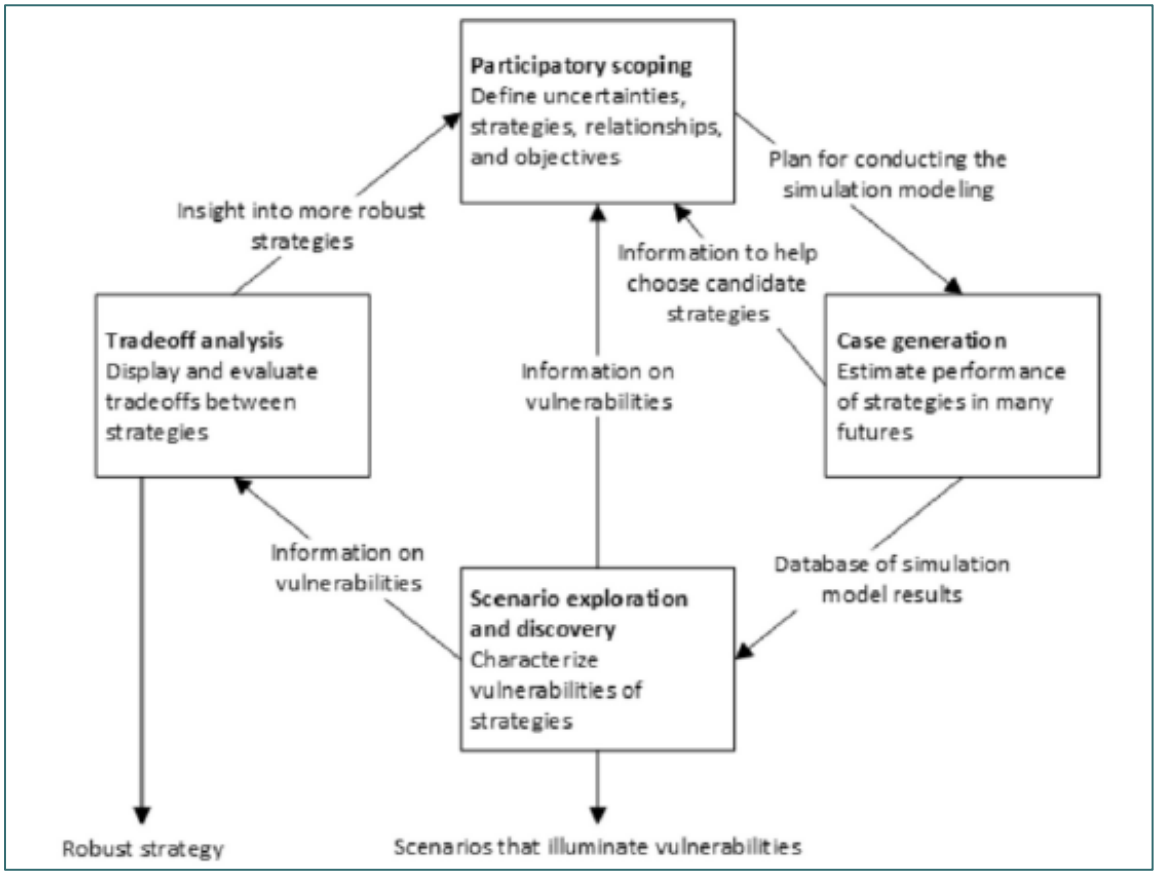


Figure 8 Steps in Robust Decision Making (Lempert et al. 2006)

One suggested methods to assist in this step is Robust Decision Making [RDM] (R. J. Lempert, Groves, Popper, & Bankes, 2006). RDM (figure 8) is an iterative model-based decision support method which can be used to generate robust plans by exploring many scenarios affecting the system. In case of RDM, a system model is required which represents a model of the stakeholders' understanding of the system under study. In the first step, known as participatory scoping, the stakeholders discuss the problem formulation and the objectives that need to be met. After this, the system conceptualization begins with the help of system experts, and numerical system model is generated. The model could be a natural system model or an exploratory model depending on the problem definition. Lastly the uncertainties affecting the system are identified and modelled into the system as external factors.

Once the system model is ready, its performance and behaviour to future uncertainties is tested. Estimations are made regarding the performance of the system. Based on the system performance, the scenarios which are pushing the system into undesirable state are identified in the scenario exploration step. These scenarios are sued for discussion and policy design in an interactive approach until the system performance reaches a satisfactory level. At this point, a trade-off analysis may be required to weigh the best strategy based on the performance of all the objectives.

A literature body on Exploratory modelling in decision support applications to generate adaptive plans is emerging (Hamarat, Kwakkel, Pruyt, & Loonen, 2014; Herman et al., 2014; Kasprzyk, Reed, & Hadka, 2016; Kwakkel & Pruyt, 2013; R. J. Lempert et al., 2006), and RDM is one of such methods which has been extensively developed over the years through collaborative research programs. Compared to DAPP, the computational requirements of RDM are lower. Furthermore, RDM requires information from the stakeholder for acceptable levels of outcomes, compared to DAPP where a multi-objective Evolutionary Algorithm will estimate this for us (Kwakkel, Haasnoot, & Walker, 2016). Therefore, for accounting for stakeholder dimension, RDM make a good fit with the proposed Implementation programming framework.

Step 4
After the adaptive program implementation plan is developed for the region, the next step, as shown in figure 7 is to map it to the program implementation framework. The operational objectives (for instance, after RDM trade-off analysis) are plotted on the system trajectory space, with each objective getting its own separate map. The adaptive space may distinguish from the maladaptive space through regional standards which are prepared by the local authorities. In the absence of these standards, stakeholder consultation in the form of workshops or interviews may be conducted. The objectives under preferred policy implementation should then be mapped to represent the system state as it is now and its transition to a new state in the near future. The program implementation framework will provide the system performance over all the objectives, providing a multi-dimensional output. If the system is in undesirable state for any of the objectives, the measures for improvement can be collectively decided by the stakeholders. Furthermore, if the system state is moving with the selected policy program towards maladaptive space, a transformative policy discussion may be required.

Step 5
With the mapping of the system to the Program Implementation Framework, it is important to understand the positions of the stakeholders on these strategies. This step is important to understand if the stakeholders agree with the implementation plan and can create a space for dialogue in case of dissidence. For successful implementation, the actors involved in the process should have a positive feeling and clarity towards the preferred course of action with knowledge on the allocation of resources. Therefore, mapping of the actor positions towards the implementation may help is clearly identifying the strong and weak points of the intended implementation actions and facilitate reaching agreements.

For understanding actor dynamics and positions in a decision making process, different methods have been developed, from the actor network analysis, to game theory ((Enserink et al., 2010; L. Hermans, Cunningham, & Slinger, 2014; Madani, 2010)). More recently, approaches inspired from behaviour sciences and psychology are getting attention of the researchers, as in the case of MOTA method (Phi et al., 2015). The Motivation Abilities and Triggers (MOTA) framework is a qualitative approach to adaptive decision making. Figure 9 below presents the concept. Through MOTA, an understanding could be gained on the reasons for action and/or inaction of implementation stakeholders. It attempts to provide the insights on the behaviour of

implementation level stakeholders to the planners, so that the most favourable strategies could be assessed from actor behaviour perspective.

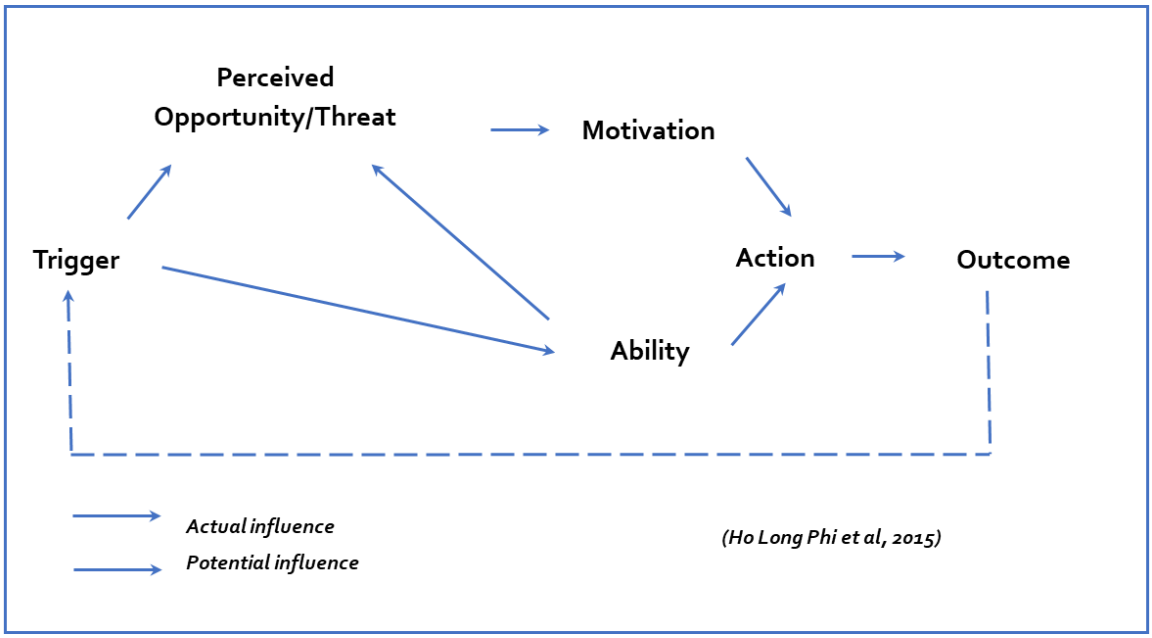


Figure 9 Motivations and Abilities Framework (Phi et al. 2015)

The benefit of using MOTA is not only limited to analysing actor positions. If the current system state is in maladaptive space, the ability part of MOTA can be used to categorize the type of transformative action required; Financial, Institutional or Technical transformation. Thus, MOTA is especially beneficial for the program implementation framework, as it provides an extension to structure the actions that are a direct outcome of the framework.

Another benefit of using MOTA is the ease and structure it provides to the data collection. With unstructured interviews, there may be issues with consistency as topic lists may not be exhaustive for data collection. MOTA automates this process by providing a clear structure about Motivations; perception to risk/threats and opportunities, and Abilities; Technical, Financial or Institutional. This reduces the burden on the interviewer which can follow this structure to generate substantial data. In developing countries such as Vietnam, where skilled manpower is lower, a framework such as MOTA can assist the local authorities to collect data and analyse quickly to understand the position of the stakeholders. Therefore, for this research, MOTA is chosen to analyse actor positions.

Step 6 & 7

Once the actor positions are clear and the course of actions has been decided, the monitoring and evaluation of the system begins, putting the system into the iterative adaptation trajectory. The strategy adaptation period plays a key role here. During the continuous monitoring, if the system is noticed to be moving towards undesirable phase, a transformative coping action (**7a**) may be required to bring the system back to adaptation. The nature of this action can be structured by the MOTA framework, as proposed, or by any other means available with the authorities at the moment. If the system is within desirable state, it can be left in "as-is" mode without altering the current course of actions (**7b**).

Step 8 & End of cycle

Once the strategy adaptation period has been reached, the consolidated information may be sent "upwards" for review purpose and indicate alignment with the strategic objectives. In case

of re-alignment of objectives due to new information, the entire process cycle needs to be repeated. If the strategic objectives are conserved, the program implementation plan needs to be updated with the new information uncovered. This step is needed to indicate if any changes have happened in the uncertainties, thereby changing the adaptive space itself (as shown in figure 6). This can be done by a re-run of the RDM cycle in case of computer assisted approach, or through deliberation and expert discussion, in case of a more qualitative approach. The changes in the system are mapped to the program implementation framework, and the process will go into another iteration.

The figure 7 is also surrounded by a dotted square, which is to represent the bounds of the institutional arrangement of the delta system, or the country. This indicates that the process needs to be performed within the bounds of legislative freedom and might in-turn highlight the need for changes in the institutional arrangements in order for the program implementation framework to work efficiently.

Conclusion

The remaining part of this research will focus on applying this approach to a case and looking at the insights it can produce. It is important to note that the application of the approach may be different, however, the preconditions need to be met for successful translation of program implementation; robust and adaptation strategy and managing stakeholders' positions. In this research, the program implementation framework will be applied to the Vietnamese Mekong Delta, where the government with the help of internal and external actors and experts, is trying to plan for sustainable delta development.

Part III – Case Application: Program Implementation Framework

4 The Case – Vietnamese Mekong Delta

The application of the implementation programming begins with this chapter and continues until the end of the thesis. In the subsequent sections, the implementation programming approach is explained for the application to the case where different steps of the approach are discussed in context of Vietnamese Mekong Delta. For each step the methods used are elaborated and the relevant chapters where the step has been performed are presented.

The second part of the chapter deals with introducing the case of the Vietnamese Mekong Delta and an introduction to the Mekong Delta Plan. The coastal province of Ben Tre, for which the analysis is performed is introduced with the challenges for delta management and the strategic direction as highlighted in the MDP.

Case Application Methodology

In this section, we will apply the steps of the implementation programming approach to the case of Mekong Delta. Figure 10 highlights (in blue) the steps that have been applied in the course of the next chapters.

In the first step, the Mekong Delta Plan was reviewed to understand the strategic vision for the delta region. All the information regarding the challenges within the delta sub-regions and proposed strategic measures were studied and the supplementary information on the pan was reviewed. Next, the region of Ben Tre within the delta was selected and the recent development towards sectoral planning and implementation measures was reviewed. This information was supplemented by the institutional setting and the planning culture within Vietnam. All the information was reviewed through literature review and has been presented in Chapter 4.

Once the information on the region was collected and the situation understood, a field research trip was conducted in Vietnam. With the help of researchers and experts in Vietnam, the strategic objectives of the MDP were translated into operational objectives for Ben Tre region. TO scope the problem and understand ground level implementation, two districts were selected as sites for primary data collection. This information is presented in the initial sections of Chapter 5.

The development of robust adaptation plan for the districts was done using RDM method with exploratory modelling. Within RDM, the livelihood system in the districts was conceptualized and modelled using the System Dynamics (SD) approach. One reason for choosing SD to model the system was the availability of an existing model of Chapman and Darby (2016), who shared their model willingly. This served as a bases for extension and provided a good starting point for system development.

Secondly, a model developed using System Dynamics can deal with information-feedback characteristics (Sterman, 2000). Accordingly, how structures, policies, and time delays of actions

interact with each other over a given time-period can be shown (Forrester, 1958). System dynamics also could represent the real-world situation with high level of abstraction (Forrester, 1994), therefore interplay between systems can be well represented in an aggregated way. SD models for socio-technical systems, unlike natural system models, are not forecasting tools. They are exploratory in nature, which can facilitate in investigating the impact of multiple systemic uncertainties over the designated KPIs to compare different plausible scenarios ((Hamarat, Kwakkel, & Pruyt, 2013; Hamarat et al., 2014; Kwakkel & Pruyt, 2013; Simonovic & Li, 2004)). With current advances in big-data manipulation and high-speed computing, SD can serve as a viable means for analysis in context of RDM. These strengths has made SD a useful method in climate change mitigation policy evaluation and hydrological-economic system policy evaluation (Ha, Bosch, Nguyen, & Trinh, 2017; Jin, Xu, & Yang, 2009; Kotir, Smith, Brown, Marshall, & Johnstone, 2016; Saysel, Barlas, & Yenigün, 2002; Venkatesan, Ahmad, Johnson, & Batista, 2011).

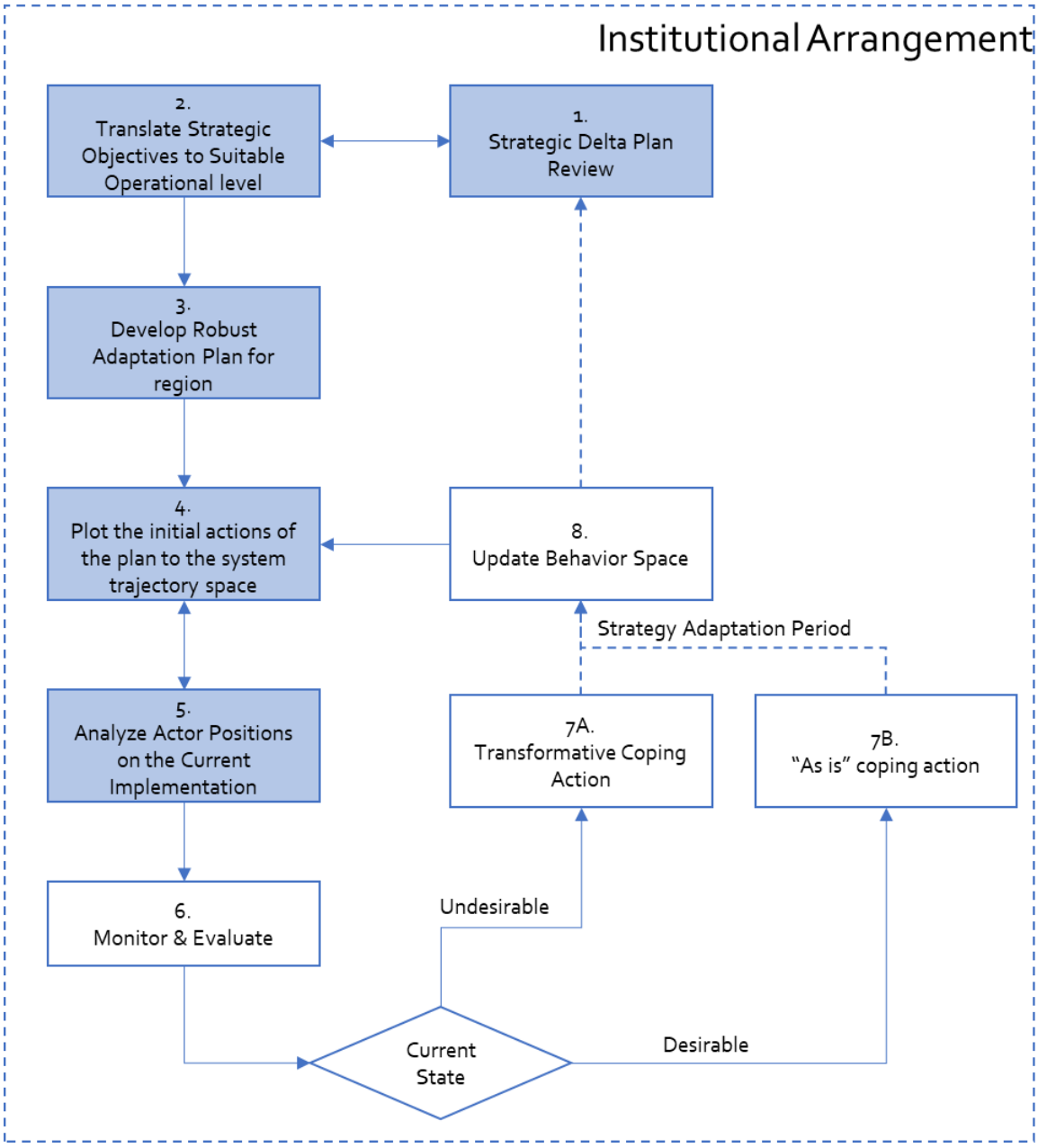


Figure 10 Implementation Programming Application

With the use of SD, an entire RDM cycle was completed on the system model to generate a robust implementation plan and compare it with the current implementation direction in the selected Districts. This process to create a robust implementation program has been discussed in Chapter 5.

After the implementation program for each region was created, the system space trajectory plots for each operational objective was created to analyse and observe the future trajectory of current implementation directions. The transformations required in case of unacceptable system performance were elaborated and discussed in Chapter 6.

Once the trajectory space plots for each objectives were generated, the position of the actors on the current implementation direction was analysed. The analysis was done by using the Motivation and Ability Framework (MOTA), where interviews of the actors were conducted (Appendix 2). MOTA was not applied as a quantitative method where the motivation and ability of the actors is measured on a scale and given a score. Instead, semi structured interviews were conducted with the regional actors to understand their position. The conversational style of MOTA enables to go in-depth in the perceptions towards risk and opportunities for development and implementation in the current region (Korbee et al., 2018).

The data collection during the field visit to Vietnam had been collected prior to generating of the plans. Due to this the findings of RDM could not be discussed with the regional authorities to see if there was any change in motivations based on the new information. The findings and discussion on MOTA have been reported in Chapter 7.

The next steps in the implementation programming approach require actual monitoring of the system over time and evaluate the need for coping actions. These steps have been left out of scope of the thesis and can be followed over time to see how the system moves forward.

Vietnamese Mekong Delta

The Vietnamese Mekong Delta (VMD), a region in the far south of Vietnam is a triangular region with an area of roughly 3.9 million hectares (figure11). The delta consists of 13 administrative provinces, with the city of Can Tho forming the approximate center of the region. Vietnam is bi-seasonal in nature with dry season that is followed by wet season. The low river flow during the dry season leads to increased saline content causing salt water intrusion in the coastal regions of the delta and affecting over 1.4 million hectares. The coastline of the delta region is around 600 km, covered with mangroves and mostly consisting of low sea dikes. The VMD is known as the "rice basket" of the nation with total rice production of 56% for domestic use and more than 90% production of the country's export. This constituted a total of 1.6 million hectare of land being used for rice production in 2016 (Vietnam General Statistics Office, 2016).

The VMD, like many other global deltas, is a densely populated area in Vietnam with approximately 17 million people (Kuenzer & Renaud, 2012). From the 17 million population, only around 25% is urbanised compared to the national average of 32%, making the delta region largely consisting of rural population. Even though the population of the region is large, the living conditions in the delta are underdeveloped and troublesome for its inhabitants. Major flooding problems, increasing salinity, drainage of naturally occurring acid sulphate soils, with high levels of potentially toxic aluminium and poor phosphorous availability are the problems that re commonplace in the delta region. The uneven distribution of seasonal rainfall further accentuates these issues, creating temporary drought conditions in the central and eastern parts of the delta.

Despite these adverse conditions, the delta region has some of the highly fertile soils in Vietnam, and abundant fresh water supply which enables highly productive agriculture and aquaculture. The livelihoods of the region include high productivity shrimp farms, fruit orchards and vegetables, apart from the known paddy agriculture. The delta also contributes to Vietnam's place among the top three rice exporters in the world (JICA, 2016). However, due to an elevation of less than 5 m above mean sea level, this region is vulnerable to natural disasters such as hurricane, storm surges, and salinity intrusion. Until 2012, around 1.7 million hectares of the 3.9 million hectares of land in the region has been affected by salinity intrusion (Kuenzer & Renaud, 2012; Wassmann, Hien, Hoanh, & Tuong, 2004) ,resulting in extensive economic losses to the region. Furthermore, in the dryer seasons, due to higher evaporation rates of the water bodies, the problem of salinity intrusion becomes extremely severe. This effect, when coupled with relative sea level rise (RSLR), may further intensify the effects in future dry spell seasons.

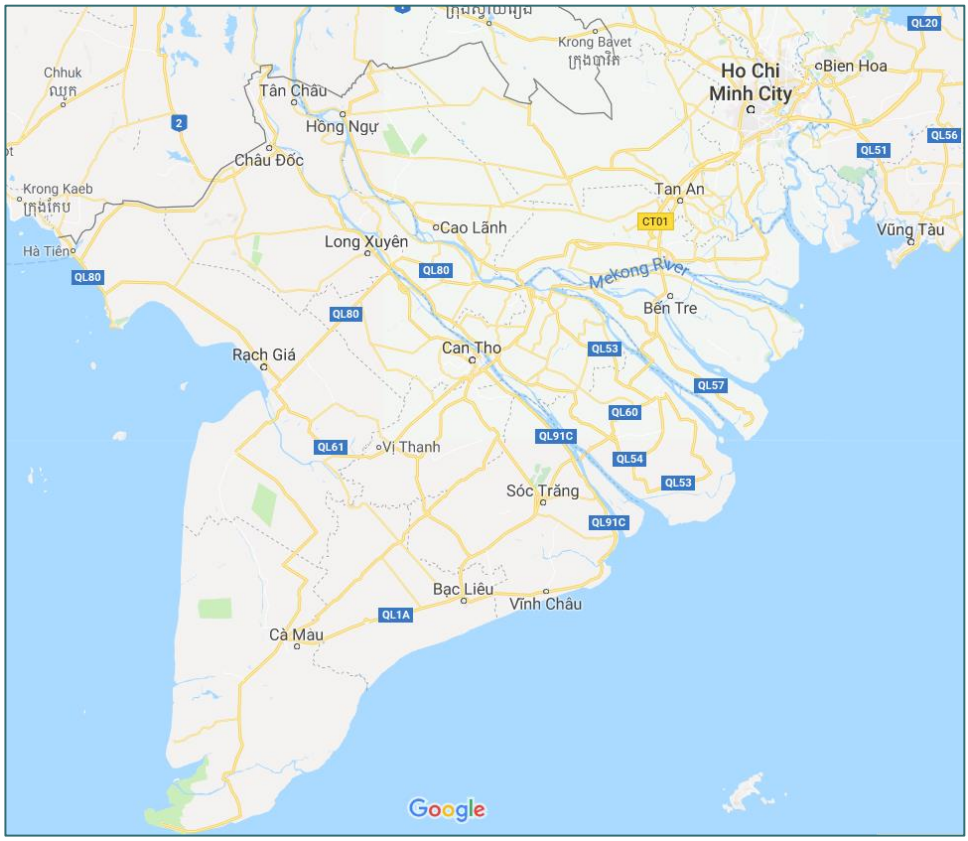


Figure 11 Map of Mekong Delta

Over the last 30 years, Vietnamese farmers have been adapting to the changing environmental conditions by modifying and diversifying their production systems and water management. But, the recent and forecasted agro-hydrological changes threaten the viability of these farming and social systems and subsequently food security within Southeast Asia. Significant constraints that limit the ability of farmers to adapt to the new hydrological regime include the availability of suitable cultivars, soil nutrient management options, the lack of knowledge of the potential threats from acid sulphate soil inundation, and planning tools.

Delta Planning in Vietnam

The issues mentioned in the previous sections are interdisciplinary in nature with multiple governing bodies responsible for different aspects of the problem. This interdisciplinary nature of the issues and interests of various local and official stakeholders create difficulties in exchanging information and matching the interests of all parties involved. Consequently, truly

integrated strategic delta planning remains a challenge in shaping the development of the region. Not only multiple ministries, agencies and planning branches are involved but also multiple levels of government (central, provincial, district, city and local people's committees). The Master Plan for Socio-Economic Development until 2020 for the Mekong Delta plays a very important role and should be the foundation for other sectoral plans (Son, Yen, & Sebastian, 2018; Veerman, 2013) . However, this master plan needs the approval of the central government, which in case of a central top-down governance structure may strongly determine the socioeconomic planning.

Traditionally in Vietnam, Planning Culture as explained by Korbee et al. (2018) as shown in figure 12. The Socio-economic plan developed by the Ministry of Planning and Investment (MPI) serves as a reference for Land use plan managed by Ministry of Natural Resources and Environment (MoNRE). Other sectoral plans are developed with reference to the above plans. The planning is initiated at the national level which moves down to the provincial and district levels, which make their own sectoral plans for the regional ministry departments.

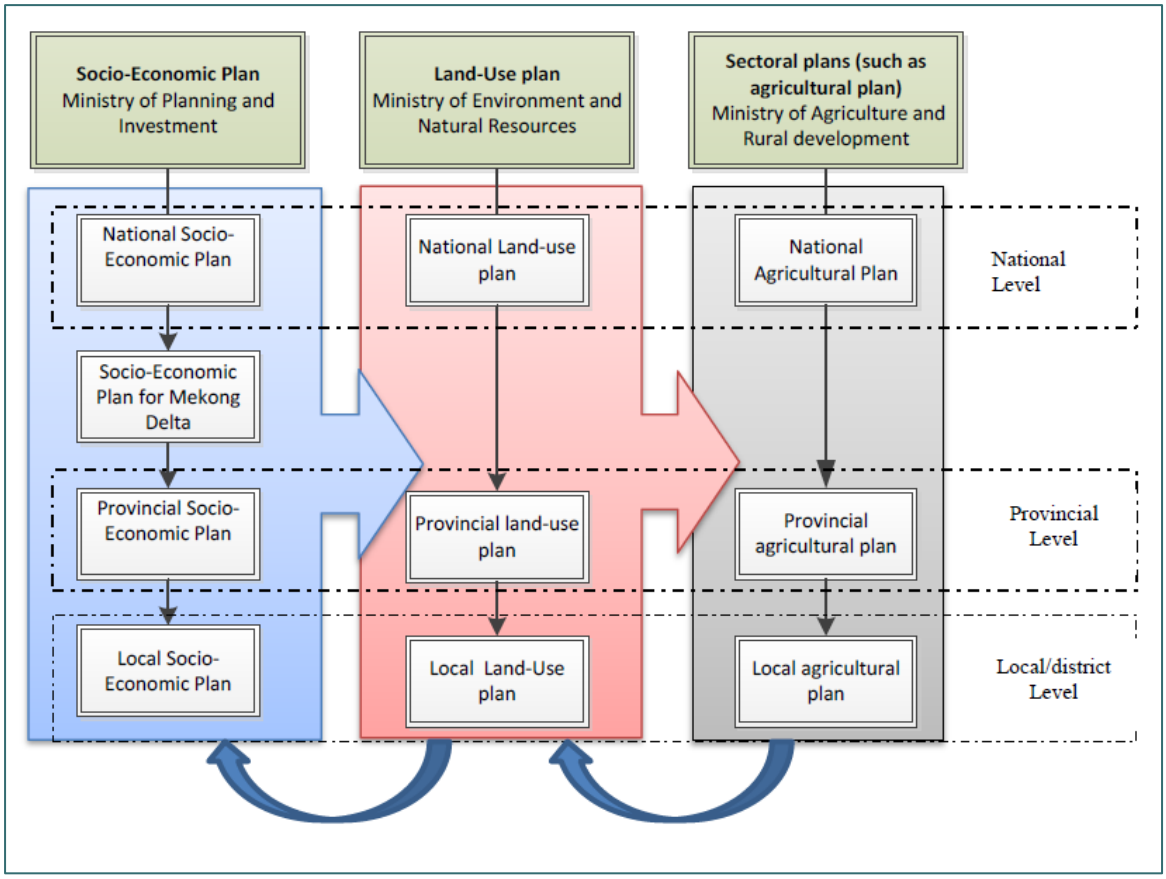


Figure 12 Institutional Setting in Vietnam (Retrieved from (Korbee et al., 2018)*)*

The presence of numerous sectoral plans with ownerships at all the hierarchical levels along with the sharing of plans at horizontal level between different departments, creates numerous coordination issues for planning and implementation. Furthermore, generation of all the plans consumes a large chunk of resources and time, where any change in the plan requiring approval at different levels. This makes adaptation extremely difficult.

The Mekong Delta Plan

In recent years, several national programs have been conducted by international and national organizations to pursue sustainable development of agriculture in the Vietnamese Mekong Delta (VMD) under increasing impacts of climate change. Starting from 2010, the Mekong Delta Plan has been developed through the collaboration between Vietnam and the Netherlands. The Mekong Delta Plan (MDP) is a strategic document that lays down the long-term vision to;

"*work towards a safe, prosperous and both economically and environmentally sustainable Mekong Delta region"* (Veerman, 2013).

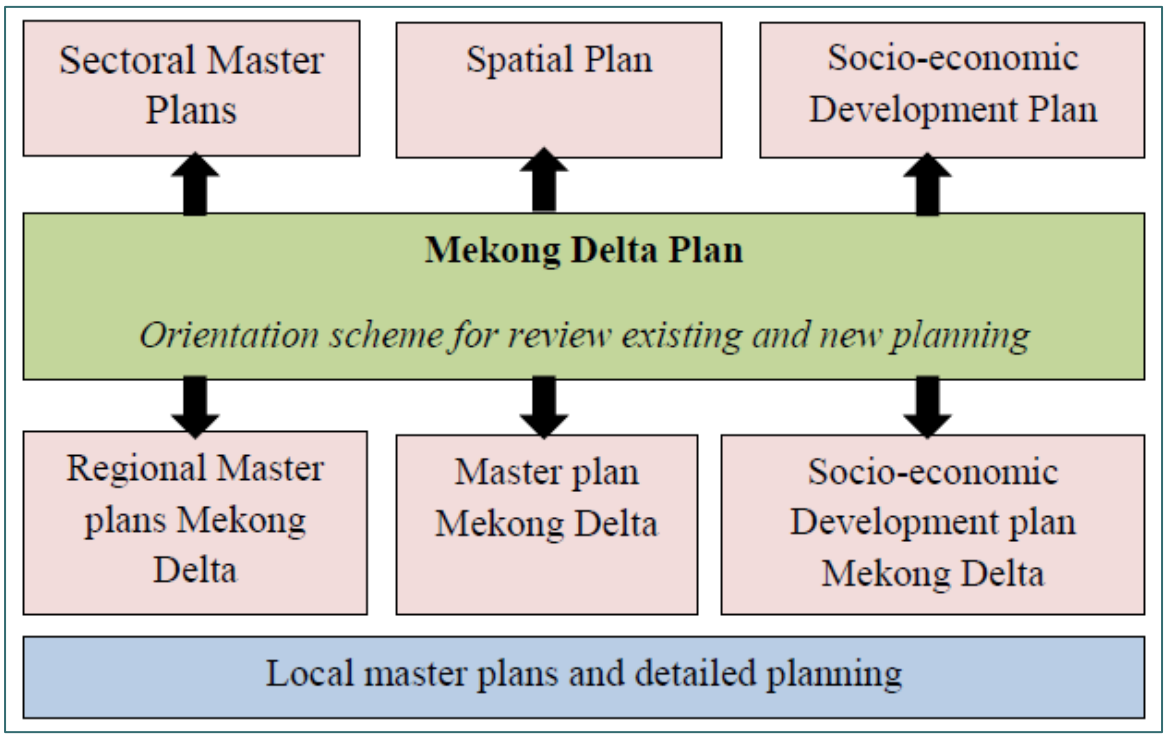


Figure 13 Role of Mekong Delta Plan in Sectoral Planning (Retrieved from (Korbee et al., 2018)*)*

The MDP has a dual focus of economic and environmental sustainability of the Mekong delta region. However, as the document moves towards defining sustainable development, the economic development takes centre stage with the undertones of safety prosperity and environmental sustainability. Being a Strategic Delta Plan (Seijger et al., 2016), the MDP serves as a guideline document for reference to calibrate the sectoral master plans (figure 13) and has no formal status with the government of Vietnam. However, in 2017, the government of Vietnam signed a new resolution on the long term development for the Mekong Delta region, which is reflective of the Mekong Delta Plan (Vietnam, 2017).

As described in previous chapter, MDP provides vision for adaptation by subjecting the delta system to different scenarios and uncertainties. The quantifiable means to cope with the situation on ground are left for interpretation. Therefore, from an implementation perspective, it is important to unpack the strategic vision into operational form. To facilitate this process, the Mekong Delta Plan distinguishes the VMD into 3 distinct regions (as shown in figure 14) based on the operational aspects that drive each of the region. The table 2 below shows the key challenges faced by each region as prescribed in the MDP.

Table 2 Key challenges faced by each delta region as per MDP

Region	Key Challenge	Description
Upper Delta	Flood Control	Flood protection and control for irrigation and shift in Agriculture
Middle Delta	Fresh water availability	Fresh water quality and availability
Coastal Delta	Adaptation to Salinity	protection where fresh water is required and adaptation to saline water through coastal protection

These regions are then subjected to four different uncertain future growth scenarios to produce insights and recommendations on the strategic measures (priority, no-regret) relevant to each region. Distinguishing these types of measures into helps in avoiding over-investment and in a flexible adaptation to foreseen and unforeseen developments.

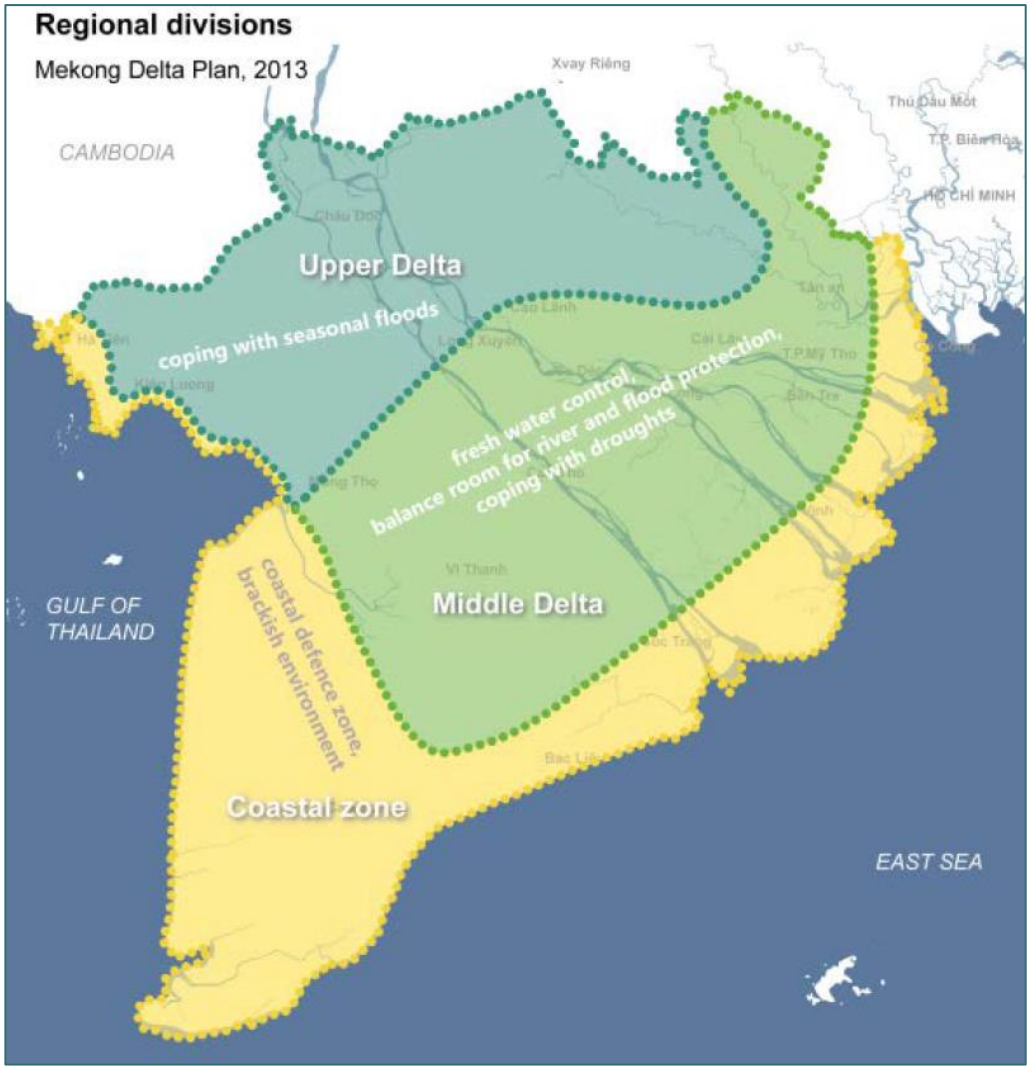


Figure 14 Delta regions prescribed in MDP (retrieved from (Veerman, 2013)*)*

In accordance with the key recommendations given in the Mekong Delta Plan, on-going national programs (The World Bank, 2016) targets the improvement of infrastructure, information system, and capacity building to enhance climate-smart planning, and integrate land and water management and sustainable livelihoods in nine provinces of the VMD. Similarly, the Vietnam government is also investing in sustainable rice-based systems in the VMD (World Bank, 2015a) to support large-scale improvement of rice-farming practices. However, the main focuses are capacity building (i.e. training and demonstration), extension skills, equipment and facility support, infrastructure, and financing. Only few activities tackle farming practices.

In general, the large national programs often look for institutional and structural options as 'no-regret' and priority measures to control water and protect agricultural land (JICA, 2016; The World Bank, 2016; Veerman, 2013);facilitate market opportunities (World Bank, 2015b) and private sector engagement (BRIA, 2015); enhance capacity and agricultural extension (IFAD & Socialist Republic of Vietnam, 2015; World Bank, 2015a); and few of them promote climate change adaptation and mitigation measures to farmers (Igwilo et al., 2016).

Furthermore, at smaller scale (i.e. sub-ecological zone and province), many research projects implemented by research organizations are trying to analyse and simulate impacts of drought, flooding, and salinity intrusion to agriculture production in the VMD. Most of the studies use modelling approach to develop recommendations (Chapman & Darby, 2016; Vu, Yamada, & Ishidaira, 2018). However, proposed measures are mostly not detailed enough for implementation at provincial level. Biophysical and socioeconomic analysis of the VMD showed levels of flooding, drought, and salinity intrusion impacts are complicated, depending on temporal and spatial occurrence of multi hydro-climate-related factors (Phong, Hoanh, Tuong, & Wassmann, 2014). Therefore, no "one size fits all" solution can be applied to whole VMD.

Given the size and scale of the Mekong Delta region, and the strategic nature of MDP, it is important to scope the research to a manageable region for application of the program implementation framework. Therefore, the focus of implementation is maintained on the coastal region, as defined in the MDP. Furthermore, using the concept of nestedness as introduced in previous chapter, we try to translate the strategic objectives for the successful implementation of the MDP, into district level implementation plan. This is done for the coastal districts of the Ben Tre province, which lie in the brackish water area. Subsequent sections will give some background on the area before attempting to lay down district objectives according to MDP.

Ben Tre – Coastal Mekong Delta Region

Ben Tre is the region on the south-east coastal zone of Vietnam located between the Tien Giang Province to the north and the Vinh Long and Tra Vinh Provinces to the southwest (figure 15). The province has the 5th largest population density in the Mekong provinces with 535 persons per km2 and a total population of 1.26 million (JICA, 2016).

Ben Tre province has the following characteristics;

- The region itself is partially in the coastal zone where the salinity control is the primary focus with economic adaptation due to RSLR
- The upper part of the Ben Tre region falls into the Middle Delta classification where the Fresh water use is crucial for agriculture. At the same time, increased ground water extraction is putting a strain on the water table, leading to potential land subsidence.
- Being at the intersection of Coastal and Middle regions, the boundary is constantly shifting upwards exposing Middle delta region to salinity problems. This puts adaptation pressures on the farmers, while stressing the need for control-based flood protection on the local governance bodies.

The Livelihood composition of Ben Tre is diverse with a combination of agriculture, aquaculture and horticulture (JICA, 2016) as shown in figure 16. The major crops in the Ben Tre region are paddy, coconut, brackish aquaculture (typically shrimp) and fruits. Each of these crops have different combinations and potential sub-cropping methods. Figure below shows the crops marked with the regions of their predominance. As can be seen, shrimp and brackish aquaculture is mostly predominant in the coastal region where the soil salinity level is high. Moving towards the upstream side, rice is the next most popular crop, in conjunction with shrimp farming, where

soil is saline with relative availability of fresh water sources. Further upstream, coconut and fruits/vegetables become popular due to lower soil salinity and alluvial soil, which is preferred for high-value crops. The cropping patterns are very diversified, and farmer may ideally use a diversification strategy to reduce the risk of crop failure.

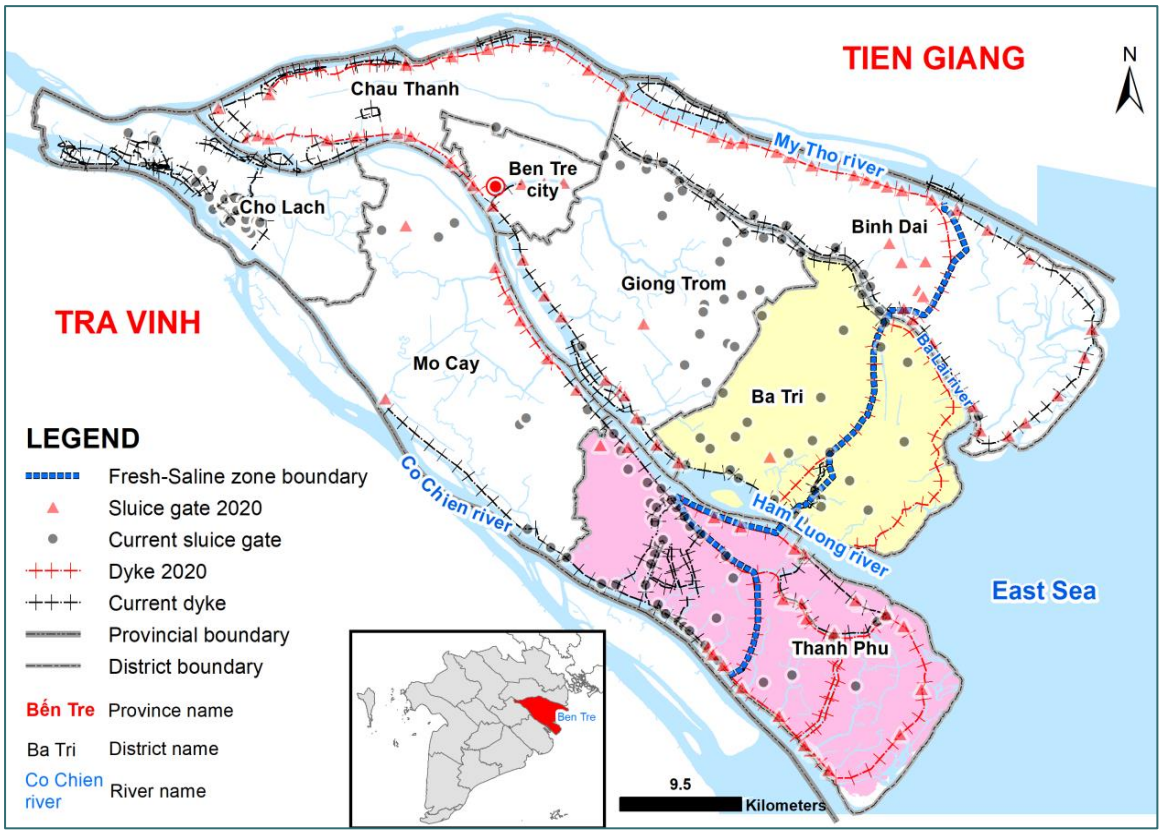


Figure 15 Map of Ben Tre Province (Retrieved from(JICA, 2016))

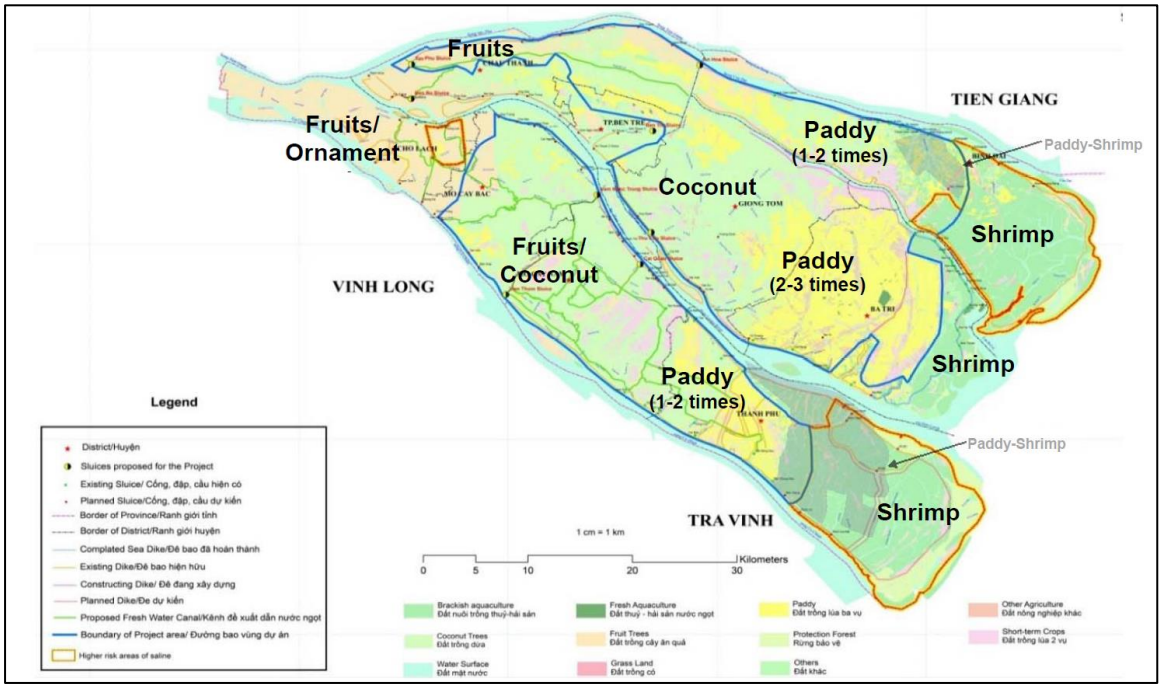


Figure 16 Livelihood distribution in Ben Tre (Retrieved from (JICA, 2016))

Being in the coastal region, the MDP sets forward the challenge of adaptation to salinity through pursuance of an agro-business model for Ben Tre. The priority and no-regret measures put forward by MDP (as given in figure 17) are sustainable aquaculture by poly-culture based system and movement of the sea dykes inland (Veerman, 2013).

Coastal Zone: Brackish water economy and advanced coastal protection			
⑥	2050 "no-regret"	**Dual Zone Coastal Management.** Brackish economy and dynamic shorelines. Modernisation and increased sustainability of aquaculture by adopting poly-culture based systems aligned with mangrove regeneration in the outer coastline. Mangrove regeneration and sedimentation along outer coast line as reinforcement of sea-shore. Movement of hard-protective sea-dyke to inner-core zone.	Food Production Agro-Business Industrialisation Dual Node Industrialisation Corridor Industrialisation
⑦	2050 "priority" and "no-regret" 2100	**Fresh water management along the coast.** Preservation of the ancient phreatic groundwater table along the coast is a priority by halting its use in agriculture and aquaculture. Limited use for rural water supply only. Combatting of land subsidence, by a) halting groundwater depletion and b) foster a brackish-aquatic environment. Use groundwater for drinking water alone. **Local fresh water harvesting and storage** in sandy areas for limited high-value agricultural use and diversification. **Investment in saline high-value agriculture** (derivatives for food, cosmetic, medicine and energy) based on salt tolerant crops, sea-weeds and algae. In the short-term investment in Research and Development..	Food Production Agro-Business Industrialisation Dual Node Industrialisation Corridor Industrialisation Agro-Business Industrialisation
⑧	2050 2100	**Reinforcement of coastal defence.** For non-Dual Zone Coastal Management areas, sea-defence structures (dykes) need to be revamped to keep up with sea level rise. Especially north-west coast, and Eastern Delta (Mekong Branch). The routing of the dykes needs to be in line with Dual Zone Coastal Management. **Unlinking road system from dyke system.** Flexibility in dyke trajectories is required to allow for natural cost effective coastal flood defence strategies. The road function impedes the flexibility for the dyke. Under extreme sea level rise, coastal defence system is upgraded to accommodate rising flood risks. This includes reinforcement of inner protection dykes.	All scenarios

Figure 17 Coastal Zone Strategic Measures in the MDP (Retrieved from (Veerman, 2013)*)*

The measures can be represented as strategic adaptation pathways where "no regret" measures until 2050 are put forward (represented by **6** in figure 17), followed by two options for adaptation until 2100 (represented by **7 or 8**). The selection of long-term measures will depend on the state of the system close to 2050. Being defined for the entire coastal zone of the Mekong Delta, these measures provide general adaptation trajectory for the system without touching on the province, district and commune specific actions. Therefore, using the system nestedness concepts of Chapter 3, there is a need to unpack them for implementation programming as shown in figure 18.

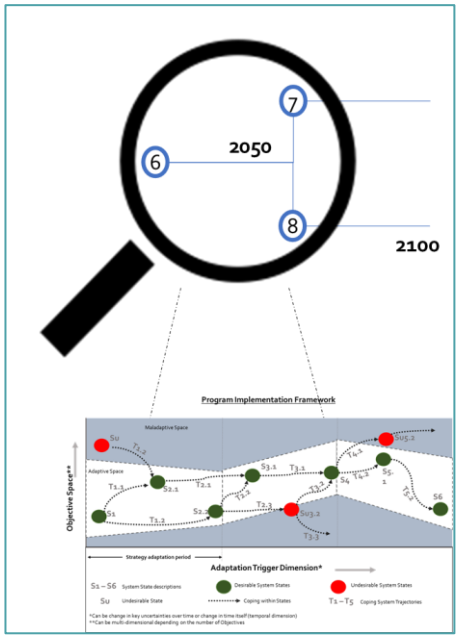


Figure 18 Implementation programming for MDP Coastal Adaptation Measures

To test the implementation programming approach for a region, the focus of the case study application has been maintained to the districts in Ben Tre, just outside of the current dyke networks close to the areas (marked in orange in figure 16) which are being exposed to increasing

salinity. The districts in Ben Tre where the interviews were conducted are Thanh Phu and Binh Dai (Appendix 2). Both the districts have predominant aquaculture farming with combinations of Rice crops with similar geographic position (figure 15 and 16). This renders the possibility to observe the development trajectories of both districts with respect to each other and compare it to the ideal growth as stipulated by the MDP.

Thanh Phu

The district of Thanh Phu lies at the intersection of brackish and fresh water zone of Ben Tre, with major livelihoods in the region consisting of Intensive shrimp farming, rice and brackish shrimp seasonal farming, and coconut farming. The livelihoods of the region have been planned by the regional governments based on the regional socio-economic development plan of 2020. In the past years, the region has seen growth in adaptive livelihoods of integrated freshwater shrimp with rice in one season and brackish shrimp in the other. However, a significant percentage of the population practices intensive farming system due to higher output and potential income. The coastal communes of the district focus on mangrove-eco shrimp livelihoods. Thanh Phu is a closed district with dike rings and Ba Lai sluice gate, having a controlled impact of salinity in the region. The pollution level of the water is high due to stagnant water, but the presence of a water treatment plant helps provide clean water for agriculture.

Binh Dai

The district of Binh Dai, like Thanh Phu also lies at boundary of brackish and freshwater. The distinction in Binh Dai is less clear as it is an open district with future plans of investment in dykes. The area has higher salinity intrusion and the main livelihoods consist of intensive shrimp farming, with certain areas focussing on extensive rice and brackish shrimp farming. The regional planning is like Thanh Phu district with increased focus on intensive shrimp, but the crop survival rates are lower, and the overall technological know-how of the farmers is not very high. This makes the commune's economic condition is not as good as Thanh Phu with lesser sustainable farming practices. The region is relying heavily on the new socio-economic development plan for the future development and improving the economic output. The coastal communes here also focus on mangrove shrimp systems however, the mangroves are being redeveloped at the moment.

The livelihood composition on the communes which were interviewed in Thanh Phu and Binh Dai is shown below in table 3;

Table 3 Livelihoods in Thanh Phu and Binh Dai under study

District	Livelihood Modelled	Source
Binh Dai	Intensive Shrimp Farming	Interviews Appendix 2
	Extensive Shrimp Farming with rice	Interviews Appendix 2
Thanh Phu	Intensive Shrimp Farming	Interviews Appendix 2
	Integrated Freshwater Shrimp with rice	Interviews Appendix 2

From the table, it can be seen that there are 3 livelihoods that have been studied; Intensive shrimp farming, Extensive Shrimp Farming, Integrated Freshwater Shrimp farming with rice. In the next chapter, the current implementation in these districts is studied and a robust implementation program is generated based on the current developments.

5 Develop Robust Adaptation Plan

In this chapter, the robust adaptation plan for implementation programming is developed. A full cycle of program implementation plan development is shown using RDM as discussed in Chapter 3. One RDM cycle is demonstrated where steps; **Participatory Scoping, Case Generation, Scenario Exploration** and **Tradeoff Analysis** (Figure 8), are demonstrated for Thanh Phu and Binh Dai region. The current implementation direction as per the Socio-Economic Development Plan 2020, of the districts is compared to a reference scenario, and discussed in the later sections to highlight the potential coping measures.

Participatory Scoping

The problem conceptualisation, uncertainties identification and demarcation, and model development were performed in the participatory scoping using the System Dynamics approach where an exploratory model was created to encompass dynamics of the case. This step was conducted as a combination of the objectives highlighted in the Mekong Delta plan 2013 and through a thorough consultation process with case experts in the Centre for Water Management and Climate change (WACC) at the Vietnam National University. Since the implementation is at the commune level for Thanh Phu and Binh Dai, more local level actions and objectives are derived through semi-structured interviews of regional actors.

Defining Objectives

As mentioned in the previous chapter, for effective program implementation at the level of communes, it is important to translate the MDP strategic objectives of safety, prosperity and sustainability into observable Key Performance indicators (KPIs), appropriate to the local conditions. These KPIs are multi-stakeholder from an institutional perspective as different departments or ministries might be responsible for them. However, the selection is made comprehensively on behalf of the actors with interviews and consultation sessions with local experts. This simplification is added due to the scope of this research, as actual stakeholder consultation process itself is an iterative process, with limited success in fair objective selection (Arrow, 1950). After detailed discussion with local experts at WACC, the Objectives were translated and linked to the strategic objectives of the MDP as shown in the table 4 below;

Table 4 Regional Key Performance Indicators

Key Performance Indicator (KPI)	Description	Association with Strategic MDP	Objective
Regional Economic Position	The total integration of individual economic positions of farmers over the districts' livelihood composition	Prosperity	Maximize
Regional Soil Nutrient Balance	The average value of soil nutrients for different livelihoods, integrated over the districts' livelihood composition	Sustainability/ Prosperity	Maximize
Regional Water Pollution	The average value of the relative change of water pollution caused by different livelihoods, integrated over the districts' livelihood composition	Sustainability/ Safety	Minimize

The linkage has been created between the KPI and the MDP by linking it to one or more strategic objectives, with an associated maximization/minimization function. The regional objective selection is done to observe difference in outcomes of the livelihood under different policies that are in process of implementation in the area. The 3 KPIs mentioned above are taken as end objectives as the uncertainties affecting the system will ultimately affect the regions' prosperity, sustainability and safety through one of these objectives from an adaptation perspective. The salinity intrusion, which may seem as a choice for objectives is factored as uncertainty instead as adaptation of the region to salinity, as mentioned in the MDP, requires monitoring of system's ability to transform economic, sustainability and safety perspective, while salinity is influencing the system.

System Conceptualisation

As mentioned in Chapter 4, to apply the RDM, a system model is required which will be used to study the delta region under different development scenarios. As motivated in Chapter 4, the modeling method used to model the livelihoods in Binh Dai and Thanh Phu, is System Dynamics (SD) (Sterman, 2000). However, before the SD model is developed, a causal loop diagram of the system is explained in this section.

Once the KPIs were defined, the next step was to create system model with factors affecting the KPIs. This was done using a causal loop diagram[2] (CLD). A causal loop diagram (CLD) indicates how different elements of the system influence each other to form positive or negative re-enforcing mechanisms within the system. The CLD created for this study was an extension of the model of rice farming practices created by (Chapman & Darby, 2016) from University of Southampton. The model, initially developed for modelling rice livelihoods, was extended into an exploratory model with three different livelihoods; extensive shrimp and rice farming, intensive shrimp farming, and integrated freshwater shrimp with rice farming. The modifications to the existing CLD were made in the form of additional feedback loops to account for the added dynamics of the local situation in Binh Dai and Thanh Phu (marked in green), as shown in the figure 19. The model thus developed focusses on the following components which can be followed in detail in Appendix 3.

1. Alternate livelihoods in the region – intensive shrimp farming, extensive shrimp farming with rice, integrated shrimp farming with rice.
2. Farmers' individual economic position – Net costs and profits incurred by the farmer for each season.
3. Soil nutrient balance – The soil nutrient cyclic pattern of each season with inundation and salinity intrusion.
4. Fertilizer application pattern of farmers – How the fertilizer for the next season is applied based in the output and nutrient requirement for the current season.
5. Regional aggregated livelihood characteristics – The sum total of the KPIs for the entire region based on the livelihood model

The figure 19 below shows the CLD and highlights the feedback effects between the KPIs (in red) through a set of intermediate factors. The arrow between two factors shows the directional causality link between them, and the sign on the arrow show the nature of the causality. A negative sign indicates that an increase of one leads to the decrease of the other factor, while a positive sign indicates an increase of one leads to increase of the other factor. The green arrows are the additions made to the existing model of Chapman and Darby. The model was extensively discussed at WACC, Vietnam, who assisted in the modifications to the existing model to make it

[2] The SD model and the CLD was generated using Vensim DLL 7.1 license.

represent the situation in Thanh Phu and Binh Dai. The causality of the model, and reference input values, has been added in consultation with them.

To exemplify this, consider the Individual economic position (shown in red). In an agriculture/aquaculture system, an increase of "Individual Net Economic Position" has a positive effect on the "Perceived Success of Current Livelihood", which increases confidence in the current livelihood and hence lower chance of "Adoption of alternate livelihood". This will require lesser new investments leading to lower "Investment Debt"[3] which will in turn positively effect "Net Economic Position" creating a full feedback loop **L1**. It can be seen from the figure that multiple feedback loops effect economic position, where the net effect on Net Economic position will be dependent on the dominant feedback loops. These loops are in turn dependent on systemic inputs or uncertainties. A plausible range of these uncertainties causes this dominance to shift based on the combination. Therefore, from a systems perspective, modelling and simulation software allow us to outsource this process and directly look at the KPIs under multiple scenarios.

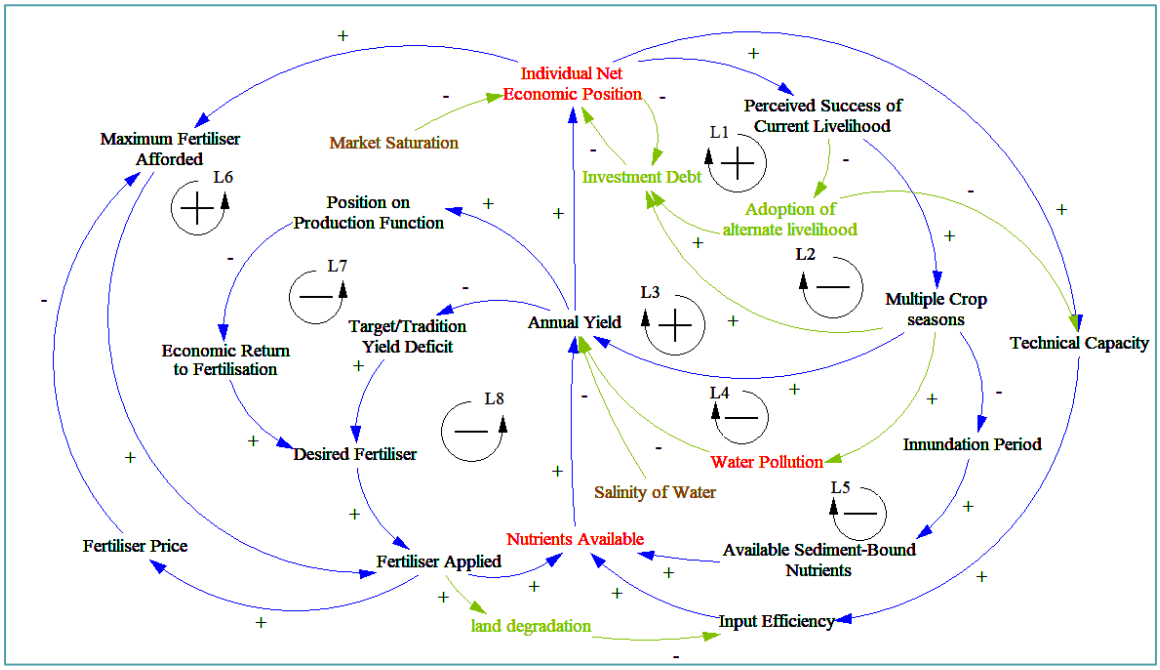


Figure 19 Causal Loop Diagram for the current livelihood system (Adapted from (Chapman & Darby, 2016)*)*

As another example, we start at the "Nutrients Available", which will influence the "Annual Yield" positively. As the "Annual Yield" increases, the "Position on Production Function" of the farmer is better, as the land is producing more. As the farm is producing more, the tendency of the farmer to invest more in fertilizer reduces, as the current level of fertilizer is perceived to be sufficient for higher outputs. Thus, the "Economic Returns to Fertilisation" from the earnings is reduced, which in turn reduces the "Desired Fertiliser" and the "Applied Fertiliser" to the farms, thereby affecting the "Nutrients Available" in the next cycle. At the same time, higher "Fertilizer Applied" to the land, over long term, can have detrimental effects on the land, especially if the farmers are not fully aware of the consequences **L7**. This can in turn-affect Soil nutrient balance through permanent degradation over time.

The factor of "Market Saturation" is depicted in the CLD as an external factor, as majority of the output products from the livelihood model under study, are export products. Therefore, to endogenize Market would require a global shrimp and rice trading sub-model with added

[3] Positive sign multiplied by a negative sign. Rules of multiplication of signs apply in case of multiple factors in the loop.

complications. However, "Market Saturation" is an important factor, especially now, in Vietnam, since the shrimp prices have been observed to be going down in the last few seasons due to over production. The issue has not fully been captured in the development of commune level livelihood plans, as shrimp farming is being proposed as a positive measure to many households without studying the global market influence of increased supply. Fertilizer price, on the other hand, is locally influenced as most of the fertilizer is bought locally and thus, has higher elasticity to local consumption. Therefore, it has been endogenized in the CLD.

Model Structure

The causal loop diagram discussed in the system conceptualization, has been made from an individual's perspective where the system dynamics of a single livelihood trajectory is observed. Therefore, to observe the regional dynamics, a higher level of aggregation is required, where multiple livelihood models are interacting with each other to give the regional characteristics. This is demonstrated in the figure 20, which represents the Vensim implementation of the conceptual model. Since there are three livelihoods under study, and the CLD represents a single livelihood, the actual model implementation required three layers of model interacting with each other. Thus, the three livelihoods (CLDs) interact with each other sharing information at each timestep of the model run. The benefit of this implementation is that it facilitates the evaluation of structural diversification of different livelihoods as a policy option. The stock flow structure of the Vensim model implementation can be found in the Appendix 3**.** The model time step is set to one Agricultural season in Vietnam, where a year consists of 2 seasons, and the entire model simulation was run for 26 seasons or 13 years.

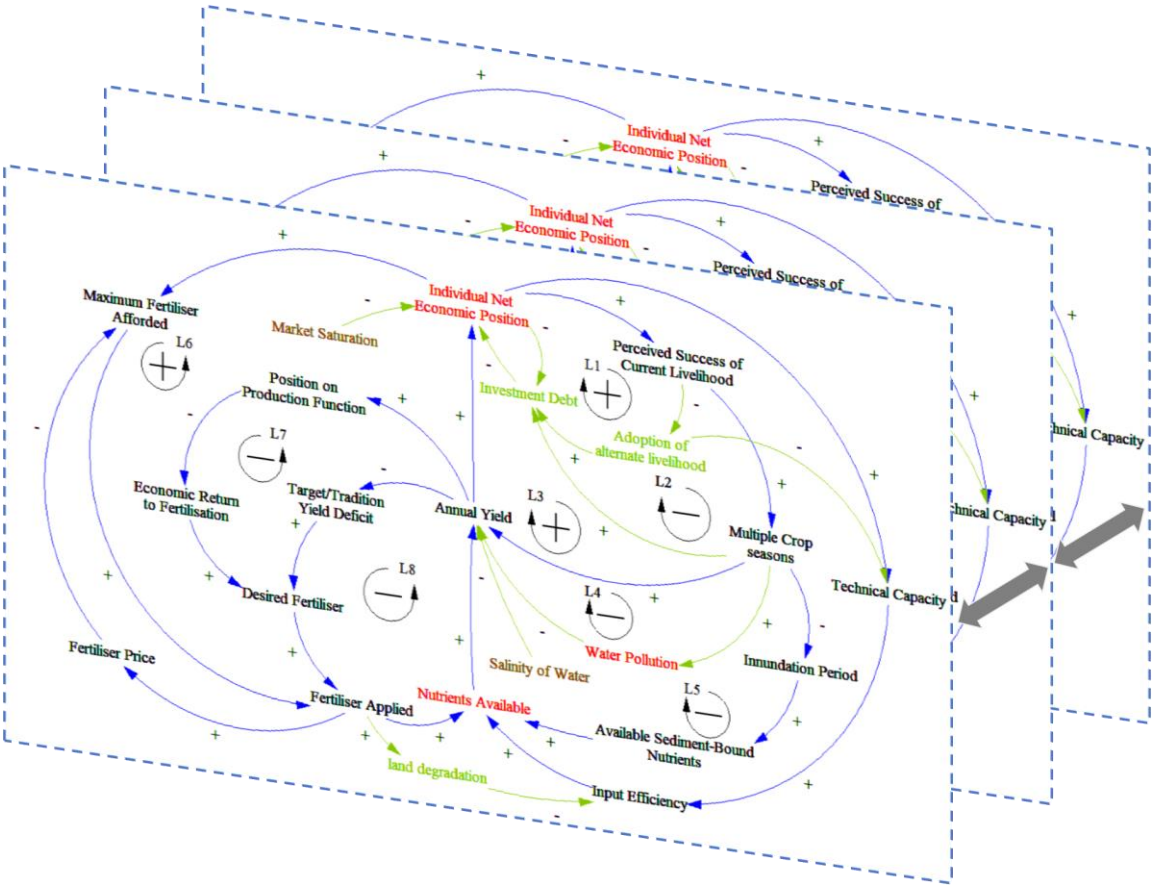


Figure 20 CLD implementation in SD model

Defining Uncertainties

Once the Objectives are defined, systemic uncertainties are explored within the system. The base reference for this is taken from (Chapman & Darby, 2016), from Southampton University, who

attempted to explore livelihood adaptation with SD in upper delta. A list of key uncertainties, along with their initial value used in the SD model as input can be seen in Appendix 3. The uncertainties serve as an input to the SD model, where instead of an occurrence probability, an entire plausibility range is provided. A combination of each value within this range then creates a plausible future scenario. As an extension to the existing model of Chapman and Darby, additional data on aquaculture livelihoods was collected through field interviews and secondary data sources. The summary of the field interview with farmers along with the actual interview Transcripts can be accessed in the Appendix 2.

It is important to highlight that the systemic uncertainties of Thanh Phu and Binh Dai vary only in terms of the distribution plausibility of livelihoods in the future (PropFracExtensive & PropFracInteg). This is due to the geographical proximity between the 2 districts to the outermost respective dyke rings and similar livelihood potential of the districts (interview WACC**).**

Case Generation

Post the development of the SD model, the Exploratory Modelling and Analysis (EMA) Workbench (Kwakkel, 2017; Kwakkel & Pruyt, 2013) was used to generate a large ensemble of potential futures covering different possible combination of uncertainties. Each of these future, is a plausible scenario that generates a plausible output space which will then be studied to study their vulnerability. This helps to identify the scenarios (or plausible futures) around which the policies need to the focusses[4]. Using Latin Hypercube Sampling (LHS), an ensemble of 100 different scenarios is generated for Thanh Phu and Binh Dai along with their Gaussian Kernel Density Estimates (KDEs) in 26 timesteps or 13 years (Oliphant, 2007).

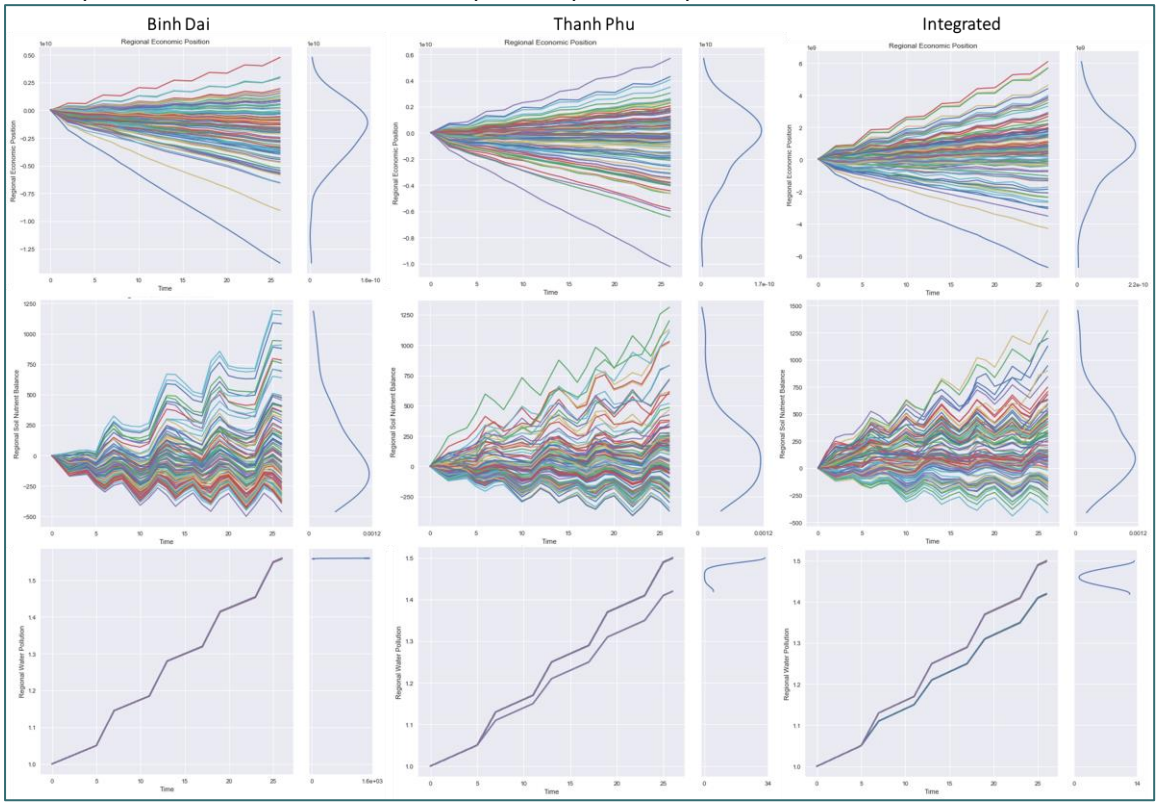


Figure 21 Open Exploration Results; Binh Dai (left), Thanh Phu (middle), Integrated Reference model (right)

[4]The entire script for the model is available on GitHub; https://github.com/agurvinder/MasterThesis_Vietnam

The first open exploration, as shown in Figure 21, was performed with the hypothetical assumption, that this is the situation of both the regions, if there was no policy intervention. This assumption was made to represent the condition prior to the revision of sectoral plans with insights from MDP. The "clean slate" assumption for open exploration helps to compare the current implementation direction in both the districts with the implementation direction if a robust adaptation plan was developed for the region through implementation programming. This implicitly (and rather cynically) assumes that the current implementation program for the region is not robust. However, if the current program is robust, this will also show in the analysis, as the difference between the current implementation and RDM implementation (developed in this chapter) will be less.

Figure 21 shows the plausible output space (seen vertically) over time (x-axis) for the KPIs (Y-axis) defined for Thanh Phu and Binh Dai regions. The rightmost part of the figure represents an Integrated Reference Model, which has all the livelihoods in equal proportions, and is used as reference for comparison. As mentioned, the difference in Thanh Phu and Binh Dai is in the initial value of the composition of their livelihoods as shown in the Table 5 below.

Table 5 Input Livelihood composition for each model run - base case

System Model	Livelihood Modelled	Run Initial Composition (%)
Binh Dai	Intensive Shrimp Farming	87.5
	Extensive Shrimp Farming	12.5
Thanh Phu	Intensive Shrimp Farming	35
	Integrated Freshwater and Shrimp	65
Integrated Reference Model	Integrate Shrimp Farming	25
	Extensive Shrimp Farming	25
	Intensive Shrimp Farming	50

Regional Economic Position

Looking at the scenarios generated for Net Economic position, the spread of plausible range on outcomes for Binh Dai, Thanh Phu and the reference scenario can be observed. The Net economic Position of Binh Dai, the mean KDE value peaks below zero at -1 trillion VND. This suggests that current livelihood practices of the district for aquaculture and agriculture, without any policy intervention, have a higher likelihood of being in the negative economic development scenarios. As the future unfolds, the current livelihood practices become unsustainable and creates a negative impact on the district's economic stability.

For Thanh Phu, the position of the KDE distribution of the scenarios peaks slightly above zero on the graph highlighting that the mean Net economic position is better than Binh Dai. However, the peak is close to zero at 800 billion VND which shows that several scenarios still affect the economic position of the region negatively. This is expected given the wide range of plausible uncertainty fed to the exploratory SD model. The integrated reference model, with the highest diversification of livelihoods clearly out performs Thanh Phu and Binh Dai for this KPI at a mean of 1.2 trillion VND, providing an initial inference which favours diversification of livelihoods has better economic performance.

It is important to note that the scale of the graph is highly magnified at 1^{10} x 1000 VND. Therefore, a small deviation in the KDE peak portrays a significant change in the Net economic position.

Regional Soil Nutrient Balance

Like the Economic position, the Regional Soil Nutrient Balance shows the distribution of outcomes for the 2 regions in comparison with the reference scenario. Again, similar pattern is observed for Binh Dai and Thanh Phu, with the soil conditions within the 2 regions are more sustainable in Thanh Phu. The resulting graph is however fluctuating in nature with clear high and

low points of nutrient balance. This is due to cleaning of the fishing ponds periodically, which is accounted for as a regular practice (Appendix 2). The Integrated reference model for Regional Soil Nutrient Balance outperforms the regions too, adding confidence to the inference of benefits in diversification.

Regional Water Pollution

For Regional water pollution, the outcomes show the increase in water pollution levels from the current levels of each region. For instance, in Binh Dai, with the current livelihood trajectory, the level of water pollution will be more than 1.6 times the current levels. The high concentration of KDE for the scenarios shows that the effect of systemic uncertainties is very limited on this KPI. This is a direct implication of the modelling of water pollution in the exploratory model. For Thanh Phu, however, a clear divergence can be seen where the KDE has 2 possible future states. The higher value has more scenario lines close to it, therefore, a higher concentration of solutions, as can be seen from the KDE distribution. This indicates of having greater future plausibility relative to the lower pollution value. In Thanh Phu, due to the presence of the Ba Lai sluice gate (site visit), the possibility to control the salinity of water is better. This diverges from the reference model, where the likelihood of a lower pollution rate is higher due to a higher KDE concentration at 1.4.

Scenario Exploration

Open exploration provides a snapshot of potential future and KPIs under systemic uncertainties. However, there is no additional information given on the causes and scenario descriptions that lead to these outcomes. Since the systemic uncertainties form the inputs to the model, it is important to dig deeper and investigate the input combinations that produce the undesirable future states. This will build a better understanding of systemic causation, while highlighting the scope for potential policies. A computer assisted scenario discovery approach is used that will utilize the Patient Rule Induction Method (PRIM) (R. J. Lempert et al., 2006) algorithm to generate uncertainty subspaces using a binary classification method (Bryant & Lempert, 2010). Having a binary classification assists in dividing the solution space into acceptable and unacceptable range of outcomes and observe how the uncertainties affect the KPIs.

Table 6 Summary of Scenario Discovery

Region	Time	KPI	Vulnerability Threshold	Key Uncertainties	Vulnerability Range	
Binh Dai	**26**	Regional Economic Position	< 0	PopFracExtensive	0.01	0.84
				Extense Selling	3.03	7.75
				Salinity Rate	0.01	0.10
Thanh Phu	**26**	Regional Economic Position	< 0	intenseSelling	0.61	1.17
				crop survival probability	0.07	0.30
				CostExtense	0.03	0.05
				PopFracInteg	0.01	0.92
				BaseTE	0.26	0.39
				CostFresh	0.51	0.80
Integrated livelihood Model	**26**	Regional Economic Position	<0	MaxNutReqPerHectare	458	550
				PopFracExtensive	0.01	0.88
				PopFracInteg	0.00	0.82
				CostIntense	0.73	1.00
				ExogNutAvailRate	8.06	14.59
				Salinity Fluctuation Intensity	3.03	6.61
				CostExtense	0.03	0.05

In the first step of Scenario discovery, the objective was to locate the pre-dominant uncertainties. Therefore, an arbitrary selection of objectives was done to highlight the uncertainties affecting borderline cases. Once the uncertainties were located, potential policy structures were explored around them. Table 6 shows some of the key vulnerabilities of this process. The extensive list can be obtained from Appendix 3. Each KPI has uncertainties linked with it with the range that may lead to unacceptable levels of outcomes.

As it can be seen from the table, each of the KPIs is influenced primarily by a limited number of uncertainties. Furthermore, for each system under study, whether Thanh Phu, Binh Dai or the integrated reference model, the key uncertainties affecting the KPIs are different due to difference in livelihoods. The last 2 columns of the table show the range of vulnerability for each uncertainty parameter, i.e. if the uncertainty values are within this range in any scenario, the KPI targets will not be met, leading the system towards maladaptive space. It is important to re-iterate that the current system is not under any external policy intervention.

For instance, in Binh Dai's current state of development, the Regional Economic Position is affected by the fraction of regional population engaged with extensive shrimp farming, along with the selling price of extensive shrimp farming. The lower fraction of extensive shrimp farming (PopFracExtensive) is not good for the growth of the region as a lower fraction leads to lower economic output, while external market fluctuations affecting the prices, can affect the regional economic growth too. This provides an interesting balancing trade-off which may otherwise be missed without the feedback effects of an SD model. A higher extensive shrimp farming practice may result in overproduction of shrimp in one season year, which may in-turn put pressure on demand and reduce the selling price of the shrimp. Another factor that is found to be affecting the economic position, in the current livelihood composition of Binh Dai is the salinity rate. The entire range of salinity is not favorable to Binh Dai's regional economic growth. One reason to justify this might be that in Binh Dai, the infrastructure to manage salinity is not developed now which results in the influence on crops to be higher.

Looking at Thanh Phu for Regional Economic Development, it is visible that the uncertainties affecting it are different, but the base issues are similar. The selling price of intensive shrimp farming along with the survival probability of the shrimp crops plays an important role. The fraction of integrated shrimp farming to support the area needs to be higher along with a higher TE (technology efficiency) value and better survival rates of freshwater shrimp which is bred with rice crops. The major economic development burden here is taken by the cost and output uncertainty indicators (intenseSelling, costextense), which is straightforward. However, a clear difference here compared to Binh Dai is the absence of salinity parameters in affecting the economic output. This indicates that even though the cost and market fluctuations are present, moving to an integrated shrimp model is mitigating the risk of salinity intrusion as the land use is manages more effectively in both dry and wet seasons.

In the integrated livelihood model for regional economic position, due to the presence of multiple livelihood compositions, the nutrient load on the soil is higher. This is reflected in the Maximum nutrient requirement (MaxNutReqPerHectare) and exogenous nutrient fixing (ExogNutAvailRate) through fertilizers. The other uncertainties affecting the regional economic position are cost and output related based on the livelihood composition. However, since the integrated shrimp farming fraction is lower, the salinity fluctuation intensity between dry and wet season becomes a key uncertainty.

Policy Structure

Development of climate change adaptation options for the VMD requires both "hard and soft implementation strategies". Beside the "hard" interventions such as dams, sluice gates, canals,

and other infrastructures in the upstream and downstream areas, "soft" interventions such as capacity building, agriculture extension, and climate-smart agriculture technologies and practices (CSA T&P) need to be considered.

After analysing the results of open exploration without policy intervention (hypothetical) and understanding the key vulnerabilities affecting the system identified in scenario discovery, five policy measures were added to the model. These policies are a combination of information gained form experts during the sessions on MOTA workshop (Appendix 4), and the actual implementation policies that are in the program implementation process in Thanh Phu and Binh Dai. The latter group of policies was added after interview sessions with the People's committee offices in the communes of these districts (Appendix 2). The policies are based on the priority and no-regret measures that have been advocated in the MDP.

Table 7 shows the policies (both hard and soft) added in the model, and the key uncertainties these policies attempt to influence.

Table 7 Policy measures for the region

Policies	Model Actions	Model Factors Affected	Reasoning (Appendix 2)
Hard Implementation Measures	Dyke and Sluice system	UpstreamTrapping	A dyke and sluice system will help regulate the salinity level in the area thereby enabling other development models. Closed gates mean that the Water pollution intensity will increase, which may speed up the water pollution process.
		SedNutContent	
		FloodDuration	
	Waste Treatment Plants	ExogPollut	The shrimp farming waste needs to be processed either through a centralized system or a subsidized decentralize system.
		Intensive Shrimp Survival Rate	
		Extensive Shrimp Survival Rate	
		Freshwater Shrimp Survival Rate	
Soft Implementation Measures	Information and training of cooperatives	Crop Survival Probability	Information about climate change and the standardization of recruitment practices will further reduce chances of crop failure.
	Eco Rice	Rate of Degradation	Eco Rice will help moving towards cleaner rice crop with less waste and lower nutrient demand.
		CostRiceUnit	
Subsidies	Subsidies on integrated shrimp farming costs	Cost of Freshwater Shrimp	This incentivizes farmer to move towards integrated model as the fresh water shrimp survival probability is low.

The addition of policies in the model can also be seen in the Appendix 3 in the Stock Flow Diagrams of Vensim. It is important to note that each of the above-mentioned policy implementation has a certain financial cost associated with it. Since the nature and scale of implementation between the 2 districts is not being compared, the cost of the policy programs has not been considered explicitly. Each program is expected to add more strain on the regional budget and thus the implementation is assumed to have a linear financial relationship with the number of policy programs implemented.

Before comparing the current implementation in the districts, it is important to understand, how the policies proposed in table 7 affect the KPIs. The effect of individual policies, all policies and no policy is analyzed on the integrated model, which represents all three livelihoods. The integrated model is chosen to create a reference scenario for comparison with Thanh Phu and

Binh Dai. In this run, the effect of each policy shown in the table 7 is visualized individually on regional indicators to provide a picture of how the implementation of different policies transforms the regional indicators. Figure 22 presents a snapshot of the individual policy performance on the KPIs over time. Time slices have been created for every five seasons, i.e. 2.5 years, with the violin density plot. Through this representation, a better visualization of the evolution of policies' performance can be observed with respect to each other.

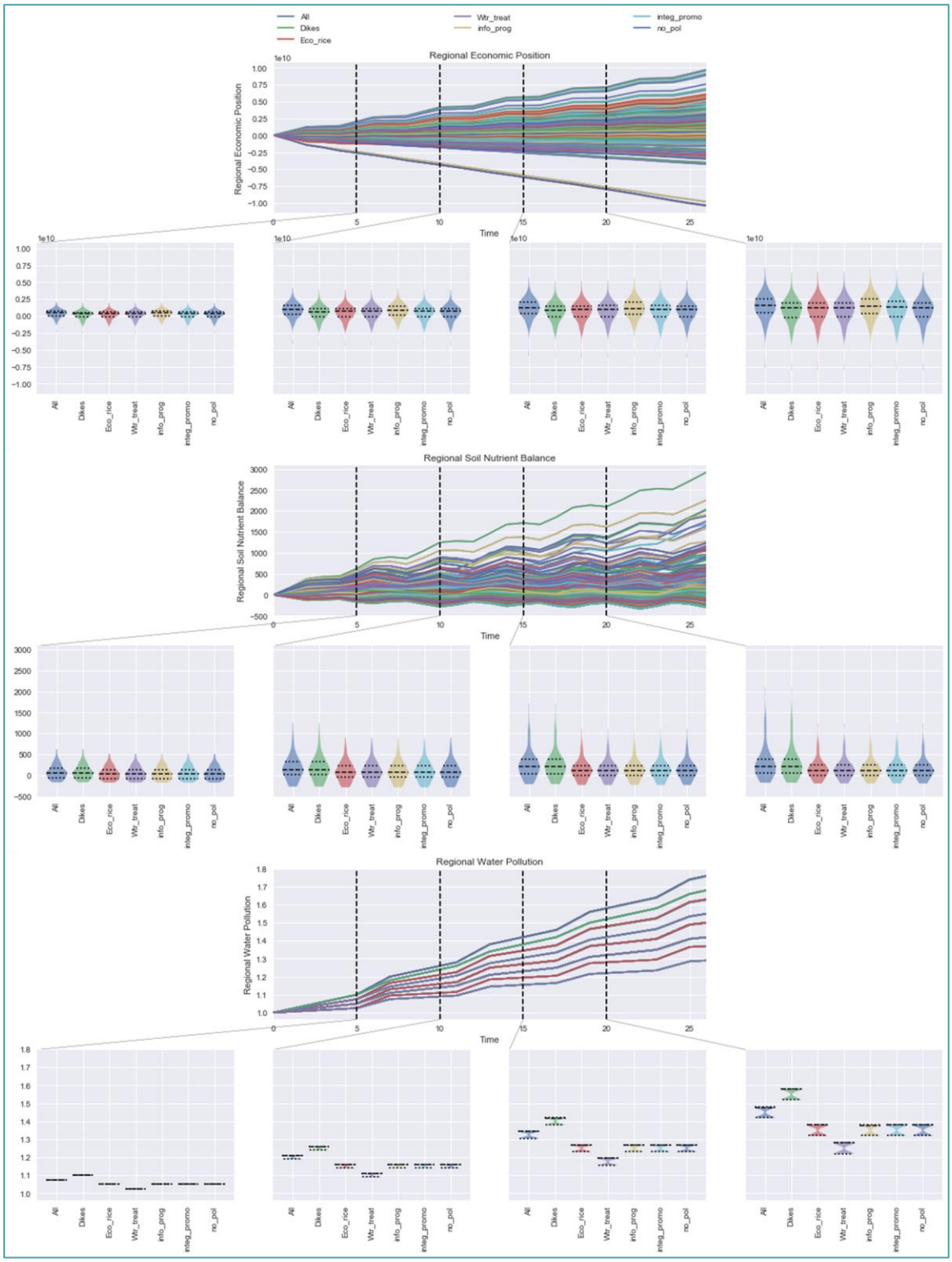


Figure 22 Integrated Reference Model time evolution of policies

For Regional Economic Position, the performance for all policies together for the first time slice has the best performance[5] compared to the no policy alternative, with most of the outputs lying in the positive region. Similarly, the policy of information and workshop sessions through cooperatives (info_prog) performs well in the short term followed closely by the subsidies on integrated shrimp farming policy (integ_promo).

On the other hand, the hard policy measure of building a dyke ring performs poorly compared to the no policy alternative. The remaining policy options individually do not affect the regional economic position substantially compared to the no policy alternative. As the solution space is observed for other time slices, the spread of solutions becomes larger indicating the increase of uncertainty in the solution space. However, the performance of the policies with respect to each other does not change[6].

Regional Soil Nutrient Balance is observed to be primarily influenced by building the dikes. Building a dyke will provide more control over the inundation cycles of the land and maintain soil nutrient quality if the inundation is maintained in current 2 season cropping cycle. An interesting observation here is that the policy of dykes is not ideal for KPI of economic growth, indicating a trade-off between the two KPIs. The reason for this is the lock-in created by dykes giving assurance to people to continue with intensive farming. Due to increasing production levels, the effect of market fluctuation on prices may become severe which is coupled by the degradation of the quality of water as more waste is produced in intensive farming (Appendix 2). Uncertainty is seen to be increasing toward the positive direction when the time slices later in time are observed.

For Regional Water Pollution, the output graph is different from the other 2 KPIs. An investment in a water treatment facility is modeled as a hard measure which will change the water quality significantly making the solution space segregated as can be seen in figure 22. It can be observed that policy of building dyke on itself, in isolation of a treatment facility, may lead to stagnation of water. This will result in increased pollution levels as time passes. The other policies except water treatment and building dyke do not affect the water quality levels in the visualization. Therefore, the all policy option reflects the water pollution levels where dyke is built in combination of water treatment plant.

After having an understanding on how different policy options affect the integrated reference model, we now move to studying the policies as applied to Binh Dai and Thanh Phu.

Tradeoff Analysis

In this step, a comparative analysis is conducted for the three different possible trajectories; the actual policy implementations in Binh Dai and Thanh Phu, the implementation of entire policy set as discussed in previous section, and the regional developments in absence of any policies which have been proposed by the regional actors.

Policy Implementation in the regions

From the policies that are discussed in table 7, not all have been implemented in Binh Adi and Thanh Phu. The ones that have been implemented are shown in the table 8. In Binh Dai, the current livelihood composition, which is reflective of the 2020 plan, is to continue to support the

[5] The scale of output time slices makes the difference between policy outcomes look smaller. However, all the values are for 1000 x 1^{10}.

[6] It is important to highlight that this exercise can be done for different policy combinations as well, to observe any compounding effects. This can be done manually, or through many-objective robust optimisation algorithms, use of which has been left out of the scope of the current application.

majority of intensive shrimp farming with a mixture of extensive shrimp farming. Due to the unrestricted saline intrusion in the area, the current proposal includes building a dyke ring around the commune to create a demarcation between brackish and freshwater zone.

Table 8 Current Regional Implementation programs

Region	Current implementation policies	Reference
Binh Dai	Dyke and Sluice System	Appendix 2
	Eco Rice	
	Focus on Intensive Shrimp	
Thanh Phu	Dyke and Sluice System	
	Eco Rice	
	Subsidies on Integrated shrimp	
	Water Treatment system	
	Focus on Intensive Shrimp	

Since the dyke ring is still under planning (Appendix 2), within the scope of policy implementation, the fraction of population to practice intensive farming is kept as uncertainty to have a robust implementation plan. The second policy which is in the plan is the testing of Eco-Rice, which is a saline tolerant rice variety developed at the provincial level with the support of a government lab (Appendix **2**). This variant will help increase the output of the rice while reducing the need for fertilizer, creating a positive effect on the land nutrient balance. It is currently being tested in the commune with a small number of households and rolled out once the results are confirmed.

Thanh Phu is a district where integrated shrimp farming is more predominant, along with shrimp farming. Due to the district being part of the Ba Lai sluice gate system, it has water treatment facility installed to prevent stagnation of water within the sluice system. The commune of visit is currently working on constructing a new dyke system which will increase the area allocation of intensive shrimp farming **(**appendix 2). Therefore, in the model implementation for Thanh Phu, the policy of adding a new dyke, along with a limited capacity water treatment facility has been added. The area is familiar with Eco Rice tolerance to high saline intrusion and the policy is in early stages of implementation. Furthermore, to sustain the practice of integrated shrimp farming, where the survival rates of fresh water shrimp are low, the regional authorities provide subsidized prices to reduce the cost burden of a failed crop. This policy has also been added to the model implementation.

In both the districts, the focus of livelihoods is more towards intensive shrimp farming, both at commercial and private level. The authorities of both the regions see large economic benefits in intensive farming and consider it an important part of livelihood transition (Appendix 2). Therefore, the fraction of intensive shrimp farming has been implicitly used as a policy lever to observe and test the assumptions of the authorities.

Policy Performance Analysis

Figure 23 below shows the policy trade-offs between Binh Dai and Thanh Phu for all the KPIs along with the KDE plot. The integrated model has been shown on the side for reference, to highlight the effect of each individual policy for comparison purpose. The integrated model is similar to the one discussed in the last section with a summarized image shown here. As can be seen in the KPIs, there are 3 different color-coded runs which represent the following scenario trajectories;

- All the policies being implemented as in table 7
- The policies currently being implemented as in table 8 and Appendix 2
- There is no policy intervention and the areas of Binh Dai and Thanh Phu grow "as-is"

Binh Dai

For Binh Dai, the results are shown on the leftmost visualization set of the figure 23. It can be observed that for all the KPIs, the proposed policy implementation direction at the commune level does not produce favorable results in the long run. For Regional Economic Position, current policy implementation program performs poorly even when compared to absence of any policies, with the mean of the KDE peaking below zero. The performance of economic position can be improved by looking at the Integrated model output. It can be clearly seen that the policy of information program in cooperatives improves the economic position significantly, which is not part of Binh Dai's current implementation portfolio, while the other policies have a negative impact on the long-term economic growth of the region. If a closer look is taken at the time-based impact of the policies as shown in the left part of the figure 24 below, it can be observed that the current policy direction pushed the economic growth down as the system moves forward in time. Through a second stage scenario discovery, it is discovered that the reason for this is attributed to the market price uncertainty coupled with higher focus on intensive shrimp farming.

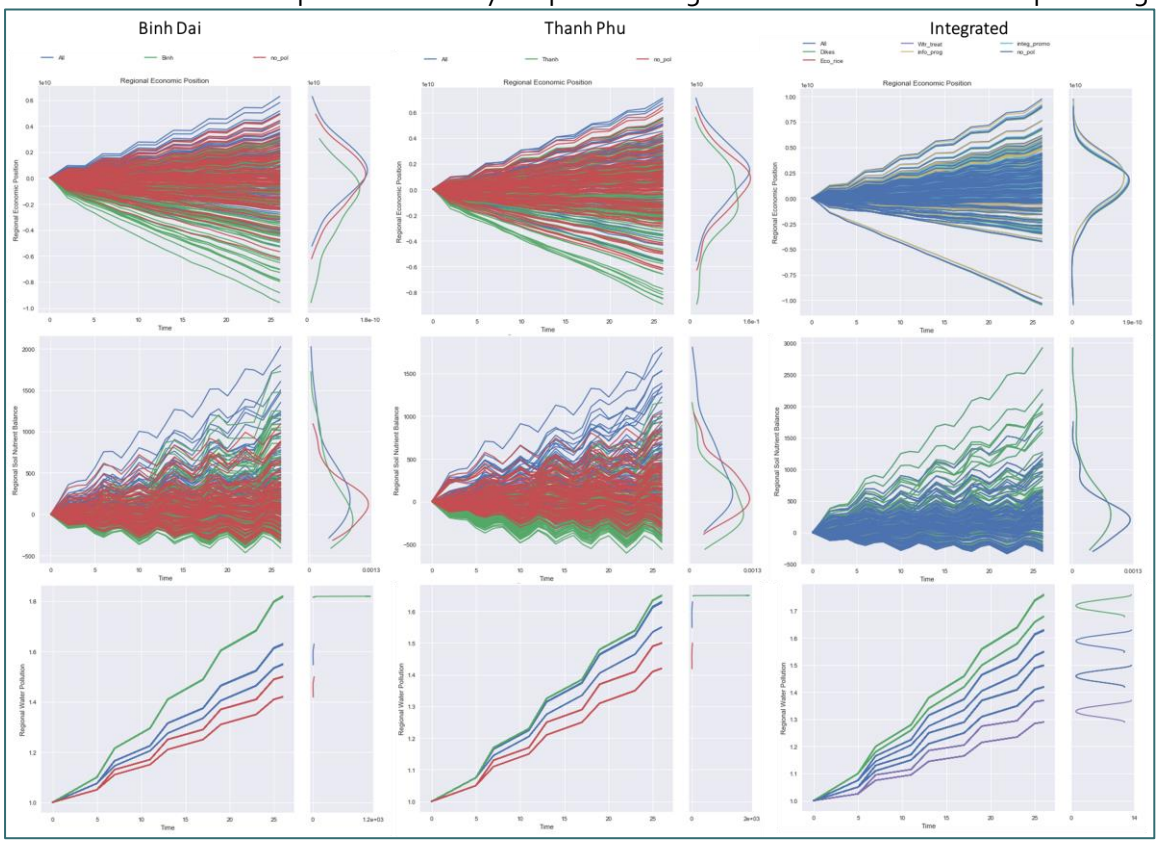


Figure 23 Actual Policy comparison; Binh Dai (left), Thanh Phu (middle), Integrated Reference Model (right)

Looking at the soil nutrient balance KPI for Binh Dai, it is observed that soil nutrient balance performs poorly compared to the no policy and all policy scenario. However, when observed at the time dependent policy effect in figure 24 a recovery is observed over time. From scenario discovery, it is observed that the increased pressure on the area pushes the soil nutrient balance downwards as the flood duration for the land is reduced. From looking at the integrated model, the policy which affects soil nutrient balance positively is the dyke system, while it can be argued that lowering the production pressures on the farm will also provide sufficient time for inundation. However, the benefits of the dyke system are only observed in the soil nutrient over the seasons as the sediment accumulates.

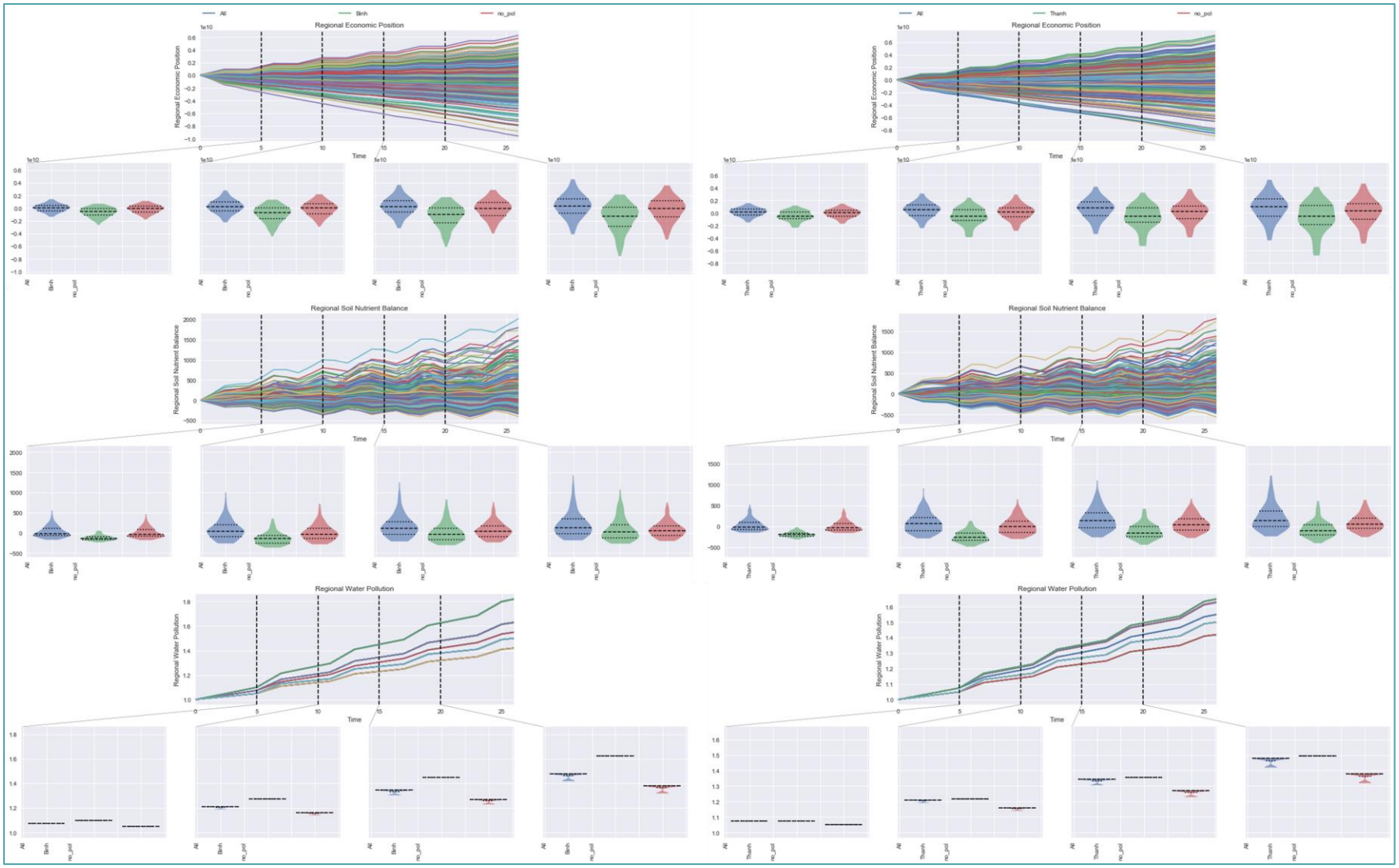


Figure 24 Time based Policy evolution; Binh Dai (left), Thanh Phu (right)

The regional water pollution with the current policy direction of Binh Dai performs poorly as the KDE is peaking at 1.8 times the current intensity. This performance, as discussed in the previous sections, is a direct consequence of the policy direction of dyke system, coupled with an increased focus on intensive shrimp farming, with no plan for water filtration and treatment system. Although, it is illegal in the region to dump the shrimp waste from dredging into to the water system, it still finds its way indirectly to the water due to the heavy rains in the wet season.

Thanh Phu

Next, we look at the communes in Thanh Phu, which is indicated in the middle part of figure 23 and the rightmost part of figure 24. For the Regional economic position, it is observed that the policies selected for this region perform better than Binh Dai, but poor when compared to itself. The KDE distribution is more spread out for the current policies, which indicates the solution has a lower robustness. The reason that the Thanh Phu's current policy direction underperforms, is the same as Binh Dai; lack of cooperative information structure. The integrated shrimp farming practice in the region provides benefit for the economic position, but the market sensitivity of the practice is not clear, which is reflected in a solution of lower robustness.

A second stage scenario discovery confirms the above, as a lower integrated farming percentage is detrimental to the economic growth, but since the freshwater shrimp is sensitive to sudden changes in salinity, the fluctuation intensity needs to be minimum. Similar system dynamics is observed for the soil nutrient balance in the figures. If the current policy direction puts a higher emphasis on integrated shrimp farming with eco rice, the soil nutrient balance may recover. However, with the increasing production demand pressures, sufficient time is not given to land inundation which increases the reliance on heavy fertilisers. Both of the above practices have a detrimental effect on the soil over longer term. The time-based policy effect shows the deficit is bridged over the years, however, the enrichment rate is significantly lower. This is also confirmed by stage 2 scenario discovery.

The regional water pollution KPI's performance in case of Thanh Phu follows closely the performance of all policy implementation, although it falls short over the longer period of time. Since the region already has a waste water treatment facility, as it has been enclosed for a longer period due to the Ba Lai sluice gate, the increase in water pollution levels is lower. However, with the current proposed dyke, there is no plan to increase the treatment capacity, which results in slightly higher pollution levels.

Robust Implementation Program

In the above steps, an iteration is described of the Robust Decision-Making process. It is referred to as an iteration, since using the outputs of the previous sections, a deliberation session may be conducted with the stakeholders, or an optimization algorithm may be used to arrive at the optimum set of policies, their implementation times and if possible, their end time. However, in this thesis, we will stop after this iteration, to limit the scope and move directly towards the program implementation mapping.

From the above policy comparison, the following observations are drawn;

1. The integrated model option used as the reference scenario, outperforms the actual implementation policies, currently being set up in both Binh Dai and Thanh Phu.
2. Not all the policies discussed in this chapter, actual implemented and self-proposed are required to run at all times to achieve the KPIs operationalized from the strategic objectives.

3. The integrated model option has all 3 livelihoods, and it still outperforms the other option as it has the highest integrated shrimp farming percentage followed by extensive shrimp farming.
4. This gives an impression that focus on intensive shrimp farming may show higher income growth in the short term, but market forces and overproduction, coupled with the leakage effects into soil nutrient and water system, will lead to undesirable effects in the long run.
5. Diversification is important to distribute market, environmental risks, and spur innovation, while methods of value addition can help in improving economic position.
6. Stronger Cooperative structure are required for information to spread faster and enable the farmers to cope with the changes in market.

Defining regional actions

Based on the above, the most favorable program implementation direction is proposed to be an integrated implementation, with focus on diversification towards integrated and extensive shrimp farming. This has been elaborated below in a multiple step coping plan;

1. Build the dyke is required as a part of coastal defense strategy. However, as it has a higher lock-in period, promoting transformation of livelihoods needs to be a parallel policy.
2. If the water pollution levels rise in the first few seasons, a water treatment plant needs to be considered in the long run
3. The information program policy has been split into two parts; Initiate cooperatives in Binh Dai and Thanh so that farmers can share and record best practices.
4. And start information programs in the cooperatives on changing climate and need to adapt livelihoods
5. Current focus on intensive farming practices needs to change quickly to give way to integrated farming in both the communes. Integrated farming alone will not improve the position over the long run, and thus diversification is required. Since the area will be clearly demarcated in freshwater and brackish water after the dyke is built, crops and livelihood suitable for each should be explored respectively.

This 5-step policy program is represented in figure 25.

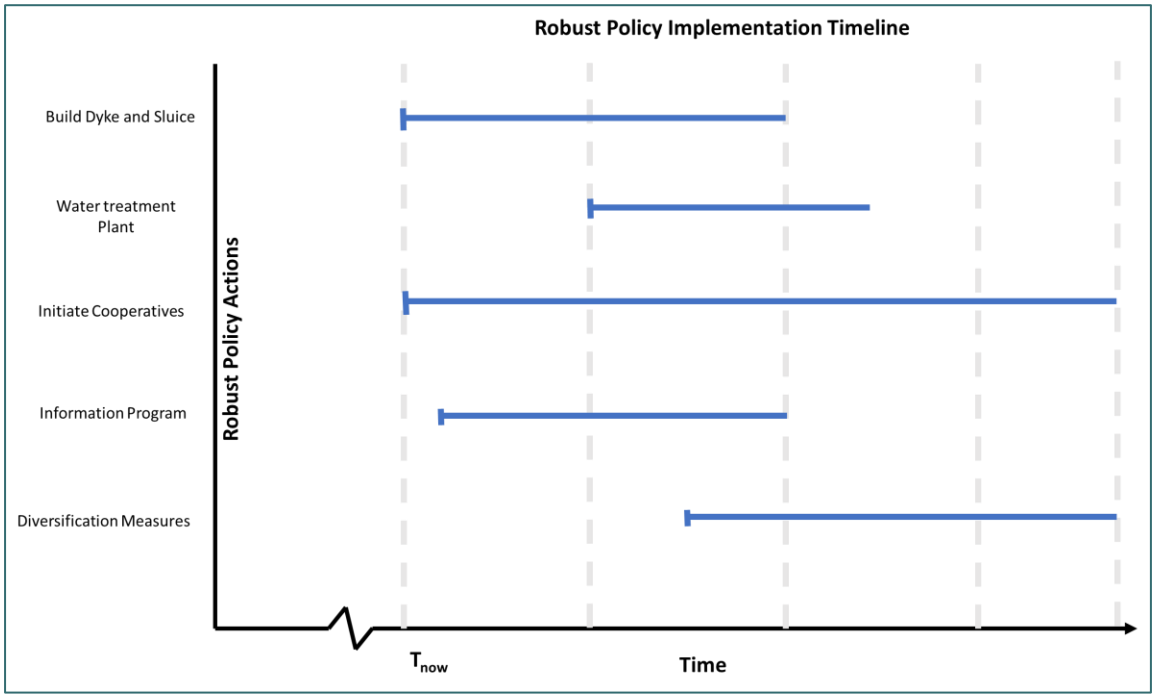


Figure 25 Robust Implementation program policy activation map

Since the policy of Dyke and sluice has been approved and has a higher lock in period, it is shown to be starting at Tnow. With its implementation, a discussion regarding the need for water treatment facility needs to begin so that the implementation of the policy can happen not long after the dyke. The need for cooperatives and its benefits have been highlighted in the model output. Therefore, the communes with no cooperative structures should begin with approval and set up. Once the cooperatives are there, the information sharing, and training programs can begin for the farmers to share their knowledge and for the authorities to share resources and maintain best practices to share with neighboring communes. The diversification measures need to be started early, however, with the current dyke system and the short-term benefits of intensive farming, it will be difficult to convince farmers. Therefore, diversification cannot begin until sufficient information sessions have been attended by farmers so that they understand the need to diversify and its benefits in the long run.

The policy actions discussed above could be directly applied to the communes had there been no implementation policy yet. However, since the implementation process has already been started, the next chapter will discuss the potential means to transform the current implementation to reach the strategic objectives of the MDP.

6 System Trajectory Space

In the previous chapter, the current implementation directions of Thanh Phu and Binh Dai were studied and were found to require changes for to achieve the strategic objectives of the Mekong Delta Plan. In this chapter, the current implementation plans of Binh Dai and Thanh Phu are plotted in the system trajectory space using the Program Implementation approach. This will highlight the current system trajectory and the potential transformative coping actions from the robust plan, to bring the system back into adaptive region. Later in the chapter, the system trajectory space will be discussed, if the robust plan as developed in the previous chapter would have been used for the implementation in both districts.

It is important to note that the system state is represented directly at the end of strategy adaptation period. This is done, as we are currently reviewing and evaluating the implementation direction based on the coping actions of the past.

Defining System Trajectory Space

Before proceeding to the analysis, it is important to define the system trajectory space in relation to the policy implementation in Binh Dai and Thanh Phu. This system definition will be applicable to all the subsequent system trajectory space visualizations irrespective of the KPI or the region.

S1 is the current state of the system with the implementation program of the 2020 regional socio-economic development plan (Appendix 2) and S2 represents the position of the system at the first implementation programming strategy adaption period. T1 is the system trajectory thus formed due to the current implementation of policy actions in the regions (Figure 26 onwards);

Table 9 System Trajectory Space Definition

Region	Implementation Policies	Adaptation Trajectory
Binh Dai	Dyke and Sluice System	**T1 → T2.2**
	Eco Rice	
	Focus on Intensive Shrimp	
Thanh Phu	Dyke and Sluice System	**T1 → T2.2**
	Eco Rice	
	Subsidies on Integrated shrimp	
	Water Treatment system	
	Focus on Intensive Shrimp	

T2.2 represents the system trajectory if the current policy direction is pursued without any changes, post the strategy adaptation period, making T1 → T2.2 the current adaptation trajectory (Figure 26 onwards). T 2.1 represents the system trajectory if the changes as proposed in the Robust plan from the previous chapter are incorporated into the implementation programming. S(u)3 represents the potential future system state based on the pursued implementation direction, and T3.(x) represents the subsequent set of coping actions. The strategy adaptation period is set to 1 year, based on the yearly plan review conducted in Vietnam

at the provincial scale to revise and adapt the implementation direction. The coping period is 1 month as a monthly review is conducted to fine tune the implementation direction.

It is important to note that the adaptation at the commune level is proposed in the implementation programming as the fastest. Since it is at the lowest level in the institutional "nested" system, the strategy adaptation period for commune should be coping period for province, and the adaptation for province is the coping period for national level. Therefore, as one goes up in the hierarchical level all the way to the strategic level, the coping and the adaptation periods become larger.

Binh Dai

In this section, the system trajectory space of the 3 KPIs of Binh Dai is discussed in light of the current implementation direction. The region of Binh Dai may not perform as expected by the regional authorities under the current implementation program. Therefore, the transformative coping required by the region is discussed below with the aid of program implementation approach.

Regional Economic Position

Figure 26 represents the Regional economic position of Binh Dai using the trajectory space representation. The left-bottom end of the adaptive space here represents the zero economic position, while the top end has not been given a fixed scale value. This has been left to the decision makers to arrest growth as an anti-inflationary measure [7]. The adaptive space at the end of the first strategy adaption period is seen to move upwards representing the current level of sustained growth will not be enough in the future. This upward move is the representation of inflation which will be accounted at a yearly basis. This measure is taken to account for increasing focus on economic growth where the target is revised due to market effects of inflation, and production pressure on the economy.

Notes:

1. The system trajectory diagrams discussed in the subsequent sections have been created qualitatively by inferring to the RDM outputs. They are not a 1:1 quantitative translation obtained from the results of the RDM. The idea here is to use the outputs obtained from the RDM analysis and indicate them on the System Trajectory space as a proof of concept. A more substantial plot is possible but would require further treatment of the RDM output with expert consultation.
2. The adaptive space in the third stage of the diagram (year 3) is not shown to change in any of the diagrams. This does not indicate that the adaptive space will have different dynamics. Rather, this has been done purposefully since the behaviour of the system in stage 3 will be dependent on the system update at the end of strategy adaptation period of Stage 2.

With the current trajectory T1, the system in the shorter period of time remains in the adaptive space as the income from intensive farming focus will increase, once the dyke system is completed. However, once the system reaches S2 and the adaptive space is revised, with the current levels of economic growth, the system will move towards Sus into the maladaptive space. This is represented in figure 23 and 24 as the current state the average KDE peak is already in the negative region. With changes in adaptive space, the potential of the system to have positive economic development reduces drastically. This is further amplified by the dropping intensive shrimp prices in the region due to oversupply, which are already being observed (Appendix 2).

[7] Based on monetary policy, and hence left out of scope of the current discussion.

Therefore, a transformative coping action is required where the implementation programing needs to be adjusted to set the system towards the trajectory T2.1. However, since the next system state S2 is still within the adaptive space, other option of regional growth may be discussed amongst the regional stakeholders.

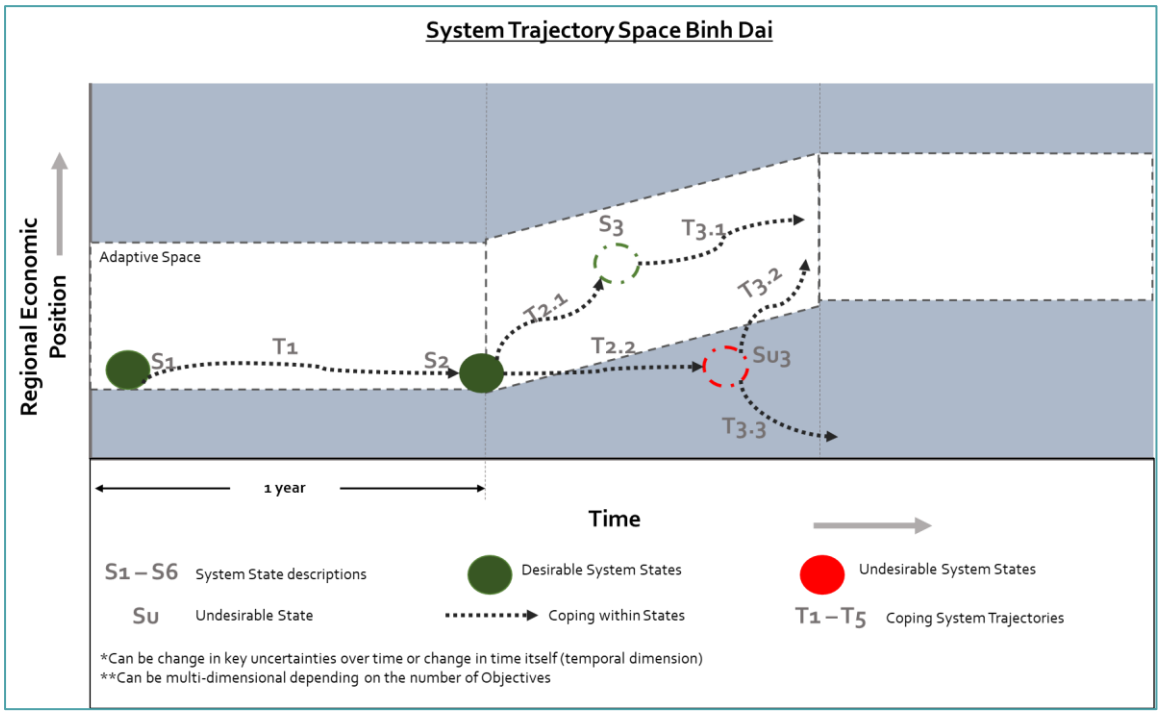


Figure 26 System Trajectory Space Plot - Regional Economic Position Binh Dai

The transformative coping recommendation is to initiate a cooperative structure with information sessions on best practices. Since building a dyke system has a higher lock-in period, the focus on intensive shrimp farming will remain for the initial period of implementation. Therefore, it is important for farmers to tune their farming practices for higher crop survival and quality. The current commune authorities have a system in place to organize training programs, however, they lack the expertise and funds required for the same. The transformation required in this case is thus a technical and financial transformation.

As a next step, the regional focus needs to shift towards diversification of crops, with husbandry, for higher regional value. In Binh Dai there is an absence of commune cooperative structures and the farmers do not see a cooperative in their interests (Appendix 2). Some of the farmers are not comfortable in sharing their own knowledge due to the fear of losing the competitive edge. Therefore, it is important to prioritize mutual learning by the use of examples elsewhere in the world.

The monitoring of the regional economic position is done through the traditional economic input-output analysis of the region which is performed every season to calculate the value of primary economic activities within the region.

Regional Soil Nutrient Balance

Figure 27 below shows the Regional soil nutrient balance of the communes of Binh Dai as a trajectory space representation. The left-bottom end of the adaptive space here represents the soil nutrient levels of 0. This boundary has been chosen as the soil nutrient balance is fluctuating in nature and with inundation and careful utilization, can be maintained and recovered. Similar to regional economic position, the upper level of the adaptive space has not been given a scale

value. Due to the increasing demand pressures on the area and observed overutilization of land in the upstream regions, a fixed fallow period has been incorporated and recommended in the regional 2020 socio-economic development plan. This is portrayed in the figure in the form of upward moving adaptive space, where previous acceptable levels of soil nutrient balance are not acceptable anymore. This trend, at the given time is assumed to continue even after the strategy adaptation period.

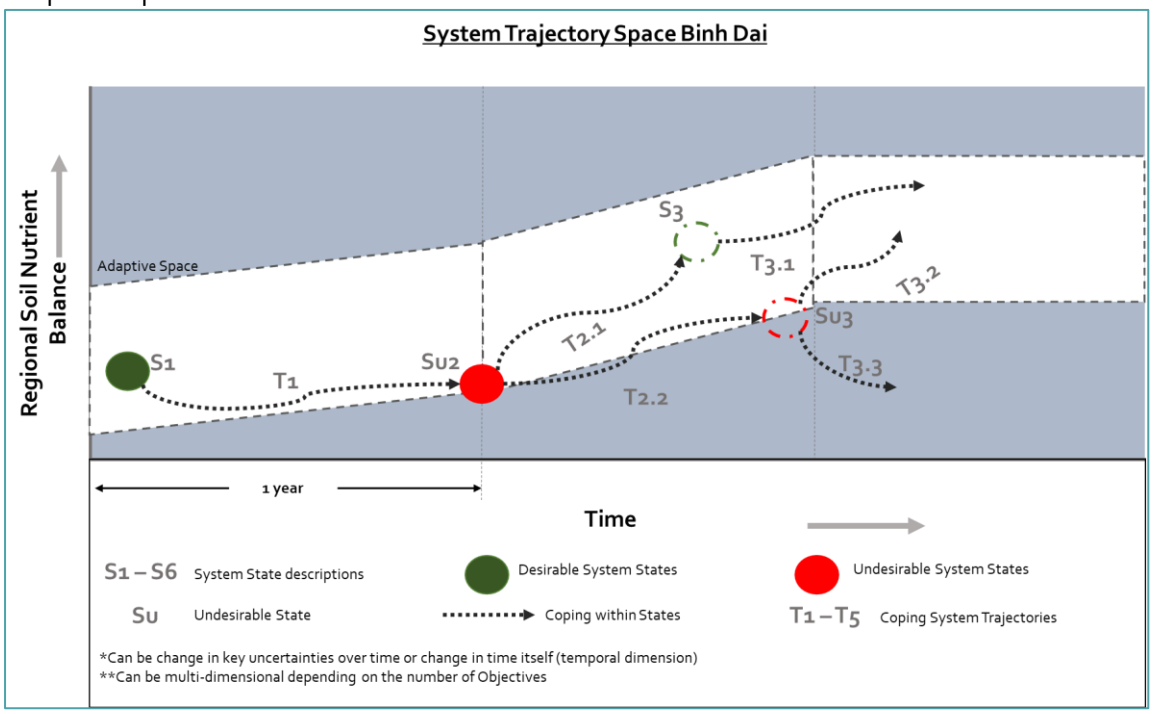


Figure 27 System Trajectory Space Plot - Regional Soil Nutrient Balance Binh Dai

With the current trajectory T1, the system is observed to move into the maladaptive space by acquiring the state Su2. The dyke construction is still in progress and the inundations are not controlled, which incentivizes the farmers to shift to intensive farming. If the farms are not periodically dredged, this has detrimental effect on the soil nutrient balance. It can be observed further that if the system moves on the current coping trajectory T2.2, the position of the system will improve, but will not be sufficient to bring it back to the adaptive space as the space is changing due to stricter fallow norms. This can potentially affect the economic growth as well, as the productivity of land may drop due to lower nutrient content and over-utilization.

The transformation coping T2.1 required in this case is not very strong and may be combined with economic growth in the form of information sharing and best practice methods. Farmers do not use scientific methods to check the water and soil quality and rely heavily on experience and last year's output (Appendix 2). However, there are some skilled farmers who have access to knowledge and methods to check the nutrient and salt levels, but do not share their information due to lack of cooperative structures. This soft measure combined with controlled inundation of dykes can lead to better soil nutrient control. Similar to economic position, the transformation required for this KPI is a technical and financial transformation.

The soil nutrient balance is monitored at the district level where readings of the soil samples are taken on a monthly basis and provided to the communes for necessary coping action. Additionally, second samples from private institutes are also taken to check for reproducibility of the nutrient readings.

Regional Water Pollution

For the regional water pollution levels in Binh Dai, the figure 28 below shows the system trajectory space representation. This indicator has a relative scale and a downward slope, i.e. the left upper point in the adaptive space indicate the current regional water pollution level and any increase in the water pollution is accounted as an increment to the current levels. In this case the bottom end does not have any scale limit, as all improvement in water pollution levels are acceptable. The objective for regional water pollution is to reduce the water pollution over time to maintain the availability of fresh water for agriculture. The adaptive space is shown to have a downward trajectory to cover the objective to improve water quality of the system relative to its current state over time.

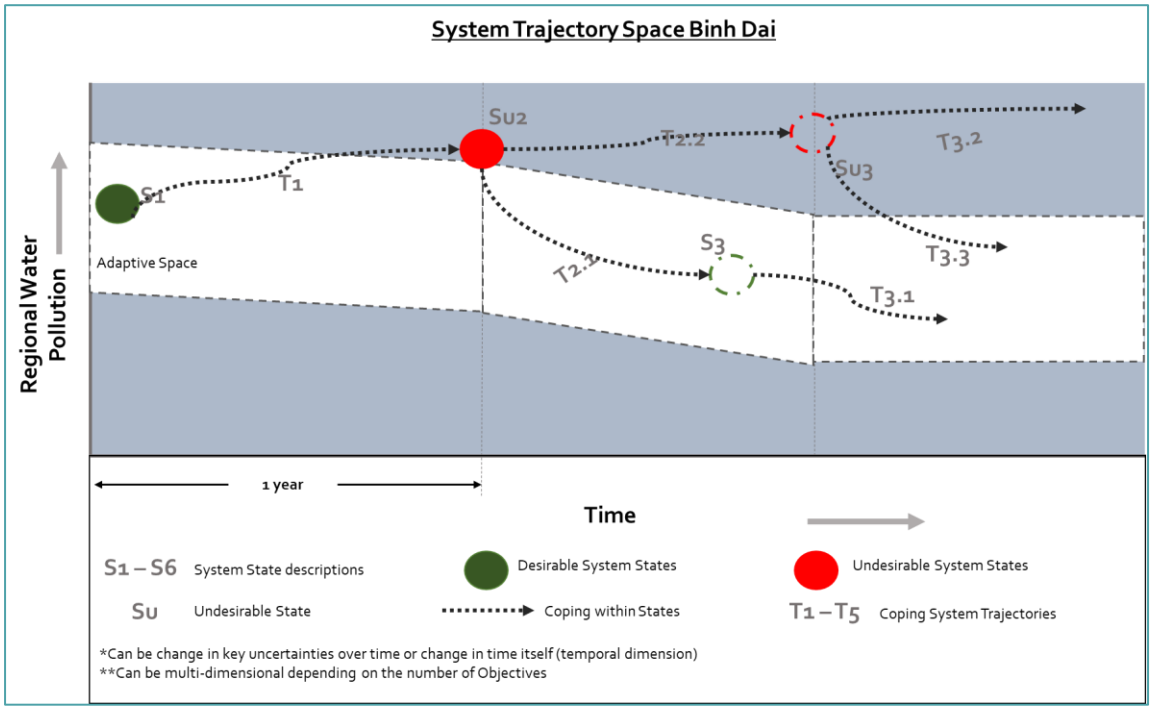


Figure 28 System Trajectory Space Plot - Regional Water Pollution Binh Dai

The system trajectory of T1 pushes the system into maladaptive space to the state of Su2. This is due to the implementation policy of dyke construction, which will cut of the flowing distributary of the river thereby hindering the waste disposal process to the sea. Even in the absence of the dyke, due to the rising sea level, most of the waste transported along the river, along with salinity remain in the coastal area. Binh Dai currently has no plans for a water treatment system in its regional development plan. Therefore, the coping trajectory T2.2, will bring the system further into maladaptive space as intensive shrimp farming produces a lot of waste which finds its way into the water sources. This has significant repercussions for the survival rate of shrimps and the economic position of the farmers.

A transformative coping action T2.1 is required in the form of investment for waste water treatment facility along with steady diversification. This is a hard implementation measure and will require a significant investment from the provincial government. To reduce the financial burden, phased implementation can be followed with the financial support of donor organizations. This measure may increase the regional deficit in the short term, but inaction in this direction may have severe repercussion on the long-term production capacity. Since the facility will be built by an external organization, while the maintenance may be handled by the commune authorities, who may need technical department to manage it, the transformation required here will be technical, financial and institutional transformation.

The monitoring of water pollution is performed at the district level which takes sample measurements based on the national technical regulation on brackish water shrimp – Conditions warrant veterinary hygiene, environmental protection and food safety (**QCVN 02-19-2014-BNNPTNT)** which is maintained by the Ministry of Agriculture and Rural Development, which recommends the permissible substance levels for shrimp growth.

Thanh Phu

The polices implementation in Thanh Phu has been more diversified compared to Binh Dai. However, the region has still does not perform up to the mark when compared to the robust policy. The increasing focus on intensive farming as an accelerator to the short-term profitability may be one of the reasons. The section below helps in understanding the current implementation direction through the system trajectory space of the 3 KPIs.

Regional Economic Position

Figure 29 below shows the Regional economic position plotted on the trajectory space. The boundary definition of the adaptive space has been done similar to Binh Dai where the lower left bound indicates 0 in economic growth and upper left is left unscaled. The adaptive space is changing from the strategy adaptation period ot account for inflation similar to Binh Dai.

In the communes of Thanh Phu, the current livelihood models are integrated shrimp farming and intensive shrimp farming, where the intensive shrimp farming is growing more compared to integrated farming. With the current coping trajectory of T1, the system will move into maladaptive space when it reaches the state Su2. The movement is attributed to the uncertainty in market prices attributed to intensive shrimp farming coupled with growth of intensive farming as the farmer prefer it. The freshwater shrimp survival rates in the integrated farms are low which is supported by the government through subsidizing the larvae costs and may influence the livelihood adoption rates positively. If the system continues with the current policy implementation direction towards T2.2, there is economic growth, but it might not be sufficient to bring the system into adaptive space.

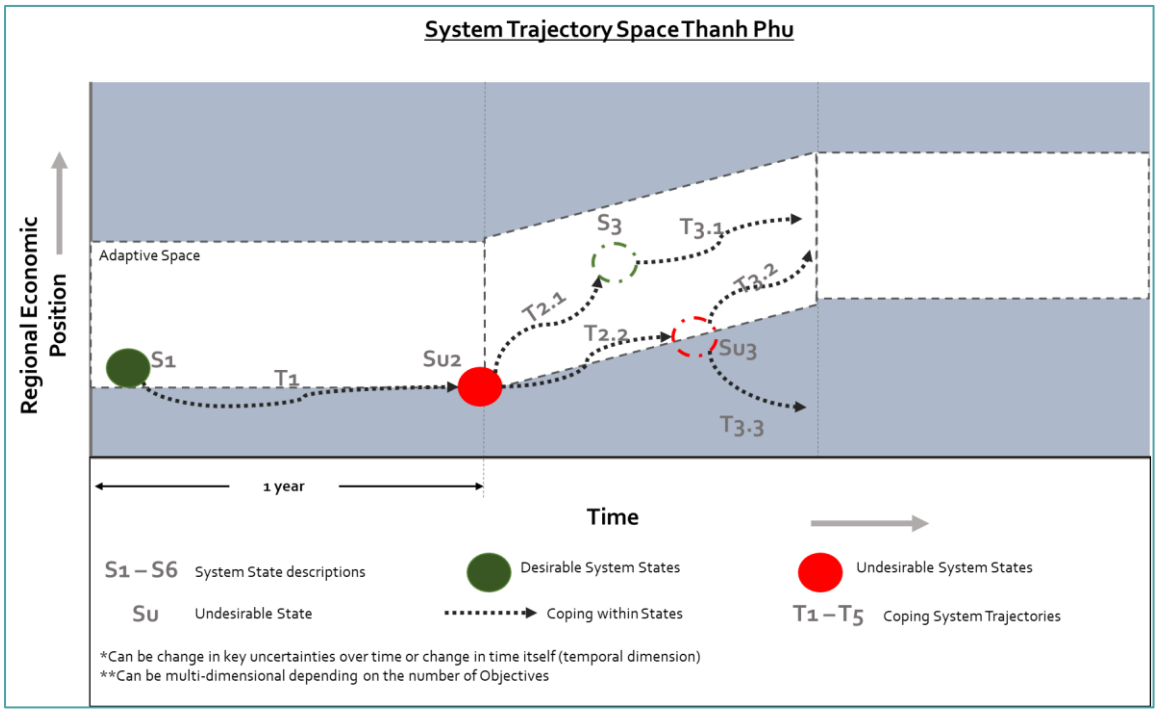


Figure 29 System Trajectory Space Plot - Regional Economic Position Thanh Phu

The lacking point in the current implementation needs to be enhanced through a transformative coping T2.1, in the form of strengthening the cooperatives and information sharing. In Thanh Phu, there are cooperatives, but the participation level is low, and the authorities have not been actively promoting it in the past few years. Similar to Binh Dai, there are some people who have established best practices which can improve the harvest quality. Furthermore, reliance on intensive farming over the long run which is secured by the current dyke policy. However, the long-term benefits of diversification through information sessions may help farmers move to high value sustainable crops. Since an existing structure is present within Thanh Phu, the transformation required here is technical and financial transformation.

The monitoring process of the KPI is similar to as described for Binh Dai.

Regional Soil Nutrient Balance

Figure 30 below shows the trajectory space of Soil Nutrient balance for Thanh Phu. The adaptive space limits are set in the manner similar to Binh Dai with the adaptive space moving upwards due to the increase balance requirements in the regional socio-economic development plan.

In Thanh Phu, the focus on integrated shrimp farming is higher, where rice crop is grown as part of one season output. The coping trajectory T1 with the current policy implementation direction will move the system to state Su2 which is falling into the maladaptive space. Though, the freshwater shrimp along with the rice help in removal of waste, however, in the absence of sufficient inundation and fallow period, the regional nutrient level will reduce over time pushing the land towards lower output over the following season. In comparison with Binh Dai, this is severe, as intensive farming along with integrated shrimp puts high pressure on the land for the nutrients, if the dredging is not performed regularly. If the trajectory of T2.2 is continued with no change in policy implementation, the system will reach state Su3 which will still be in the maladaptive space.

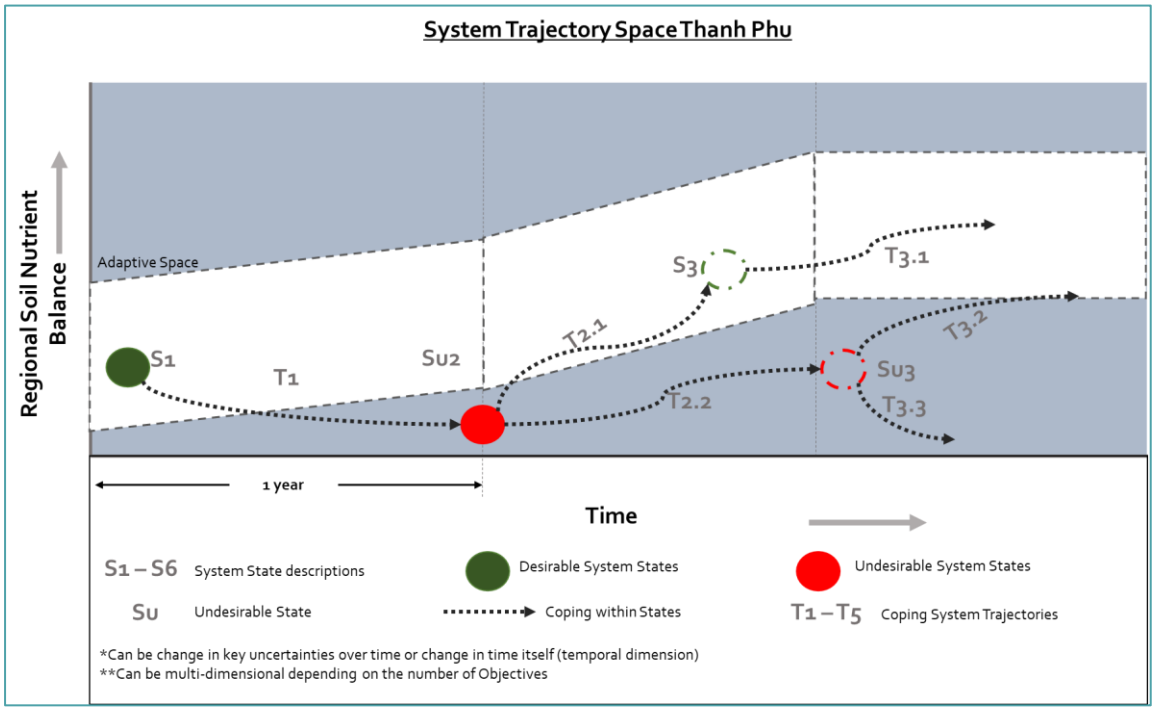


Figure 30 System Trajectory Space Plot - Regional Soil Nutrient Balance Thanh Phu

The current implementation direction needs the bolstering support of a transformative coping trajectory T2.1 where the diversification is required to bring in husbandry to balance the seasonal

soil nutrient cycle. Systematically focus needs to shift from intensive farming to reduce the dredging load on the land. This can be achieved through collaboration with research centers and donor institutes which can test alternate livelihood models. The transformation required here is technical and financial as workshops may be required to organize to invite external support.

The monitoring for soil Nutrient is similar to Binh Dai.

Regional Water Pollution

For the Regional water pollution in Binh Dai, the system trajectory space is shown in the figure 31 below. The Adaptive space definition is similar to Binh Dai, where the scale is relative, and the adaptive space is moving downward, indicating a potential interest of the regional authorities in reducing the pollution levels.

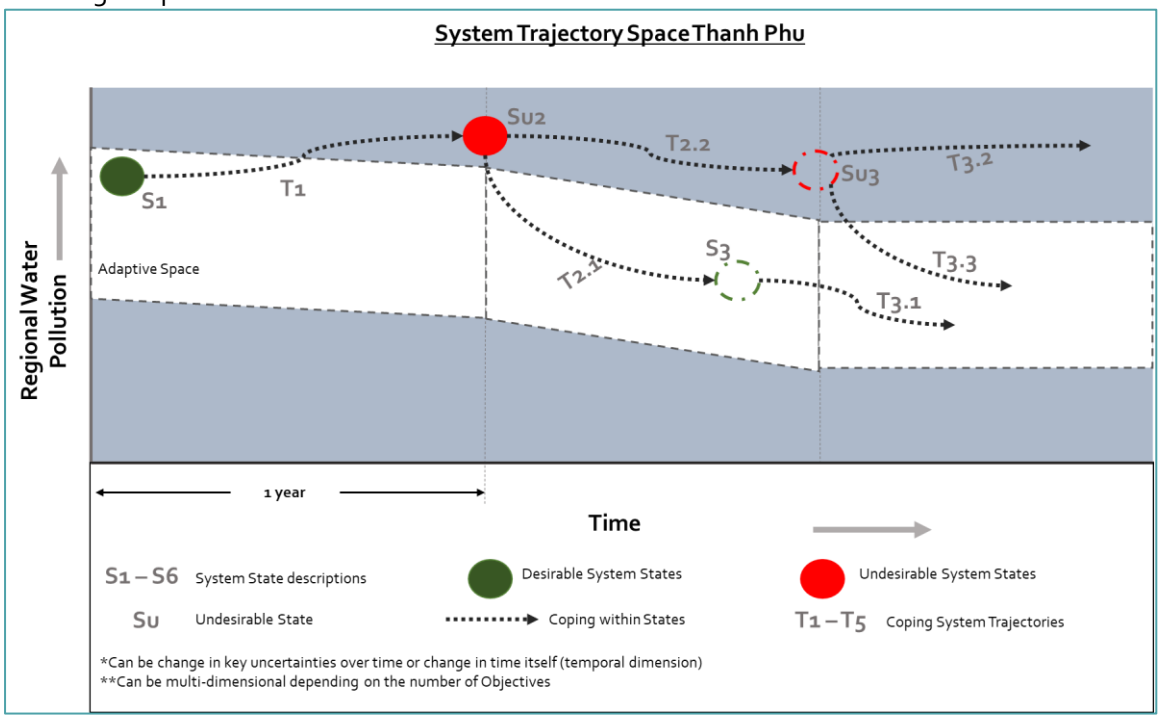


Figure 31 Figure 27 System Trajectory Space Plot - Regional Water Pollution Thanh Phu

Large parts of Thanh Phu are an enclosed district due to the Ba Lai sluice gate, but the presence of a water treatment system put the system state S1 into adaptive space. However, the current dyke investment proposed in the area puts the system on the coping trajectory T1 to reach the state Su2, which is in the maladaptive space. With no changes in coping actions, the system will move towards state Su3 through T2.2 and will remain in the maladaptive space.

A transformative action T2.1 is required in the form of additional capacity for water treatment along with steady diversification. Similar to Binh Dai, this will require additional funding capacity to bring the system to S3 into the adaptive space. Steady diversification will help reduce waste generated from intensive farming which will in turn reduce pressure on the capacity of water treatment. The transformation type here is also technical and financial.

The monitoring arrangement for the KPI similar to Binh Dai, based on the standard **QCVN 02-19-2014-BNNPTNT** as explained for Binh Dai.

Implementation Monitoring

For successful implementation, along with monitoring and evaluating the objectives, it is equally important to design arrangements to monitor and evaluate the implementation actions and key

vulnerabilities. In the previous sections, we discussed the monitoring practices currently used in Binh Dai and Thanh Phu. Here we will look at the arrangements for the current and transformative coping actions.

Table 10 Implementation monitoring measures

Coping Action	Current Monitoring	Proposed Monitoring
Dykes and Sluice System	Visual Monitoring by local farmers	Construction progress reports (monthly)
Eco Rice	Production output, Production Quality and Soil Nutrient Levels	No Change
Water treatment plants	Water quality samples	No change
Information sessions in Cooperatives	No Monitoring	Livelihood Adoption rate, Production output,
Livelihood Diversification	No Monitoring	Adoption rates, satisfaction surveys
Salinity	Intensity and fluctuation	No Change

In the Table 10, it can be seen that the three are actions such as Eco Rice, Water sampling and Salinity, that have existing well established monitoring arrangements with a pre-defined frequency of sampling. However, other coping actions still require monitoring arrangements around them. The table is just a quick snapshot of the potential arrangements, and the mechanisms can be elaborated into full-fledged control plans through discussion with subject matter experts.

Form the above sections, it is observed that the current implementation direction in Binh Dai, and Thanh Phu need transformations to meet the operational objectives, and in-turn, the strategic objectives prescribed in the Mekong Delta Plan.

7 Analyzing Actor Positions

In the previous chapters, we developed a robust implementation plan and compared it to the current implementation plans of Binh Dai and Thanh Phu with the help of the system space trajectory plot. In this chapter we move to the next step of the implementation programming approach, where we map the position of the regional stakeholders for both the regions on the current implementation trajectory.

Motivation and ability framework (MOTA) is used to structure the information collected in the semi structured interviews as explained in Chapter 4. The analysis was conducted through comparative analysis of the elements described by the interviewees to constitute motivation, and a comparative analysis of elements described as abilities or the lack thereof. The analysis was also used a starting point for policy space exploration in Chapter 5 and later used for argumentation for system space plots in Chapter 6.

It is important to highlight that the interviews, were conducted prior to development of the plan and conducting the analysis of chapter 5 and 6. Therefore, any independent findings made from chapter 5 and 6 have not been presented to the stakeholders for discussion. Furthermore, being a strictly hierarchical governance system, only the motivation and abilities of the officials has been discussed in this chapter. The data collected from the farmers was pertaining to the current livelihood practices and not about implementation in the current region (Appendix 2).

Binh Dai Officials

In Binh Dai the interviews were conducted with the representatives of the People's committee, the executive organ of the Communist party in the communes of Dinh Trung and Thanh Phuoc on May 24. The interviews were conducted based on the pre-prepared topic list, where questions were asked to the representative of the committee in a semi-structured fashion. The average interview duration was 1.5 hours, the transcripts of which can be found in Appendix 2.

The area of Binh Dai had never been interviewed before by the project team, and therefore, the information collected was extremely beneficial for setting the course for future studies in the region.

Motivation

As an initial finding, the knowledge about the existence of MDP received mixed reactions in different communes. On Dinh Trung, the official was unaware of the existence of MDP or the resolution 120, while in Thanh Phuoc, they were well aware of it. Both the communes highlighted economic development of the region as the key objective of the current implementation direction. While environment was important but not at the cost of economic growth. This finding indicates a departure from the operational objectives of pollution and soil Nutrient, as established with regional experts.

On the perception of risk, both the commune officials pointed out weather (not Climate) to be a major risk for economic development. Fluctuation in the weather, specifically temperatures has been observed in the past seasons, which is deemed responsible for lower shrimp survival rate.

The other risks mentioned in the interview were market price fluctuation in the recent seasons for shrimp prices and the pollution level of the water. All of these were considered to be a hindrance to the economic growth of the region. Salinity of water was not mentioned as threat in both the communes, which is interesting as it is highlighted as a key vulnerability of the system in the coastal areas by the MDP. In Thanh Phuoc, it was mentioned that salinity could be managed by using groundwater.

In terms of opportunities, both the communes saw economic growth opportunities in intensive shrimp farming as it generates higher revenues. As seen in the previous chapters, this is observed to be potentially risk the economic growth in the longer run. More opportunities are seen in Eco rice initiative for clean rice and the certification for organic shrimps to add value to the local production, but this will be done after the construction of the dyke in the region. Both the communes see opportunities for knowledge transfer in the cooperative structures, but the farmers are not willing to share information and join communes.

From the institutional level, the current support of the district and commune is deemed sufficient by both the communes with scope to propose ideas for the communes. However, in practice, no proactive implementation plan has been submitted by either of the communes for approval. Furthermore, the strictly vertical flow of decisions provides no opportunities for communes to communicate with each other and share ideas

Overall, both the communes had a high motivation about the current Socio-Economic Development plan, with no immediate need to have any transformative action to change the course of implementation. Furthermore, the commune actors do not "see" any other transformation alternatives. The current socio-economic development plan takes inputs from MDP; however, the current implementation actions are not fully aligned with the strategic objectives of MDP.

Ability

Given the top down structure of governance in Vietnam, both the communes rely on direction on a monthly basis from the district and provincial authorities. These directions serve as an adjustment to the current coping direction and are mostly in the form of announcements or data collection requests. This limits the implementation ability of the communes, but initiatives from them are put for discussion at district level. The applicability of assessment of these initiatives is performed in-line with socio-economic plan provincial plan. Therefore, transformational changes from bottom-up are difficult to propose as they may disturb the perceived flow of implementation in-line with the plan.

Both the communes stressed on the lack of Financial abilities for implementation as most of the funding allocated from the province is earmarked for planning and administration activities. This includes communicating alarming events to the farmers in case some anomaly in water quality or temperature is observed. This restricts their ability to report and communicate with limited scope to organize training or information sessions with experts and farmers. Furthermore, they cannot have more people allocated for the task due to lack of finances.

The actors also stressed the lack of institutional ability, i.e. they lack the framework to monitor regional implementation ensures such as the construction of dyke in the region. This limits the response mechanism and the officials have to rely on the visual observations of the farmers living nearby for any non-conforming issues. However, the official from Thanh Phuoc clarified that the current system of top-down structure is effective, and they get quick response from the district authorities.

To implement the eco-rice pilot conducted in the households, and spread information regarding sustainable farming practices, the communes need to rely on external experts which belong to research institutes or private organizations. Therefore, a lack of technical ability to address the local implementation tasks is felt by the officials, including monitoring and evaluation of the current direction.

In conclusion, although the motivation for the current implementation direction in Binh Dai is high, there is a lack of abilities to achieve those tasks. This poses a bigger challenge, if the need for transformation is accounted, as the officials need some arrangement to update their understanding and knowledge to effectively implement the programming change.

Thanh Phu Officials

For Thanh Phu, the interviews conducted were also with the representatives of the People's committee in the communes of Anh Nhon and Thoi Thanh on May 23. The format of the interviews was similar ot he ones in Binh Dai with a pre-prepared topic list, where questions were asked to the representative of the committee in a semi-structured fashion. The average interview duration was 1.5 hours, the transcripts of which can be found in Appendix 2.

Thanh Phu had been visited previously by the project team and data had been collected in the past with the officials at the district level but not at the commune level. Therefore, this provided a perfect opportunity to understand the flow of information from district to the communes. The clean rice initiative is also seen as a good opportunity as it will reduce the waste produced in the area and help in maintaining soil nutrient balance.

Motivation

The officials were aware of the MDP and its implications in context of the regional development in Thoi Thanh but the official in Anh Nhon was unaware of it. However, Anh Nhon did acknowledge that the regional plans had been changed an re-aligned after the historic salinity event in 2015. Similar ot Binh Dai, here also the primary goal, as per the officials, was the economic development of the region through intensive shrimp farming as they observe many benefits of the practice.

As a first finding about the perception of risks towards current implementation, the risk of salinity intrusion was recognized in Anh Nhon, but it was attributed to changes in weather (again, not climate) every season. So, to have a higher production output, they want to control salinity and dyke is considered as the only option for that by the commune. In Thoi Thanh, however, the main risk is attributed to the market fluctuations and dropping shrimp prices along the value chain. This is seen by the officials to be a primary factor for reducing profits of farmers.

The opportunities seen by the communes are the need for dyke to control salinity and have a clear demarcated area for intensive shrimp farming. This is assumed to increase the economic output of the region making intensive farming as a favorite in both communes. Both communes agree on the benefits of the cooperatives and have set up a knowledge sharing initiative recently. The official at Thoi Thanh also stressed the need for infrastructure investments in the region for transportation to improve the connectivity to cities and markets.

The position of the actors on the institutional support was mixed. The involvement of the communes in making the plans and providing suggestions was welcome, but the incorporation of the suggestions in the plan itself was in the hands of the district. The preference to the suggestions as per the actors, is given if they align with the provincial plan.

Overall the motivation of the actors in Thanh Phu was high towards the current implementation, but the concerns with the sustenance of growth in the future were higher here compared to Binh Dai.

Ability

The lack of Financial abilities in the both the communes was stressed multiple times during the course of the interviews. The financial budget allocated at the beginning of the fiscal year is specifically earmarked for administrative activities with complete reliance on donor organizations for monitoring measures and providing funding for implementation. The dyke development in the region was sanctioned in 2015 with the approval of funds, however, the fund allocation has yet to be made. The delay in starting the construction has encouraged more people to move to intensive farming due to higher resistance to brackish environments, which according to the officials is "deviation from the plan".

The communes have better institutional arrangement is comparison with Binh Dai, where the structure for cooperatives has been established. The flow of decisions and implementation direction is similar to Binh Dai, and hence the role of commune in actual implementation is limited to that of communication. However, the communes pointed out to the lack of a system for communication, unlike Binh Dai.

The reliance for funding on donor organizations and NGOs poses a serious limitation for the technical know-how of the officials. The data is collected and monitored from the regional authorities at the district level and only by external agencies, which leaves the commune authorities with limited knowledge of monitoring and evaluation. This demands a faith in the institutional system which explains the concern of the regional authorities with the future of the commune.

In conclusion, the motivation observed in the commune for the current implementation direction is high. There are concerns among the officials as they recognize their lack of ability to influence the decision making and act towards implementation. This again poses a challenge, if the need for transformation is accounted.

Conclusion

In this chapter, a preliminary MOTA analysis of the regional authorities of Binh Dai and Thanh Phu was presented. Both the regions are positive about the direction of implementation with no concerns for adaptation. The need for economic growth in the regions, according to the interviewees outweighs the other objectives as stated in the Mekong Delta Plan.

With the observations of the previous chapters clearly highlighting the need for transformative coping for long-term balanced growth of the region, the interviews raise concerns that the system will move towards maladaptive space. Even if the commune acknowledges the need for change, strict hierarchical structure of decision-making and governance will require the change to come from the top and re-align the regional plan. Therefore, even with the possibility for a robust implementation programming, it seems unlikely that the current direction of implementation will change in the coming years. This poses a risk to the region as with increased promotion by the regional authorities towards intensive farming in the area may put the farmers into the same situation as with rice in the late 1980s. Only this time, due to rising salinity and relative sea level, the damage to the coastal area in the long term may be irreversible.

The regional socio-economic development plans need to be reviewed and aligned towards the actions discussed in the previous chapters.

8 Conclusion & Reflections

In this Chapter, we visit the research questions as stated in the beginning and provide an answer to them based on the findings of this thesis. Each research question is answered in a two-step method, where an answer is provided to the research question in the first step and the limitations of the findings is discussed as second step along with the scope for future research. The second part of the chapter will put forward a retrospective critique on the research process in the form of a reflection.

Revisiting Research Questions

***Sub RQ 1**:* What is implementation, and how can it be conceptualized for Strategic Delta Planning?

The research question was answered through an exhaustive review of the implementation literature. Implementation in strategic delta planning is the extent to which the plan is put into practice while being adapted itself over the course of being "implemented". It has multiple aspects;

6. **Implementation Classification matters**: The nature of implementation can be described by classification of implementation. With respect to flow of decisions, it is can be characterized as top-down or bottom-up, whereas from the nature of measure, it may be hard or soft. Both the classifications have implications for strategic delta planning, where the decisions may be taken at multiple hierarchical levels and the resulting measures may be physical or non-physical.
7. **Uncertainty in Implementation should be managed**: In Strategic Delta Planning, implementation of plans is a flexible process, which needs to adjust to evolving system and the uncertainties surrounding this evolution. Uncertainty adds unpredictable information to the system, which may result in divergence from the plans. Therefore, uncertainty in an implementation process needs to be accounted and managed.
8. **Preconditions of Successful implementation must be met**: As the delta system is continuously exposed to uncertainty, for implementation to be successful, the strategies for implementation needs to be robust and adaptive. This requires the flexibility in programming to move between different measures, while the measures themselves must withstand the uncertainties without failure. Furthermore, if the strategy is robust and adaptive, it must account the position of the stakeholder towards implementation. Without these conditions, the plausibility of successful implementation reduces significantly.
9. **Implementation is a nested process**: The meaning of implementation changes with respect to the context in which it is being applied. From an institutional perspective, the implementation at national level might only set the agenda for the regional level and so on. This makes implementation a nested process with challenges in coordination at all levels and within departments. Therefore, it is important to choose the context wisely and adjust the objectives and measures.
10. **Implementation needs continuous monitoring and evaluation**: For implementation to handle uncertainties needs arrangements to track its progress. The monitoring of implementation needs to be done for the objectives which are being pursued, the actions that are required, and the key uncertainties that are affecting the system.

Sub RQ 2: *How can the aspects of implementation help to design an approach for implementation programming of Strategic Delta Planning?*

The aspects of implementation were synthesized into a implementation programming approach to answer this research question. Using the implementation concepts, a visual representation of the system as it moves forward with implementation was developed. This was referred to as the system trajectory space, where the objectives of the system are plotted against time or key uncertainties. The space was divided into adaptive and maladaptive space which defined the range of acceptability of the system with the current implementation trajectory. A differentiation was made between short term measures (coping) which over the time fulfill long term measures (adaptation).

If the system is moving towards maladaptive space, there needs to be some change in the current direction in the form of immediate coping measure. This was called as transformative coping. Throughout the entire implementation process, monitoring arrangements measure and evaluate the system performance to give feedback for adjustment in system trajectory, if required.

The implementation programming approach was thus designed using this structure into a multi-step iterative process which needed to; review the strategic program, translate into operational objectives and create an adaptive plan. Then map the plan and current trajectory into the visualization, understand the position of stakeholders towards current direction and then evaluate the need for a coping action. This is designed as an iterative process which keeps updating the system plan as the uncertainties affect the adaptive space over time.

Sub RQ 3: *Is the approach useful and applicable for implementation programming in a real case?*

The approach developed in the previous question was then applied to the Mekong delta region where the Mekong delta plan was translated for 2 coastal districts in the Ben Tre province. After the system trajectory was mapped, it produced interesting insights that showed that the current implementation trajectory of both the regions is moving towards maladaptive space. An integrated robust set of measures was proposed which can potentially fulfil the long-term objectives, however, the actors perceive the current direction to be beneficial for the area and have limited authority to bring about a bottom-up change in the implementation direction.

The implementation programming approach has been found useful in this research as the output in the form of system trajectory space provides a clean and structured way of representing the system and providing an overview into the possible measures. If the visual is updated, over time the entire system history can be traced.

The approach can further help in starting discussions among the actors in case the immediate response is required. The multi-dimensionality of the outcomes can visually represent different trade-off scenarios which can then be negotiated between different actors to decide the acceptable course of coping and/or adaption. In a non-trade-off scenario, if the approach is combined with an actor behavior framework such as MOTA, it can even pin-point the nature of measures required by the actors and lack thereof. (Financial, Technical and Institutional). However, for effective application to a case, the most favorable institutional arrangement is decentralized top-down structure, where each "level" each level uses the outcome of the level above as agenda setting for itself. This makes the information flow within the system efficient while providing enough maneuverability to each level to adapt their actions as the system moves forward.

Limitations and Future Work

Despite the attempt for exhaustiveness, no research is void of assumptions and limitations, which need to be made explicit. By highlighting the limitations, the premise can be set for future research in this direction. The limitation are grouped into three categories;

Limitations of Implementation Programming Approach

1. The multi-step approach developed in this thesis is essentially a top-down implementation approach. It can be made decentralized and broken down by using the nested aspect of implementation. However, it will always require a decision-making authority as it creates a linkage between planning and implementation.

2. The program implementation approach is dependent on the institutional arrangement of the case under evaluation. In case of Vietnam, it was found that even though coping actions exists to bring the system back into adaptive space, the strict top-down institutional setting make it practically impossible for commune level coping. Since the plans are made at the top and translated downwards, any change will have to travel through the entire chain. The most ideal institutional structure for this approach is a decentralized top-down structure.

3. From a use case scenario, the approach borrows its concepts from abstract ideas and ne terminology and can be confusing at times. Therefore, training will be required for the lowest implementation levels where the effectiveness of use will depend on the understanding of the concepts by the user.

4. The system space representation is a qualitative representation of the system, which is used as a visualization tool to present a system overview. This may introduce the system analysts bias while creating the visualization. The quantitative initialization, on the other hand, requires detailed data input for the adaptive space definition of objectives along with credible key uncertainty ranges.

Limitations in implementation plan development

1. In case of computer aided plan development, the time and expertise requirements increase significantly. In the confines of a research university, this is manageable, however, in communes in Vietnam where there is no guarantee of basic IT infrastructure, generating such plans will be extremely challenging.

2. Current plan has been developed using a single stakeholder perspective to decide tradeoffs on objectives for demonstration purposes. In real life, this will not be possible and improved participatory planning methods may be required

Limitations in stakeholder positions mapping

1. While accounting for stakeholders' positions, the power dynamics between different ministry departments and the internal hierarchy were not considered. The tradeoffs accepted in the planning phase may demotivate some stakeholders towards the current implementation direction.

2. Another important limitation of mapping the stakeholders' position is that most of the data collection is done through structured/semi-structured/unstructured interviews. The quantitative scoring of the elements may be subjective, and the mapping may introduce bias as two different people might score and interpret the datasets differently.

Recommendations for future research

1. Extending the actor positions mapping by adding the step of actor scan. With this, actor specific system space trajectories can be created which can be combined to create a multi-actor system trajectory space.

2. Another extension to the approach can be to link the implementation programming measures to the specific owners. This will help identify if there are measures that need support of multiple actors.

3. One interesting future work can be to analyse the effect of institutional arrangement on the implementation programming process.

4. Creating an interactive serious game for stakeholders where they can see the impact of an implementation measure on the system trajectory.

5. Test the implementation programming approach on other cases.

Reflection

In this section, I have provided my critique on the numerous aspects that I came across during the last 6 months. The critique here presents my personal reflections on the insights that I gained during the process.

The Mekong Delta Plan

The Mekong Delta Plan has been a very helpful document in the entire process of the thesis which I revisited a couple of times, each time only to find something new. a good document for planning, however, it has been developed as strategic document to facilitate the development of sectoral master plans. The planning approach in Vietnam on the other hand is traditional with focus on sectoral plans that need to prioritize coordination among multiple departments. Sectoral master plans have ambitious targets but often lack coordination or prioritization across master plans. For implementation at the local level, the strategic guidelines need to be translated into concrete actions with arrangements for monitoring and evaluations. These actions depend on the understanding of the local actors' understanding of the regional situation and how well the strategic guidelines fit within the local context.

Furthermore, MDP divides the entire delta into 3 regions, which are not based on the regional governance boundaries. This requires some interprovincial governance linkage arrangement, which if not acknowledged by the government, may reduce the effectiveness for implementation of the MDP

Implementation in Ben Tre

For decentralized adaptation of the implementation programs in Ben Tre, the current governance structure of Vietnam poses bigger challenges. In order for coping actions to happen as the adaptation trajectory moves forward, there needs to be some degree of autonomy with the local authorities. This does not lie at the commune level but at the district level. The role of the commune level is only monitoring and reporting the information at the district level who send reports upwards and wait for further planning orders from the province. Due to strict sectoral planning all the way down to the farmer level, there is not much scope to maneuver from a diversification or an adaptation perspective. In this sense, the MDP has been used to update the very detailed sectoral plans with virtually no authority to farmers or communes to decide what is good, even based on research alternatives. Every implementation decision comes from province

and if the commune raises concerns, an assessment is done by the province which makes the decision afterwards.

Real implementation in the region is missing as the major chunk of financial resources goes into planning, without major institutional or technical review for transformation. Reliance for technical support is from the university and international donor partners, while institutional transformations, such as a separate delta management body is missing. This creates a bigger coordination issue as different departments within different districts struggle for central support and funding with no proper oversight body to align with the resolution or strategic directions. Even at the commune level, the only interaction is to discuss the regional plan, but there is no horizontal resource or information transfer on a regular basis.

System Dynamics

It is important to acknowledge the bounded rationality of the modeler and in-ability to capture all the systemic/feedback effects that are affecting the system. As George Box famously said, "All models are wrong, but some are useful". In system dynamics especially where we proceed with the undisputed mental model of the entire system and its causal relations in our head. To avoid going down this rabbit hole and build a system model on biases rather than understanding, I approached the regional experts in WACC at all the occasions possible, but not model can be devoid of flaws and my mode is no such exception. I have attempted my best to treat the system under of livelihoods exhaustively, but due to the time constraint, I could not add the exogenous economic sub-model which, in my opinion, would have added more depth to the current model.

Too much time spent in modelling over the curse of the thesis was detrimental for the depth of the research and the initial balance between implementation programming and stakeholder complexity, that was promised. This is one of the things where I would have acted differently.

The research process

The research process has provided many firsts to me. This the first assignment I took which started as majorly qualitative but kept on becoming quantitative further in the process. My previous experience has mostly been with quantitative assignments and I somehow tend to have carried that with me into my thesis. Due to this I spent more time on building the model, running the simulations and compiling the results. I have attempted to include a MOTA analysis in my research, but at a very rudimentary level. Given some more time, that is the one thing I would like to build upon as improvement.

This project was also my first actual field research project where I had to interview people and collect data. It was also the first time I was working on a project which would impact the lives of a lot of people. The field work in Ben Tre was more challenging than I expected due to the language, regional institutional arrangements and complex administrative and security procedures. Although I collected less data than I was hoping, the quality of the data that I collected was not compromised. The interaction I had with the experts in the MOTA workshops were deeply enriching and provided me relevant insights.

After one and a half year of overwork, all-nighters and bad work-life balance, I finally felt the effect of it during my thesis period. The month of April, where I thought I would not finish was one of the most difficult times during the entire process. But after Vietnam, I felt motivated and was able to get back on track, with the realisation that work-life balance is very important with regular intervals of rest. This is another learning I take away from these 6 months. The entire process for me has been challenging where I had to integrate new concepts with old ones, but writing the last lines of my thesis, I feel proud.

Epilogue to the Research

In complex problems such as the one seen in Vietnamese Mekong Delta, there are bipolar forces that are working to solve the issues.

1. There is the top-down effort where national government is providing context to the regional government bodies, which in turn are trying to re-align their regional plans to national agenda while managing local expectations. This chain goes all the way to the local government authorities.
2. The other process Is bottom up adaptation, where the people who are being affected by changing climate, try to adapt/adjust their livelihoods considering increasing challenges. They may adopt a new practice, modify existing or completely move away altogether. The spread of success and failure comes from experience and what they observe locally. This may be in line with regional authorities' expectations or maybe more "tragedy of commons" situation, where each agent is trying to maximize local benefits, without the knowledge of the bigger picture

The reason this misalignment might exists is due to institutional, financial or technological abilities, coupled with their motivation to move in a direction. The visible triggers of land loss, crop loss, and intangible triggers of word of mouth fear spread might push them to act in a way. However, it is important to acknowledge that motivations and abilities influence each other too and are not completely independent of each other.

The solution thus, is not government trying to push on initiatives and planning to implement. Neither is it the actions of locals with aim of maximizing personal or regional benefits. It is rather a combination of 2 where one meets the other midway and builds upon each other.
At the same time, it is important to acknowledge that this process can be observed at different levels in the nature and is therefore important to realize the context and choose boundaries and scope very carefully.

There are studies which try to develop sectoral plans, and there are studies which work on smallholder adaptation. It is important to find an integration point in them to share insights and support each other's development.

References

Arrow, K. J. (1950). A Difficulty in the Concept of Social Welfare. *The Journal of Political Economy*.

Birkmann, J., Garschagen, M., Kraas, F., & Quang, N. (2010). Adaptive urban governance: New challenges for the second generation of urban adaptation strategies to climate change. *Sustainability Science*, *5*(2), 185–206. https://doi.org/10.1007/s11625-010-0111-3

Bryant, B. P., & Lempert, R. J. (2010). Thinking inside the box: A participatory, computer-assisted approach to scenario discovery. *Technological Forecasting and Social Change*, *77*(1), 34–49. https://doi.org/10.1016/j.techfore.2009.08.002

Cairney, P., & Jones, M. D. (2016). Kingdon's Multiple Streams Approach: What Is the Empirical Impact of this Universal Theory? *Policy Studies Journal*, *44*(1), 37–58. https://doi.org/10.1111/psj.12111

Chapman, A., & Darby, S. (2016). Evaluating sustainable adaptation strategies for vulnerable mega-deltas using system dynamics modelling: Rice agriculture in the Mekong Delta's An Giang Province, Vietnam. *Science of the Total Environment*, *559*, 326–338. https://doi.org/10.1016/j.scitotenv.2016.02.162

Creswell, J. W., & Plano Clark, V. L. (2007). *Creswell and Plano Chapter 4 Mixed Methods Designs.pdf*. *Applied Linguistics* (Vol. 2nd). https://doi.org/10.1111/j.1753-6405.2007.00096.x

de Bruijn, H., & Dicke, W. (2006). Strategies for safeguarding public values in liberalized utility sectors. *Public Administration*, *84*(3), 717–735. https://doi.org/10.1111/j.1467-9299.2006.00609.x

De Bruijn, H., & Ten Heuvelhof, E. (2012). *Management in networks: On multi-actor decision making*. *Management in Networks: On Multi-actor Decision Making*. https://doi.org/10.4324/9780203885666

Delta Committee. (2016). Delta Programme 2017: Work on the delta, 102. Retrieved from https://english.deltacommissaris.nl/binaries/delta-commissioner/documents/publications/2016/09/20/dp2017-en-printversie/DP2017+EN+printversie.pdf

Druckman, J. N. (2004). Political preference formation: Competition, deliberation, and the (Ir)relevance of framing effects. *American Political Science Review*, *98*(4), 671–686. https://doi.org/10.1017/S0003055404041413

Enserink, B., Hermans, L., Kwakkel, J., Thissen, W., Koppenjan, J., & Bots, P. (2010). Policy Analysis of Multi-Actor Systems. *Lemma*, 51–77.

Flyvbjerg, B. (2007). Policy and planning for large-infrastructure projects: Problems, causes, cures. *Environment and Planning B: Planning and Design*, *34*(4), 578–597. https://doi.org/10.1068/b32111

Forrester, J. W. (1958). Industrial dynamics: a major breakthrough for decision makers. *Harvard Business Review*. https://doi.org/10.1225/58404

Forrester, J. W. (1994). System dynamics, systems thinking, and soft OR. *System Dynamics Review*. https://doi.org/10.1002/sdr.4260100211

Ha, T. M., Bosch, O. J. H., Nguyen, N. C., & Trinh, C. T. (2017). System dynamics modelling for defining livelihood strategies for women smallholder farmers in lowland and upland regions of northern Vietnam: A comparative analysis. *Agricultural Systems*, *150*, 12–20. https://doi.org/10.1016/j.agsy.2016.09.008

Haasnoot, M., Kwakkel, J. H., Walker, W. E., & ter Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global Environmental Change*, *23*(2), 485–498. https://doi.org/10.1016/j.gloenvcha.2012.12.006

Hamarat, C., Kwakkel, J. H., & Pruyt, E. (2013). Adaptive Robust Design under deep uncertainty. *Technological Forecasting and Social Change*, *80*(3), 408–418.

https://doi.org/10.1016/j.techfore.2012.10.004
Hamarat, C., Kwakkel, J. H., Pruyt, E., & Loonen, E. T. (2014). Simulation Modelling Practice and Theory An exploratory approach for adaptive policymaking by using multi-objective robust optimization. *Simulation Modelling Practice and Theory*, *46*, 25–39. https://doi.org/10.1016/j.simpat.2014.02.008
Herman, J., Zeff, H., Reed, P. M., & Characklis, G. W. (2014). Beyond optimality: multistakeholder robustness tradeoffs for Regional Water Portfolio Planning Under Deep Uncertainty. *Water Resources …*, 1–22. https://doi.org/10.1002/2014WR015338.Received
Hermans, L., Cunningham, S., & Slinger, J. (2014). The usefulness of game theory as a method for policy evaluation. *Evaluation*, *20*(1), 10–25. https://doi.org/10.1177/1356389013516052
Hermans, L. M., Haasnoot, M., ter Maat, J., & Kwakkel, J. H. (2017). Designing monitoring arrangements for collaborative learning about adaptation pathways. *Environmental Science and Policy*, *69*, 29–38. https://doi.org/10.1016/j.envsci.2016.12.005
IFAD, & Socialist Republic of Vietnam. (2015). *Adaptation to Climate Change in the Mekong Delta in Ben Tre and Tra Vinh Provinces*. Retrieved from https://operations.ifad.org/documents/654016/004c8165-4c12-412d-ba89-83570e4ce7af
Igwilo, A., Number, I. D., Engineering, E., Code, M., Curriculum, N., & Health, W. (2016). *Climate Change Affecting Land Use in the Mekong Delta: Adaptation of Rice-based Cropping Systems (CLUES) Theme 5: Integrated adaptation assessment of Bac Lieu Province and development of adaptation master plan*.
Ipcc. (2007). *Climate Change 2007: impacts, adaptation and vulnerability: contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel*. *Genebra, Suíça*. https://doi.org/10.1256/004316502320517344
Islam, S., & Susskind, L. E. (2012). *Water Diplomacy*. *Water Diplomacy: A Negotiated Approach to Managing Complex Water Networks*. https://doi.org/10.4324/9780203083659
JICA. (2016). THE PREPARATORY SURVEY FOR BEN TRE WATER MANAGEMENT PROJECT, (October).
Jin, W., Xu, L., & Yang, Z. (2009). Modeling a policy making framework for urban sustainability: Incorporating system dynamics into the Ecological Footprint. *Ecological Economics*, *68*(12), 2938–2949. https://doi.org/10.1016/j.ecolecon.2009.06.010
Johnson, R. B., & Anthony J. Onwuegbuzie Lisa A. Turner. (2007). Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research*, *1*(2), 112–133. https://doi.org/10.1177/1558689806298224
Kasprzyk, J. R., Reed, P. M., & Hadka, D. M. (2016). Battling Arrow's Paradox to Discover Robust Water Management Alternatives. *Journal of Water Resources Planning and Management*, *142*(2), 04015053. https://doi.org/10.1061/(ASCE)WR.1943-5452.0000572
Kingdon, J. W. (2003). The policy window, and joining the streams. In *Agendas, alternatives and public policies* (pp. 165–195). https://doi.org/10.1017/CBO9781107415324.004
Korbee, D., Nguyen, H. Q., Hermans, L., & Phi, H. L. (2018). Navigating the bureaucracy; an analysis of plan implementation feasibility by local government actors in the Mekong Delta, Vietnam, *Sp. Issue*(Under Review).
Kotir, J. H., Smith, C., Brown, G., Marshall, N., & Johnstone, R. (2016). A system dynamics simulation model for sustainable water resources management and agricultural development in the Volta River Basin, Ghana. *Science of the Total Environment*, *573*, 444–457. https://doi.org/10.1016/j.scitotenv.2016.08.081
Kuenzer, C., & Renaud, F. G. (2012). *The Mekong Delta System*. *The Mekong Delta System*. https://doi.org/10.1007/978-94-007-3962-8
Kwakkel, J. H. (2017). The Exploratory Modeling Workbench: An open source toolkit for exploratory modeling, scenario discovery, and (multi-objective) robust decision making. *Environmental Modelling and Software*, *96*, 239–250. https://doi.org/10.1016/j.envsoft.2017.06.054

Kwakkel, J. H., Haasnoot, M., & Walker, W. E. (2016). Comparing Robust Decision-Making and Dynamic Adaptive Policy Pathways for model-based decision support under deep uncertainty. *Environmental Modelling and Software*, *86*, 168–183. https://doi.org/10.1016/j.envsoft.2016.09.017

Kwakkel, J. H., & Pruyt, E. (2013). Exploratory Modeling and Analysis, an approach for model-based foresight under deep uncertainty. *Technological Forecasting and Social Change*, *80*(3). https://doi.org/10.1016/j.techfore.2012.10.005

Lempert, R. (2013). Scenarios that illuminate vulnerabilities and robust responses. *Climatic Change*. https://doi.org/10.1007/s10584-012-0574-6

Lempert, R. J., Groves, D. G., Popper, S. W., & Bankes, S. C. (2006). A General, Analytic Method for Generating Robust Strategies and Narrative Scenarios. *Management Science*, *52*(4), 514–528. https://doi.org/10.1287/mnsc.1050.0472

Lempert, R. J., Popper, S. W., & Bankes, S. C. (2003). *Shaping the Next One Hundred Years: New Methods for Quantitative, Long-Term Policy Analysis*. *Technological Forecasting and Social Change* (Vol. 71). https://doi.org/10.1016/j.techfore.2003.09.006

Madani, K. (2010). Game theory and water resources. *Journal of Hydrology*, *381*(3–4), 225–238. https://doi.org/10.1016/j.jhydrol.2009.11.045

Madani, K., & Hipel, K. W. (2011). Non-Cooperative Stability Definitions for Strategic Analysis of Generic Water Resources Conflicts. *Water Resources Management*, *25*(8), 1949–1977. https://doi.org/10.1007/s11269-011-9783-4

Mintzberg, H. (1978). Patterns in Strategy Formation. *Management Science*, *24*(9), 934–948. https://doi.org/10.1287/mnsc.24.9.934

Newig, J., & Koontz, T. M. (2013). Multi-level governance, policy implementation and participation: the EU's mandated participatory planning approach to implementing environmental policy. *Journal of European Public Policy*. https://doi.org/10.1080/13501763.2013.834070

Oliphant, T. E. (2007). SciPy: Open source scientific tools for Python. *Computing in Science and Engineering*, *9*, 10–20. https://doi.org/10.1109/MCSE.2007.58

Ostrom, E., & Janssen, M. a. (2004). Chapter 13 Multi-Level Governance and Resilience of Social-Ecological Systems. *Development*. https://doi.org/10.1007/1-4020-2858-X_13

Phi, H. L., Hermans, L. M., Douven, W. J. A. M., Van Halsema, G. E., & Khan, M. F. (2015). A framework to assess plan implementation maturity with an application to flood management in Vietnam. *Water International*, *40*(7), 984–1003. https://doi.org/10.1080/02508060.2015.1101528

Phong, N. D., Hoanh, C. T., Tuong, T. P., & Wassmann, R. (2014). Sea level rise effects on acidic pollution in a coastal acid sulphate soil area. In *Proceedings - 7th International Congress on Environmental Modelling and Software: Bold Visions for Environmental Modeling, iEMSs 2014*.

Pressman, J. L., & Wildavsky, A. B. (1973). *Implementation : how great expectations in Washington are dashed in Oakland*. *The Oakland Project Series*.

Sabatier, P. A. (1986). Top-Down and Bottom-Up Approaches to Implementation Research: A Critical Analysis and Suggested Synthesis. *Journal of Public Policy*, *6*(1), 21–48. https://doi.org/10.1017/S0143814X00003846

Sabatier, P. A. (1998). The advocacy coalition framework: Revisions and relevance for europe. *Journal of European Public Policy*, *5*(1), 98–130. https://doi.org/10.1080/13501768880000051

Saysel, A. K., Barlas, Y., & Yenigün, O. (2002). Environmental sustainability in an agricultural development project: a system dynamics approach. *Journal of Environmental Management*, *64*(3), 247–260. https://doi.org/10.1006/jema.2001.0488

Seijger, C., Douven, W., van Halsema, G., Hermans, L., Evers, J., Phi, H. L., … Hoang, V. T. M. (2016). An analytical framework for strategic delta planning: negotiating consent for long-

term sustainable delta development. *Journal of Environmental Planning and Management*, *60*(8), 1485–1509. https://doi.org/10.1080/09640568.2016.1231667

Seijger, C., Vo, H., van Halsema, G., Douven, W., & Wyatt, A. (2018). Do strategic delta plans get implemented? The case of the Mekong Delta Plan. *Regional Environmental Change*, (Under Review).

Simonovic, S. P., & Li, L. H. (2004). Sensitivity of the Red River basin flood protection system to climate variability and change. *Water Resources Management*. https://doi.org/10.1023/B:WARM.0000024702.40031.b2

Son, N. H., Yen, B. T., & Sebastian, L. (2018). Development of Climate-Related Risk Maps and Adaptation Plans (Climate Smart MAP) for Rice Production in Vietnam ' s Mekong River Delta Development of Climate-Related Risk Maps and Adaptation Plans (Climate Smart MAP) for Rice Production in Vietnam ', (220).

Sterman, J. D. (2000). *Business dynamics: Systems thinking and modeling for a complex world*. *Management*. https://doi.org/10.1057/palgrave.jors.2601336

Teisman, G. R. (2000). Models for Research into Decision-Making Processes: On Phases, Streams and Decison-Making Rounds. *Public Administration*, *78*(4), 937–956. https://doi.org/10.1111/1467-9299.00238

The World Bank. (2016). *MEKONG DELTA INTEGRATED CLIMATE RESILIENCE AND SUSTAINABLE LIVELIHOODS PROJECT*. Retrieved from http://documents.worldbank.org/curated/en/840701467996680631/pdf/PAD1610-PAD-P153544-IDA-R2016-0110-1-Box394889B-OUO-9.pdf

Van Driel, W., Bucx, T., Makaske, B., Van de Guchte, C., Van der Sluis, T., Biemans, H., … Adriaanse, B. (2015). Vulnerability Assessment of Deltas in Transboundary River Basins. *Delta Alliance Contribution to the Transboundary Water Assessment Program, FSP River Basins Component. Delta Alliance Report*, *9*.

Veeneman, W., de Bruijne, M., & Dicke, W. (2009). From clouds to hailstorms Safeguarding public values in networked infrastructures. *Public Policy*, *4*(5), 1–17. https://doi.org/10.1504/IJPP.2009.025080

Veerman, C. M. (2013). Mekong Delta Plan: Long-term vision and strategy for a safe, prosperous and sustainable delta. *Vietnam*, (December), 126pp.

Venkatesan, A. K., Ahmad, S., Johnson, W., & Batista, J. R. (2011). Systems dynamic model to forecast salinity load to the Colorado River due to urbanization within the Las Vegas Valley. *Science of the Total Environment*, *409*(13), 2616–2625. https://doi.org/10.1016/j.scitotenv.2011.03.018

Vietnam General Statistics Office. (2016). Population and Employment in Vietnam. In *Statistical Yearbook of Vietnam 2015*.

Vietnam, T. G. Resolution 120: ON SUSTAINABLE AND CLIMATE-RESILIENT DEVELOPMENT OF THE MEKONG DELTA, Pub. L. No. No. 120/NQ-CP (2017). Vietnam. Retrieved from https://societyforhumanecology.files.wordpress.com/2018/01/vietnam.pdf

Vu, D. T., Yamada, T., & Ishidaira, H. (2018). Assessing the impact of sea level rise due to climate change on seawater intrusion in Mekong Delta, Vietnam. *Water Science and Technology*, wst2018038. https://doi.org/10.2166/wst.2018.038

Walker, W. E., Haasnoot, M., & Kwakkel, J. H. (2013). Adapt or perish: A review of planning approaches for adaptation under deep uncertainty. *Sustainability (Switzerland)*, *5*(3), 955–979. https://doi.org/10.3390/su5030955

Walker, W. E., Harremoës, P., Rotmans, J., van der Sluijs, J. P., van Asselt, M. B. A., Janssen, P., & Krayer von Krauss, M. P. (2003). Defining Uncertainty: A Conceptual Basis for Uncertainty Management in Model-Based Decision Support. *Integrated Assessment*, *4*(1), 5–17. https://doi.org/10.1076/iaij.4.1.5.16466

Walker, W. E., Rahman, S. A., & Cave, J. (2001). Adaptive policies, policy analysis, and policy-making. *European Journal of Operational Research*, *128*(2), 282–289.

https://doi.org/10.1016/S0377-2217(00)00071-0
Wassmann, R., Hien, N. X., Hoanh, C. T., & Tuong, T. P. (2004). Sea level rise affecting the Vietnamese Mekong Delta: Water elevation in the flood season and implications for rice production. *Climatic Change*. https://doi.org/10.1023/B:CLIM.0000043144.69736.b7
Wilson, J. Q. (1991). Bureaucracy: What Government Agencies Do And Why They Do It. In *Bureaucracy: What Government Agencies Do And Why They Do It.* (Vol. 5, pp. 1–30). https://doi.org/10.5465/AME.1991.4274691
Wise, R. M., Fazey, I., Stafford Smith, M., Park, S. E., Eakin, H. C., Archer Van Garderen, E. R. M., & Campbell, B. (2014). Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change*, *28*, 325–336. https://doi.org/10.1016/j.gloenvcha.2013.12.002
World Bank. (2015a). *Project Appraisal Document for Sustainable Agriculture Transformation Project*. Retrieved from http://documents.worldbank.org/curated/en/783441467998463415/pdf/PAD1168-PAD-P145055-IDA-R2015-0175-1-Box391456B-OUO-9.pdf
World Bank. (2015b). *Vietnam - Agriculture Competitiveness Project (VN-ACP).* Retrieved from http://documents.worldbank.org/curated/en/613891467998481010/pdf/ICRR14698-P108885-Box393183B-PUBLIC.pdf
Zandvoort, M., van der Vlist, M. J., & van den Brink, A. (2017). Handling uncertainty through adaptiveness in planning approaches: comparing adaptive delta management and the water diplomacy framework. *Journal of Environmental Policy and Planning*, *0*(0), 1–15. https://doi.org/10.1080/1523908X.2017.1347035

Appendices

Appendix 1: Visit Report Vietnam

Beginning of Week 1 (Introduction to the Research Project)

I am Gurvinder Arora, Master student of Engineering and Policy Analysis from TU Delft. As a part of my master thesis research, I will be travelling to Vietnam in the coming weeks. Over the course of my stay, I will share my research journey with you all on how the farmers in Vietnam can shift to more sustainable livelihoods under the threats of climate change.

I will be working with the Centre for Water Management and Climate Change (WACC) at Vietnam national University, Ho-Chi-Minh city. Here we will develop models with local experts to see what livelihood options are most suitable for the farmers in coastal regions, as the threat of sea level rise is increasing. We will conduct a field study in the region of Ben Tre, where we will interview the farmers on how they perceive the situations and the threats to livelihoods.

The Vietnam government, in collaboration with Dutch research partners have developed a strategic plan for the development of the Delta region for the next 100 years. My research will try to combine the local knowledge and the to develop flexible implementation plans for the region.

End of Week 1 (Introducing WACC team & Model development activity)

This week, I was introduced to the team at the Centre for Water Management and Climate Change (WACC), which is located outside the city near a very beautiful lake. The team there is working on many projects; from a floating house made of bamboo to a water absorbing cobblestone design for the garden. But I am here for the project on livelihood changes in the Mekong Delta, where I presented my research proposal to the local experts and gained their feedback.

Over the week, I had the opportunity to interact with the subject experts to build my System dynamics model and test different livelihood possibilities in the Ben Tre province. I also visited the Binh Dai district, which is in the coastal region of the Ben Tre province, where farmers are practicing shrimp aquaculture in the natural setting of the mangroves without disturbing the natural ecosystem. We collected some salt level rise data and interviewed farmers on their experiences so far with the natural model. With the data collected, I enriched my understanding of livelihoods in the region, which will help me design better strategies for livelihood adaptation of the farmers

End of Week 2 (Local interviews in the coastal province and filed work)

This is my third brief from Vietnam where we are working for livelihood adaptation in the Mekong Delta due to the changing climate. This week I had the opportunity to visit the study areas for livelihood changes in the Ben Tre province. Ben Tre is in the coastal regions of the Mekong delta and is directly connected to the South China sea. This means, that as the sea level rises, the salt water from the sea enters the river inland making the lives of the rice farmers difficult. There is a huge Sluice gate (Ba Lai gate) in this area which can be closed to disconnect the river and maintain fresh water in the inland region, where fruits and vegetables are grown., but our research is in the areas outside the gates where salt content of the water is higher.

In my research, we are establishing the adaptation possibilities of farmers in this area from only rice crops to a seasonal pattern of rice and shrimp farming. The rice is proposed in the wet season with high rainfall when the salt level becomes lower. The shrimp farming is proposed in the dry season when the salt content is higher, as shrimp can sustain higher salt contents. We conducted semi-structured interviews with farmers who had already adopted this model to map their

current economic situation and motivation to continue, and the technical, financial and support challenges faced by them. On day 2, we interviewed farmers in a different part of the Ben Tre where farmers still cultivate only rice to map their adoption potential and threats perceived by them due to climate change. In the coming weeks, we will interview the experts and the government officials to understand the plans to transform regional livelihoods and how effectively they are being implemented.

End of Week 3 (Workshop with stakeholders to share insights)

This is my fourth and final brief from Vietnam where we are working for livelihood adaptation in the Mekong Delta due to the changing climate. In the beginning of the week, I had an opportunity to participate in a workshop organized by our research team, about techniques to understand the motivations and abilities of the farmers and government officials that are involved in livelihood adaptations at the commune level. Key experts from different ministries joined for the workshop, where I also got an opportunity to present my thesis research and gain their feedback. The sessions also provided insights into developments to link provincial level plans and help in efficient resource allocations for planning and implementation activities.

After the 2-day workshop, the next step was to re-visit the communes in the Ben Tre province, where we spent the next 2 days interviewing the officials. The focus of the interviews was to understand their perceptions on the current provincial plans and how they intend to move forward with the implementation. It was interesting to observe the different ways in which "implementation" is carried out; from physical actions like building dikes, to monitoring the salinity and pollution content of the local water sources. After conducting all the necessary interviews, we headed back to Saigon, where I spent my last day conducting a workshop on using quantitative methods for planning. This included the tools we learn during our master's program, which were deemed important by the Vietnamese partners for knowledge sharing with the Netherlands.

Looking back at the last few weeks spent in Vietnam, I have developed a better understanding of the problems in the coastal Mekong region in Vietnam. I also witnessed the challenges and progress made towards implementation of the set targets, which has given me more confidence on being able to provide something useful back to the local team in the form of a good thesis document.

Appendix 2: Interview Transcripts

List of Interviews

Table 11 List of All interviews

District	Commune	Designation	Date
Thanh Phu	An Nhon	Farmer 1	16 May 2018
		Farmer 2	16 May 2018
		Farmer 3	16 May 2018
		Official 1	23 May 2018
	Thoi Thanh	Official 2	23 May 2018
	My An	Farmer 7	23 May 2018
Binh Dai	Tan Binh	Farmer 4	17 May 2018
		Farmer 5	17 May 2018
		Farmer 6	17 May 2018
	Dinh Truong	Official 1	24 May 2018
	Thanh Phuoc	Official 2	24 May 2018

Reference Topic sheet for Questions

In case Integrated Rice Shrimp (Brackish-Fresh-Rice) model is followed;

- Do you see any Key concerns with current livelihood? (If yes)
    - Perception;
        - perceptions on the risks
        - perceptions on possible solutions
    - Have you seen any developments regarding these perceived issues? (Government, project groups?)
    - Ability
        - Financial
        - Technical
        - Institutional

In case Integrated Rice Shrimp (Brackish-Fresh-Rice) model is not followed;

- Do you see any Key concerns with current livelihood? (If Yes) what are the key perceived threats?
    - Perception;
        - perceptions on the risks
        - perceptions on possible solutions
        - perceptions on mandates
    - Have you seen any developments regarding these perceived issues? (Government, project groups?)
    - Ability
        - Financial
        - Technical
        - Institutional
- Have you considered other livelihood models?
- If yes, when will be ideal to change?
- (If no), Have you seen/heard about the Integrated Rice Shrimp (Brackish-Fresh-Rice) model?
    - Where/how?
- Have you considered adopting to this model?
    - Why/Why Not?
    - Perception;
        - perceptions on the risks

        - perceptions on possible solutions
        - perceptions on mandates
- What were the challenges?
    - Ability
        - Financial
        - Technical
        - Institutional

Part II (THIS SECTION WILL BE ASKED IF THE FARMERS HAVE NOT MENTIONED SALINITY IN THE PREVIOUS SECTIONS)

Salinity Intrusion (If salinity is not mentioned)

- Is there salt-water intrusion observed in the area?
- Do you consider saltwater intrusion as a threat to the livelihood?
        - perceptions on the risks
        - perceptions on possible solutions
        - perceptions on mandates
- Can you do something about it?
        - Financial
        - Technical
        - Institutional

Farmer interviews

FIRST FARMER

Background information:

Location: An Nhon ward, Thanh Phu district, Ben Tre province

Model: Brackish shrimp – Rice and Freshwater shrimp

Area: 1.2 ha of land in which 1 ha for shrimp pond and 7000 m2 for rice

Types of shrimp: Brackish: Black Tiger shrimp
Freshwater: Giant Freshwater shrimp
Rice: OM6162 (duration 100 days)

Crop calendar: (in Lunar time): In month 5 and 6, start cultivating freshwater shrimp. In month 12, start cultivating brackish shrimp. Start cultivating rice in month 6.

Farming practice:

Brackish shrimp: stocking density 100,000/ha. Brackish shrimp was harvested discretely from month 3 to 5. Water exchange is conducted regularly.

Freshwater shrimp: stocking density is 25,000/ha. Shrimp is grown in two periods. In the first period, post larva will be hatched in smaller areas of around 500m2 surrounded by nets for about 3 months. Fish deterrents is applied before post larva are hatched. Chemical used to kill fish is Saponin, farmer use 2 packs of this chemical in one season. Industrial food is also applied in this period. Farmers use around ten packs of industrial food, each pack weigh 25kg. In the next period, farmer stop using industrial food, he uses other kinds of foods instead, rice or fish meat for instance. Each month in this period, he uses 100kg of rice to make shrimp food.

Rice: farmer does not use pesticides but uses 6 packs of fertilizers (DAP).

Shrimp pond is dredged every 3 years.

Investment

Brackish shrimp:

Freshwater shrimp: 10 x 25-kg pack of industrial food x 550,000 VND/pack (in first 3 months)
2 x 50-kg pack of rice x 450,000 VND/pack (every next month)

Rice:

120,000 VND of seeds

6 packs of DAP fertilizers, each pack cost 500,000 VND

No cost of labours for farmer receive support from other farmers, in the return, other farmers can collect straw

Cost for pond dredging is 5,000,000VND/ha in every 3 years

Profit:

Brackish shrimp: with price of Tiger shrimp of about 160,000VND, farmer earn 50,000,000 – 60,000,000 VND/year, after subtracting to 10,000,000 VND of investment, the net profit is around 40,000,000VND/year.

Freshwater shrimp: with price of Giant Freshwater shrimp of 200,000VND/kg (15 shrimps/kg), farmer earns 50,000,000 VND/season. After subtracting to investment, the net profit is from 30,000,000 to 40,000,000 VND/season.

Rice: rice yield is 4.2 tons in which 2 tons will be sold and the rest is for domestic use, earning from selling rice is 15,000,000 VND.

Farmer's experience:

Adopting extensive shrimp farming more than 20 years ago. He only adopted the brackish shrimp – freshwater shrimp and rice model in the last 2 years.

For freshwater shrimp, crop calendar; the time to start stocking shrimp in specific, is decisive factor. If larvae is released late, the survival rate is very low. If larva is released at salinity from 5-10ppt, the survival rate is high.

Debt:

Farmer is in debt. The loan is 100,000,000VND for house construction, not for shrimp farming. He hasn't paid yet.

Institutional:

Farmer attended yearly training in which he got opportunities to see completely-male Giant freshwater shrimp model, how to break the legs of Giant freshwater shrimp and the way of zoning to do it.

The household is in cooperatives. However, it is only the cooperatives of organic rice not shrimp. The output for rice is therefore, secured.

Perception:

Farmer needs a stable market for shrimp.

For rice, there should be a processing factory for rice nearby. The cost of building such factory is only from 1-2 billion VND. It can help reduce the cost of production and improve the price of rice.

SECOND FARMER

Background information:

Location: An Nhon ward, Thanh Phu district, Ben Tre province

Model: Semi-Intensive shrimp farming

Brackish shrimp – Rice and Freshwater shrimp

Area: Intensive shrimp pond: 2000m2

Extensive (Brackish shrimp – Freshwater shrimp and rice): 1 ha of shrimp pond in which 4000-5000m2 for rice farming

Type of shrimp: Intensive: White-leg shrimp

Extensive: Brackish: Black Tiger shrimp;

Freshwater: Giant freshwater shrimp;

Rice: seasonal rice

Crop calendar (Lunar time):

Intensive: First season starts in month 4, harvest in month 7. Second seasons starts in month 7,8. Harvest in month 10.

Extensive: Month 1 farmer starts stocking brackish-water shrimp. He later stocks brackish shrimp discretely in next months. Harvesting brackish-water shrimp from month 3-4 to 6-7. The freshwater shrimp and rice season starts from month 7 to 12.

Farming practice:

Intensive: Pond treatment before stocking larvae. Stocking density of White-leg shrimp is 200,000/2000m2. Chemical applied to kill microorganism, snails, bivalve. Lime is also applied to adjust ph. Industrial food is applied. Each season take around 3 tons of food. Farmer does not always do 2 seasons of shrimp a year, he only does the second shrimp season in case the first season is successful.
The farmer relies on another successful farmers' crop calendar
The shrimp food store also instructs farmer
Regular pond repair is conducted after every season of shrimp. Pond dredging is conducted every 3 years. He has not conducted pond dredging in the last 3 years and still wait for successful season to do it.
Extensive: Stocking density of brackish shrimp is 100,000/ha; for giant freshwater shrimp, the number is 10,000/ha. Freshwater shrimp is hatched in about 10 days before being released into the environment. Special area is prepared for freshwater shrimp hatching by killing off fish using 10kg chemical. He tested the salinity level in the shrimp pond by tasting the water. If the salinity is OK, he then releases the larvae into the pond.

Investment:

Intensive:

Initial cost of intensive: 100,000,000 VND for pond construction, buying fans.
Operational cost of Intensive:
22,000,000 VND for larvae.
102,000,000 VND for industrial food (34,000 VND/kg)
20,000,000 VND for electricity
10,000,000 VND for chemicals
Maintenance cost: 20,000,000 VND for pond dredging every 3 years. 3,000,000 VND for regular pond repair.

Extensive:

Operational cost of extensive:
8,000,000 VND for brackish shrimp larvae
2,000,000 VND for freshwater shrimp larvae
400,000 VND for fish deterrent before hatching freshwater shrimp larvae
400,000 VND for food for freshwater shrimp larvae while they are being hatched

Profit:

Intensive: With price of 100,000 VND/kg, net profit is 100,000,000 VND for 3 tons of shrimp. Price of white-leg shrimp this year is reduced to 76,000 VND/kg. The farmer experience 2 consecutive years of crop loss.
Extensive: Net profit for Black Tiger shrimp and Giant Freshwater shrimp and crabs is 100,000,000 VND/year.
Farmer's experience:
He adopted extensive shrimp farming long time ago. He has adopted intensive shrimp farming in the last 3 years.
He has never tried intensive Black Tiger shrimp

Debt:

Farmer is not in debt

Institutional:

The farmer doesn't receive support from government like training, larva provision etc
Local government gave warning before every season, but it is up to the farmer to decide to grow shrimp or not

Perception:

Intensive shrimp farming is very risky because of disease. Disease on shrimps can be seen after 20 days to 1 month
Intensive shrimp farming is risky, depending on crop calendar and the weather

In brackish – freshwater shrimp and rice: shrimp is also affected by disease but farmers can still move on, unlike in case of intensive shrimp.
Many farmers turned to Black Tiger shrimp this year because price of White-leg shrimp is going down.

THIRD FARMER
Background information:
Official of An Dinh village
Location: An Dinh village, An Nhon commune, Thanh Phu district
Model: Brackish shrimp – Rice and Freshwater shrimp
Area: Shrimp pond: 10,500m2; Area for rice: 6,000m2
Type of shrimp: Brackish shrimp: Black Tiger shrimp
Freshwater shrimp: Giant Freshwater shrimp
Rice: short-term rice like OM6162 and Dai Thom 8
Crop calendar (Lunar time): Brackish shrimp season starts in month 12; Rice season starts around the end of month 6 and rice harvest is in October; Freshwater shrimp season start in month 4 and harvesting is in month 12.
Farming practice:
Freshwater shrimp: Stocking density is 10,000/10,500m2. Hatching young larvae before releasing into the pond. Duration of hatching is 1 month in which farmer uses 3 packs of industrial food, each pack weighs 20kg. Lime is also applied to help recover the pond. Shrimp is harvested many times. Shrimp larvae is hatched at salinity level of 15ppt, the more the shrimp grow, the more they can endure the salinity.
Water level for shrimp hatching is 1m, deeper is not good. Farmer guesses salinity level by tasting the water. Farmer also uses lime to adjust the ph.
Rice: Farmer use 120kg of rice seed every season. 2 packs of fertilizer, 1 pack of urea and 1 pack of Dau Trau fertilizer, each pack weighs 50kg. Farming is conducted by relatives. Harvesting is conducted by cowherds.
Brackish shrimp: Farmer applies 10kg of fish deterrent before stocking. Black Tiger shrimp can endure average salinity level. They would grow slowly when salinity level is high. Shrimp is released into the pond two times; the second time is 1 month after the first time. Stocking density of each time is 50,000/10,500m2. Feeding starts from second month, rice is shrimp food.
Regular pond repair is conducted yearly. Pond dredging is conducted every 3 years.
Investment:
Brackish shrimp:
Cost of larvae: 3,000,000VND
Fish deterrent: 10kg x 35,000VND/kg
Food: Maximum 4,000,000 – 5,000,000VND (30,000VND/kg)
Freshwater shrimp:
Cost of larvae: 1,800,000VND for 10,000 larvae (in year 2017, this cost was covered by the government)
Cost of food: 15,000,000/season (30% supported by the government)
Rice:
Cost of seed: 150,000VND
Cost of fertilizers: 350,000VND/1 pack of Urea; 650,000VND/1 pack of Dau Trau fertilizer
Profit:
Freshwater shrimp: price of Giant Freshwater shrimp is from 150,000VND/kg to 200,000VND/kg. Best price is in case 7-8 shrimps/kg, second best price is in case 10-12 shrimps/kg. Net profit from Giant Freshwater shrimp in case stocking density of 10,000 is 25,000,000VND; in case it is 25,000, net profit is more than 40,000,000VND.

Brackish shrimp: price ranges from 170,000-180,000VND/kg to 280,000VND/kg. Best price is in case 20 shrimps/kg. In case 40 shrimps/kg, price is 170,000-180,000VND. Net profit from Black Tiger shrimp is from 30,000,000 – 60,000,000VND.
Rice: harvest 2.5 tons of rice. 1 ton is for domestic consumption. The rest is for selling. Price of OM6162 is 7,200VND, and 7,600VND for Dai Thom 8
Farmer's experience:
Farmer adopted the Brackish-Freshwater Shrimp and Rice model in the last 3 years. He grows freshwater shrimp in 2014, 2016 and 2017.
Debt:
Institutional:
In year 2017, he adopted the model supported by the government. Only make Giant Freshwater shrimp is cultivated
Rice seed is from Center of Crop Seed in the South. Rice harvested is sold to two big rice companies including Tien Giang Food company and Ben Tre Food company.
He sells shrimp to available collector. He attended yearly training by local government.
Perception:
pH of water is the most important. pH in range 7.5-8 is good.
Farmer doesn't want to intensive shrimp farming because he doesn't have financial ability and labours. Extensive shrimp farming; in his opinion, is stable
Cultivating rice on shrimp pond can help shrimp farming because residual from rice become natural food for shrimp, creating better environment for shrimp so the risk is lower.

FOURTH FARMER
Background information:
Location: Binh Dai district
Model: Brackish shrimp – Rice
Area: Shrimp pond: 5,000m2; Area for rice: 3,000-4,000m2
Type of shrimp: Brackish shrimp: Black Tiger shrimp
Crop calendar (Lunar time): Stocking larvae in month 1, if everything is fine then stop stocking; if not, stocking in the second time after 1-1.5 months. Harvest shrimp in month 4. Rice season starts from month 6.
Farming practice:
Black Tiger shrimp: Stocking density is 100,000/5000m2 in the first time and 30,000-40,000/5,000m2 in the second time. Before buying larvae, farmer takes some water sample to the larvae store, larvae seller will adjust the salinity level to match with salinity level of water sample for the larvae to adapt more easily. In extensive model, no need to apply industrial food. Shrimp is harvested discretely in many occasions. Water exchange is conducted once a day and in 3-4 consecutive days depending on the water.
Rice: Farmer cultivates 40kg of rice seed. One pack of Urea fertilizer is used. Farmer hires labours to cultivate the seed and harvest rice. Farmer also rearing fish with rice.
Regular pond repair is conducted every season. Pond dredging is conducted every 2-3 years.
Investment:
Initial investment: 12,000,000VND to construct pond
Brackish shrimp:
Cost of larvae: First time: 100,000 larvae x 35 VND/larvae; Second time: 40,000 larvae x 35 VND/larvae
Rice:
Cost of seed: 400,000VND/40kg of seed.
Cost of fertilizer: 550,000VND/pack
Cost of labours: Cultivating: 6 labours x 200,000 VND/labour/day x 1 day

Harvesting: 6 labours x 200,000 VND/labour/day x 1 day (if crop loss, only hire 4 labours)

Fish: Price for fish seed is 55,000VND/kg.

Profit:

Black Tiger shrimp: if stocking density is 50,000, farmer earns 60,000,000VND not subtracted to investment cost of larvae. Price of shrimp varies by its size. Price is 250,000VND/kg, 145,000VND/kg and 70,000-80,000VND/kg in case of 20 shrimps/kg, 30 shrimps/kg and 70-80 shrimps/kg respectively. In case crop loss, profit is around 5,000,000-6,000,000VND/season.

Rice: Rice yield is 800kg. All harvested rice is for domestic consumption

Fish: All fish is for domestic consumption

Farmer's experience:

Farmer adopted the rice-shrimp model in the last 10 years.

Debt: Farmer is not in any debt.

Institutional:

Farmer attended training hosted by food and larvae company at commune scale.

There is warning by commune authority to Panel of Farming Management about risk. Meeting will be hosted at village level to inform farmers. The farmer attends the meeting always.

Farmer heard about the brackish – freshwater and rice model but he does not have access to source of Giant Freshwater shrimp larvae.

Farmer changes collector depending on the success of crop. He decides collector by buying price and sells shrimp to the one the give the highest price.

There is no cooperative, but the farmer thinks cooperative is good

Perception:

The rice-shrimp model is more advantageous because of low investment.

Salinity level does not matter, water pollution is more serious

Farmer does not have enough financial ability to do intensive shrimp farming.

FIFTH FARMER

Background information:

Location: Tan Binh village, Binh Dai district, Ben Tre province

Model: Brackish shrimp – Rice

Area: 2 ponds, area of each pond is 1 ha, 7,000m2 of each pond is for rice farming

Type of shrimp: Brackish shrimp: Black Tiger shrimp

Crop calendar (Lunar time): Shrimp season starts in month 1, there were normally two times of shrimp stocking in previous years. Rice season starts in month 6. Rice will be harvested after 5.5 months.

Farming practice:

Black Tiger shrimp: Stocking density is 100,000/1ha for each pond. In total, one season farmer uses 200,000 for two ponds. Farmer takes water sample from his pond and brings it to larvae seller. The larvae seller will adjust salinity before selling larvae to the farmer. Farmer uses many types of food; industrial food is applied after 2-2.5 months of shrimp season. Farmer harvests shrimp in the third month.

Rice: Farmers uses 2 packs of URE fertilizer. He hired 30 labours in 2 days for rice cultivation and 10-15 labours in 2 days for harvesting.

Regular pond repair is conducted every season. Pond dredging is conducted every 3 years.

Investment:

Cost of pond maintenance: every 3 years, farmer hire labours to dredge the pond. Cost of pond dredging is 5,000,000-10,000,000VND/2 days (450,000VND/hour).

Brackish shrimp:

Cost of larvae: 3,000,000 – 4,000,000 VND/200,000 larvae (2,000,000 VND/100,000 larvae). If there are two times of stocking, cost of larvae will be double to 6,000,000-7,000,000VND/season).

Rice:

Cost of fertilizer: 2 pack x 500,000VND/pack

Cost of labours: 30 labours x 200,000VND/day x 2 days for cultivation

10-15 labours x 200,000VND/day x 2 days for harvesting

Profit:

Black Tiger shrimp: In case of crop win, farmer harvests 100-200kg of shrimp. On average, there are around 30 shrimps/kg. Price is 150,000-200,000VND/kg. Net profit for farmer is 30,000,000VND. In case of crop loss, farmers harvests 30kg of shrimp. On average, there are around 40 shrimps/kg. Price is 100,000VND/kg.

Rice: Rice yield is 400kg. Selling price is 200,000VND/20kg.

Farmer's experience:

Farmer adopted the rice-shrimp model in the last 10 years.

Debt: Farmer is not in any debt.

Institutional:

Farmer buys larvae from one store repeatedly because the store usually gives more larvae as a gift and price is low.

Farmer heard about the integrated rice-shrimp model. He also has access to Giant Freshwater shrimp because his nephew is selling Giant Freshwater shrimp larvae.

Commune organizes training, but only selected farmers can attend.

Farmer calls collector by phone after harvesting shrimps. If selling price is good, he will sell shrimp. If harvested volume is big enough, collector will collect shrimp at ponds; otherwise, farmer will bring shrimp to collector.

Perception:

Farmer finds it easy to access the loan

Farmer finds himself old and no longer sharp enough to learn new model

Farmer feels cooperative is necessary for such organization can help choosing larvae and selling price is more stable.

Farmer finds hot weather has serious impacts on crop because it makes shrimp vulnerable to diseases. Salinity is not very serious. He also suggests pond should be deep and depth should be recovered every 1-2 year.

Farmer finds the recent crop loss is due to bad water or larvae. All his neighbors have crop success, unlike him.

SIXTH FARMER

Background information:

Location: Tan Binh village, Binh Dai district, Ben Tre province

Model: (Semi)-Intensive shrimp farming

Area: 2 ponds, one 1,500-m2 pond in operation, and other 1,700-m2 pond under construction

Type of shrimp: White-leg shrimp

Crop calendar (Lunar time): Farmer does 4 seasons of shrimp farming. One season starts in month 11 and ends in mid-month 2. Second season starts soon afterwards, also lasts in 100 days. Third season starts after second season ends and lasts in 50 days. After third season ends, farmer will stop farming in about 1 month, and starts the fourth season afterwards.

Farming practice: Stocking density is 80,000 either for 100-day and 50-day crop. Farmer used 2 tons of industrial food every season for 100-day crop; for 50-day crop, he only uses 600kg. Regular pond maintenance is conducted after every season. In case of crop loss, he will do it after two seasons. Farmer applies 4 packs of lime in every season to adjust the ph. He also use

other chemicals like micro-organism deterrent (Emeron), Gelite. Around 2 months after shrimp season starts, farmer uses Gelite to remove poisonous gas emitted from bed.
Investment:
Initial investment: 50,000,000 VND in total including pond construction and buying equipment like fan system.
Cost of larvae: price is 100 VND/larvae, farmer invests 20,000,000 VND in 4 seasons.
Cost of food: 100 packs x 300,000VND/pack for 100-day season
30 packs x 300,000 VND/pack for 50-day season
Cost of electricity: 7,000,000 VND/season
Cost of chemicals (micro-organism, Gelite etc): 4,000,000 VND/season
Cost of lime: 4 packs x 30,000 VND/packs
Cost of seasonal pond maintenance: 2,000,000 VND/season
Profit:
Net profit for 100-days crop is 100,000,000 VND
Net profit for 50-days crop is 10,000,000 VND
Farmer's experience:
Farmer did extensive shrimp farming long time ago. He later turned to intensive shrimp farming in the last three years. Previously, he cultivated Black Tiger shrimp. Now he turns to White-leg shrimp in the last two years.
Debt: Farmer is not in any debt.
Institutional:
Farmer has toolkit to measure water parameters. However, he rarely uses it. Technicians from larvae store come every 10 days to do the measurement for him. Water parameters to measure include pH, salinity level.
Farmer is not in cooperative.
There is meeting in commune scale for farmers to discuss. The meeting is hosted by Panel of
Farming Management.
Farmer choose larvae store by rate of success. If rate of success is high, he will stick to the store to buy larvae.
Shrimp collector comes to his farm to collect shrimp. Farmer chooses collector through relation, not by high price.
Perception:
After 2 years of doing intensive shrimp, farmer thinks intensive shrimp farming is stable.
Shrimp dies because of hot weather. Hot weather makes poisonous gas emitted from pond bed.
Non-seasonal rain also has negative impacts on shrimps by making shrimp eat less.
Farmer thinks it is easy to access loan

SEVENTH FARMER
Background information:
Job: Official of Division of Fishery of Ben Tre province. His main concern is about disease in aquaculture. His duty is to monitor the water quality, post the result onto website of DARD and inform the commune authority. The test is conducted 3 times/month.
Location: My An commune, Thanh Phu district
Model: Intensive shrimp
Area: 2 ponds, 1 pond of 1,400 m2 and the other is 2,000m2
Type of shrimp: White-leg shrimp
Crop calendar (not in Lunar time): 2 seasons a year, first season starts in June. The season duration is 100 days. Second season starts in September after a minor pond maintenance, also in 100 days. The remaining time is for pond maintenance.

Farming practice: Stocking density is 80 larvae/m2. Before stocking, farmer conducts water treatment. He also applies Chlorine and Gelite in farming. The amount of food applied is 1.2-1.3 times the weight of harvested shrimp. Farmer releases the water in shrimp pond after every season to take new water in.

Investment:

Initial cost: Farmer hired land to do shrimp farming at price of 10,000,000VND/ha/year, land is empty, and farmer had to invest into buying equipment. He later hired land in My-An commune at price 34,000,000VND/year but equipment for shrimp farming was already installed.

Cost of larvae: 100 VND/larvae

In general, to produce 1kg of white-leg shrimp, farmer spends 70,000VND. Cost of labor and chemicals take 50% of total operational cost, the rest is by foods and larvae.

Cost of maintenance: 5,000,000 VND in every 3 years for pond dredging

Profit: Farmer harvests 5 tons of White-leg shrimp in case of crop success and 2.5 tons in case of crop loss. Current price of White-leg shrimp is 70,000VND/kg in case of 100 shrimp/kg. Last year, the price is 100,000VND/kg in case of 100 shrimp/kg last year, the lowest price is 80,000-85,000VND/kg for 100 shrimps/kg.

Farmer's experience: Farmer adopted intensive shrimp farming from 2008 to now. In previous years, his farm was in Ba Tri and Binh Dai district. He moved to My An commune of Thanh Phu district since last year.

Debt: Farmer borrowed 200,000,000VND from the bank in the beginning to do shrimp farming. Interest rate is 1%/year. The loan is due in 3 years. Farmer is out of debt after 3 years.

Institutional

Farmer works at Division of Fishery, so he knows prestigious place to buy larvae.

Collector comes to his farm to collect shrimp. Farmer also has access to information of price of shrimp on the market. He then assesses the size of shrimp and decides which collector to sell shrimp to. Each collector has contract with processing company which exports shrimp to other countries. Depending on regulation on disease control of the country, the collector must test the disease on shrimp. In case the shrimp is negative to disease, the price would be 5,000-10,000VND higher on the market; in case the shrimp is positive to disease, price would be lower and can be sold to other market.

There is training workshop by local officials at village scale. Information about the workshop is sent to the commune authority. There is also workshop by food company hosted at the store which invites nearby shrimp farmers. The company must have permission by Division of Fishery to host such events.

At the company there is lab where farmers can take water sample to test.

Farmer cannot get more loan from the bank in 5 years because he gets 'bad debt'.

Farmer is not in the cooperative because it was already established before he came. However, he thinks that being in cooperative is good.

Perception

Farmer mentions about hot weather and storm as risk to shrimp farming. Farmer adjusts the crop calendar to avoid hot weather. He waits for the rain to start stocking. He stops farming when storm comes. Besides, he thinks stocking at smaller density would reduce the risk.

Farmer thinks water quality including pH, dissolved oxygen, poisonous gas, salinity can be controlled unlike high temperature caused by hot weather.

Farmer links the risk of disease to abnormal temperature, either too hot or too low. Fluctuation of temperature between day and night also make shrimp shocked.

Farmer assesses the salinity of input water by tasting it.

Farmer prefers the enclosed model of shrimp farming. He also thinks that it is hard to convert to other models different than intensive shrimp farming because the land is already transformed.

Farmer can read the instruction on toolkit

Table 12 Livelihood summary of farmers

		Farmer 1	Farmer 2		Farmer 3	Farmer 4	Farmer 5	Farmer 6	Farmer 7
District		Thanh Phu				Binh Dai			
Ward		An Nhon	An Nhon		An Nhon	tanh binh	tanh binh	tanh binh	My An
Model		Integrated Model	Integrated Model	Intensive Model	Integrated Model	Brackish + Rice	Brackish + Rice	Intensive Model	Intensive Model
Area (ha)	**Shrimp**	1	1	0.2	1	0.5	2	0.15	0.35
	Rice	0.7	0.5	-	0.6	0.5	0.7	-	-
Shrimp Type	**Brackish**	Black Tiger	Black Tiger	White Leg	Black Tiger	Black Tiger	Black Tiger	White Leg	White Leg
	Fresh	Giant Freshwater	Giant Freshwater		Giant Freshwater	-	-		
Rice		OM6162	Seasonal	-	OM6162			-	-
Stock Density (/ha)	**Brackish**	100,000	100,000	1000000	50000	150000	100000	500000	800000
	Fresh	25000	10000		10000	-	-		
Dredging Period		3	3	3	3	3	3	3	3
Dredging Cost		5000000		20000000		12000000	10000000		5000000
Initial Investment		-	-	100000000	-			50000000	
Investment Overhead operational	**Brackish**	19200000	8000000	157000000	7850000	4900000	4000000	138000000	412000000
	Freshwater	19200000	2800000		16800000	-	-		
	Rice	3120000			1200000	3350000	18000000		
Cost of farming per unit	**Brackish**	192	80	785	157	35		431.25	1471.428571
	Freshwater	768	280		1680	-	-		
	Rice	1418.2			800	4187.5	45000	-	-
Selling Price per unit	**Brackish**	5000	5000	1000	7500	5000	5000	1200	1000
	Fresh	13000	13000		17500	-	-		
	Rice	6500			7500	-	10000		
Market Volume	**Brackish**	10000	10000	260000	7100	12000	6000	300000	500000
	Fresh	3800	3800		2500	-	-		
	Rice	2200			1500	-	400		
***All Cost is in Vietnamese Dong**									

Government Interviews

Legend
I – Interviewer
G – Gurvinder
L – Dorien

Reference Topic Sheet for Questions

General questions

1. Names & positions of interviewees:
    a. .....
2. Knowledge on the Mekong Delta Plan (*when they are not familiar, give a short intro*)
    a. Familiar with the MDP?
    b. Ideas on their role within the MDP?
    c. Involvement in drafting the MDP?
    d. Perception on the MDP? (positive/negative/focal points)

Provincial Plans (introductory questions)

3. What is the responsibility/mandate of your organisation regarding the following plans:
    a. Socio-development plan (Planning, implementation, not involved)
    b. Land-Use Plan (Planning, implementation, not involved)
    c. Agricultural Plan (Planning, implementation, not involved)
4. What is the policy or rule that forms the basis of your responsibility?
    a. Socio-development plan:
    b. Land-use plan:
    c. Agricultural plan:
5. How is the land-use plan structuring your work?
    a. Purely provisioning of information to the Land-use plan
    b. The land-use plan structures their activities
6. Are you also involved in the planning/development of infrastructure (dikes, sluices, irrigation)
    a. Involved in planning
    b. Involved in implementing
    c. Not directly involved

Perceptions on the linkages between the agricultural plan, the land-use plan and the Mekong Delta Plan

In the Mekong Delta Plan it is indicated that Ben Tre should adapt to salinization and modernize the agricultural sector into an 'agrobusiness' model. We would like to ask some questions on how you perceive these policy proposals.
In the Mekong Delta Plan, it is proposed that saline water will be allowed to intrude Ben Tre province further in-land. (see also figure)

7. What is your perception on this proposal?
    a. Will it be feasible?
    b. Will it cause problems?
8. What is your understanding of the current state of implementation of the provincial plans at the district level?
    a. Is there a district level plan for Thanh Phu/Binh Dai?

b. How far is the current implementation process?
c. Is it in line with the Provincial plan?
d. What are the accountability measures in the implementation?

9. What is the role of private sector in the agribusiness model approach?
10. How is this addressed in the land-use plan and the agricultural plan?
    a. Can it directly be applied?
    b. Need a revision of plans and practices?
11. What should be changed in order to make this work?
    a. New infrastructure?
    b. Agricultural transformation?
    c. Adaptation of the plans?
    d. Cooperation with other organisations?
12. What is your perception on Implementation of this proposal?
    a. Will it be feasible?
    b. Will it cause problems?
13. How is this be monitored and addressed in the land-use plan and the agricultural plan?
    c. Can it directly be applied?
    d. Need a revision of plans and practices?
14. What should be changed in order to make this work?
    a. New infrastructure?
    b. Agricultural transformation?
    c. Adaptation of the plans?
    d. Cooperation with other organisations

Motivations

In this set of questions, we will ask you about your motivations to improve the situation in Ben Tre. The answers on these questions will help us to assess the perceptions and motives for the implementation of the MDP. We have divided these questions into two blocks: questions on your perception on the problem of salinization and your perceptions on possible solutions; and questions on your professional role and how you think you can address the issues within the institutional setting. It is important to note that we are interested in your perceptions, how you – in your presence as government official – think about these issues. There are no good or wrong answers.

Perceptions on problems and solutions

15. What do you think are important implementation challenges risks for the Ben Tre Plans **(General question**)
    a. Monitoring
        i.
    b. Accountability
        i.
    c. Re-evaluation process
        i.
    d. Cross- Evaluation between departments
        i.
16. What do you think are possible solutions to address these risks? **(General question)**

17. How can the Land-use plan and the agricultural plan help to overcome these problems? **(General question)**
    a. Does it already address these questions?
    b. Should it be adapted? How? By whom?

Perceptions on professional role

18. What is your main responsibility in your job? **(ASK EACH INTERVIEWEE TO ADDRESS QUESTION)**
    a. Improving the lives of farmers/citizens of Ben Tre
    b. Improving the natural environment of Ben Tre
    c. Improving policies and plans as directed from Hanoi
    d. Influencing the debate on climate change
    e. Drafting plans for Ben Tre
    f. Other….
19. Do you feel like you have space to alter current practices?
    a. Through cooperation with others
    b. By providing information to others
    c. Directly influencing farmers/citizens

<u>Abilities</u>

In this set of questions we will ask you to reflect on the abilities (means) that you have to address the situation in Ben Tre. The answers on these questions will help us to assess the abilities for the implementation of the MDP. We have divided these questions into three blocks: institutional abilities; financial abilities; technical abilities.

Institutional abilities

20. What other organizations are involved in developing/implementing the land-use plan? (General question)
    a. Governmental organisations (national, provincial, municipal)
    b. Divisions within your organisation
    c. People committees
    d. Research institutes
    e. Others
21. With which organizations (or divisions) are you cooperating in developing/implementing the land-use plan?
    a. Governmental organisations (national, provincial, municipal)
    b. Divisions within your organisation
    c. People committees
    d. Research institutes
    e. Others
22. How are these cooperations structured?
    a. Who provides information to whom?
    b. Is this cooperation institutionalised (bounded by rules) or informal?
    c. Is there a hierarchical structure?
23. What are bottlenecks?
    a. The (non)cooperation with other departments on developing/implementing the land-use plan

b. Hierarchical structure
c. Differences in content

24. What are organisations you would like to cooperate with?
    a. Why has this not happened yet?

Financial abilities

25. What is the financial capacity to develop/implement the land-use plan?
    a. Budget of organization
    b. State-owned money
    c. International donors (WorldBank, JICA, ADB, Nature organisations)
    d. National donors
26. What is the financial capacity that you have to improve/alter the land-use plan?
    a. Budget of organization
    b. State-owned money
    c. International donors (WorldBank, JICA, ADB, Nature organisations)
    d. National donors
27. Do you have sufficient financial abilities?
28. What are priorities?

Technical abilities

29. What are technical abilities that you have to develop/change/implement the Land-Use plan?
    1. Availability of information on climate, hydrology etc.
    2. Availability of information on economic aspects
    3. Support to farmers
30. Do you have sufficient technical abilities?
31. What are your priorities?

May 24th Interview Binh Dai Dinh Truong - Commune People's committee

I: So, we got one official of the district level and one official of the office of rural and agricultural development at the commune level. He is official of economics and climate at commune level. He works on rural transformation and irrigation and electricity. I will ask about MDP. He has never heard about MDP. He knows a guy who is responsible for climate and they do something to materialize the plan. But he himself does not know.
G: …and about resolution 120?
I: so, I skip the question about resolution and MDP?
G: yes
I: so, I moved to the apart about adopting new farming practices?
L: also, which plans are they now working with?
I: yes. They got an investment from the central government, it's about 50 billion to develop and support aquaculture. But this plan is now only on the paper right now, no money yet.
G: but this 50 million is for this commune only?
L: and for what kind of aquaculture is that?
I: because the intense shrimp farming is the most dominant in here, so it's the investment for that.
L: so, the investment is for the infrastructure for the intensive shrimp farming?
I: yes.
L: maybe I did not understand…you said 50 billion is only the plan because they need money to implement it? And did they use 50 billion just for the plan making or…?

I: 50 billion is for the infrastructure
G: but they haven't received the money yet, it's just on the paper?
I: yes, just on the paper. It's especially for electricity because he said that intensive shrimp farming needs a lot of electricity. They invest a lot in electricity.
G: so, then this comes under "socio development"?
I: he said the level of planning is one master plan on the provincial level and one from the district level, but they just implement it. They are not involved in drafting the plan.
L: and they can change and then choose? The current situation how the plan is, is that different?
I: so, they got the provincial master plan to divide the commune in 2 areas - one fresh water area and another practice area. But in practice because shrimp farming from this area is from a long time ago. So, in practice, the area for shrimp farming is more. And he said because the main reason is the dike system to protect the area to clearly divide it to fresh and brackish water, but the system has not been finished yet. So, the area for shrimp is more than the plan
L: And is it a problem for them? So, will they try to change the plan, or will they try to change the farmers?
I: there are 2 points. Firstly, he said that the idea for household is outside the plant brackish area, so in the future when the dike system will be completed they will encourage the farmer to transform the crops to fresh water like fish, aquaculture or even fresh water prawn. The 2nd point is that there are meetings with the farmer to test the plant, so that the current practice area, they can keep doing the shrimp farming practice. But the province, there has not been any respond yet.
G: but their preference is the 1st or 2nd?
I: they are quite in favor of the second one because it keeps them from the problem if we encourage farmers to change. So, for the dike the budget is from the central government and it was planned for 2013, but it has not been completed for a very long time.
G: but is it still as planned or there are issues why it has taken so much time?
I: I will ask about that later. His role for the commune is not the same as previous one, just to monitor. It is the duty of the commune authority. The people will report to commune authority, commune will report to district authority and district will deal with it. They got special office for dike to help with it. Kind of a panel for management.
I: he said there are many benefits of the cooperative like qualified shrimp ???lover?? and he said that farmers, when they are form cooperative, they can cut the costs of investment. He said that there is market for shrimp, but they don't know how to do it, that is problem now. But some farmers they refuse that, because they still don't see the benefit of cooperative. I will ask about cooperation with agro business. He said the shrimp farms they still very much rely on the experience of farming. To improve the situation, they need technical training from the higher level.
G: and is there a plan for that?
I: they got yearly training in which certain companies come and explain how to improve the farming practice.
G: How are the farmers selected for this training?
I: it's for all farmers, they invite all of them.
G: but I assume not everyone joins for the training, or is it all of them?
I: its most of them, 17-18 farmers.
G: I had one question regarding the agribusiness model where he mentioned that they are establishing the cooperative and cutting down cost of investment. Other than that, so they see other opportunities in agribusiness? Because they guy from yesterday mentioned they do some other opportunities like certification? Improving the quality of products? Is there something similar in this area also?
I: they see the opportunity in the high-quality product, so they can increase the value of the product.

G: Okay.
I: He said in the future they will hire the Vietnamese govt to certificate the intensive shrimp. Because most of them are doing intensive shrimp.
G: is it certification of quality?
I: Certificate that it is clean. I can google it for you, that certificate.
G: Did he mention something about the role of private sector? Is it involved in some other way?
I: the companies also do it but in a different way. They will go to a local area and do some workshops. Private sector is only one company – Shrimp lover company.
G: just one thing I wanted to ask…. I forgot…It was not about motivation…I forgot it, sorry, what was it
I: so, we move to the later part?
G: I remembered, sorry. So, did we discuss about the adaptation part?
I: so, they got the support from the IMD for adaptation, but it is not, there's nothing about adaptive model. But They are involved in a project on the commune scale. The project with local authority to install a warning system. So, when there is a salinity increase, they will inform the farmers. The local farmer with provide husbandry for the household. They also provide fresh water tanks. Basically, it is not about transformation, but about support. It is for any sudden incident like sea level rise or salinity. It is environmental monitoring.
G: so, is it a device?
I: it is like a system like you see…with some antenna, when they want to announce…
G: ah, so its communication system.
I: yes.
G: but how do they know its increased? Did they also provide the technical system or is it just communication?
I: it's communication and they receive it from the higher level.
G: when you said it's a warning system, I though they installed some device to monitor…
I: no, it is just a communication system, to communicate. And what they try to do in this area is they try to do the next value chain in shrimp farming.
G: so in terms of tasks, here, it's more about implementation than planning? So, can we ask specifically which tasks are similar to the ones from yesterday? like workshops? What do they mean when they say it's for implementation? it's difficult question…
I: so basically, I asked him about in order to communicate the provincial plan they discuss it in the mitten??? on the local scale, so in that mitten they also introduce the model and encourage to come.
G: may be a follow up can be about the general risks that they see?
I: he said about the weather and the relativity on the market – the price of shrimp is too low now.
G: is there something specific about the weather?
I: hot weather and temperature
L: is he saying about the weather or the climate change?
I: he never mentioned about the climate change, just weather.
L: but is it about the future or the current weather conditions? I
I: no, it's not climate change. Now the duration of the hot weather is much longer and there are more fluctuations in weather conditions. It is also a problem. Not climate.
L: …and migration?
G: regarding those challenges, are there some solution possibilities?
I: he said first the problem is for farmers to experience this hot weather and then he mentioned about the machine…. the device to reduce the risk.
G: but he doesn't see the transformation alternatives, it all is to do with intensive shrimp?
I: he said about the new technology to reduce the risk like prevent the disease and water treatment and installment of the oxygen pumping machine.

G: but it's still about the intensive shrimp?
I: yes, because that is the most common model.
G: why I wanted to ask this, is are there any plans in the future in the long run to slowly encourage people to transform to other models from intensive shrimp? Is it just for intensive farming even in the long run?
I: and this is shrimp farming from 2000s, so a really long time ago.
G: is it because it fits in provincial level plans that this area is designated for intensive shrimp?
I: this area for intensive shrimp is getting old plans….
G: is it a little bit more because the dike is not completed?
I: yes.
G: Can you ask about the main responsibility?
L: …a little bit about his personal motivation….
G: …this question here…
I: but we have already addressed this question, he is a leader for economic development
G: no, but for himself, what are his personal thoughts? Does he do it per mandate or what are his personal goals?
I: first about the environment and improve the livelihood, and he wants support from the upper level.
L: may be abilities now?
G….and other organizations in this area, you can say like…in the commune the functioning organizations…
I: he said there is a man from higher level and they implement it
L: but are they also working with other people's committees to implement, other research institutions.
G: but I need specific to ask him, because there are many organizations working in this area. I have already asked about the others, I need something more specific.
L: may be, because he knows the plan about the dike – which organizations are also involved in this? From the dike's point.
I: so basically, they got meeting in which they invite representatives from each commune.
G: but in the day-to-day activities, do they also exchange information with other communes?
I: he said that they need to collaborate, but each commune works independently
G: so, once they have the responsibility for each commune they more or less work for themselves, independently?
I: yes, yes. so, to come up with the plan the provincial authority they all meet, the officials from each commune exchange information, but in day to day activities, each commune will work independently.
G: So, in this process, do they have conflicts or difference of interests with other communes, or not enough of cooperation with other departments? Can he give examples?
I: they have conflicts because in this commune they are in favor brackish of shrimp farming, but in the next they are in favor of fresh water shrimp farming. Because of this you have one side brackish and another – fresh water, and it really divides the area.
L: can he show on the map, where is this?
I: may be here…and here…
G: so, if there is a conflict, who makes the decision in this kind of situations?
I: I need a mouse…
G: my mouse is in my bag, sorry…
I: he said the province decides.
G: can they challenge the decision after? Say if the province says you don't need a sluice??? Gate. Can they go and challenge it?

I: he says normally there is a common voice between the provincial authority and the commune authority. So, if they suggest something and the provincial authority see relevance and importance, they will come to local area to see and assess.
G: it is up to the provincial authority…
I: yes.
G: so, can we ask about the financial aspect, because he has already mentioned about the 50 billion, they have financial support. But are there other sources also?
I: yes, the 50 billion is from the central government.
G: so, do they have some financial support from the other organizations?
I: the investments from private sector are limited for this project, so they receive regular investments from the central government.
G: are there some projects they want to prioritize but they still have not received funding or approvals for those?
I: not at the moment.

May 24th Interview Binh Dai Thanh Phuoc People's Committee Officials
Guru(G): let's start with this one.
Interviewer(I): he said that it is practical, he knows it because of the TV.
Guru: It's library.
I: he said he's impressed with MDP.
Guru: the responsibilities….
I: yes yes…Economic management, general management. They are responsible for aquaculture. So basically, it is planned on the district level so that they can raise their opinion about the plan.
Guru: similar to last…
I: yes, and then they assimilate the district plan in one master plan.
G: so, this is the provincial level where they do this or district?
I: it is district.
G: Okay, so that means that they are involved in the planning process?
I: yes, they are writing their opinion.
Lady(L): so, it is more kind of participatory plan making where they are allowed to provide input? It's like that they don't make the plan, but provide opinion?
I: yes. So, in the district level they give the orientation to each commune. If orientation fits, they adopt it.
G: and what if it does not fit?
I: they express their opinion about the district planning, that is how they interact with the plan.
G: and once the plan is made then their responsibility is once again implementation, similarly?
I: yes. After receiving the plan from the district level, they will host a meeting to give a plan to stabilion???
L: so, they receive the plan, if they agree with the district level. The district level makes the plan. So, they are not involved with talking to the consultants or really drafting the plan, they just get the plan.
I: yes, they just get the plan.
G: so, its prepared by filling and the district will account for those fillings somehow. So, there was the meeting to communicate, right? Are there any other tasks which they consider for implementation?
I: he said that if they don't like the plan they can raise their voice and they communicate it to the district or upper level.
G: why I asked this was because in the last commune there were similar projects, so is this something in this commune also? So right now, is it only adapting only based on communicating?

L: can you ask about the mist recent plan? What is the current plan for this commune?
I: the most recent plan…they have a plan to divide the commune to half. The 1st half is for 6 months - it is for the rice, shrimp and the 2nd one is for the intensive shrimp farming, the year-round saline
G: and the 6months rice, 6 months shrimp…? 6 months brackish is for…
I: rice, shrimp
G: but how is it managed? Are there sluice gates to control it?
I: they rely on the natural salinity??
L: so this is the plan, the 50/50??
I: it is not the 50/50, it is two models, to two prompt.
L: so, the plan is to have two district models and how is it in reality?
G: yes, in reality?
I; it is mixed together… like rice, shrimp and intensive shrimp.
G: oh, okay. And like…is it?
I: so, he said that there are clear geo boundaries for the two, but now it is all mixed.
L: and is it OK for him that practice and plan are not the same? Or is he trying to steer it?
G: …to steer it…
G: you said there are 2 models, but not 50/50. So, what is the share? Is there one more predominant model?
I: there's actually no dominant. He said rice shrimp is prioritized in the area
G; may be the next one can do the transformational and adaption, before you go?
I: talking about the transformation and ???husbandry?? there are chicken, cow farmers in the area
G: I/m not sure how to ask that question, but basically there's more and less extensive, like the rice shrimp model…Do they also consider the integrated more for the transformation?
I: he said previous there were some problems with ???press?? industry on the rise, but population is low. And also, there is some group from the university, they came here to promote the model
G: and do they consider their model to be a part of transformation planning?
I: they tried it, but it wasn't good.
L: and what king of farming were they trying? Was it intensive farming or the mixed system?
I; you can only do it on the rice/shrimp field
L: okay.
G: may be before going to agribusiness it's nice to ask - he says it was not good but let's talk about the motivation of this particular model then. What did they think were the risks of that model? Why was it not good? And are there some solutions?
[PAUSE IN INTERVIEW, PROBABLY INTERVIEWEE LEFT??]
….so, they have government and police in the same building?
I: it's civil service, not police, they are of higher authority.
G: okay, so he is from economic management?
I: he's from general management of aquaculture. So, he said he does not know. He says from the university they came here, and they chose one house for the experiment. But then they failed to promote the mono here because people here are more in favour of Black Tiger shrimp. You know the difference, when you do the black tiger shrimp and then fresh water, you see rapid change in farming practice
G: with brackish you can't do the black tiger?
I: it's different because if you do the mono brackish shrimp and then rice, the brackish shrimp is a main crop, but if you integrate the black tiger in the mangrove, the focus shifts. It is not the man focus anymore. That is why people are more in favour of black tiger shrimp.
G: then I do not understand the advantages of integrated over just brackish with rice…may be that's for a different discussion between us…

I: we need some very detailed assessment, we can discuss tomorrow, I hope we can work now on this project.
G: yes, that is a different discussion, we can discuss that later.
I: I will ask about agri-business and their preferences. So, they only got already the mangrove shrimp, just only the mangrove shrimp.
G: So, this commune has mangrove shrimp too?
I: yes, they are farming mangrove shrimp already. Right now, they are targeting to have the market for mangrove shrimps. It's not yet established, but they have made some effort to ensure the output. But that's only for eco/aqua shrimp. If it will work for the mangrove shrimp, they will do the same for the intensive shrimp and rice shrimp.
G: and this is the cooperative and the cooperation is with the company?
I: yes, the company. To cooperate with the company because the market for shrimp is more stable. He said they are aware of the risk of ???salinity intrusion?? And then he immediately linked it to the practical operation of the daily life. How every household is encouraged to buy more water storage tankers to deal with the fresh water shortage.
L: Do they also have the ??lake?? for fresh water storage?
I: every household should be equipped for fresh water shortage, and store ground water.
L: ground water or rain water?
I; ground water.
G: so in his perception to counter? salinity? you need water from the ground?
I: to counter salinity they have access to ground water, but the normal household does not have it. [36.30].
G: you they should store in water? We have seen in the shrimp eco system that there was water collection
I: there are water tanks
G: but when he says that households should have water tanks he means rain water? Or he means ground water?
I: just fresh water. And it could be rain or ground
G: so just to store fresh water.
I: I will just ask him how about the salt solution changing farming practices?
G: yep
I; so they adopt salinity tolerating rice or PPT
G: was it through…how did they develop that? Though private sector? Institutions? Or just through practice? How did it develop?
I: through provincial level. They got a lab and they invented new rice crop.
L: and is it widely adopted here, the new rice crop?
I: 3 households are trying this new rice crop and only one succeeded. That is because they grow earlier than the normal rice and then they were rotten. So not very successful. He mentioned you need a special technique to grow this rice. They have 600 acres for rice and shrimp. The area for rice/shrimp is bigger than for intensive.
G: maybe we can move to motivations?
L: yes
I: [47.03]. About the risks he mentioned firstly the weather and secondly about polluting the water.
G: is there something specific about the weather? What does he mean?
I: normal weather is usually hot, he means the long duration of the rain. And it's negative impact on shrimp.
L: can we ask as well about migration?
I: do you mean bout the lack of labour?
L: yes, about young people moving to the cities
I: he said now you need to hire more labour. Normally you don't need to hire labour.

L: is it a risk? The fluctuations?
I: the market is not stable.
G: when he says polluted water, what does he mean by pollution?
I: he relies on the monitor result from Quan. The warning is included in the result paper.
G: technically the fisheries at provincial level compile the report. So, he is a compiler and interpreter? He uses that 2016 MNP standard? Is it possible to take a copy? Oh, it's on google…okay. For the ranges – that sort of what I need to decide what is a good range for each province.
Moving forward, does he see any solutions to those risks?
I: to make advice on crop calendar.
G: did he mention about transformation?
He does not mention transformation as a solution. Do you want me to ask?
G: yes, let's ask.
I: he mentioned about the cool period of shrimp farming practice. So 1st young shrimp will be hot in the greenhouse and after will be released in the point. That is a good solution from his point of view.
G: so, we've seen similar
I: there they don't use the green house, here they do it. To isolate shrimp from the environment. It's not really a greenhouse but isolate with something like a net.
G: do they use it already in this area?
I: 7 farmers already implemented it.
G: do they have positive results those 7?
I: very effective and profitable. They did not receive any financial support. They own it themselves.
G: should we ask if in the long run he thinks intensive shrimp is a good solution?
I: [1.02.40] in his opinion to better serve the economic development, intense farming is more favourable. Firstly, about the consumer side – maybe they are more in favour of rice /shrimp because it is a more natural way of farming.
G: can you ask him about the challenges in his day to day activity to implement that?
I: for communication that is not a problem, but someone may be left out because not every has the same access. There is a panel for upper management where one leader represents a village.
L: can we ask about the personal goal?
I: he takes care about everything like transportation etc.
G: those are all his responsibilities, but is there something personal from this list that he cares more? Like farmers or environment?
I: he said he wants farmers to have a good life and he wants to educate farmers on the impact of their farming practice etc. I think his role is more management.
G: the abilities, the last part.
I: so, they collaborate with municipality on the commune scale on communication and education and in the vertical direction he said that they mandate people committee on the district level.
G: are there any other organizations involved? NGOs? Governmental?
I: NGOs are involved.
G: do they have conflict of interests with the other communes? And how are they resolved?
I: each commune has its own goals planned, so no conflicts. Nothing conflicts.
G: are there any other departments which he wants to cooperate with?
L: would he want to cooperate with any other university?
I: he said that the upward linkage is effective.
G: he is happy with that structure? He does not see the need to cooperate with the other divisions.
I: he thinks that the commune scale is fine.

G: just the last part – about financial. Do they have enough funding and support?
I: the funds are from the higher authorities and some more from farmers.
G: but not from donor organizations?
I: donors also contribute and local people.
G: so, funding is sufficient for implementation?
I: No.
G: okay, any priorities for which there is not enough funds?
I: he manages everything in general and he relies on the existing funds to make plans.
L: maybe we can ask if he has more money what would he do?
I: to spend on road, to construct better roads.
G: at their present level do they think they can handle or do they need additional training?
I: so, they see it like that: from the district level→ planning→ orientation→ operationalize the model. I asked about the resource to operationalize the plan, and he said the higher level is very reluctant about it.
[1.36]. They received a budget promise from the government, but he does not know about the exact procedure about the funds allocation to different commutes.
G: have they already received the money?
I: they received the money but that is for communicating and educating, for communication activities.
High value: shrimp, some intensive and regular.
G: the report that he has to operationalize, where does it come from?
I: the plan? It comes from the people committee at the district level.

May 23rd Interview Thanh Phu Commune Anh Nhon People's Committee Official
Interviewer(I): He has never heard about Mekong Delta Plan. I will ask may be about adaptive process. They got the plan at the upper district level, especially from 2015, when historic salinity event occurred. So according of the commune authority in charge to prevent the salinity increase and sea level rise, there is a need to wrap the local situation and give support to farmers. But there is no practical support like human resource or financial one.
Lady: do they also work with the climate change scenario?
I: you mean the guy here, if he participates?
L: yes
I: RSCC
G: RSCC something about Climate Change?
L: Climate Adaptation something?
I: they have scenario for climate change and this project is to benefit women, they get women tasked to measure salinity. They have local people to …how to say to …recognise the weather signal, yeah.
G: and this is RSCC project?
I: yes
G: and one more thing, they mention 2015…due to this salinity event, some decision came, did it come from the people's committee or some department. Where did it come from?
L: maybe we can also ask if this decision influence the planning after the 2015 decision? Whether it has an influence in the planning for this commune?
I: he said at this public event they just reported the damage to the upper level, but there's no support as the budget is limited, they don't have enough financial capacity to build the dikes to prevent salinity intrusion. They just report the damage.
L: so that would be the preference to build more dikes to prevent salinity?
I: The whole province is struggling because of salinity and they need more slow gate. He said the main responsibility is at the district level and at the district level they will decide which commune will get the dike or the slow gate.

G: okay…did you ask about the decision from 2015, where did it come from?
I: from the district level department…from People's committee, the communist party. This organization is even higher than the district level.
G: from which the de
L: so, it's from the party?
I: yes, yes. So, the role of commune in the district planning?
L: yes…
I: so, the district authorities are who design the planning and the commune just implements the planning. So, they are not involved in planning, just the implementation. The district authorities in the planning only consult. So basically, before they come up with the plan at the district authority, they create a survey. In that survey they involve the communal authorities. You want to ask specifically about social development of land use and agricultural planning?
G: no, not really
L: we can ask about the plan for the commune and its implementation, if the plan and implementation are the same? what the difference is between the plan for the commune and implementation?
I: So, one year ago they got the plan promoting the rice shrimp and previously they got that survey and they had a different area to control the rice shrimp, like rice, mono rice are etc. and local farmers were based and relied on that plan which means they were allowed to do shrimp farming, but it's flexible. It is up to the farmer.
L: and what is the change rate?
I: they [did] it completely. So, we move to the agricultural planning. They already proposed the agricultural planning, but the problem is shortage of budget, so they cannot implement it. They want a dike.
L: the picture in the hall way, is it the dike they propose? Also, Is there really no money or that they have at district level another perspective on building dikes?
I: so, the plan is similar from commune to district to province level. So primary reason is the funds.
G: so, I understand that there are limited budget and limited resources. But are there any active implementation strategy that they have?
I: in implementation?
G: yes
I: he said that there is no adaptive planning because the area he mentioned is not the area where is acidic, so there's no way to do [aquaculture], only rice, shrimp and fish.
G: so other than rice and shrimp, there are no options, and that's why they want to build the dike?
I: they want to build the dike to stop salinity intrusion.
G: okay.
L: and so, they have problems with coastal erosion in this area?
I: two km is erosion.
G: in what period does this happened?
I: it happened a long time ago, and especially in wind season and normally this happen at the end of dry season. This is annual.
G: and this is only in this region or is it generally common?
I: this area is directly hit by the wind. This has also happened in another commune.
L: can we continue with the risk, what they see as the prime risks of development of this area?
I: he mentioned about the climate. There was abnormal weather that killed the shrimp and also affected rice. The weather.
L: and other things like e/immigration….?
I: he mentioned about poor households and landless people, they don't have land and they are just season labour.

G: what does he mean about the weather, can he unpack it?
I: normally the weather is for example in rainy season - it will rain normally. But now it is rain in 1 month. And then it stops. It affects rice farming because rice, you need to do it in rain season. So local poor people, they need to go somewhere else to find jobs. So, I will switch to the role of public sector?
G: if we are speaking about it, can you ask about potential solutions to those risks?
I: For the abnormal weather, the local authorities say they need to inform farmers about crop calendar, when to start cultivation of crops. Then farmers, through meeting in villages will get info. He mentioned about the lack of the system, lack of a warming system...like in Japan.
G: lack of a warning system...
I: he said they already have plan for organic rice. They got to know their rice product is certified as organic rice, but not yet for shrimp. They are planning to turn to organic shrimp farming to increase the value of shrimp on the market.
L: are they working together with other communes? Or are they doing it at the commune level?
I: so, the planning for organic shrimp will happen like this - they firstly invite the company and the company will come and will test the shrimp sample. Then they will sign the contact. He said it happens at the commune level. It is the idea of commune authority. But the company is from another area, not local.
L: Vietnamese?
I: Yes, Vietnamese.
G: this question sort of builds to the next one...about the role of private sector...
I: he said they not yet cooperate with private sector, the only involvement of private sector in the commune is that they buy the shrimp form the province in central Vietnam. That is his idea about involvement of private sector.
G: does he see another opportunity for the private sector involvement?
I: He keeps on mentioning about the quality of shrimp LOVER???? In local areas no one can be sure about the quality.
G: but maybe they could do some private public partnerships and bring in public sector rather than rely on the government? Cause he mentioned that there is a lack of funds...that was my thought behind this question, that rather than relying on the government to cooperate with private sector.
I: he said the government authority cares about the benefit of citizens, but for private sector if you want to make them do something, they have to see the profit. You have to make them see the profit first.
L: yes.
I: and about the investment from local people - most of the ppl are very poor, and suspicious about the dike construction.
L: so, his motivation is cleared...
G: so maybe you can ask...because here they are more focused on implementation, so are they more focused on monitoring or is it about physical actions and how do they define successful implementation?
I: so how to define successful implementation...?
G: yes.
I: He said based on the effectiveness of planning. He gave an example of transformation to another model. If the transformation is good that is no way to revert this.
G: but the example of transformation, how do they know if that is good? Do they have clear KPIs?
I: because at the monthly meeting at the village scale, each farmer will report the socio-economic situation to the local authority.
G: okay, so by socio-economic they mean debt or production or?
I: Each farmer will report their profit.

L: does it mean that at the commune they have information about each and every household?
I: I don't think so. I think like it's a general number. It's a representative in a village.
L: so, this monthly meeting is not by individuals, but someone reports for the group?
I: yes.
G: so, this is done on a monthly basis?
I: yes
G: and the outcome of this is used for what?
I: the result will be sent to the commune level…the result will be sent to district and commune level, but there's no practical activity
G: there's no action that comes out of this?
I: yes
G: and then they send it to district?
I: yes. So, they use this information to make monthly reports about socio-economic development and send it to district level.
G: And I assume it moves more up? Like they compile, and it goes up? And it's more for reporting purposes?
I: yes. So, the district level received feedback and they send another paper to ask local authority to ask farmers to choose proper crop calendar and encourage planting certain crops. But there is no financial support.
G: But how are financials organized if there's no financial support?
I: finance on what?
G: for example, if the district gives feedback and says "encourage more" is there like a budget allocated? Or how do they manage financial activities?
I: They only have every year the commune will receive budget but only to maintain the operation of authority. Even if they ask for salinity intrusion, the budget needs to come from private donors.
L: so, the budget is just for maintaining the buildings and paying salaries?
I: yes.
G: I find it interesting that his opinion on private public cooperation is that they will look for profit and I do not see any other source for additional activities…
L: NGOs? And World Bank?
G: okay. And the last one, just about the challenges other than finance that he sees in this job?
I: okay.
L: is there a World bank project in this area?
I: No
G: So, budget is one of the major constraints.

May 23rd Interview Thanh Phu Commune Thoi Thanh People's Committee Official
I: He heard about the MDP. I will ask about his role and the MDP. He received it from a man of upper level. He just received the information from the upper level about MDP, it is just one abstract, without breaking the specific components of MDP. I asked about his perception about the MDP, is this fit to the local conditions or not. And he said the coastal area is severely affected by climate change and this area received a lot of attention from the authority. They got plan to strengthen the dike and also support farmers in their livelihood and they also received financial support from the province.
G: From province or from district?
I: From province.
G: ah!
L: For the Dike or for the farmers?
I: For farmers livelihood.
G: okay.

I: And for the dike it's not defence because this is the coastal area, so basically it is also the idea of the central government at the commune level because they want to construct new rural residential area, so somehow to check the [MITCH] and they got the budget for that.
G: but the financial support is majorly for the dike?
I: all from provincial level.
G: hmm, okay.
I: Small men responsibility is to encourage farmer to transform their livelihood. Also, he mentioned recently in the beginning of 2015 they also established agricultural cooperative.
L: so, you said the task is to change the livelihood?
I: yes
L: so, what is the preferred livelihood…to change from what to what?
I: So, they got financial support from the district level on husbandry, but for shrimp coconut is only technical support and training, no financial one yet. But he mentioned at the district level there is a financial support for farmers to borrow money from the bank, and they cover the interest rate. That is for shrimp. I will skip the question about the land use. We asked about educational planning, about the dike. So, there is a man responsible for monitoring the constructions and also when they…basically everything is from the provincial level. And when there is a problem, they tell it to provincial level.
G: do they have the expertise, or do they hire external parties to do so?
I: They rely on neighbors, on people who live nearby the construction.
G: to relocate them?
I: I mean… they chose the local people to monitor it. Before the construction started, they got a meeting with local people. The local people they know what is going to happen on the land, and they will monitor the construction. And in case…because they lack expertise, in case there is something wrong but because they already know the area, they will report it.
G: so, they monitor the length of the dike, the limit of the dike?
I: yes, but also, they lack expertise, so they only inspect the visual.
G: do they get paid to do that? I mean what is their incentive to do that?
I: i.e. their property rights that they can participate in monitoring.
G: Okay, that is their property right.
I: so, everything from the provincial level, but the report comes up in which people inform about construction. So, they can participate in monitoring.
G: I had a question about the livelihood transformation that they mention…that they have this responsibility to educate. Or inform people…
I: about what?
G: about the transformation.
I: So, the structure is like this - there are many communes in one district, and in each commune, there are many villages, and, in each village, they divide in many groups and they call it group self-management. So, they got meetings for each group when they want to inform farmers about the transformation. And also, in this meeting they choose typical farmer for training.
G: it is more clear now, we can go forward.
I: So, about the agrobusiness model, they got …how to say…resolution from provincial level establish a value chain and that started 2 years ago, but in implementation process they faced many difficulties, especially in the market of agricultural products, it is not stable. The main challenge is that [THEY CHANGE THE PROFIT AND FARMERS THEY ALSO DO THE SAME] and the role of the government is not the referee, but this role is not very convincing…effective, so there is a problem with value chain.

Appendix 3: SD Model

In this appendix we will discuss the details related to the System Dynamics model used in this thesis.

List of Uncertainties

The first part of this appendix discusses the parametrization of the model. In Chapter 5, the Causal loop diagram which conceptualizes the system model has been discussed. The CLD is an extension to the model developed by Chapman and Darby (2016), with additional alternate livelihood parameters. These parameter values were either taken from the Chapman and Darby model or added based on the expert and field interviews conducted in Vietnam. Table 23 below shows all the parameters that have been used within the model as inputs.

Since we are using the SD model under Robust Decision Making (RDM), the input parameters are characterized as parametric uncertainties and a plausible range is defined rather than a single value. The parametric uncertainties are defined in the model in shorthand, which is done for the sake of convenience. This may make the model unreadable for some, but the shorthand has been kept as intuitive as possible. For instance ExogNutAvailRate, refers to Exogenous Nutrient available rate, InitInvestIntenseShrimp refers to initial investment in Intensive shrimp farming, PopFracExtensive refers to Population fraction with Extensive farming as livelihood and so on.

Table 13 System Parametric Uncertainties

Number	Model parameter	Lower range	Upper range	Sources
1	UpstreamTrapping	0.9	1.1	(Chapman & Darby, 2016)
2	SedNutContent	270	330	(Chapman & Darby, 2016)
3	FloodDuration	0.1	1	(Chapman & Darby, 2016)
4	ExogNutAvailRate	8	15	(Chapman & Darby, 2016)
5	TimeToNutAvailable	2	10	(Chapman & Darby, 2016)
6	MaxNutReqPerHectare	450	550	(Chapman & Darby, 2016)
7	YielGrowRate	1.001	1.005	(Chapman & Darby, 2016)
8	LeachingRate	3	9	(Chapman & Darby, 2016)
9	Salinity Rate	0.01	0.1	WACC Data
10	Salinity Fluctuation Intensity	3	7	WACC Data
11	crop survival probability	0.05	0.4	Interview (Appendix 2)
12	Rate of Degradation	1	5	Assumed
13	BaseTE	0.25	0.4	(Chapman & Darby, 2016)
14	TECoefficient	0.025	0.04	(Chapman & Darby, 2016)
15	RiceFarmSize	0.2	1.5	Interview (Appendix 2)
16	RicePriceChngRate	1	1.003	Interview (Appendix 2)
17	RiceStartPrice	3	9	Interview (Appendix 2)
18	CostRiceUnit	1	8	Interview (Appendix 2)
19	Dredging cost	750	1250	Interview (Appendix 2)
20	InitInvestIntenseShrimp	80000	120000	Interview (Appendix 2)
21	CostExtense	0.03	0.05	Interview (Appendix 2)
22	CostIntense	0.7	1	Interview (Appendix 2)
23	CostFresh	0.5	0.8	Interview (Appendix 2)

24	IntenShrimpFarmArea	0.1	0.5	Interview (Appendix 2)
25	ExtShrimpFarmArea	0.8	1.2	Interview (Appendix 2)
26	intenseSelling	0.6	1.3	Interview (Appendix 2)
27	Extense Selling	3	8	Interview (Appendix 2)
28	Fresh Selling	9	15	Interview (Appendix 2)
29	Extensive Shrimp Recruitment per hectare	75000	100000	Interview (Appendix 2)
30	Extensive Shrimp Survival Rate	0.1	0.5	Interview (Appendix 2)
31	Intensive Shrimp recruitment per hectare	900000	1100000	Interview (Appendix 2)
32	Intensive Shrimp Survival Rate	0.7	0.98	Interview (Appendix 2)
33	Freshwater Shrimp Recruitment per hectare	10000	25000	Interview (Appendix 2)
34	Freshwater Shrimp Survival Rate	0.2	0.5	Interview (Appendix 2)
35	MinWage	5000	10000	(Chapman & Darby, 2016)
36	BackupFraction	1.05	1.3	(Chapman & Darby, 2016)
37	FertPriceChngRate	1.01	1.05	(Chapman & Darby, 2016)
38	FertStartPrice	3	7	(Chapman & Darby, 2016)
39	PopFracExtensive	0	1	Interview (Appendix 2)
40	PopFracInteg	0	1	Interview (Appendix 2)

Output Scenario Discovery

The next part of the appendix deals with the entire output space of scenario discovery. In the section on Scenario exploration in chapter 5, some of the results from the table below are discussed. The vulnerability range of the parametric uncertainties which causes the KPI to go below the vulnerability threshold is defined in Table 24 below.

Table 14 Full Output of Scenario Discovery

Region	Time	KPI	Vulnerability Threshold	Key Uncertainties	Vulnerability Range	
Binh Dai	**26**	Regional Economic Position	< 0	PopFracExtensive	0.01	0.84
				Extense Selling	3.03	7.75
				IntenShrimpFarmArea	0.10	0.48
				MinWage	5198	9989
				Salinity Rate	0.01	0.10
		Regional Soil Nutrient Balance	<100	FloodDuration	0.10	0.91
				FertPriceChngRate	1.01	1.05
				PopFracExtensive	0.05	1.00
		Regional Water Pollution	>1.2575	Extensive Shrimp Survival Rate	0.17	0.40
				Extense Selling	3.73	7.79
				BackupFraction	1.05	1.29
				Intensive Shrimp Survival Rate	0.70	0.97
				Dredging cost	777	1246
Thanh Phu	**26**	Regional Economic Position	< 0	intenseSelling	0.61	1.17
				crop survival probability	0.07	0.30
				ExtShrimpFarmArea	0.80	1.18
				Extensive Shrimp Recruitment per hectare	75989	99899
				CostExtense	0.03	0.05

				PopFracInteg	0.01	0.92
				RicePriceChngRate	1.00	1.00
				Dredging cost	775	1224
				BaseTE	0.26	0.39
				CostFresh	0.51	0.80
				Freshwater Shrimp Survival Rate	0.21	0.50
				IntenShrimpFarmArea	0.10	0.49
		Regional Soil Nutrient Balance	<200	FloodDuration	0.10	0.82
				ExtShrimpFarmArea	0.82	1.20
				Extense Selling	3.00	7.75
				FertPriceChngRate	1.01	1.05
		Regional Water Pollution	>1.232	Extensive Shrimp Survival Rate	0.15	0.40
				PopFracInteg	0.01	0.87
				Extense Selling	4.19	7.98
				ExtShrimpFarmArea	0.86	1.20
				crop survival probability	0.07	0.30
Integrated livelihood Model	**26**	Regional Economic Position	<0	MaxNutReqPerHectare	458	550
				PopFracExtensive	0.01	0.88
				PopFracInteg	0.00	0.82
				CostIntense	0.73	1.00
				BackupFraction	1.08	1.30
				Dredging cost	769	1247
				FertStartPrice	3.40	6.97
				CostFresh	0.50	0.79
				ExogNutAvailRate	8.06	14.59
				Salinity Fluctuation Intensity	3.03	6.61
				TECoefficient	0.03	0.04
				BaseTE	0.27	0.40
				ExtShrimpFarmArea	0.80	1.16
				Intensive Shrimp recruitment per hectare	901192	1092201
				CostExtense	0.03	0.05
				UpstreamTrapping	0.91	1.09
		Regional Soil Nutrient Balance	<100	FloodDuration	0.11	0.75
				PopFracInteg	0.00	0.87
				TECoefficient	0.03	0.04
				Intensive Shrimp recruitment per hectare	909862	1099836
				SedNutContent	274	330
				CostRiceUnit	1.68	7.62
		Regional Water Pollution	>1.227	PopFracExtensive	0.01	0.73
				PopFracInteg	0.00	0.84
				IntenShrimpFarmArea	0.10	0.47
				Dredging cost	769	1208
				Freshwater Shrimp Recruitment per hectare	10601	24124

STOCK FLOW DIAGRAM (SFD)

In this section of Appendix 3, the stock flow diagram created after building on Chapman and Darby model has been discussed. The SD model implementation of Chapman is different compared to the model discussed here. Therefore, it has been treated as a separate entity from the existing model.

The model was conceptualized from the point of view of a single individual and the choices available to the person based on each season's economic output. This choice of modelling as taken by Chapman and Darby gives the model 2 distinct characteristics;

1. It gives the model an agent-based behaviour characteristic where each time step becomes a discrete signal for the farmer to decide on fertilizer application, savings, inundation and expenses for the next season.
2. It accounts for the feedback between, economic position, fertilizer application, land nutrients and rice market.

This choice of modelling is unconventional making the model a hybrid model rather than a simple continuous model. However, as the feedback loops are present and the casual linkages between the different sub-models are pre-defined, it has still been characterized as a System Dynamics model. Since the model was pre-made, it provided a good starting point for extensions required for this thesis. This is the sole purpose for selecting the model and extending it, as a conceptual base was available to extend.

As highlighted in Chapter 5, the entire SFD can be divided into the sub-models which are either existing in the model or were added to the model for this research. The additions were made in consultation with the members at WACC, both staff and the experts present for the MOTA Worksop (Appendix 4), and the data collected in the field trip to Ben Tre.

Land Nutrient Sub model

The section highlighted below in figure 32 shows the stock flow structure of the Land Nutrient Sub-model. This sub-model has been largely derived from Chapman and Darby's work. The key stock here is TotalNutPerHectare which represents the seasonal nutrient soil balance. This is also one of the KPIs in this thesis.

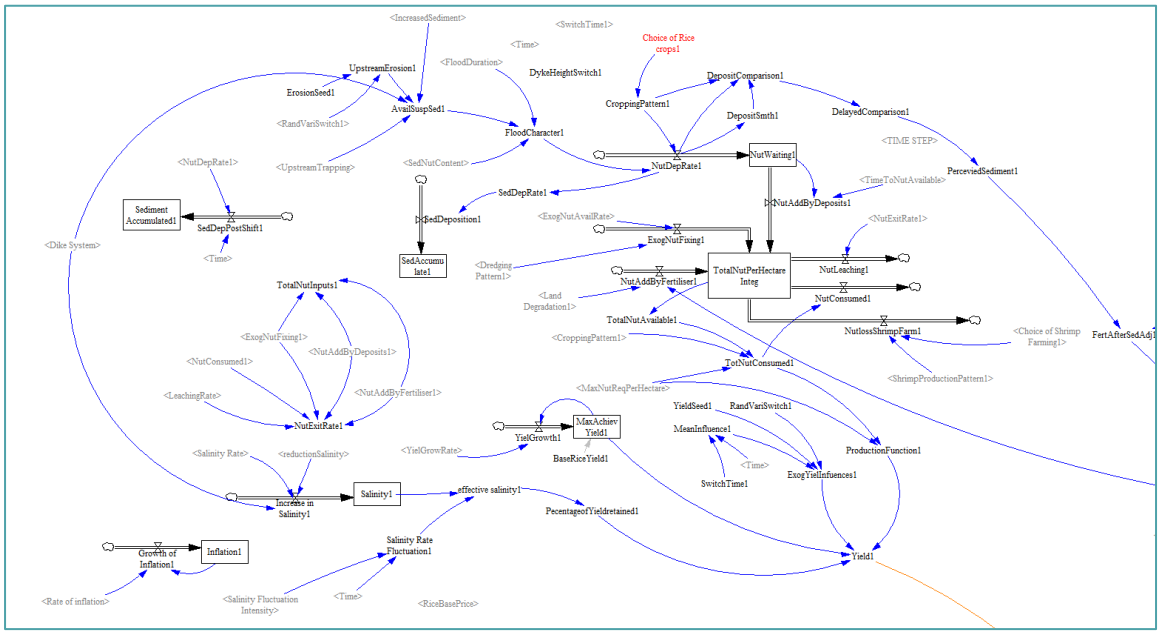


Figure 32 Land Nutrient Stock Flow Diagram

The inflows to the Stock, which help in nutrient deposition are modelled as;

- **NutDepRate** (Nutrient Deposition Rate): This flow is influenced by the flood character and the cropping pattern selected in the model. The flood character defines the sediment carried by the river from upstream which is deposited over the soil. The character is randomised to give it the discrete element as each season, the flood character can be different. The actual inundation period is controlled by the decision-making individual as they can decide whether to inundate or not based on the cropping pattern. The flood character can be further controlled by the "Dyke" implementation policy, as can be seen at the extreme left of the figure. The NutDepRate on the other hand influences the perceived sediment deposit of the farmer if the inundation is allowed. This perception influences the need to adjust fertilizer on the land to maintain nutrient level and thus Yield.
- **ExogNutFixing** (Exogenous Nutrient Fixing): The Exogenous nutrient fixing represents the unaccountable fixing of nutrient within the scope of the model. Another factor affecting this flow is the dredging pattern of the land, if the farmer is engaged with a shrimp livelihood model. The dredging is required periodically as the waste accumulates.
- **NutAddbyFertilizer** (Nutrient Added by Fertilizer): As the name suggests, this flow deals with the nutrient that is added to the land by fertilizer application. The NutDepRate along with NutAddbyFertilizer complete a loop as information goes out from the former and is received in the latter. The nutrient value added by the fertilizers is bisected by the land degradation variable which represents the permanent degradation of land due to over utilisation. This the flow reduces with time.

The outflow to the stock are modelled as

- **NutLeaching** (Nutrient Leaching): This outflow represents the leaching out of the nutrient from the soil due to erosion or rainfall and is defined by the leaching rate observed of the land.
- **NutConsumed** (Nutrient Consumed): Once there is a positive Nutrient balance, the crops growing in the land can consume the nutrients. This is primarily done by the rice crops coupled by the number of crops grown per season.
- **NutLossShrimpFarm** (Nutrient Loss due to Shrimp farming): As shrimp farming produces a lot of waste which needs to be dredged periodically, it causes degradation of land over time. This Nutrient loss is different for intensive shrimp farming, compared to extensive shrimp farming or integrated rice and freshwater shrimp farming. Therefore, it needs to be accounted from the soil nutrient.

The Stock of Nutrient Available in the soil, in-turn influences the yield of the crop growing through the production function. The yield is further influenced by the salinity fluctuation and the salinity intensity which degrade the yield of the land over time. The salinity data was modelled with the help of the actual data collected by WACC, Vietnam over more than 10 years. Any un-accounted yield degradation is added to the model as ExogYielInfluence (Exogenous Influence on Yield). The output from Yield, in combination with the alternate livelihoods sub-model becomes the input for the Individual economic Position Sub-model.

Fertilizer application Sub model

The sub-model shown in Figure 33 represents the Fertilizer application sub-model. This sub-model is directly taken from Chapman and Darby and has been used in the current model. The fertilizer sub-model acts as a comparator, where the yield of the previous season is compared with the desired yield based on the economic position of the farmer. The stock of the recent yield is compared with the maxAchievYield (Maximum achievable yield) to calculate the deficitdesire (the deficit from the desired value of yield). At the same time the stock of the recent Fertiliser Applied, which provides the fertiliser applied in the previous season, is used along with the yield of the last season to create a compound metric of fertiliser performance desires (performance

desired). This is then converted into a Fertmultiplier, which provides input to the Soil Nutrient sub-model for the amount of fertiliser to be applied to achieve the desired performance based on historic data.

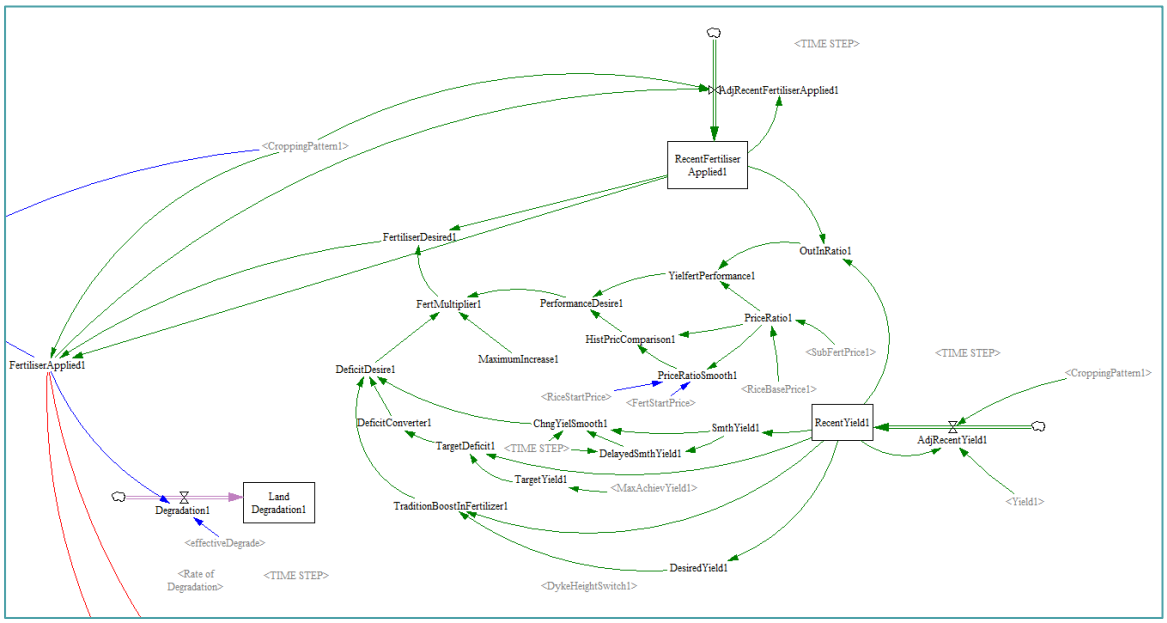


Figure 33 Fertilizer Application Stock Flow Diagram

Another important stock flow structure modelled here is the Land degradation. The fertiliser applied, in the long term, is modelled to have degradation effect on the land. The policy of "eco-rice" (not visible in figure 33) is one option explored to reduce this impact.

Alternate Livelihoods Sub model

The alternate livelihood sub-model as shown below is a completely new sub model which was added to the Chapman and Darby model as an extension. The sub-model as shown in figure 34 represents the shrimp models of Binh Dai and Thanh Phu.

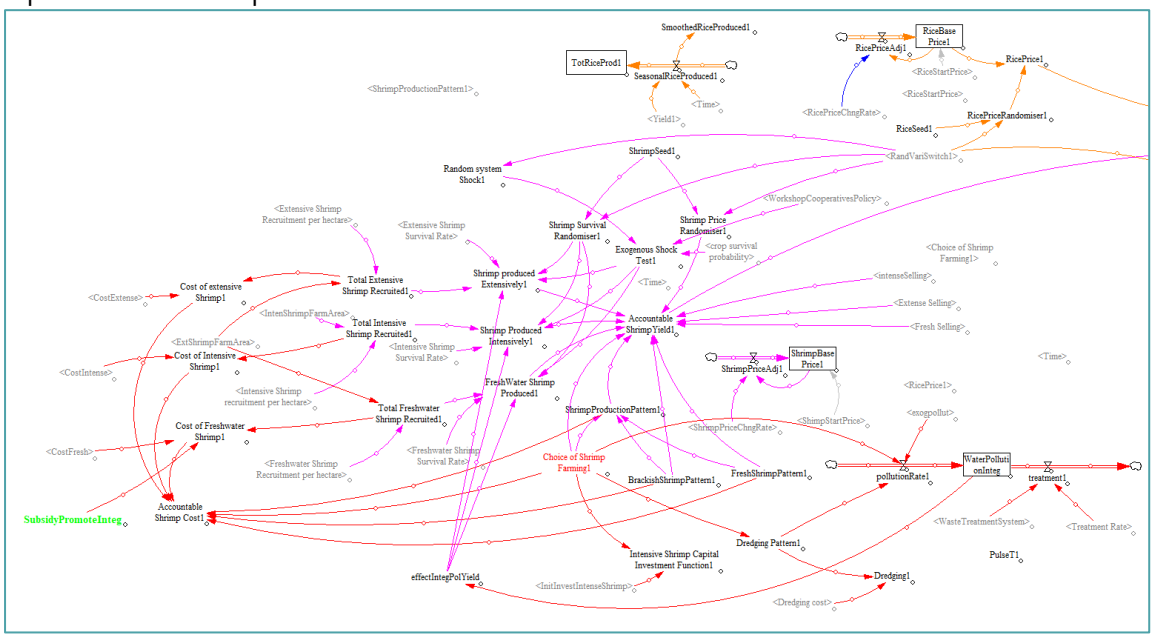


Figure 34 Alternate Livelihoods Stock Flow Diagram

The livelihoods modelled here include; One rice crop with alternate season brackish shrimp farming (Extensive Shrimp Farming), Intensive shrimp farming for both season in industrial/semi-industrial conditions, and one rice crop in parallel with fresh water shrimp and brackish shrimp in

the alternate season (Integrated shrimp and rice farming). This sub-model from the left onwards starts with cost modelling for each of the shrimp model, moving towards the recruitment of shrimp per hectare. This information along with the survival rate of the shrimp produces the yield of the shrimp per season. Using market price randomiser to account for price fluctuations, the total yield selling price is calculated. The top end of the sub-model does the same for rice. This 2 become the inputs for the individual economic position sub-model. In addition, crop survival is added as a probability as shrimp crop is extremely sensitive to changes in weather and water conditions, with potential of killing the entire crop. Another stock flow structure observed in the figure is the water pollution level which is also a KPI in the thesis. The water pollution is modelled in relative terms to the current pollution level in the districts. As the pollution due to exogenous factors and dredging adds up, the degraded water quality has an inverse relation with the survival of shrimp crop. This is modelled through a look-up function.

The 2 policy options visibly explored in the sub-model are "subsidypromoteInteg" which represents the cost subsidy on integrated shrimp practice, and "WaterTreatmentSystem" which is a hard implementation measure for waste-water treatment.

Individual Economic position Sub model

The individual Economic Position is one of the biggest and most complex sub-model is the individual economic position. The Model is complicated as it takes input from all the sub-models discussed above and forms the basis of decision choices in the upcoming season. The initial model structure has been taken from the original Chapman model, however, it has been significantly updated to account for added system dynamics.

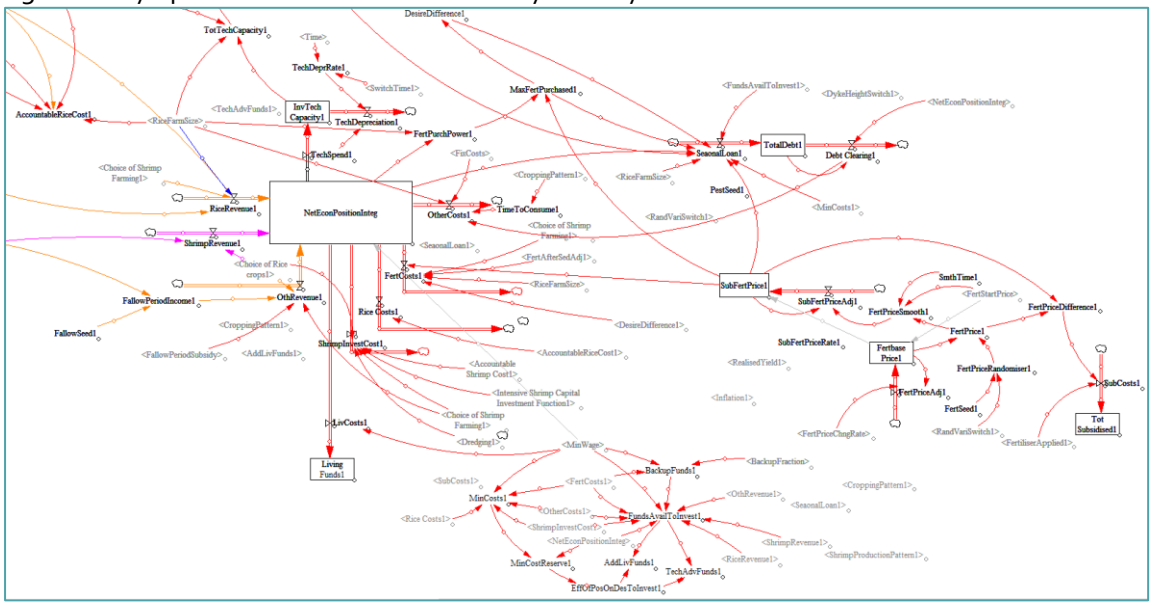


Figure 35 Individual Economic Position Stock Flow Diagram

The major stock flow observed in the figure 35 is the NetEconPosition which represents the economic position of the farmers based on the costs incurred, debts, profits from yield, individual spending and availability of funds to re-invest in the next cycle. The Stock has the following inflows;

- **RiceRevenue:** The inflow, as clear by its name is a function of the revenue generated from rice. This is calculated by the yield of rice combined with the cost of rice under market fluctuations. In case of intensive farming, this is equal to zero.
- **ShrimpRevenue:** The shrimp revenue is slightly more complex than rice. It is dependent on the choice of shrimp farming practice of the individual, as an individual can only chose one type of shrimp practice. Based on the farming practice, it is function of yield and the

shrimp selling price subject to market price fluctuations. In case of triple rice cropping, the shrimp revenue will b zero.

- **OthRevenue** (Other Revenue): This inflow represents any other source of income that the farmer is engaged with during the fallow period. It is unlikely that a farmer will not work and earn a livelihood while the land is under fallow conditions. Therefore, it is considered exogenous to the model and added as a factor based on regional averages.

The outflows have been modelled as;

- **LivCosts** (Living Costs): The outflow of living costs is modelled as a function of minimum wage. As the minimum wage is fixed in the model start, so is the living costs.
- **ShrimpInvestCosts** (Cost invested in shrimp farming): The cost invested in shrimp farming is dependent on multiple factors as shown in the figure. Based on the choice of shrimp farming, the fixed capital costs, the cost of dredging and the cost subsidized in integrated shrimp farming are used to calculate this flow.
- **RiceCosts:** This cost is dependent on the cost incurred in rice cultivation and may account for the subsidy provided by the government, if the policy of Eco-rice has been implemented.
- **FertCosts** (Costs spent on Fertilisers): The Fertiliser costs are driven by two factors; the fertilizer quantity applied based on the fertiliser sub-model, and the cost of fertiliser in the market based on the change in demand and supply of the fertilisers. Since the fertiliser market is local, it was modelled endogenous to the boundaries. This is a direct extension from Chapman's model and has been maintained in the same way.
- **OtherCosts:** This outflow accounts for all the other costs that have not been accounted in the other outflows. The most significant portion of the costs accounted here is the debts incurred by the farmer, in case the net economic position is negative, but more funds are required to invest in the next cycle. The current model does not account for creditworthiness of the farmer, on the assumption that any positive income after living costs will first be used to pay of the previous debts.
- **TechSpend** (Costs spent on technological upgrades in farming): In the bottom part of the figure 35, all the costs are accounted to see if there are any funds left to make investments after clearing of debts. If the value is positive, these funds will be used in tech spending, which increase the technological efficiency (TE) of the system. This TE influences the yield making it possible to grow more with less inputs. However, If the value of FundsAvailToInvest is negative, a new debt is incurred.

Regional Characteristics aggregation Sub model

As discussed in the previous sub sections, the model of Chapman was for individual behaviour. However, for regional KPIs an aggregation of the individuals was required to the district level. This was done using the regional characteristics sub-model.

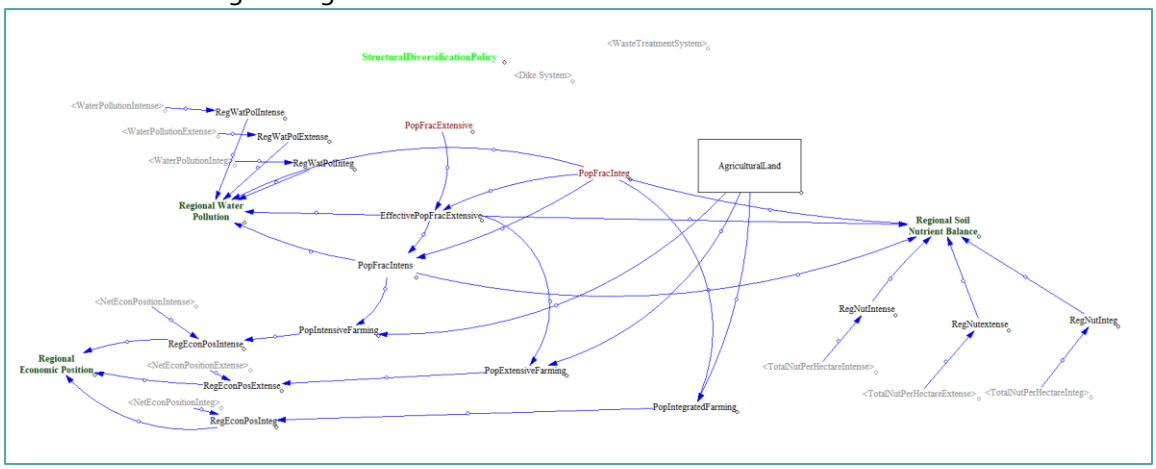


Figure 36 Regional Characteristics Stock Flow Diagram

Since a single region could have multiple livelihoods distributed with population fractions engaged, it was initially decided to subscript the model. However, the existing implementation of the model made this extremely difficult. Therefore, instead of subscripting, the model was copied to 3 screens and connected to each other. Each screen represented one livelihood type and the choice of cropping and shrimp farming along with input uncertainties were shared between models.

This brought forward the need for an aggregation sub-model, which will aggregate the individual results of each livelihood based on the livelihood distribution of each region. Figure 36 shows the sub-model with all 3 regional KPIs. The inputs driving this model are the PopFracs (Population Fractions) that are engaged with each sub-model. The input is given for fraction of Extensive and integrated shrimp population, and the difference is used to calculate the fraction of intensive farming population. This combined with the individual KPIs gives us the regional KPIs. The agricultural land available to the area is represented as a stock of fixed value.

Appendix 4: MOTA Workshop

Day 1

Introduction Round

Everyone introduced themselves and the work they have been involved. People are there from different departments. WACC research group was introduced (established in 2011, currently 20 members) . Quan put forward the agenda

Introduction of the case.

Introduction of the case: Initially the practice case is introduced by Quan from which the participants will fill the provided questionnaire. The submitted answers will be analyses and the MOTA scores will be mapped and presented in the second half of the day.

Ben Tre Province, Thanh Phu and Ba Tri districts are selected for livelihood studies. Thanh Phu is more open districts and Ba Tri is more closed, as they are trying to develop more dikes. There have been multiple projects running in the IUCN in the last 3 years. We will look at the land use and Agriculture planning. Ba Tri (Bao Than) – Rice and salt production is more dominant. There are sluices on the provided map to the participants which controls the irrigation network. Further the planning MAP is introduced to the participants about what the plans are up to 2020. The focus is more towards Rice-Shrimp farming system in the study area for the sample case.

For Thanh Phu district, the existing focus in An-Thuan area, there is a lot of rice focus which is also shifted to rice shrimp in the planning proposed for the transformation of the area. The livelihood distribution within the communes is displayed and the question set is put forward. The aim is to show that the current land use plan in this very specific part, and how it is proposed to adapt in the coming years. The participants are asked to fill out the questionnaire to the best of their knowledge based on their area expertise. This is to map their perspective on the transformation and their knowledge on the opportunities and threats related to the transformation. If the transformation is positive, the next step is to map the ability constraints for them to achieve the transformations. This hands-on exercise primes the participants towards the methodology of the MOTA and gives them a first-hand impression of how to apply the MOTA method.

MOTA Framework Recent Developments– Nguyen Hong Quan

The context of MOTA application is the UDW project on strengthening the urban deltas. Quan introduced the project and a brief about the research and institutional actors involved in the project. Initially MOTA was developed by prof. Ho long Phi and used in the IUCN study. The objectives of the UDW projects is to enhance the understanding of the delta planning process to the different stakeholders. The hourglass framework (Seijger et al. 2016) was introduced and the position of the MOTA in the hourglass framework. Gurvinder will later cover this in the presentation.

The challenges in the Mekong Delta and the different case studies were highlighted for planning and implementation process. The key idea is to address the challenges on plan implementation, and the lower impacts of the projects that have been already implemented. An example of this was discussed in context of the hydraulic planning, where even if the environmental impacts are considered, it does not address the research gaps of the environmental research. Additionally, the impact is low due to the unexpected lock-in which is a result of physical implementations which are perceived useful initially. Another example discussed was the livelihood adaptation proposed for a region from rice to rice-shrimp. This may be due to multiple factors of lack of financial or technical capacity. Furthermore, if the adaptation is completed, in case the neighbor does not adapt, the yield of his/her farm will be affected due to salinity leakage from the rice-shrimp system.

The reasons that plans cannot be implemented are;

- Quality of the planning is not good and does not dive deep into the issues which are linked to each other. Integration issues between sectoral plans, as water system affects the piping system below the roads.
- Financial issues are always predominant. There is not enough money for the implementation of plans. Most of the funding issues to the province is in the form of loans which the provinces must pay back.
- Institutional gaps to carry forward the implementation. The programs are now managed at the national level but for the management of the Mekong Delta implementation, there is no delta committee
- Incentives are mismanaged due to the prevalent corruption which leads to leakage of funds.
- Linkage between plans is weak and details may be lost while communicating between the different departments.

The 3 dimensions of project planning;

- Performance: The experts present their point of view here in terms of the robustness and effectiveness of the project. It can be assessed by tools but may not necessarily mean the deciding criteria.
- Feasibility: The governments asses the feasibility of the project based on the internal criteria. It can be financial or institutional feasibility. It can be considered as a combination of consent and ability.
- Adoptability: This is community based where the social impact and acceptance of the plan are major indicators.

A balance between the 3 is required to be accounted for successful planning. That is where MOTA (Motivations, Opportunities, Threats, Abilities) helps to bridge the gap. In MOTA, the Motivation is a balance between threat and opportunities. The implement ability is unpacked as institutional, financial and technical abilities. Motivations decides the direction where you will go, while the ability decided the constraints on how far you can go. These factors are mapped on a 2-dimensional space. (Capacity Building Vs Consent Building). Both capacity and consent need to be sufficient to reach an action. However, there needs to be a presence of an external trigger. Most of the plans overlook the soft implementation (Seijger et al. 2017) aspects of the plan, with the hard solution at the center of the plan. The application of MOTA into different participatory planning contexts is still debatable. A participant brought forward the point about the in-depth application of the MOTA in their sector. Within a top-down system, where the national level plans are translated into provincial plans, the time to apply MOTA is limited and this may have effect on the outcomes of its application.
One of the major applications of MOTA was IUCN project where interviews were conducted for 8 provinces

Assessment of Strategic Delta Plan using MOTA framework – Dorien Korbee

Presentation about application of MOTA framework to assess the implementation feasibility of MDP in Ben Tre. The scope of the project was on Capacity to implement and how it can be extended. The MDP is introduced and the focus of transformation in different sectors. The implementation feasibility at the local government level was the primary aim of the study, and at a meta level, the study was used to improve and develop the MOTA framework. The framework was updated to unpack motivation into perceptions;

- To risks of the adaptation plans
- On Solutions that have been recommended in the regional plans
- On mandate of their role and responsibility in the process

The MOTA of the government is further linked to the Farmer MOTA and how the one influences the other respectively. The approach differs from the traditional MOTA was the departure from the use of structured questionnaire formats to semiostructured interviews. This is suggested to give insights into the nuances of the perceptions of different stakeholders. The interviews were conducted with officials at provincial and district level, and at the commune level the data was collected from the farmers. The questions were based on a topic list:

- Provincial Plans
- Linkage MDP and provincial plan
- Motivations
- Abilities

The insights were that in the first round of interviews, there was little awareness about the MDP and its role in the process. In the second interview, the awareness about the MDP was higher. The synthesis of the interviews was presented in the form of a table highlighting the risks, solutions and mandate part of the motivations. The importance of Dams/dikes was visible in the DARD and DPI interviews whereas the DoNRE was more interested in the erosion control.

Implementation planning framework from a combination of RDM and MOTA – Gurvinder Arora

The next session focused on the master thesis research project of a student from TU Delft – Gurvinder Arora. As a part of the thesis, gurvinder is trying to use Strategic Delta planning framework to suggest an initial implementation framework. In the plan formulation phase in strategic delta planning, Robust decision making can be used as a participatory planning method to create comprehensive plans with potential for adaptation.

These plans can then be used to account for stakeholder motivations and abilities using MOTA, where the stakeholder position on the plan can be understood. Once the plan is made and accounted for the stakeholder positions, a framework was introduced by Gurvinder, which can keep track of this planning throughout the implementation phase. This is done through iterative adaptation where plan is reviewed under changing external conditions. This is an initial attempt to account for implementation possibilities and in the coming days, gurvinder will make interviews with the local officials to understand how they see the implementation process.

Concluding Session – MOTA Scores – Loc

In the last session after the break, Loc presented the analysis of the data collected from the experts of the workshop during the first half of the day. From the data, the motivation scores for the 2 districts and the perceived abilities map was generated and discussed with the participants. It was surprising to see that the MOTA scores of the experts' perception of the situation was similar to the farmers' MOTA scores of the districts. This also emphasized the use of MOTA as a visual tool which can give an overview of the situation and start the discussion among the decisionmakers for a relevant course of action.

End of Day 1 Suggestions

- Sample Size?
- Tool vs Framework
- Background information provision
- Background in Social Sciences methodologies?
- The time dimension of MOTA, when should different stakeholders be mapped?
- What level of MOTA (national, provincial, or district)?

Quan invited the participants to collaborate on development opportunities of MOTA. The trade-off between MOTA as a framework and a planning tool is highlighted. The acceptability of the

tool is more likely as it is easier for the decision maker to understand. As a framework, it becomes extensive and difficult to operationalize for the policy makers.
For effective policy making, there are 2 key factors (as per discussion)

- The process should be participatory with multidisciplinary group of experts
- The quality of information provided to the policy maker. That can be of concern as most of the process is methodological and difficult to understand for the policy making.

The role of visualization in the process is important along with the simplicity of the tool.

2 plans discussion - Short term for immediate actions and long terms for fallback scenarios.
To do a case study for interprovincial linkage to understand the interactions between different provinces. This can be done as a publishable paper and MOTA can be tested for the feasibility and sustainability of the master plan. Work fast to produce the manual for MOTA
In the long term, more meetings are required where WACC can join and introduce the method to key stakeholders. WACC is positive about the opportunity for collaboration and can have follow up with additional resources on development of MOTA.
In the interprovincial linkage program, one of the components; value chains; has to be finished in August and presented to the chair of the committee. With interprovincial linkage, there is a lot of talk about abolishing the provincial borders and integrating water management and crop calendar. Currently CAP is preparing subcomponents of the projects and have a lot of surveys and consultation.
Another thing to consider is the added value of MOTA as that needs to be justified to be the part of the project. Furthermore, the boundaries of the MOTA must be clearly defined for it to be made effective as a tool. The key question for interprovincial linkage program is that which institution is responsible for the governance of the program. MOTA can help address this question.
Within the policy paradigm, which are the key policy owner for the planning & implementation of the policy.

Day 2

Introduction of Andrew from IUCN; MOTA and the World Bank
Andrew is IUCN manager for Mekong Delta and has been involved with the discussions about large scale transformations of livelihoods in Mekong Delta. This started with the MDP where IUCN was involved with some of the first farmer consultations, before the MDP was submitted in 2013. MDP utilized a very large expert group who provided feedback on the plan. Between 2013 -16, when world bank stepped in, to implement the MDP, it was the first big project at the time. Multiple challenges were identified;

- Consensus building
- Political support
- Knowledge gaps
- Alternative solutions
- Farmer Support
- Capacity to implement
- Regional coordination.

Farmer support is where MOTA came into picture to capture their perceptions for transformations. IUCN was one of the technical advisors for the WB project. By 2016, the input was completed for the design of the project regional social assessment, which was a safeguarding project. The assessment was completed in 2016 and was approved for implementation. The progress is slower and in 2018, it has just moved forward from preliminary implementations.

Andrew showed the safeguard assessment document, where the methodology used was focus groups and consultations, and the expectations was a standard socio-economic survey. At this time, IUCN got in touch with WACC and MOTA methodology was introduced. The intimal survey was modified to include the MOTA support questionnaire and Ho Long Phi's team was involved in data collection, while IUCN was involved in the focus groups. For MOTA, different sub-project regions were visited under the WB project, and data was collected for the farmers motivation and ability on current and proposed livelihoods. The suggested livelihoods were proposed by the provincial governments and WB used these models for MOTA assessments.

For example, in Dong Thap, there were already Rice-shrimp models which were relatively successful. These models were considered as opportunities to transform other areas. The final report was submitted with regional social assessment as a background. The technical details of MOTA along with the findings are discussed in this report, along with the recommendations. The report was discussed with example on sugarcane to Shrimp farming transformation in Cu Lao Dung province. One of the important point of consider is that the conclusion drawn by the farmers from Climate change in the short run might not be valid in the longer period. Most of the farmers acknowledged that intensive sugarcane farming ill be bad for soil fertility, however, the motivation to change for the farmers was still very low. This was explored further to uncover that the risk of failure of the shrimp farming was a big factor that was responsible for the low motivation.

From the MOTA summary, the investment prioritization strategies for the WB project could be formulated. Another example discussed for the MOTA application in the IUCN WB project was for Ngoc Hien district in Cau Mau. The transformation in the is region was from eco shrimp (integrated Mangrove) to organically certified eco shrimps. With this small step, the profit premiums can be increased due to the organic certification of the shrimps. The motivation in this district is positive as the increase in income was acknowledged by the farmers. The WB project is now focusing on upscaling this in Tra Vinh and Ben Tre province too.

The recommendation from the WB project suggested that in the upper delta, the motivation for triple rice farming was low MOTA, as the perception of failure and risk was very high. Therefore, the WB project will not fund any of these areas due to the low motivation. All the investments are the locations with Rice-Aquaculture models, as the risk of investment loss was lower. Hence the recommendations were to start the initial pilots near the triple rice crop areas so as to change the risk perceptions of the triple rice farmers.

Next, the limitations of the MOTA were discussed. Whenever there is a farmer interview, more often the information of the farmers is limited to the commune, while the risk perception goes beyond the commune. Therefore, the limitation was that the scientists had seen the risks of high Dikes, which displaces water and creates the risks elsewhere, either in neighboring countries or areas. Therefore, during the dike building period of late 2000s, almost half of the flood plain of upper Vietnamese Mekong basins was lost. This problem with high dikes within the academic world does not reach the farmer who uses high dike system for livelihood.

Therefore, if MOTA is mapped for farmers, scientists and governments; scientists always have high motivations to change as they have access to research and information from a wider perspective. Hence, it is difficult to rely completely on the farmers viewpoints for change. This emphasizes the importance of political leadership which has a broader picture on the issues. Hence decisions like (PM Decision 593) of sub-regional socio-economic planning are extremely important as it can be used to enable to political leaders to manage the adaptations with a broader worldview. The IUCN was involved in facilitating the process of the vision creation and bring to light the strategic directions. This was one of the first efforts to highlights the trade-offs of the third rice crop in the upper Mekong delta and a large-scale area of flood plain might need restoration upstream to maintain the salinity level downstream. This is still theoretical now but is being acknowledged steadily.

One of the discussion points raised during the discussion is that if the farmers knowledge needs to be extended, who is the one to decide about which scenarios should be discussed with the farmers? MOTA being a survey, it presents only a snapshot of their current capacity to adapt. However, from the development perspective, the recommendations can be drawn about where the knowledge capacity should be built of the farmers.
MOTA was useful in recommendation process as it complemented the WB socio-economic survey. With the standard SES, it may show similar conclusions, but, with MOTA, the process becomes simple and structured and the insights can be reached easily with relevant conclusion.
The new planning law – to get away from sectoral planning to integrated planning,

Presentation from Khoi – Interprovincial Linkage
The presentation focus on the following;
- The process so far and possibilities to use MOTA
- To get opinion of experts on the pilot

In the government, there is a big movement of reshaping the organization of the delta planning. The MDP was not the 1st pa but the 3rd. The 2s was in 1974 by US, and the second was 1984. The third was the MDP. The MDP has a lot of similarities with the 1st plan but there is still no concrete implementation. In resolution 120, there are 3 main activities;
- Re-planning Mekong River Delta; where MDP 2013 is used a guideline to re-plan. However, there are issues of implementation (MPI)
- Water management of Mekong Delta (MoNRE) and is key for 120
- Agriculture transformation plan for the delta – Pathways of implementation

In the end of this year, the agriculture transformation plan will be approved by the PM. The Agri plan and water plan needs to be integrated somehow. To achieve this objective, there was a study commissioned 3 months ago where more than 100 districts have been visited. The DARD, The DonRE and Dep of industry and commerce and dep of social and labor affairs. This collaboration is key to drive the integration of the plan. In each province, discussions were initiated with farmers to understand the farmers views on the climate change and key issues. This was done in consultation with the provincial authorities and encourage them to have vision in this issue. After 2 months, a proposal was submitted to the ministers who suggested to have consultation rounds for the development. There are 6 components;
- Water; where consultations were conducted with experts in the field. The issues related to water, and how to manage the interprovincial water systems
- Discussion on the agribusiness opportunities. Workshops were organized
- Transportation; How transportation link with agriculture and rural development, exploring the location and potential of the sea ports.
- Rice; to see the potential of changing from triple rice to intercropping with aquaculture
- Horticulture; to discuss potential for fruits
- Aquaculture; Not only in land aquaculture, but also sea- based aquaculture as in the future the vision is to link delta with the sea.

After the consultations, the report will be prepared and shared with the interprovincial ministries. In July, a conference will be organized, chaired by the minister where the paper will be created and shared. This will lead to create a Target Program which will lead to creation of a list of all the projects running. This overview will make it easier to sanction investments from the central level. Th plan will focus first on the current situations for 3 factors
- Upstream hydropower development
- Climate change effects on livelihoods

- Internal Economic development; urbanization, industrialization, mining, building high dike problems

The key challenge is on how to divide the Mekong delta. The proposal to divide the Mekong delta into 6 regions has received mixed response from different ministries. The solution proposed to discuss with the provincial leaders on their impressions of this divisions. Therefore, the final solution was to use the Dutch MDP division for planning guidelines and the 6 divisions proposed plan for implementation. The historical movement of the cropping system has moved over time from 1 to 3 rice through infrastructure measures. However, recent diversification has split the system either towards rice-shrimp adaptation or completely to horticulture-based transformation. Changes in the rice have been from long term rice to short term rice with higher salinity resistant. Also, from high quantity rice to high quality rice.
For fruit, there are similar changes, but the consistency is lower compared to rice system. Some areas have consistent fruit crops while others change based on changing market systems. This shows that some areas have higher market orientation while others have higher cultural and value orientation. For aquaculture, the orientation is changing towards intensive shrimps, but the households in clusters never have similar farming practices.
There is also changes in residential areas, where farmer living preference has changed from close to rivers, towards away from river. In case of regional and sectoral linkage, there are not very close connections and the entire initiative is in its nascent phase. Further, for each area, these trends have been studied and the issues have been summarized to identify the problems in each area.
In the transformation plan;
- Climate change will have more effect
- For Hydropower, there are a lot of plants that have not been updated yet and may have adverse effects
- The market potential for rice will be reduced in the future, but the market for fruit and aquaculture, hence a recommendation is to reduce rice.

Res 120 key points
- Follow the natural rules instead of going against
- Brackish water is not the enemy
- Link the delta to the sea
- Change from natural food security to aquaculture
- From Quantity to Quality
- Focus on need of the market
- From top down to integrated top-down & bottom up with cooperation from farmers
- Integrated panning and interprovincial linkage
- Instead of heavily focus on hardware, focus on no-regret soft rules

Rice reduction;
- Reduce from triple to combine system
- Focus of high quality
- Still try to maintain part for lower quality for traditional market
- Divide rice in 3 groups
    - Special rice production zone, upstream in the area of close dike system, develop close cluster of rice production with higher technology. Keep some areas for 3-3-2 system.
    - Focus on Special rice by combining rice fish system
    - The outer area is proposed to be flexible where the farmer is encouraged to practice mixed system, based on market response.
- For Horticulture

    - Similar decision with focus on coconut in coastal, and create a trademark for Mekong delta
- For Aquaculture
    - Shrimp – fresh, Tiger, Wild Lac
    - Catfish in upstream
    - Sea based aquaculture (still in discussion of feasibility, mostly in the west side.)
    - Livestock – not for export only for domestic and with focus on HCMC
- Another issue is to consolidate land to create floodplains.
- Stop the construction and expansion of the dike system.
- MOTA can assist here to improve the administrative and institutional system, by establishing a research group to study the linkage possibilities within provinces. Establish protocols of cooperation.
- However, **Implementation is still the biggest challenge.** Should there be a Delta Commission and law?

A comment on the plan comes in terms of environmental mapping and overlay it on this plan, as it is extremely important. If there is not very concrete implementation plan, it will become big. In integrated planning, will account for water and agriculture planning. The agriculture planners look at water only from availability perspective, but not from quality issue and sediment carried by water. Another attractive factor for 120 is that it stresses the reduction of investment costs. So, if fruit is grown in coastal areas, if the soil quality is suitable, the water quality is not, and hence you need control measures. Therefore, it is very important to integrate water and agriculture resources and it is important to assess the combined function of both resources.
Khoi's comment is the problem of time and resources. This has been developed without government support. Without access to the information from the government, it is extremely difficult to come together with an integrated approach.

Discussion - End of Day 2
MOTA can really build into feasibility study for GCF and other development initiatives. Here since the sanction depends upon the quality of the proposal, the government does not fund the feasibility studies. MOTA can be an effective tool here. If Khoi has to get together a draft program by August, after that, MOTA can be used to examine the parts of the program plan. Khoi's concern is the time availability to use MOTA. A brief Manual/Guideline needs to be submitted for the initiation of the project. This must accompany with analytical framework and the tools/questionnaire.
- Decision in July
- GCF – the content needs to be linked with GCF
- How to apply MOTA - Maybe MOTA can be a facilitating tool.

MOTA can focus on the content of each branch or it can focus on the decision itself.