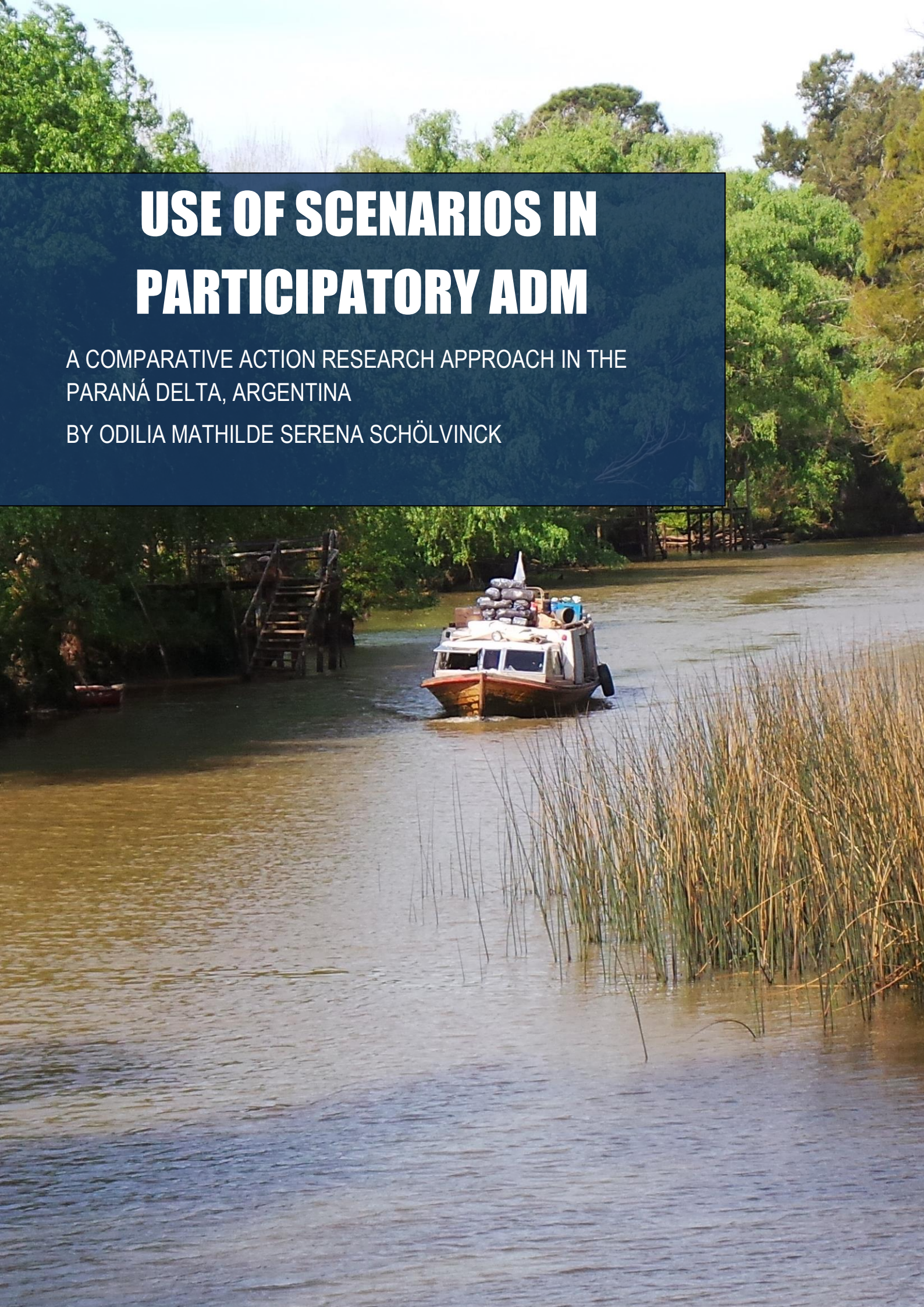
USE OF SCENARIOS IN PARTICIPATORY ADM

A COMPARATIVE ACTION RESEARCH APPROACH IN THE PARANÁ DELTA, ARGENTINA

BY ODILIA MATHILDE SERENA SCHÖLVINCK



‘The future engineer should be an alpha, beta, gamma in one’

Jan Mengelers, former chairman of the TU Eindhoven

Use of scenarios in Participatory ADM

An action-research approach to the case of the Paraná Delta, Argentina

By

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Preface

With this report, a journey to finish two theses for the master's program's Engineering and Policy Analysis and Water Management is completed. One and half year ago, I was doing my internship in Argentina and learned about the issues in the Paraná Delta. I immediately felt a sense of curiosity to contribute to the domain of Adaptive Delta Management for the Paraná Delta. I feel fortunate that I was able to do my thesis on this subject. The thesis period has been a highly inspiring period for me, being gathered by many intelligent and wise people, teaching me knowledge and life lessons. The extended length of this project has provided the opportunity to delve into the subject and make new research choices later on. I was able to make several visits to Argentina and I performed many activities there as organising workshops,measurements, modelling, group model building, interviews and participated in many activities and workshops related to the topic myself. This report is the accumulation of knowledge I gathered along the way.

|Acknowledgements

Doing a combined thesis project resulted in a big team of supervisors. I would like to thank the members of my graduation committee for their support, for providing me with valuable feedback, and for directing me in new directions which I might not have discovered if not guided there, and for having the patience and stimulation that all the challenges of combining two theses gave. First of all my daily supervisors, Maurits Ertsen and Jan Kwakkel have been a great support throughout the process. Thank you, Jan Kwakkel, for teaching me ADM and accepting my participatory approach in your computational world. The rest of the committee also gave me many insights and input. I would like to say thank you to: Markus Hrachowitz, for supporting the ontological way of thinking in the faculty of CiTG. Bert Enserink, for teaching me how to use social science principles in the engineering world and supporting me throughout the entire EPA studies. Alex Curran, for guiding me through modelling and always being supportive in your comments. Martin de Jong, for deciding it was time for me to graduate. I would like to acknowledge Deltares for giving me this opportunity of a thesis. Judith ter Maat, thank you for taking up the difficulty for supervising me in this chaos of a thesis and stimulating my many visits to Argentina. And of course, William Oliemans for getting me on this project and making this research possible. Furthermore, I would like to thank all the employees and interns of Deltares and the staff and students of TU Delft that have given me input throughput this thesis.

Maurits, I want to thank you especially for enlighten me with new ideas, making my brain sometimes hurt, but always being there for me. I appreciate the time you have spent to support me; I look forward to many more intellectual conversations we still may have in the future.

Then, I would like to pay gratitude to all my colleagues and friends in Argentina who have supported me throughout the project. My Argentinean counterpart, Sabrina, my partner in crime throughout this project. We set up such great workshops together, and I'm sure we will stay friends for the rest of our lives. Also, I would like to thank all the Argentinean partners that have been very supportive, all the researchers of INA and INTA, and especially without Martin Sabarots and Adrian Claudio Gonzalez, this research would not have been possible. Thanks to Veronica Zagare for being our local supervisor, and Pablo Arecco for giving me an office to work in and a friendly smile in the moments when it was difficult. Also, big thanks to my former colleagues at the embassy of the Netherlands in Argentina, who were also helpful throughout this thesis

Then, of course, a big thanks to my dear friends who have supported me throughout my thesis and giving me enjoyable moments during this time. A big hug for my (former) roommates at the KM39 for their warmth and laughs. Maarten for being so supportive during the stressful first months of the set-up phase. Especially I would like to thank Anais, Maarten, Chiara, Joe, Lexy, Anna and Emilie for correcting my thesis so thoroughly. And to Peterke, Marieke and Martine for supporting me on these final final moments when the stress was the highest, correcting the thesis and bring beauty to it.

Last but not least, I want to thank the people who have always have been there for me, my very loving parents, I want to say thank you for supporting me in all possible ways throughout the years, without your input, care and love I would not be the person I'm today.

| Summary

Introduction

Various pressures impact the world's river deltas and coastal cities, like climate change, relative sea level and population growth. Traditionally, policymakers and water managers aim to predict the future and make scenarios for this. They will produce a plan that is expected to function in the most likely future scenario. However, the future can be very different than the hypnotized future scenario. Policymakers seem to adapt their plans over time, to varying uncertainties. From this perception, the concept of Adaptive Delta Management (ADM) was developed (Haasnoot, Kwakkel, Walker, & ter Maat, 2013). ADM is implemented in the Delta program to deal with the uncertainties of climate change and socio-economic developments while making policies to protect the Netherlands against flooding and safeguard its fresh water supply. It is defined as 'a smart and intelligent way of accounting for uncertainties and dependencies in decision-making on Delta management, while reducing the risk of overspending or underinvestment ' (van Alphen, 2016). The government of Argentina seems to be interested in this approach for the management of the Paraná Delta.

Research gaps exist in the use of scenarios for participatory purposes for ADM, especially in a different cultural setting than the Netherlands. The scientific foundations of ADM, the practical planning applications and the participatory applications of ADM, all use scenarios in a different stage in their framework. The value of positioning scenarios at the beginning of the ADM cycle is that all other steps, such as the development of actions, vulnerabilities and opportunities, will be influenced by scenarios. On the other hand, it can also be argued that in cultures which score low on the long term planning and uncertainty axes of Hofstede et al. (2010), such as Argentina, will have difficulties formulating scenarios. For these countries, scenarios should, therefore, be introduced at a later time in the analysis. This research gap is also suggested by practitioners of ADM. Furthermore, it is shown that no workshop design could be found showing the application of ADM for participatory purposes.

The Paraná Delta is an estuary delta, consisting of wetlands (Zagare, 2018). It faces different pressures of flooding from the seaside, as well as from different rivers. Furthermore, different developments take places such as the construction of various polders for residential purposes, agriculture and forestry expansion. Due to the context of many uncertainties and the interest by the national government by Argentina, ADM seems to be useful for the planning of the Paraná Delta.

Research goal

The following research question will be addressed:

Main research Question
When should scenarios be used in participatory ADM cycle, in the institutional and cultural context of Argentina?

Therefore, this research aims to support ADM in the following ways:

1. Design of a participatory ADM workshop format
2. Investigate the moment scenarios should be introduced in the ADM cycle in the case of Paraná Delta, Argentina

Two types of cases were compared in order to investigate the most suitable place for scenarios in the ADM cycle. The first case is the "Scenario Approach", Figure 1, left, in which the scenarios are used in the beginning of the DAPP cycle; the second case is the "Action Approach", Figure 1, in which the scenarios are implemented after the establishment of the adaptive pathways. Both cases were structured according to this framework, only the place of the scenarios was varied. Data was gathered by means of triangulation, and the cases were compared on pre-defined criteria. The different research methods are observations, surveys, critical incidents evaluation and an evaluation of the pathways. By using this variety of methods, significant insights could be found in a context with a limited number of cases. In order to translate the two ADM approaches to practice, the work was set up through/using action research approach.

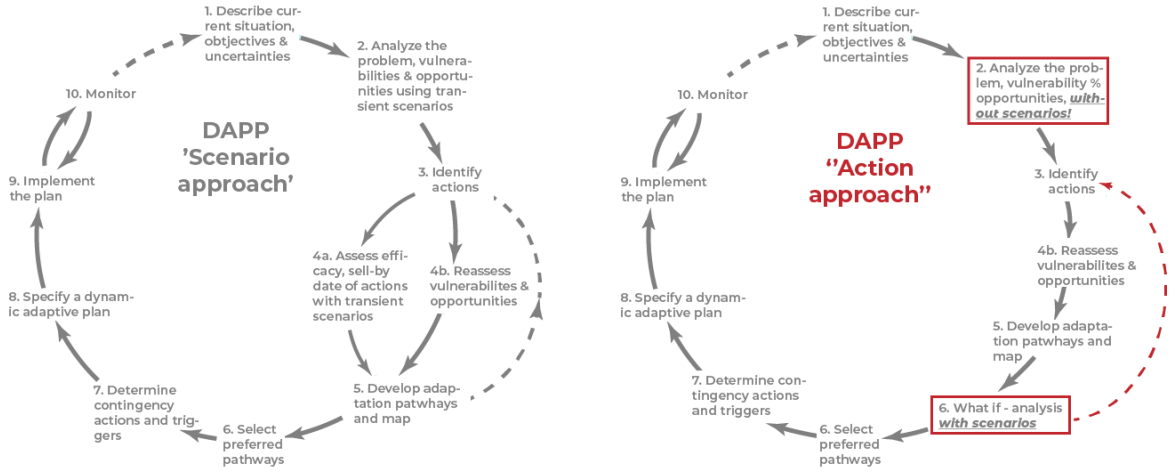

Figure 1 DAPP 'Scenario Approach' and DAPP 'Action Approach'

Findings

The two approaches were compared based on criteria which were established by literature research. Given the limitations of the research, such as the lack of experience of DAPP of participants and facilitators, lack of computational support to identify tipping points, limited availability of time for workshop and amount of cases to generalize results, Table 1 presents a comparison between the two cases.

Table 1: Comparison of results 'Scenario Approach' and 'Action Approach' on criteria

Criteria	'Scenario Approach'	'Action Approach'
Quality of pathways		
1. Policies constructed based on timing of tipping points and scenarios	Pathways are not constructed based on the timing of tipping points, and the combination of scenarios and tipping points seemed to be very confusing. Participants seemed to understand the concept of scenarios before the workshop. However, scenarios are not used for the construction of the pathways.	Without explaining the concept of scenarios, the concept of tipping points is very confusing for the participants. They themselves came up with the concept of scenarios, and when they are later introduced to the concept, they use the concept in a natural way. Scenarios are used to improve the pathways, and these are constructed on tipping points.
2. Actions consider scenarios, by looking at robustness and flexibility, can identify lock-ins.	Actions that are selected are mostly related to preparatory actions. Issues of robustness and flexibility are not addressed.	Scenarios helped to discuss more flexible and adaptive strategies.
3. Inclusion of multiple different types of strategies	No well-functioning different strategies are found.	Different strategies are discussed by participants to reach the objectives
4. Comparison possible based on objectives	Objectives are not taken into account when constructing the pathways, comparison difficult	Strategies developed aim to improve the objectives. However, they are not fulfilling all objectives, comparison is possible of strategies on objectives
5. Triggers and signposts are highlighted	No triggers are drawn. Signposts can be differentiated for some pathways.	No triggers are drawn. Signposts are discussed when the pathways are developed and improved after the discussion of the scenarios.
Reaction of participants		
6. Understanding pathways	The participants have great difficulty to understand concepts and are tired and overwhelmed.	The participants seem to understand the idea of dynamically changing actions for reaching objectives, and the need to keep actions open
7. Participants will use ADM future work, stimulation of new ideas and discussion	Participants showed that they liked the participatory working style, but doubted if the approach would work in future studies. Planning two years ahead is the maximum that is possible in Argentina. The method stimulates discussion on actions.	Many different views are exchanged, the strategies proposed aim to show these different views. The participants mentioned they liked the development of strategies under uncertainties, also in future work.

The analysis shows that when comparing the 'Action Approach' to the 'Scenario Approach' at the start of the workshop, the concept of adaptive pathways seemed more difficult to explain without introducing the concept of scenarios. While in the end, the 'Action Approach' gave more usable pathways, and the participants seemed to understand the methodology better. This outcome is different from the initial hypothesis, which stated the 'Action Approach' would work better because people would have difficulty in assessing different scenarios of the future in the culture of Argentina. However, participants seemed to understand the scenarios explained well in both the 'Action Approach' as the 'Scenario Approach'. These results may be explained because the 'Action Approach' applies the principles of experiential learning. Still, cultural and institutional influences seem to play a role, since the participants mostly constructed short term actions to improve the current system, which they contribute to the situation of Argentina.

In conclusion, when applying ADM in a small scale workshop in the Paraná Delta, scenarios should be introduced after a first construction of the pathway map, not before. This enables a learning possibility for participants; it creates a more positive atmosphere and better pathways in the end.

Future research should focus on how this study can be generalized to other cultures. Furthermore, if the study will be set-up to support 'real' ADM planning, the study design could be expanded to include a lecture/teaching of the DAPP phase before doing the real workshop. Research on how experimental learning can contribute to learning in ADM seems highly valuable. Moreover, the results of this study provide many suggestions for future research of ADM in general and ways to compare various ADM approaches by taking complex actor systems into account, as could be observed in the Paraná Delta.

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Foundation

1| Introduction

In this chapter, an introduction is given to the thesis. In Section 1.1 the research is introduced and the main motivations of the research are described. Afterwards, in Section 1.2 key concepts are explained to understand the main research gaps in Section 1.3. Then, in Section 1.4 a description is given of the set-up of the thesis project and the activities performed in this thesis. In section 1.5 is explained how to read this thesis. Finally, in Section 1.5 the structure of the report is described.

1.1 Research Introduction

Deltas and coastal cities around the world are becoming more vulnerable to several uncertain threats, such as climate change, relative sea level rise and population growth (Jeuken, Haasnoot, Reeder, & Ward, 2014). In order to provide guidance to decision-makers in such uncertain environments, Adaptive Delta Management (ADM) has been developed. ADM was implemented in the Delta program to deal with the uncertainties of climate change and socio-economic developments while making policies to protect the Netherlands against flooding and safeguard its freshwater supply (Delta Program, 2015).

The government of Argentina expressed their desire for an ADM plan for the Paraná Delta (personal conversation). In the Paraná Delta, various land uses can be seen as tourism, urban development, large forestry polders and ecological reserves. The local population lacks many essential services such as transport possibility and electricity; furthermore few possibilities for employment are available. Pressure can be found from the forestry, livestock sector and the gated communities at the border of the Delta. A desire exists to develop the delta, but in a sustainable way by both the national politicians as well as the local inhabitants (Bucx et al., 2014).

Several issues still can be found when implementing ADM (Zevenbergen, Khan, van Alphen, Terwisscha van Scheltinga, & Veerbeek, 2018). Furthermore, participatory applications of ADM are poorly investigated, as Timmermans, Haasnoot, Hermans, & Kwakkel (2016) suggest, ADM might be sensible for cultural influences. Especially, the moment that scenarios are introduced in the ADM cycle may depend on local cultural characteristics. In my study, I aim to meet the desire for more research into the moment of introduction of scenarios by providing guidance to the implementation of ADM in Argentina for the Paraná Delta. I did this by fulfilling two separate MSc thesis projects, both aimed to support ADM in Argentina[1].

[1] I performed two MSc thesis projects simultaneously regarding the implementation of ADM in Argentina. This thesis, and one thesis for the MSc Civil Engineering in which I investigate the use of ontologies for the modeling of the Paraná Delta. The two thesis are highly related, and the work for one continuously inspired the other.

In this thesis I investigate the usage of scenarios for the participatory application of ADM in the context of the Paraná Delta, in Argentina. The focus is two-fold: The research focuses on how a participatory design for ADM can be made, and it focuses on which moment of the framework scenarios should be introduced in the participatory ADM

The remainder of this introduction looks at literature on (participatory) ADM and the usage of scenarios. First, several key concepts are introduced, that are needed to understand the research gaps from literature identified in Section 1.3.

1.2 ADM & key concepts

In this section key concepts as Adaptive, Delta Management, DAPP, Adaptive Pathways , Tipping Points and Scenarios are introduced. For a detailed overview of all concepts, the reader is referred to Appendix B1.

1.2.1. Adaptive delta management

Adaptive delta management (ADM) is described as:

"a smart and intelligent way of taking into account uncertainties and dependencies of decision-making on Delta management with a view of reducing the risk of overspending or underinvestment" (van Alphen, 2016).

Main elements include linking short-term decisions on the fields of water, land use and spatial planning to long-term issues in the fields of the water system and other ambitions such as nature and construction, by using scenarios (Deltacommissaris, 2018; Gersonius et al., 2015; van Rhee, 2012; Zevenbergen, Rijke, Herk, & Bloemen, 2015). Stakeholders are included in the model in a joint decision-making process to enhance legitimacy and feasibility (Zevenbergen et al., 2015). Various applications can be found of ADM in other contexts for national plans: in New York city strategy after Hurricane Sandy (New York City Panel on Climate Change, 2013; Rosenzweig et al., 2011), the Jakarta Coastal Defense (JCDS, 2011), in Vietnam, Bangladesh, Myanmar and Australia (Zevenbergen et al., 2015; Zevenbergen et al., 2018). Participatory approaches of ADM are increasingly receiving attention (Barnett et al., 2014; Campos et al., 2016; Carstens et al., 2019; Lawrence & Haasnoot, 2017; Murphy et al., 2017). Zandvoort et al. (2017) show in their comparison of cases that participatory research was most successful in reaching the objectives of ADM in comparison to the non-participatory applications of ADM.

1.2.2. Adaptive pathways and Dynamic Adaptive Pathways

While ADM is used as an overarching framework for different adaptive planning methods (Timmermans, Haasnoot, Kwakkel, Rutten, & Thissen, 2015), Dynamic Adaptive Policy Pathways (DAPP) method (Haasnoot et al., 2013) is a commonly cited method to represent ADM (Timmermans et al., 2015; W. Walker et al., 2013, Denton et al. 2014, Maru and Stafford Smith 2014). In this research, I followed the principles of DAPP to formulate my research activities. The key of DAPP is to first plan possible actions, then evaluate under which circumstances an option might fail, and then identify actions that can be triggered later and lastly to represent these actions, visualized by an 'adaptation

pathways map' (Haasnoot et al., 2013). DAPP planning identifies several stages, which are to be approached in an iterative cycle:

1. Describe the current situation, objectives and uncertainties
2. Analyze possible futures by using uncertainties. Several problems, vulnerabilities and opportunities are analyzed to describe the future. Furthermore, the malfunctioning of the status-quo policy is evaluated.
3. Identify actions
4. Assess sell-by date actions with the scenarios and reassess vulnerabilities and opportunities
5. Develop adaptation pathways and map, selection of preferred pathways
6. Determine contingency actions and triggers
7. Specify, implement, monitor, evaluate, report, and improve ADM plan

DAPP generates a variety of possible pathways, which can be compared to a variety of criteria. Similar to a metro map, pathways may present different routes to go to the same point in the future (Haasnoot et al., 2013). An example is shown in Figure 2. Each pathway consists of a series of possible measures. When the pathway reaches a terminal, called an Adaptation Tipping Point (ATP) , this implies that the current strategy is not effective in reaching its objectives and the strategy needs to be changed to another action.

The adaptation tipping point (ATP) is the critical value (threshold) under which the policies fail to meet their objectives (Haasnoot et al., 2013). The ATPs can have a variety of forms depending on the project, such as a given water level, a certain time, norms or safety standards (for example: water safety, water quality norm), financial thresholds (economic growth and cost-benefit) and societal threshold (social agreement) (Haasnoot et al., 2013; Jeuken & te Linde, 2011). In order to identify the relevant ATP, a trigger is identified, which specifies the condition under which a new action needs to be taken, that was previously identified (Haasnoot et al., 2013).

Adaptation pathways have the following claims to support decision making: use of objective-based thresholds, handling of uncertainty in principle drivers, structuring of a wealth of options, identification of lock-ins and incorporating of multiple stakeholders preferences (Haasnoot, Middelkoop, Offermans, Beek, & Deursen, 2012; Zandvoort et al., 2017). Moreover, DAPP differentiates itself by being robust and flexible, important themes lacking in traditional master planning approaches (Loucks & van Beek, 2017).

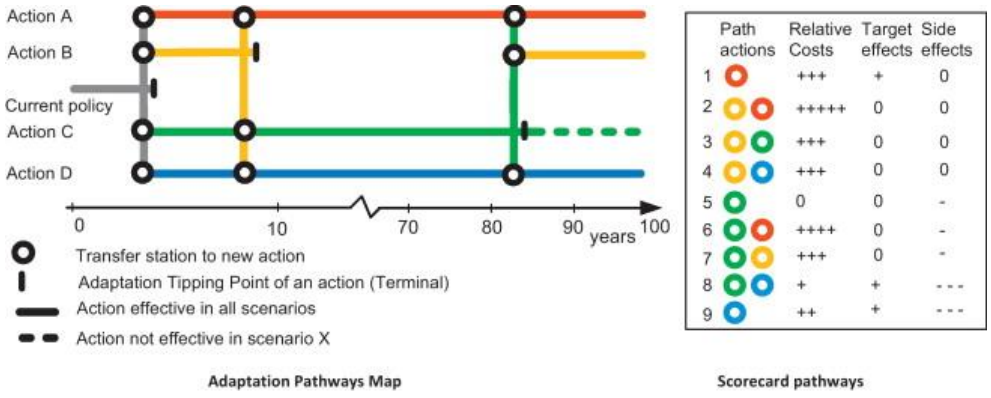


Figure 2: Example of an adaptation pathway map and scorecard representing the costs and benefits of nine alternative pathways. Once an objective is missed, an adaptation tipping point is reached (left). The different paths can be quantified on different criteria on a scorecard (right). (Haasnoot, Warren, & Kwakkel, n.d., p. 7).

Several strengths of DAPP have been described in literature, including its easiness to explain adaptive planning to policymakers (Ray & Brown, 2015). Furthermore, the method also encourages decision-makers to think about a context of uncertainty. DAPP helps to access path dependencies and lock-ins. Also, the method is a way to frame that adaptation is a constant process over time; in this way transient scenarios are encouraged to be used instead of a few points in time (Haasnoot et al., 2013; Jeuken & Reeder, 2011; Ray & Brown, 2015; van Veelen, Stone, & Jeuken, 2014).

1.2.3. Scenarios in DAPP

Scenarios are descriptions and consistent stories about possible different futures. One accepts that he/she cannot fully understand the future and create a plausible story with a logical plot and narrative to describe how events may unfold (ter Maat, Andrew, & van Aalst, 2018; Van Scheltinga et al., 2013). It helps to guide the decisions we need to make today (ter Maat, Warren, & van Aalst, 2018). Scenarios differ from strategies/actions since the former are beyond our control while the latter we can steer. Often a set of scenarios is specified to describe the range of uncertainties (Van Scheltinga et al., 2013).

The most important characteristic of a scenario is that it will fulfil its objectives (Alcamo, 2001). Different objectives of scenarios can be differentiated in adaptive planning. Firstly, it can help to assess the impacts of particular developments. Secondly, it is used to identify and test whether a strategy will work in different futures. It analyses if a strategy still will be robust in the future. Thirdly, it helps to envision opportunities and vulnerabilities. Finally, it may help to identify actions to prevent or enable certain developments. In order to make strategic development decisions, explorative scenarios seem the most applicable in ADM (ter Maat, Warren and van Aalst, 2018). Therefore, it seems to be essential to differentiate actions/strategies from scenarios (Van Scheltinga et al., 2013). Furthermore, a scenario should be well documented and transparent (Alcamo, 2001). Also, a good scenario is a plausible scenario. Scenarios may also help to questions the beliefs and broaden the understanding of experts and policymakers (Alcamo, 2001).

Scenarios can be constructed in different ways. They can differ in the type of developments to include (such as climate, socio-economic and subsidence), the type of scenarios (predictive, normative and explorative), the time scale of the scenarios (projection years and horizon) and the temporal nature (discontinuous or trends) (Jeuken et al., 2014). Furthermore, they can be developed by experts, in combination with stakeholders, or completely participative (Tompkins, Few, & Brown, 2008). Also, they can be qualitative, quantitative or a mixture (Alcamo, 2001). The extensive work of Jeuken et al. (2014), Seijger et al. (2017) and Zandvoort et al. (2017) show that various types and numbers of scenarios are used in ADM delta studies (see Appendix B1 for a detailed literature review).

1.3 Research Gaps

Despite the recognition of DAPP in the use of ADM approaches, several limitations currently exist which restrict its widespread use: lack of participatory ADM design, lack of investigation towards the place of scenarios in the ADM framework, limited research to connect participatory ADM to a cultural context. In this section, a description of these factors is given and contextualized. For a detailed overview of all literature, the reader is referred to Appendix B1.

1.3.1 Participatory ADM

Little research can be found on the application of ADM in a participatory setting (Campos, Vizinho, Lúcia, Moreira Alves, & Penha-Lopes, 2015; Lin et al., 2017). Most work seems to be focusing on the application of DAPP in a theoretical case study or for larger planning purposes (Aguiar et al., 2018). While, it seems to be a successful approach of ADM (Zandvoort et al., 2017).

The several participatory studies that could be found do not seem to present a step-wise approach for scenario generation in an ADM. Campos et al. (2015) show a successful application of participatory action research for the Ílhavo and Vagos Coast in Portugal. This approach did not include the use of scenarios for the generation of ATPs . In the Big Hole Valley (USA), Murphy et al. (2017) only showed the development of scenarios in a narrative scenarios building process but did not use sequent ADM steps. Barnett et al. (2014) investigated the application of a local adaptation pathway in Lakes Entrance, Australia. They developed a pathway by using detailed stakeholder interaction. However, they did not present the steps applied to come to these pathways. Lawrence and Haasnoot (2017) developed a game to enhance ADM. The game itself is described in detail in the manual. Yet, the participatory ADM work and pathway generation afterwards is described in a limited way, when an ADM plan was developed for the New Zealand government (Lawrence & Manning, 2012).

Carstens et al. (2019) suggest a participatory DAPP design but combine this with the risk framework of Climate Risk Informed Decision Analysis (CRIDA). They only show the main elements of this design in their publication. However, they did not test different types of frameworks. This introduces the first research gap:

Research Gap 1
Existing literature on participatory ADM shows a lack in formulating workshop design.

1.3.2 Scenarios in (participatory) ADM in the context of Argentina

As suggested to me by practitioners of ADM, the moment that scenarios are used in the ADM cycle is of great importance for the success of ADM applications. It is suggested that in a culture with a low certainty index (Hofstede, Jan Hofstede, & Minkov, 2010) will have difficulties to use scenarios at the beginning of the ADM cycle. The use and time of use of scenarios within the ADM are discussed next.

1.3.3 Moment of scenarios in ADM foundations

The main foundations of ADM have extensively studied by Timmermans et al. (2015) and Walker et al. (2013) whose studies highlight the following points: strategic management (Mintzberg & Waters, 1985), adaptive management (Holling, 1978), transition management(Loorbach, 2010; Loorbach & Rotmans, 2010), adaptation tipping points (Hoogvliet et al., 2010), adaptive policy making (APM) (Hamarat, Kwakkel, & Pruyt, 2013), assumption-based planning (Dewar, 2002;) and dynamic adaptive pathways (Haasnoot et al., 2013).

For each of these foundations, Figure 3 presents when scenarios were used within ADM approaches. As can be seen from Figure 3, the type of uncertainties used in the framework and the timing of the introduction of scenarios differs for each of the foundations of ADM. More information on the foundation of Figure 3 is provided in Appendix B1.

When evaluating the different scientific foundations of ADM, DAPP is a method generally used to represent ADM. If DAPP scenarios are introduced at the beginning of the ADM cycle, scenarios play a significant role in the exploratory phase of DAPP to identify opportunities and vulnerabilities in the future, thus identifying the adaptation tipping points on which the pathways can be based. We can say that, in other frameworks, uncertainties can have a different level and a different place in the ADM cycle. For example, in adaptive policy, making scenarios play a role after the introduction of an initial base policy. In IWRM scenarios play only a role in a " what-if analysis" after the construction of the policies.

The same can be found when we evaluate current ADM applications of national adaptation plans and participatory studies, as will be presented in the following section.

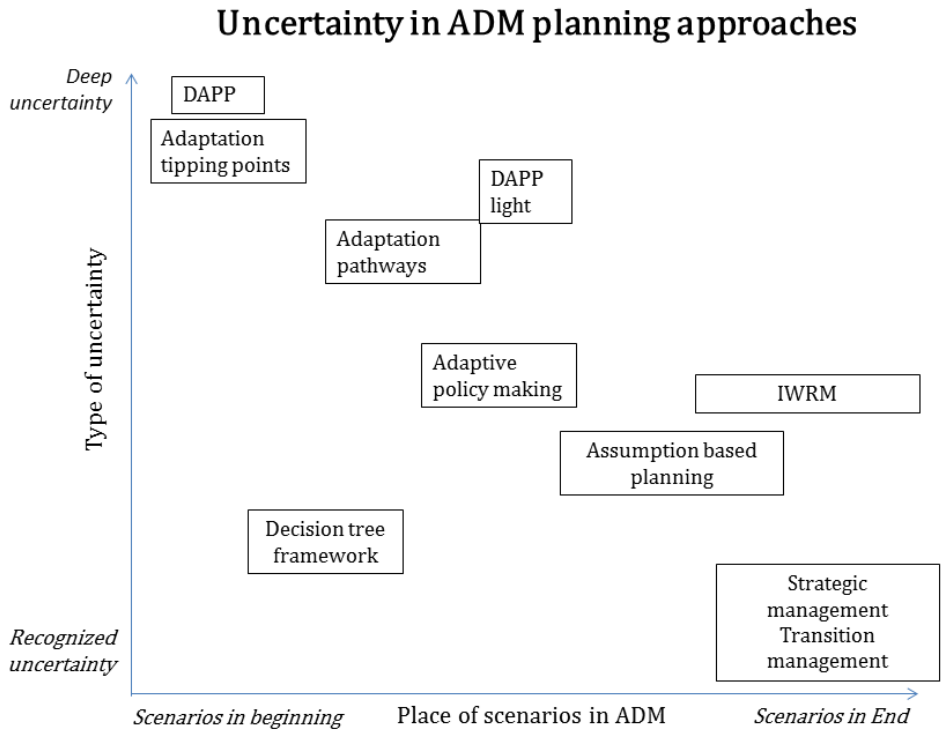


Figure 3: Uncertainty in ADM planning approaches the place of scenarios and type of uncertainty

1.3.4 Moment of scenarios in ADM applications

For the application in practice, it could be seen from the comparison of the Delta studies (Jeuken et al., 2014) that scenarios are applied in different ways. In Jakarta, for instance, only one scenario was used in the exploration phase, while in the Thames estuary project, a wide range of scenarios was used, also for action evaluation. Furthermore, scenarios did not seem to be used extensively in the real planning phase in New York but mostly for illustrative purposes. This means that scenarios are used differently in these planning studies, as suggested by DAPP (Haasnoot et al., 2013).

In the different participatory applications, an explorative phase of scenarios was only partially implemented. For example, in the study proposed by Carstens et al., (2019), scenarios were introduced after an initial action generation, after which the actions could be improved. First, , a risk assessment was done before identifying actions. Also, In the DAPP for the Hutt River scenarios played an essential role in the exploratory phase (Lawrence & Manning, 2012). Pathways were defined based on ATP conditions and scenarios.

In some cases, scenarios were created in the beginning but not directly used for action development. For example, in Portugal (Campos et al., 2016), scenarios were used at the beginning of the study, even before identifying the objectives or describing the system. However, scenarios were not used in a participatory way to address uncertainties, to identify ATPs, but only as visions. Pathways were initially suggested by researchers and could be improved by participants in changing the actions. They did not consider the relation to uncertainties. In the context of New Zealand, uncertainties are very clearly defined and introduced at the beginning of the workshops. Adaptation tipping points were not identified based on uncertainties, and actions were directly formulated without considering uncertainties (Lawrence & Manning, 2012).

In other cases, scenarios were developed at the end of the ADM cycle. Barnett et al. (2014) show that in the first place, pathways were developed based on goals, triggers and actions. Afterwards, participants could comment on these pathways and evaluate them by use of scenarios and triggers. The use of scenarios in a later stage of ADM was also seen by ADM practitioners to be functioning successfully (Deltares, 2018, personal conversation).

These examples seem to show that as well as in the scientific foundation of ADM, and in planning studies, the use of scenarios is poorly investigated, addressing the second research GAP:

Research Gap 2
The moment of scenarios for participatory ADM has not been studied and integrated into literature.

1.3.5 Participatory ADM in Argentinean context

In their practical work, van der Brugge and Roosjen (2015), Zandvoort et al. (2017), Haasnoot et al. (2013), Zevenbergen et al. (2018), Lenselink, Meijer, & van de Guchte (2013), Lawrence & Haasnoot (2017) suggest that ADM is influenced by cultural circumstances. For example, in the comparison between the Dutch and Bangladesh Delta Program, ADM is not an approach to easily transfer, but it depends on the fundamental change in institutions, relationships and policy frameworks. Furthermore, it depends on local socio-economic characteristics, culture and governance (Zevenbergen et al., 2018). Also, DAPP practitioners highlight that the local context is assumed to have an impact on the successful implications of DAPP outside the Netherlands and that DAPP should be adapted towards it (Lenselink et al., 2013; van der Brugge & Roosjen, 2015).

However, little work can be found on the cultural influence of ADM studies on a more participatory scale. Still, Wise et al. (2014) suggest attention should be paid to the process of ADM when applying it in a new cultural context. Furthermore, as Timmermans et al. (2015) highlight, a particular interest should be made when facing methodological choices in the application of ADM in cultures that score extremes on the long term orientation in the cultural dimension of Hofstede (Hofstede et al., 2010). Also,

it is highlighted that the structure of a successful ADM application could depend on its cultural context (Deltares, 2018, personal conversation).

This reflection seems to imply that culture may have a strong influence on the application of participatory ADM, and especially in the use of scenarios. No studies could be found addressing this issue using a participatory study. This leads to the introduction of the third research gap:

Research Gap 3
Existing work on participatory ADM limits in reflection on cultural characteristics of a given case in order to set-up a fitted participatory design for this case.

As could be seen, the research gaps relate to the establishment of participatory design, addressing the timing of introduction of scenarios and keeping the local context in mind. In Chapter 2, the research approach and question(s) will be presented addressing these issues.

Info: what is culture and how is it studied?

As Hofstede defines cultures 'it is the collective programming of the mind that distinguishes the members of one group or category of people from others' (Hofstede et al., 2010, p. 6). Culture is learned from one's social environment, in comparison to genes which are inherited from the biological parents. Furthermore, it can also be differentiated from one's personality. Earlier researchers, especially in the field of anthropology, studied societies and communities (Joy & Kolb, 2009), in the latter half of the 20th century this changed to a study of a comparison of cultures by means of a numerical approach, such as by the work of Hofstede (Hofstede et al., 2010) A lot of critism can be found on the numerical approach especially by anthropologists regarding the simplification of the issue, the fact that it does not reinforce stereotyping and reflect how the local population sees it (Jones, 2007). Hofstede introduces the concept of continuous cultural dimensions for comparison. In this dimensions the cultures are grouped into: power distance, uncertainty avoidance, individualism-collectivism, masculinity and femininity, long-term vs short term orientation (Hofstede et al., 2010).

1.4 Integration of two theses

This research is done for the MSc. Engineering & Policy Analysis, in Appendix X a description is given how this simultaneously with another MSc. thesis project for the MSc. Civil Engineering, track Water Management. For this thesis, a framework to investigate different ontologies of the Paraná Delta was done. In this way, both theses were always inspired by each other.

1.4.1 Research activities

I performed various research activities as can be seen in Table 2.

Table 2: Phases of theses

Phase of research	Activities
1. Preparation in NL	Literature research, expert workshops and preparatory work scoping in Argentina. I also participated in a mission of the Argentinean researchers to the Netherlands on ADM
2. May-June, 2018 ARG	A scoping mission: group model building exercises, detailed actor analysis and practical investigation to possibilities of research. Participation in different workshops and activities in Argentina in order to understand participatory workshops in Argentina. And, the organisation of an ADM game day at the water institute.
3. Set-up in NL	Work out scoping mission, determine research set--up, expert sessions and modelling, organize workshops and experiments
4. Aug, Sep, Oct 2018, ARG	Binational workshop on the development of the Paraná Delta and various other activities on the Paraná Delta, interviews with local stakeholders, measurements, development scenarios, modelling and meetings to organise the workshops
5. Design in NL	Development of scenarios, workshop design, expert session and practical organization workshops
6. Nov-Dec 2018 ARG	Workshops, evaluation workshops with team, interviews and participating hydraulic conference, organisation ADM game for local students
7. Final in NL	writing reports of all data, analysing the results of the research in Argentina and writing the two different theses.

1.4.2 Cooperation

During the entire project, Deltares guided me throughout the research. I was supported financially by the institute as well as by the TU Delft. Furthermore, I was sent to Argentina under the cooperation with Delta Alliance, based on this cooperation, I worked closely together with the Argentinean student Sabrina Couvin. In the Netherlands, I had daily Skype conversations with her, and in Argentina, we closely cooperated. Furthermore, the Argentinean wing coordinator of Delta Alliance was my local supervisor in Argentina. For my technical work, I was guided and helped by INA (Instituto Nacional del Agua), especially in terms of model development and experiments in the field. Furthermore, for the organisation of the workshops, I cooperated with INTA (Institute national de Agropecuaria). For support in Buenos Aires, Rotterdam Port consultants were of great help. The framework of these different cooperation's made it possible to set-up this thesis. In my personal reflection, I will reflect on my experience of working in such a diverse environment.

1.5 The audience of this thesis: how to read

As will be explained in the research approach (Section 4.2), the primary approach for this study is action research, which aims to empower the participants in research. The aim of this thesis is, therefore, to perform next to a graduation work aimed to be read for my supervisors at TBM, also as a handbook for local water managers interested in using a participatory ADM approach in their cases. However, since I am aware of the requirements of the MSc. thesis, I have provided a detailed appendix giving

more information from literature for the interested reader. Finally, I have provided a summary with main outcomes, both in Spanish and in English in a separate document for the stakeholders I worked with.

Due to a large amount of work gathered for this thesis, three appendices support this document:

1. Report Appendices, with additional information on work of study, referred with letter R (Public)
2. Background Appendices, with background information, referred with letter B (Public)
3. Data Appendices, of the data found in this thesis, referred with letter D (On request)

1.6 Structure of the report

The thesis is structured in the following way:

- **Part I: Foundation** establishes this introduction, the research definition of this study (Chapter 2), and the various methods applied (Chapter 3).
- **Part II: Results & Discussion** establishes and discusses the results of the research suggested in Part 1. Included in this part will be the results for the workshop design (Chapter 4), the comparison of the two approaches placing scenarios in another part of the ADM cycle (Chapter 5) and a discussion on the validity of the found results (Chapter 6).
- **Part III: Conclusion& Future** describes the final conclusions that can be made on this research (Chapter 7), suggestions for future research (Chapter 8) and a personal reflection (Chapter 9).

2| Research definition

In this chapter, the research definition of the work is given. The main question of the research is presented in Section 2.1.: *"***When should scenarios be used in participatory ADM cycle, in the institutional and cultural context of Argentina?**

In order to investigate the main question, in Section 2.2, two approaches are identified which differentiate the position of scenarios in ADM. In Section 2.3, supporting questions are provided which are used throughout this thesis to answer the main question, In Section 2.4 is shown how the thesis fulfils the criteria for an Engineering& Policy Analysis master thesis. Finally, in Section 2.5, the theoretical perspective of the study is given so that the reader can understand the decisions made in this thesis.

2.1 Research question

The gaps defined in Chapter 2 provide the foundation for this master thesis. The goal is to perform a comparative analysis that considers the most suitable place to use scenarios in the ADM cycle for a participatory implementation in the Paraná Delta in Argentina. Considerations include the quality of pathways ,the usability of the results and the reaction of the participants.

Therefore, the research question is the following:

Main research Question
When should scenarios be used in the participatory ADM cycle, in the institutional and cultural context of Argentina?

The presented question above gives several research aim and hypotheses, which will be discussed in the sections below.

2.1.1 Research aims

The following research aim can be distinguished: Comparison of two types of participatory ADM approaches by varying scenarios. Of which, one approach is assumed to fit better in the given case due to its cultural and institutional characteristics, and the other approach is suggested by the classical theory of DAPP (Haasnoot, 2013). This gives the following sub-aims:

- Develop a workshop design for these two approaches and organize workshops for comparison (see Chapter 4)
- Compare the workshop design based on criteria suggested in the literature (see Chapter 5)

2.1.2 Hypothesis

In DAPP, scenarios have an effect on all the steps following it in the cycle, and thus have some influence on the opportunities and vulnerabilities, ATPs, action development and adaptive plan construction (Haasnoot et al., 2013).

On the other hand, Timmermans et al. (2015) highlight that DAPP is highly focused on the future due to its focus on uncertainties. He highlights the limitation of DAPP for cultures scoring low on the uncertainty index of Hofstede et al. (2010). Argentina shows a relatively high uncertainty avoidance (86 of 105), which is the extent to which members will feel threatened by unknown situations and have created beliefs and institutions to avoid this (Hofstede et al., 2010). They have a complicated, abundant and sometimes conflicting legal system. However, for the individual, this does not count and corruption also plays a role (Hofstede, n.d.). Most interesting for this study is the long-term orientation. Argentina has a very low long term orientation (20 of 105), which has a very normative culture. They have great respect for traditions and remain with strong links to the past (Hofstede, n.d.; Hofstede et al., 2010) (See the Appendix B.1 for more cultural characteristics of Argentina as suggested by Hofstede). This suggests that formulating scenarios at the beginning of the ADM cycle will not function in the Argentinean context since thinking in scenarios requires the ability to think in uncertainties and long-term. Therefore, the suggestion was made by practitioners of ADM that by formulating scenarios in the final stage of the ADM cycle, this would be helpful for a successful ADM participatory application, as could be observed in other as well. It seems likely that if the participants understand the method better, they will have a higher willingness to use it in their future work, but only if it gives useful insights to them.

2.2 Supporting questions

To support the main research question, several sub-questions are addressed, also consisting of lower level questions. This study and therefore sub-questions are organised in an Introduction, Methods, Results and Discussion section as advised by Nair & Nair (2014) to structure the research.

Introduction

1. **In what ways can scenarios be used to support participatory ADM?**

- What are the claims of adaptive delta management?

- Given the various published applications and scientific foundation of ADM, how does the use of scenarios differ across these applications?
- What is the value of positioning scenarios in their respective position in the ADM framework?
- What is the role of scenarios in participatory ADM suggested by literature?
- What institutional and cultural characteristics are suggested by literature to affect the applicability/efficacy/utility of scenario planning for a participatory application of ADM?

Methods

2. **How can a comparative analysis be set-up for comparing 2 ADM approaches for the chosen case?**

- How can a comparative analysis be done for participative action research with a limited number of cases?
- What are the criteria for the comparison of two ADM methods?
- How can two different approaches in ADM be translated to practice for the given case study?

Results: case comparison

3. **What insight does method 1 and method 2 give for the application of ADM for the case?**

- What results can be found by applying ADM on the case with method 1 for the selected criteria?
- What results can be found by applying ADM on the case with method 2 for the selected criteria?
- How do the results differ when comparing method 1 and 2?

Discussion

4. **How do the expectations regarding theory match with the response of the participants to both methods?**

- What is the theoretical assumption of the results of method 1 and 2?
- How can the difference from the theory be explained?
- What are the limitations to the study?

2.3 Research approach

To answer the main research question, I have applied a comparative approach (Pennings, Keman, & Kleinnijenhuis, 2006) to compare two types of cases in order to investigate the most suitable place of scenarios in the ADM cycle. The cases are implemented as participatory workshops by means of action workshop. Two different approaches of DAPP are used to represent ADM (Haasnoot et al., 2013), representing the different workshop formats. Workshops were analysed by using different research methods (triangulation). Afterwards, the approaches were compared on pre-established criteria. Pennings et al. (2006) give a suitable reference for performing comparative research, which is used to structure the research approach. In order to make a design for the workshops, I have applied the approach of design thinking (Davies et al., 2008).

2.3.1 Comparative analysis of cases

I have compared two types of cases in order to investigate the most suitable place of scenarios in the DAPP cycle. Pennings et al. (2006) define ‘cases’ as units of observations that are under comparison. The cases were set-up according to the steps suggested by Yin (2017). The first case is the “Scenario

Approach" in which the scenarios are used at the beginning of the DAPP cycle. The second case is the "Action Approach" in which the scenarios are implemented after the establishment of the adaptive pathways. In Figure 4 the approaches are presented visually. Secondly, the cases were designed as an embedded multiple-case design (Yin, 2017). This means that multiple cases were organized of different type (2x Scenario approach and 2x Action approach). Thirdly, the theory used to design the case was the analytical framework for Dynamic Adaptive Policy Pathways approach, as suggested by Haasnoot et al. (2013). Both cases were structured according to this framework, only the place of the scenarios varied (see Figure 4). The topic of the workshop was to develop a DAPP for the sustainable development of polders in the Paraná Delta.

The focus of the workshops on polder and dyke development in the lower Paraná Delta was chosen based on literature and group model building exercises in the first scoping mission. As mentioned, the unit of variation is the place of scenarios in the ADM cycle. Various units of variation were not initially intended but were established due to the action components of the research. This is discussed in Chapter 6.

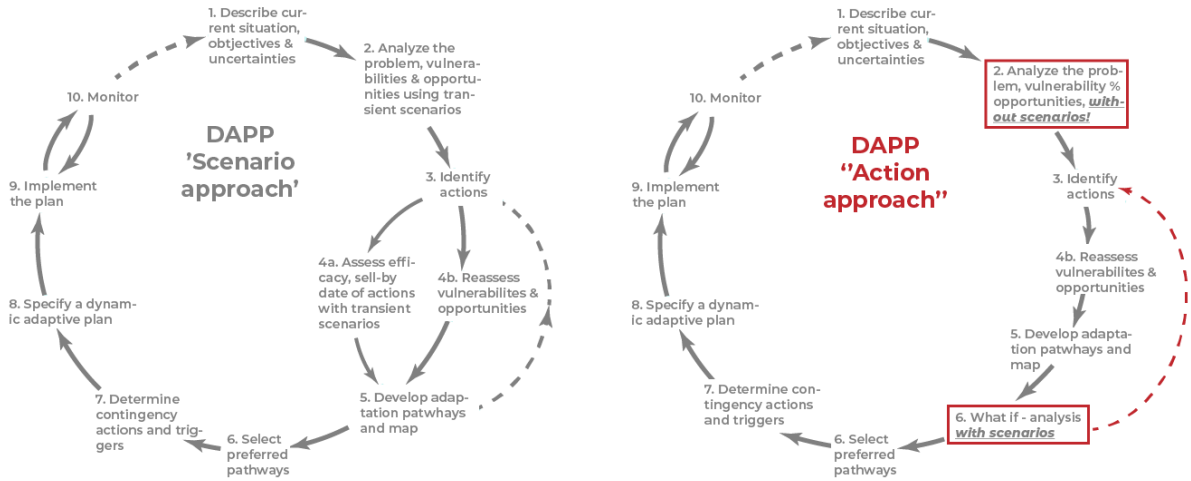


Figure 4: Two approaches of ADM with different locations scenarios, based on Haasnoot et al. (2013)

The cases were four full-day workshops organized in October and November in Tigre and Campana in the Paraná Delta, Argentina[2]. At both locations, one scenario workshop was organized and one action workshop. It was aimed to have max. 10 participants (ideally 7-8), in order to facilitate the chairing. Also, a practice workshop was organized for the testing of the workshops in Buenos Aires in October for befriended researchers.

In other to gather data, triangulation (Jick, 1979) was used. This is an approach to compare the outcomes of different research methods that investigate the same research phenomena. The different research methods are observations, surveys, critical incidents and an evaluation of the outcomes of the

[2] All took place from 09:00 hrs in the morning to 16:00 hrs. in the afternoon. Two workshops were organised in Campana on 9/11/2018 and 14/11/2018 Estación Experimental Agropecuaria del INTA Delta, Campana. The aim of these workshops was mostly to attract participants from Campana, Zarate and the inland delta island. The workshops in Tigre were organised in the municipal cultural building the aim was to attract participants of Tigre, San Fernando and Buenos Aires. The workshop dates were discussed with the partners in the research and the participants.

research. In Section 5.1 a more detailed evaluation is made of the concept. In the next Section will be explained how the data could be compared.

2.3.2 Action research

In order to make a comparison between the two approaches, it was necessary for participants to be taught about ADM and empower them to use ADM in their future work. This research approach is called action research. In Action research, the research attempts directly to change people's behaviour and gather and analyse data at the same time (Punch, 1998). Campos et al. (2016) highlight in their Portuguese case studies the usefulness of action research in combination with scientific and real-life knowledge for change in planning practices. It led to the creation of knowledge into adaptable and consensual solutions. action research is mainly used to find solutions for practical problems with a primary goal to spark change (Blair, 2016). In my case, it is used in a relative moderate version. Different types of action research can be found in this thesis (Herr & Anderson, 2005):

- In order to find the topic and context to make the ADM framework, Participatory Action Research (PAR) (Herr & Anderson, 2005) was applied. Participants were included in the research, and they were active influencers of the research outcome (Blair, 2016; Bryman, 2016; Marshall & Rossman, 1999; Punch, 1998).
- Bryman (2016) mentions that Action research is an approach in which researchers and members of a social setting collaborate in the diagnosis of a problem and the development of a solution. During the first scoping visit, group model building exercises with stakeholders were organized (see Appendix 2) to define the scope of the problem. Due to the stakeholder interviews, the case changed its initial focus from gated communities to forestry polders in the lower Paraná Delta.
- In a participatory way, the workshops were afterwards set-up, in order to shape the knowledge of the Paraná Delta together to make an ADM plan.
- Self-study (Herr & Anderson, 2005) was used to reflect on the adjustments made during the workshops.

In the discussion is reflected on how action research implemented, and how this might have affected the research outcomes. Furthermore, it is highlighted how the research findings can help to contribute to other people's practices, which is an essential characteristic of action research (McNiff & Whitehead, 2009).

2.3.3 Comparison of Criteria

In order to compare the data, an evaluation has to be performed on established values of criteria that are set-up on literature analysis. Also, in action research, analysis is done based on criteria (Herr & Anderson, 2005; McNiff & Whitehead, 2009; Pennings et al., 2006). Criteria are set up based on the literature study on DAPP (Haasnoot et al., 2013, n.d.; Kwakkel, Haasnoot, & Walker, 2016) and by looking at similar studies that also evaluate ADM or pathways approaches (Burgess & Chilvers, 2006; F. L. P. Hermans, Haarmann, & Dagevos, 2011; van Vliet, Kok, Veldkamp, & Sarkki, 2012; Zandvoort et al., 2017). The main criteria are presented below in Table 3, together with statements from literature supporting these criteria.

Table 3: Criteria on DAPP and supporting literature

Criteria	Support from literature
Quality of pathways	
1. Policies are constructed based on timing of tipping points	The value of including scenarios in ADM, in contrast to IWRM, is that DAPP identifies tipping points that determine when a particular policy or action is no longer acceptable, and another action is needed (tipping points). Pathways are designed based on the timing of the tipping points (Loucks & van Beek, 2017).
2. Actions consider scenarios, by looking at robustness and flexibility and so identify lock-ins.	The focus of ADM to make policies robust and flexible (Kwakkel, Haasnoot, and differentiates itself from traditional master planning (Kwakkel et al., 2016; Loucks & van Beek, 2017). In robustness, the chosen strategy will function in a variety of circumstances and scenarios (van der Brugge & Roosjen, 2015)1. On the other hand, with flexibility concerns itself with how changeable is the strategy when it appears that de future develops differently than expected, and we need to change the strategy1 (Haasnoot et al., n.d.; Loucks & van Beek, 2017; Zandvoort et al., 2017). In this way, the presence of lock-ins may be limited (Haasnoot et al., n.d.).
3. Inclusion of multiple stakeholder preferences in pathways/ different types of strategies	Moreover, DAPP can help to show different possible strategies to be applied,(Haasnoot et al., 2013, n.d.), and is a way to include preferences of multiple stakeholders (Haasnoot et al., 2012; Zandvoort et al., 2017). Also, van Vliet et al. (2012) show that multiple pathways show creativity.
4. Comparison possible based on objectives	Zandvoort et al. (2017) present as a key characteristic of ADM that the pathways can be compared on objective-based thresholds.
5. Triggers and signposts are highlighted	Triggers and signposts are essential to know when a specific action will take place (Haasnoot et al., 2013)
Reaction of participants	
6. Understanding pathways	One of the important aims for comparison if the participants are able to understand what pathways, given the hypothesis that one approach will be more accessible in Argentina than the other approach. Ideas can also be found in organisational learning (Argyris & Schön, 1978) and, comparative educational studies (Flick, 2006; Suter, 2012).
7. Participants will use ADM future work, stimulation of new ideas and discussion	Also, DAPP is a way to enhance cooperation and decision making since it may help to facilitate the development of a plan in the context of many varying opinions (Haasnoot et al., 2013). Development of social-cultural capital also seems applicable for this case by developing a relationship of trust between the participants and an improved relationship for social learning (Hermans et al., 2011). Furthermore, another aim is that the participants can use it in their further work, thinking from an action research perspective.

2.3.4 Workshop design

The workshops were designed based on the DAPP framework (Haasnoot et al., 2013), and they were designed as a script. To set-up this script, inspiration was done at the conference of system dynamics I followed in summer 2018, in Iceland, Reykjavik. There, I followed a group model building session of Scriptapedia. They have developed a rationale to make scripts, as a theatre script, designing all exercises in workshops and group model building. On Scriptapedia (Wikibooks, 2018), many reference scripts are provided. The workshop's exercises, including the development of pathways, were set-up in a similar style. In the 'Action Approach" pathways were constructed before introducing the subject of scenarios, while in the "Scenario Approach" actions and pathways were developed after introducing scenarios. The scripts were discussed and improved with a variety of ADM experts in the Netherlands and experts in participatory workshops in Argentina. In four expert sessions (Andrew Warren, Jan Kwakkel, Bert Enserink and Maurits Ertsen), the design was presented to the experts, and for each step, the overall set-up, the games, the exercises were discussed, and if the workshop followed the ADM steps well. Furthermore, during the practice workshop, the workshop design could be tested and was improved. Then, as suggested by action research, the workshop design was continuously improved throughout the workshops; in the reflection, I discussed how these changes might have impacted the final outcomes. In the final design, these changes are also presented.

2.4 The philosophical base of the work

The theoretical perspective of the work is an epistemological stance (Ritchie & Lewis, 2003). Epistemology is related to the theory of knowledge; it focuses on questions as to how it can be known about the world and what is the basis of our knowledge. I aim to investigate what is the most appropriate location of scenarios in the ADM framework to construct a framework for ADM in the Paraná Delta, Argentina, and thus create knowledge. In the epistemology, my stance is of interpretivist. I believe that the researcher and social world impact each other, mainly due to the use of action research. I, therefore, take a stance of 'empathic neutrality' (Ritchie & Lewis, 2003). I recognize that the research cannot be value-free, but I am to make my assumptions transparent and investigate how I impacted the study. Related to knowledge building, I believe that by using the research approach described above, it will be possible to give meaning to phenomena explored. However, causal relations can only be discussed, not directly confirmed. Furthermore, the deduction is applied (Ritchie & Lewis, 2003). By starting with an initial hypothesis from literature, I have performed an analysis to test this hypothesis.

3| Methodology

The previous chapter described the use of action research to compare two different approaches of ADM by means of workshops. It highlighted that different methods are used in order to provide data for comparison of the two different ADM approaches and that these methods are converged by means of triangulation. In this chapter, we consider triangulation and the applied methods in depth.

This chapter begins with a description of all the methods used for the comparison of workshops, The different methods described are triangulation (Section 5.1), comparison of the pathways (Section 5.2), observation (Section 5.3), surveys (Section 5.4), critical incidents (Section 5.5) and a literature analysis (Section 5.6) for reflection of the results. There is a short description of how influencing factors on the research are investigated (Section 5.7). Finally, all the methods used to describe the case are shown (Section 5.6).

3.1 Workshop input

The methods to construct the workshop set-up are discussed in Section 3.2.4 (such as script development, expert sessions, and iterative improvement during the workshops). Many other inputs had to be investigated upfront in order to design the workshops as well. These were: the Case selection, study population &stakeholder analysis, the tipping point condition, the scenarios and the key performance indicators. Since the design choices are highly related with their outcomes, the methods for selecting these specific inputs, are directly presented together with their results, as seems to be a convention in design thinking (Davies et al., 2008). In Chapter 4, the reader can have a clear overview of all the design steps of the workshop and immediately see the outcomes. In the remainder of this chapter, the methods used for the comparative analysis of the 'Scenario Approach' and the "action Approach', are explained.

3.2 Comparison by triangulation

As briefly introduced in the research approach, triangulation is an approach applied in this study using different methods that study the same phenomena, in order to give more insights in the results and to verify information[3] (Carter, Bryant-Lukosius, DiCenso, Blythe, & Neville, 2014). The main reason for using multiple methods is the belief that problems and bias of one method can be overcome (Oppermann, 2000).

[3] Triangulation can also be found as research approach, instead of a research method (Oppermann, 2000). However, since action research is the overarching research framework it is chosen to represent triangulation here in the research section.

Two main advantages of triangulation can be found. The first is the insights it brings by looking at the same issue in different ways (Carter et al., 2014; Ritchie & Lewis, 2003). Furthermore, by seeking explanations for divergent results, new explanations of unexpected contextual might be found (Jick, 1979). For example, the results of the workshops can give an understanding of the timing of the ATPs, while the observations and critical incidents can give information about the atmosphere and the understanding of the method. Furthermore, two different methods can give different types of insights on the same phenomena, given a more detailed and thorough explanation of the issue as observation and critical incidents do in describing the difficulty participants have when constructing the vision on the future The second motivation is that triangulation can help to validate information, and to give credibility and confidence to the conclusions drawn (Carter et al., 2014; Yin, 2011). Triangulation is particularly useful in this study due to the limited number of workshops that are organised. By comparing the different results of the methods, greater confidence of the conclusions can be made.

Various forms of triangulation were applied in this study as suggested by Denzin (1978) and Ritchie and Lewis (2003), as presented in Table 4.

Table 4: Types of triangulation

Type triangulation	**Explanation (Denzin, 1978 ; Ritchie &Lewis, 2003).**
Methodological	Comparing data that is constructed by using different types of qualitative methods: observation, pathways, critical incidents and surveys
Investigator	Two different observers were present in the workshop (Francisco and Odilia), the results were discussed by Sabrina, Francisco and Odilia by means of a critical incident method and an expert judgement session were done with dr. V. Zagare, and finally the results of the analysis were discussed with the committee
Theory	Looking at research from different theoretical perspectives (Decrop, 2013). I did not analyse the data from different perspectives in social science as epistemologically and ontologically, but I tried to explain the results of the triangulation by using different theories as learning theories or socio-cultural studies
Multiple	Can also be found when at least two triangulation types are used.

Analysis of all the methods is described in the data analysis sections for each method. Afterwards, the results are compared to each of the criteria. The comparison of the data was an iterative process (Carter et al., 2014). Whether the results provided further confidence and lead to conclusions, or give different and conflicting outcomes is discussed for each of the criteria in the results.

Table 5 highlights which methods were used to evaluate the criteria presented in the research approach (Section 2.3.3). In the following sections, the different methods that are used in triangulation are highlighted.

Table 5: Criteria for each method of research

Method	Pathway evaluation	Observation	Survey	Critical incidents
Quality of pathways				
1. Policies constructed based on timing of tipping points and scenarios	X	X		X
2. Actions look at robustness and flexibility, can identify lock-ins.	X	X		X
3. Inclusion of multiple different types of strategies	X	X		X
4. Comparison possible based on objectives	X	X		X
5. Triggers and signposts are highlighted	X	X		
Reaction Participants				
6. Understanding pathways			X	X
7. Participants will use ADM future work, stimulation of new ideas and discussion			X	X

As could be seen in this section, the concept of triangulation was presented as well as its motivation and application in the study.

3.3 Comparison of pathways

As shown in the previous section on triangulation, evaluating the pathways constructed in the workshops is one of the methods applied to compare the two different approaches of ADM based on pre-established criteria. The Dynamic Adaptation Policy Pathways are the main product of the DAPP cycle, as Haasnoot et al., (2013) suggest. In the available workshop time, the DAPP cycle could not be investigated further than in the development of the dynamic adaptive pathways. Therefore, by comparing the pathways, the final products of the participatory ADM workshops could be compared.

In the workshop, together with the participants, the different pathways were constructed. The pathways were constructed first using the pathway generator. However, when this did not seem to work, these were drawn on the whiteboard by the facilitator and the observer. Pictures were made of these pathways. Also, notes were made writing down the discussion the participants had on the pathways. After every workshop, a small report was written explaining the pathways and constructed in PowerPoint explaining the pathways. The pathways were qualitatively evaluated on the criteria presented in Table 3. The reports and the figures of the pathways constructed in PowerPoint were used as an input for the comparison (see Figure 5). Results were discussed with the Argentinean student.

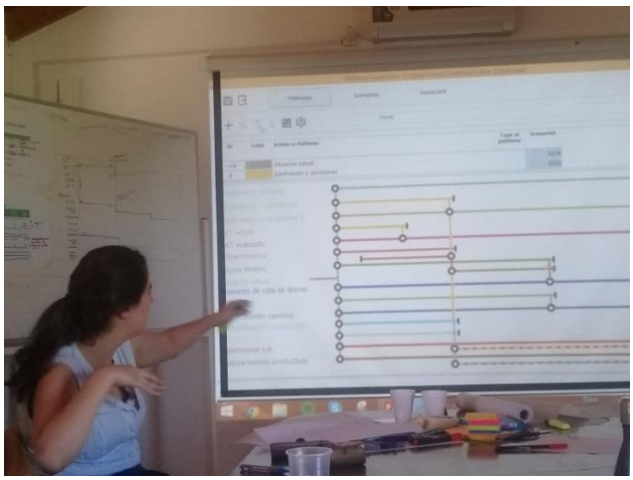


Figure 5: Discussion of pathways

3.4 Comparison by observation

Observation allows us to understand, record and analyse the individual behaviour and interactions at the moment they occur (Ritchie & Lewis, 2003; Vallaster & Koll, 2002). A form of selective semi-structured observation was applied, which already a focus was made on several activities (Marshall & Rossman, 1999). The purpose of the observation was to understand the reaction of the participants to the "Action Approach" and "Scenario Approach". Based on the criteria presented in Section 4.2, special attention was given to the following topics: (1) atmosphere in the room, (2) understanding of the participants of the subject (3) comments relevant for the comparison of the methods. I performed the function of the observer regarding these points, while a hired note maker wrote down the outcomes of the exercises, in the form of a narrative (Winstanley, 2010). As a double check, I also wrote down the answers of the exercises, and the note maker also the observation form to secure inter-observer consistency (Bryman, 2016) Since the notemaker was a man, differences between observations notes due to gender (Flick, 2006), could be overcome. The Argentinean student, Sabrina Couvin, performed the function of a facilitator.

An observation form was set up together with dr. Bert Enserink. The atmosphere in the room could be described with smileys. The smiley axes were roughly inspired by the methodology presented by Wilson & Hanna (1996), describing the social-emotional area of each of the participants by means of observation. After each smiley, I, as an observer, gave an explanation for the reason for choosing this smiley. Then, I wrote down if the participants seemed to understand the issue. I also made notes on the conversation of the participants and on their behaviour that seemed to be relevant for comparing the methodologies. The form was divided into sections based on the set-up of the workshop suggested by the DAPP theory (Haasnoot et al., 2013). An example of a filled-in observation form can be seen in Figure 6. The process of observation can be seen in Figure 3. Furthermore, when a lot of discussions took place, the workshop was audio recorded. As Marshall and Rossman (1999) suggest, I made separate notes based on my own feeling, thoughts and assumptions, and observations. During the workshops, the observation form was filled in by the note taker and by the observer.

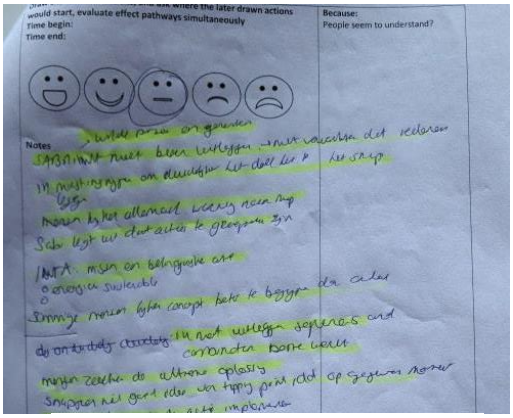


Figure 6 observation form

Figure 7: Observation during the process

Limited scholarly work can be found to analysing data of observation; most of the work is related to reflecting on the roles the researchers had in the field (Scheibelhofer, 2018). Two main categories can be used to analyse data: the anthropological tradition approach (the researcher reads their material many times, and writes down the conclusions) and Grounded theory coding (by means of observations to construct a new theory) (Scheibelhofer, 2018). In the case of this study, a combination was made of two approaches. First, an outline was made based on the criteria on which the workshops would be compared then the codes are written down as anecdotes (Scheibelhofer, 2018). Memoing was done to describe the relationship between the codes (Vallaster & Koll, 2002). Afterwards, the codes with memos were characterized per criteria. Then a narrative was written per criteria (Marvasti, 2014).

3.5 Comparison by questionnaire

Different types of surveys and questionnaires were used during the workshop. The aim of the surveys was to evaluate the workshop design, the learning of the participants and their willingness to use ADM in future work, as suggested by van Vliet et al. (2012). The study design was discussed with dr. Bert Enserink and Veronica Zagare (expert on the case area). The Spanish version can be found in Appendix R.1.

By asking the participants to fill in a survey before and after the workshop, it was aimed to measure the learning of the participants. The before-the-workshop questionnaire (See Appendix M.1) was set-up in order to make a reference case for learning after the workshops. The aim of the questions was to form a baseline of the participants regarding adaptive thinking (question 1), strategy thinking (question 2) and uncertainty thinking (question 3). The after-the workshop-questionnaire was combined after the practice workshop with an exercise often used in workshops to measure learning and let participants reflect on their experience of ADM. The exercise is shown in Figure 8 and the filling in of the questionnaire and exercise in Figure 9. Afterwards, a game was played in which the participants were encouraged to share their most important findings by means of a ball.

The work of van Vliet, Kok, Veldkamp and Sarkki (2012) and Hermans et al. (2011) was used as a basis for the indication on the level of agreement of the statements. All the surveys were anonymous. The surveys were tested in the pre-workshops, and no need was found to change the surveys.

Survey before the workshop (in English)	Survey after the workshop (in English)

1. When planning a Delta, some actions for development should be applied immediately; other actions should be left for later 2. Different possibilities exist of how the delta can look in 2050 3. When planning actions for the development of a delta, one should take into account that the future is uncertain. "Totally disagree/ Disagree/ neutral/ agree/ completely agree". 'Because?'	1.: Is it possible the plan the Delta for 2050? The participants could reply with "Totally disagree/ Disagree/ neutral/ agree/ completely agree". Afterwards, a clarification was asked with 'Because?' A final exercise "What I Got from Today" is used. By making use of a drawn quadrant with the following words 'Know, Challenge, Change, and Feel, Recommendation; participants could reflect on the workshop

Data were analysed by comparing the statements of "Totally disagree/ Disagree/ neutral/ agree/ completely agree", furthermore codes were made, and memoing was done (Marshall & Rossman, 1999). By making an overview of the responses, overlapping responses could be found regarding the responses of the participants for the workshops. The comparison was made based on the pre-established criteria (see Section 2.3.3). Furthermore, the results were used to give an explanation for the results of the other methods. By means of quotes and citations (Marshall & Rossman, 1999), examples could be given in the result section in order to clarify the main results.

Figure 9: Evaluation game in practice workshop

Figure 8: Filling in final survey by participants

3.6 Comparison by support of critical incidents

The critical incident method describes incidents during social research and gives a reflection on these incidents. Critical incidents refer to real experiences in which a communication issue was involved and where appropriate responses were not clear. Witteveen and Enserink (2007) provide a framework to reflect on the intercultural communication on incidents in their multi-cultural project team by using a narrative approach. Their framework is used to identify critical events that presented themselves in the workshops. During the workshops, different unexpected dynamics could be found, that hampered the workshop flow. These events may have been caused by the facilitation, workshop set-up or by the other phenomena. For each incident, I described what happened, how the participants seemed to perceive the incident, and what could be an explanation for the incident. In this way, the feelings of me, the observer, can be separated from the things that actually happened.

After each of the workshops, several questions were discussed by the facilitator Sabrina Couvin, the note keeper Francisco, and myself. The discussion was done in Spanish and audiotaped.

The questions were:

- *Which incidents took place? Give a description of what happened.*
- *How did the participants seem to feel?*
- *Can we give a first explanation of what happened?*

Later in the week, the discussion was summarized in English on a written report (See Appendix D.3). Expert judgement was given on this report by Dr Veronica Zagare. Together with her, the different incidents and the suggested explanation were evaluated. Afterwards, literature was used to explain these points further, and comparison was made to other workshops.

The methods only described unusual incidents and were not set-up in a way to directly compare the two approaches but to strengthen or attack the results of the other methods.

3.7 Literature: Evaluation and explanation results

Further literature research was done in order to give an explanation for the results. The analysis was done based on learning studies, cultural studies and ADM reflection of different cultures. Based on the insights received, keywords were discussed with experts and handbooks of the different domains were read. For example when learning seemed to play a role in the reason for the well-functioning of the "Action Approach", a comprehensive educational book was read, and from there, different keywords were looked up in Scopus and Google Scholar.

3.8 Factors influencing research

In different forms, the research may be influenced, or the data can contain limitations, it is impossible to have value-free research Therefore, it is important to evaluate the limitations of the study that are encountered (Ritchie & Lewis, 2003), Also, the researcher may impact the study by his or her actions as due to the facilitation or observation (Scheibelhofer, 2018). Notably, in action research, it seems to be of relevance how the researcher influenced the outcome of the study (Ritchie & Lewis, 2003). These arguments show the importance to evaluate the limitations, reflect on the values of the researcher and the influence of the researcher. For the reflection on the values I had as a researcher, I made my pre-supposed values and how these values changed during the research. Furthermore, of each of the methods, I wrote a reflection on how the facilitation team might have influenced the outcomes.

Results & Discussion

4| Workshop design

In this chapter, I will present the methods together with the results of the workshop inputs, due to its convention in design thinking (Davies et al., 2008).

This chapter begins with a description of the various design choices that should be made before the workshops: The selected case (Section 4.1), the stakeholders and sample (Section 4.2), the workshop inputs as indicators, scenarios and actions (Section 4.3). Then the techniques applied in the workshops are described (Section 4.4). Finally, the research design of both types of approaches is presented (Section 4.5).

4.1 Case: Lower Paraná delta

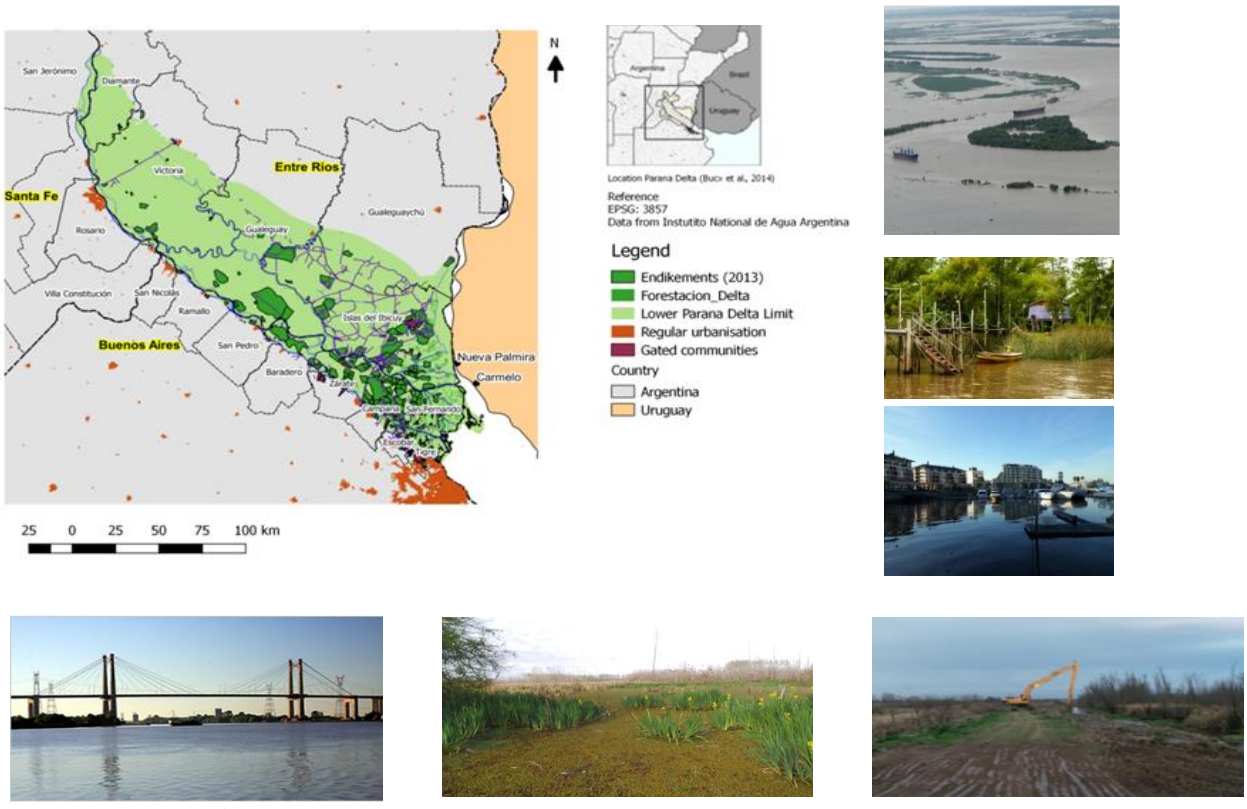


Figure 10: Overview of Parana Delta (Pictures and graphs created by the author)

For the case description, workshop outcomes, planning studies of governmental authorities, newspaper articles, literature, government documents, results of expert interviews with causal loop diagrams, interviews with local participants and finally field research and measurement data are used. The variety of these methods was not only done for this study, but also for the MSc.. of water management. The reader is advised to study this thesis of the MSc., Water management for further details. The case was finally selected by means of the local workshop team. For a detailed overview of the case, the reader is referred to Appendix B2.

The Paraná river starts in Brazil, flows through Paraguay and Argentina, and ends up in the Rio de la Plata (Zagare, 2014). The focus of this research is on the Lower Paraná (see Figure 10), situated from Entre Rios until to coast of the La Plata river (V. Zagare, 2018). The Lower Paraná has a length of approximately 320 km and a maximum with of 60 km (Badano, Sabarots Gerbec, Re, & Menendez, 2012). In the north, the city of Rosario is situated, in which 1.2 million inhabitants live (V. Zagare, 2018). In the south, the river faces the greater Buenos Aires, with a population of around 12.8 million inhabitants (V. Zagare, 2018). It can be seen as different physical systems: a delta, a wetland and an estuary (Zagare, 2014). The Lower Paraná can be seen as a delta since it is an area dominated by sedimentation and due to the interaction of fluvial and marine forces (Marcolini & Parker, 1992). Secondly, wetlands, which are terrestrial and aquatic ecosystems along watercourses that are permanently flooded, making a connection with the groundwater (Junk & Piedade, 2010). The floodplain river-fed wetlands are recognized for their possibility to adsorb floods. Finally, it is also an estuary, since it is a transition of two distinct water bodies; a river and a sea (Savenije, 2005). The Paraná Delta is a complex estuarine system since it does not discharge its sediments on the Sea, but first on the river Rio de La Plata (Marcolini & Parker, 1992).

The Rio de la Plata was formed by the confluence of the Rio Paraná and the Rio Uruguay. From the north, the influence can be found of the Paraná river. In the investigated area, the Rio Paraná splits between Rosario in the Paraná de Las Palmas and the Guazu river, with average river flow of 18000 m3/s (Bucx, Driel, Boer, & Graas, 2014). Furthermore, the river transports 160 million ton/year (Badano et al., 2012) of sediments, causing a continuous growth of the Delta front of approximately 72 m/year of the Paraná de las Palmas along its 60 km frontline and 27 m/year m northern sub front close to the Guazu river (Badano et al., 2012). The delta itself is new land, formed by sediments of the Paraná's tributaries, while the edges of the delta are ancient (Zagare, 2014). From the South-west, flooding occurs due to strong South-east winds (Sudestada) that steer up to the water level of the Rio de la Plata. The time of a Sudestada is also variable (it can be hours or days) Also, the recurrence is variable, in Tigre, for example, the recurrence of a Sudestada is between 4 and 8 weeks (Fundación Metropolitana and Municipio de Tigre, 2013). Furthermore, Sudestadas are associated with the El Niño Southern Oscillation (ENSO) cycle, which is a phenomenon that takes place in the tropical Eastern Pacific Ocean and is characterised by a change in temperature and pressure of surface waters. The ENSO is the leading cause of climate variability in South America (Berbery et al. 2006). From the West, flooding takes place, due flooding of the tributaries (as for example the Lujan river). Finally, from the west, the influences of the Uruguay river can be found (Guizzardi & Sabarots Gerbec, 2018). The influence of climate change was investigated by various studies (Barros, Clarke, & Silva, 2006; Barros, Menéndez, & Nagy, 2003; Medina & Codignoto, 2013; Re & Menéndez, 2006). However, the exact implications on water level and water flow variations are still debated.

Besides climate change, anthropogenic influence has also played a role. During the 1990s, a state reform occurred, resulting in the privatization of public services (Zagare, 2014). This gave a possibility for private developers to invest in large gated communities along the border of, and sometimes even in the Delta (Zagare, 2014). A gated community is a neighbourhood that is isolated from the surrounding communities with polders. Also, industries can be found along the edges of the Delta (Fabricante,

Minotti, & Kandus, 2015). In the Delta's islands, polders can be found for forestry, agriculture and housing purposes (Minotti & Kandus, 2013). The government has not installed any system for the prevention of the floods on the islands, meaning that all flood protection is made by individual actors (Bucx et al., 2014). Another technique that can be found is "attajerepuntes", lower dykes in which flooding can occur to let sediments in. Often a second dyke is placed behind the attajerpunte, in which gates regulate the water system for irrigation purposes (Bucx et al., 2014) By using an open ditch system (Sistema de zanja abierta) water can run off by gravity from the fields by means of open ditches (Bucx et al., 2014).

Another complicated issue is the institutional structure. Authority in the Delta is divided amongst the national government, three provinces, and 18 municipalities (Zagare & Manotas Romero, 2014). In order to simplify responsibilities, the national government is responsible for a healthy environment, the province is responsible for natural resources, and the municipalities are responsible for urban development (Zagare, 2014). Attempts are made by the current government to investigate the development of the Paraná Delta (binational conference). Other planning attempts can be found as a regional plan (PIECAS-DP, 2011b), local municipal plans (Fundación Metropolitana, 2015) and local workshops (Wetlands international, architects Zarate). The government of Argentina has expressed its interest in ADM. Due to the context of many uncertainties and the request for planning ADM, the case study seems to be able to benefit from an adaptive planning approach.

In order to select a specific area of the case, different decisions had to be made in order to make the study feasible. It was chosen to focus only on the lower part and the half of the middle part of the Paraná Delta. First of all, in this area, stakeholders of the main areas of the selected case study could be invited to the workshops. Furthermore, different dynamics of changing type of polders, in combination with different conditions of the climate could be analysed, given a complex system full of uncertainties. Also, many different extreme hydrological dynamics can be found in the different areas of the lower Paraná Delta. In the upstream part, for example, nobody lives due to the high flooding. For this reason, an area was selected consisting of the current habitation and polders, but with the possibility to expand. An additional map was provided in the workshops in case the participants would want to expand the polders outside this area; however, this was not the case. In the Delta Bonaerence, the leading forestry development can be found. As can be seen, an area a little bit larger than the Delta Bonearence is selected for the workshops. By selecting this area, it gave the participants the possibility to reflect on the development of polders in the area. This was chosen as the central theme of the workshops for which the pathways were constructed. The selected case area is presented in Figure 11.

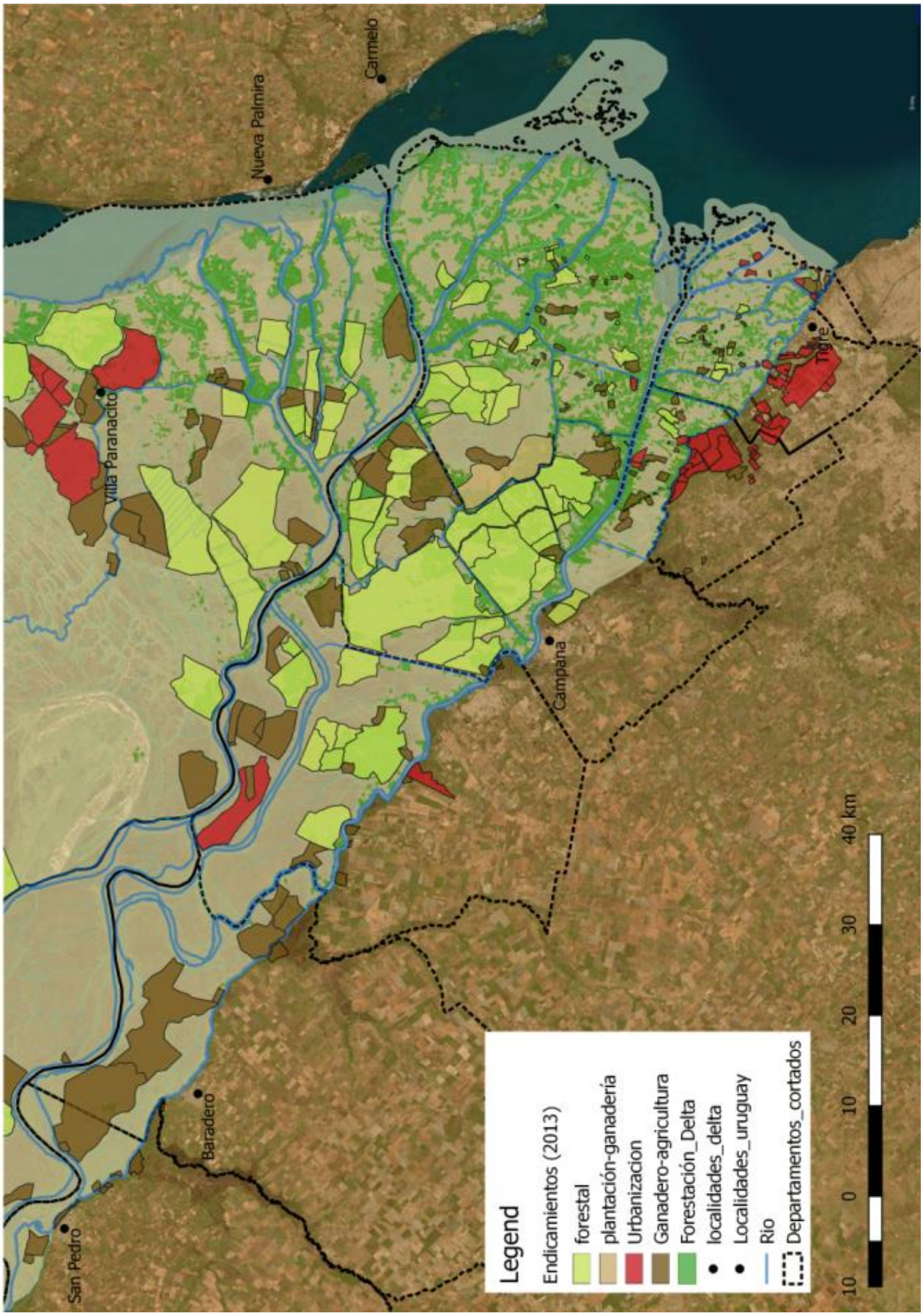


Figure 11: Case area Delta Bonaerence for workshops (created by the author)

4.2 Study population, sample and stakeholder analysis

In order to identify the sampling for the study, Ritchie & Lewis (2003) advise studying the sampling subject (population), and secondly to investigate the most appropriate information selection source (sample frame) to select respondents. The stakeholder selection was done together with the Argentinean student Sabrina Couvin.

4.1.1 Study population

It was chosen to select a similar population for the study as would be participating in DAPP (Haasnoot et al., 2013), since the methodology of ADM was under investigation here. The target population to select had to be stakeholders in the Paraná Delta having an interest in the development of the polderisation in the Paraná Delta as DAPP suggests in a participatory format, the relevant stakeholders should be included in the process (Carstens et al., 2019). The reason for this seems to democratize the decision-making process (Bert Enserink et al., 2010).

4.1.2 Stakeholder analysis to construct a sample for workshops

Ritchie & Lewis (2003) advise the sample to be as diverse as possible. For this reason, the study population was investigated using stakeholder analysis as suggested by Hermans & Thissen (2009) and Enserink et al. (2010). In particular, advice of ADM literature was taken into account to invite public sector actors of multiple levels of governance and the private sector (Lawrence & Haasnoot, 2017). The steps for an actor analysis, as suggested by Enserink et al. (2010) were applied to construct the sample. Various techniques were applied to get information for the stakeholder analysis and also to find people as representatives of their stakeholder group.

At first dr. V. Zagare suggested literature relevant for the Paraná Delta. Based on this literature, the principal researchers in the Paraná Delta could be found. Furthermore, experts from Deltares expert on

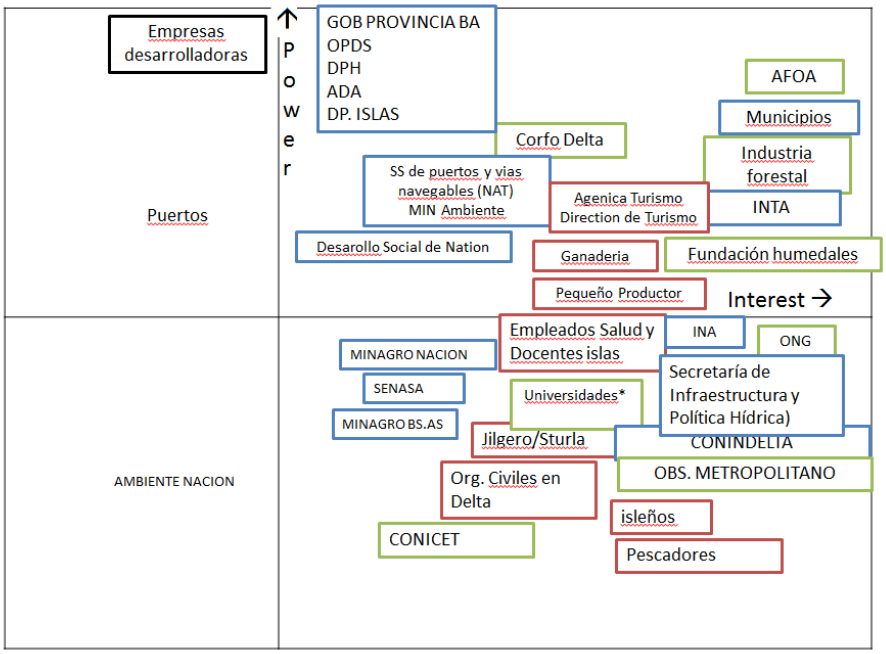


Figure 12: Power interest grid of the Parana Delta

the Paraná Delta advised stakeholders due to previous encounters. Also, Bucx et al. (2014) and Zagare and Manotas Romero (2014) provide an overview of relevant types of stakeholders for their given studies. Based on these insights, experts and relevant persons in the Delta were contacted. During the first visit to Argentina over a period of two weeks, the experts were met. As a participatory exercise, a power-interest diagram was filled in together with the stakeholders (Bert Enserink et al., 2010). Snowballing (Decrop, 2013) was used to connect to new stakeholders. In a total of 11 Power interest grids were developed with key informants (see Figure 12). Afterwards, these power-interest grids were combined, and a workshop session was organised for respondents validation (Decrop, 2013) to validate the matrix (see Figure 12). To improve the analysis, work session with Zenzi Pluut (specialist in stakeholder management of Twynstra Gudde) was organised in order to structure all the agencies and stakeholders on influence, based on the ideas of the circle of influence. Stakeholders were invited based on their main category for the workshops.

A major challenge in the research was to have the selected stakeholders, to actually come to the workshops. Since we did not have an already existing network, and we purely performed a scientific study, we saw this as one of the hardest challenges of the research. Several experts promised their assistance in connecting us to possible participants. Some were very helpful, others made promises to help, but did not respond later on. This gave the need to put a lot of energy in contacting stakeholders to participate in the workshop. Since the study was set-up without any policy implications, it initially seemed hard to get to know more stakeholders.

Luckily, a high-level workshop was organised by INA and Deltares, and the stakeholder list that was developed previously was used for the invitations by the government, having many people to come to this workshop. By participating in the Deltares-INA workshop, we were able to approach participants and invite them to our workshops. In this way, more participants could be traced and motivated to participate in the study. Furthermore, since I also performed measurements for the MSc. Water management I got to know a lot of local people and organisations. As Ritchie & Lewis (2003) suggest, working through an organisation which provides service to a distinct population, can be a way to contact this population. Thankfully, INTA (national agriculture of agriculture) was a great help in connecting us with local stakeholders. Together with them, the stakeholder list was polished, and local participants were contacted.

After this workshop, we knew we could organise four workshops and two practice workshops. For each workshop we invited a participant in the forestry sector, an environmental organization, the different delta organisations, province, municipalities, water research institute, agriculture institute and local island inhabitants. An example of the invitation is attached in Appendix W.6. The only reason for dividing the stakeholders in a special workshop was closeness to that location, willingness to travel to that location, or relation with the respective assistant of INTA.

4.3 Workshop input

4.2.1 Key performance indicators

Key performance indicators (KPI's) were used for the investigation of the success of the pathways were chosen, based on the group building exercises with experts in the first scoping mission. By drawing the system with these experts, the primary indicators were highlighted. A long list of these leading indicators was set up, together with calculative approaches. However, after the preparatory workshop, these quantitative indicators seemed to take too much time in the workshop process. Therefore, the indicators were slightly adjusted. By discussing the indicators in depth with Argentinean experts, a final

list of indicators was provided. Reference values of the indicators were looked up in literature. The indicators are shown in Table 6.

Table 6: Indicators

Indicadores	Subcategorías	Actuales
Producción	Producción forestal (ha / Tn.) [1]	80.000 ha 250.000 Tn.
	Mimbre (ha)	200 ha
Calidad de vida	Población (hab.) [2]	10.000 hab
	Calidad de Vida	
Ecología	Áreas de reserva (ha) [3]	16.300 ha

1. *Valores 2014 (INTA).*
2. *Valor promedio de radio censal de zona de estudio (INDEC, 2010) contempla bajíos e islas.*
3. *Contempla Reserva Ciervo de los Pantanos y Zona Estricta de Reserva de la Biósfera, San Fernando*

These indicators were for preliminary discussion with the participants; the participants had the possibility to correct the literature values and add or change indicators. If significant improvements were made in one workshop, these indicators were used for the next. For example, the weekend population in the delta turned out to be of great importance. However, in some workshops participants preferred to see it as a separate indicator, while in other workshops it was disregarded.

4.2.2 ATP condition

Most studies that are found for the application of ADM in workshop format only handle a limited amount of uncertainties on the tipping point axes (see for example, Marjolijn Haasnoot et al., 2013). However, in the Paraná Delta, many uncertainties can be found both regarding the technical system and the social system. For the technical system, the following main uncertainties are highlighted: Influence of Sudestada, the frequency of Sudestada, the height of Sudestada, increase/decrease in rainfall Delta, Increase/Decrease flow Paraná and the Influence river Uruguay. Furthermore, little knowledge exists of for example the influence of the dykes, the sediments etc. For the social system, the main uncertainties can be found as well as the government presence in the Delta, the price of soy, wood, houses, the creation of infrastructure, the popularity of the Delta to live, tourism, the social conflict that can occur, the change of livestock to agriculture, the price of a man-hour in order to construct dykes can be seen.

The water level was taken in the preparatory workshop as the ATP condition. However, while this seemed to be of great importance in the lower section, next to the border with the La Plata River, River discharge seemed to be highly relevant in the upper section. Therefore, the preparatory workshop was highly complicated due to this different dynamic to define ATPs, since the two dynamics could be turbulent and even conflicting. However, the most extreme conditions can occur with both frequent, and intense Sudestada, high discharge of the Paraná and Uruguay river and extreme rainfall, in this situation of extreme climate change, the failure of the system would be interesting to analyse. Therefore, in the

first workshop climate change was chosen to be the ATP condition. However, this seemed to be highly confusing for participants, since in the scenarios, climate change was also present as one of the axes. Therefore, in consultation with ADM practitioner Andrew Warren, it was decided to take time as ATP condition. He advised only to apply time if no other overarching ATP condition can be found.

4.2.3 Scenarios

The scenarios were used as an input to create dynamic adaptive pathways. By formulating different contextual developments, ATPs could be formulated. Therefore, explorative, contextual scenarios were applied, showing multiple ways the system could develop (Enserink et al., 2010). These were defined as follows:

> *"Explorative scenarios sketch one or more possible images of the future (or developments) without any statement being made about the desirability of it"* (Enserink et al., 2010, p. 124)
> *"Contextual scenarios provide images of possible futures environments of the policy or system to be taken into account. They are mainly used to make statements on the robustness of possible policies"* (Enserink et al., 2010, p. 125)

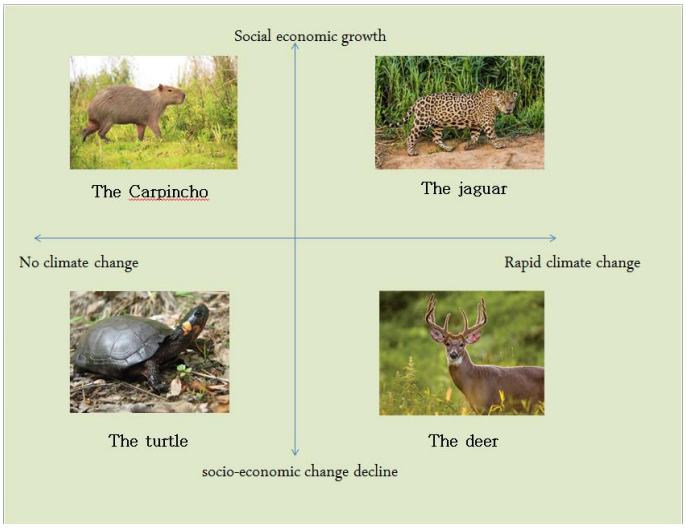
The methodology proposed by Enserink et al. (2010)[4], was followed to construct the scenarios. Two main driving forces were found: climate change and pressure by socio-economic development, this formed the scenario logic (Enserink et al., 2010). As a reference for the presentation of the scenarios, the scenarios were presented as in the Delta plan (Bruggemans, 2018). In this context, by connecting the scenarios to the pathways, it would be identified and test whether the strategies work in different futures, to assess impacts of certain developments, and to identify actions to prevent or enable certain developments (ter Maat, Warren and van Aalst, 2018).

By means of visual storylines, presented in a PowerPoint and given the names of the scenarios of animals in the Delta , the scenarios were aimed to be communicated effectively (see Figure 13). In Appendix W.3, the storyline of the scenarios is shown. The timeframe of the scenarios will be in 2050 (32 years from now). This timeframe could be tested if participants were able to think long-term. The scenarios were established based on literature, expert judgement in the Netherlands and Argentina, workshop Deltares and the insights of the first scoping missions. Then, they were tested in the preparatory workshop; the participants agreed on the scenarios. Also, in the workshops, most participants could relate themselves to the scenarios.

As an underpinning analysis, the following steps were done:

- Climate series was developed for the upstream and downstream conditions, based on predictions of discharge conditions and sud estada events
- Initial Socio-economic inputs have based the work of Zagare (2014), group exercises and group work and talks with experts of the Delta
- Analysis of the water level and discharge in these events. The results were shown on maps for the participants

[4] See Swarz,1991; Mojica et al., 1999; Topmkins, Few and Brown, 2007 and Rhydderch, 2009 for other approaches.



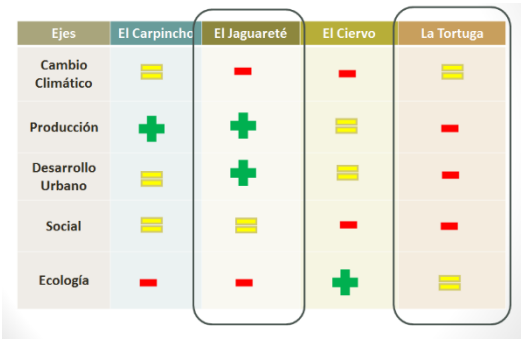


Figure 13: Main values of the scenarios

4.2.4 Action cards

In order to facilitate a quick action generation, actions were prepared in advance as fact cards. The idea of making actions of fact cards came from the sustainable delta game (Lawrence & Haasnoot, 2017; Warren & Haasnoot, 2018). An analysis based on relevant actions for the lower Paraná Delta was made from the masterplans of PIECAS (PIECAS-DP, 2011b, 2011a), the masterplan of the municipality of Tigre (Fundación Metropolitana, 2015), development plan of the Delta Bonaerence (Menendez, Lopólito, & Badano, 2010) and the development of the productive delta (CEDYAT, 2016), the sustainable delta game (Warren & Haasnoot, 2018) and the workshop of INA and Deltares. In Appendix W.5, an overview is given of the actions needed for the Paraná Delta based on these masterplans.

These actions were adapted to the context of the Paraná Delta and translated to Spanish (see Appendix W.4 for overview of all actions). Many actions relate to the building of palafitos, floating houses, an early warning system, increasing dykes, zoning etc. An example of an action card for an atajerepuntes is shown in Figure 14.

Figure 14: Examples of action card

4.4 Techniques to improve the workshop

Various techniques were applied to improve the workshop flow. As suggested by Warren (, 2018, personal communication), by using games participants will feel more connected to the outcomes of the workshops. Myself, I got training in the use of games for facilitation during water conflict management of IHE Delft and my fieldwork in Nicaragua for which I worked together with anthropologists that specialized in using games for facilitation. Therefore, I felt comfortable to implement games in the workshops. We applied various games in the workshops for the flowing objectives:

- In order to introduce the concept of adaptive delta management by laying the sustainable delta game (Lawrence & Haasnoot, 2017; Warren & Haasnoot, 2018)
- As icebreaker to get to know each other
- As a way to create a shared vision
- In order to get back in the process after the break for the participants to focus
- To give feedback on proposed actions
- To reflect on the methodology

Furthermore, as Hermans, Wim, Haarmann and Dagevos (2011) highlight, it is important for stakeholders to comment on intermediate products during participatory processes. For this reason, in all the stages of the workshops, participants were given the possibility to give feedback on intermediate products.

The workshop preparation was done together with the Argentinean student, Sabrina. In order to prepare and train ourselves for the workshops, we participated in several workshops in Argentina on Delta planning such as the workshop of Wetland international and Fundacion Pensar to learn about the issues in the Delta and workshops in the area, as well as the workshop organised by INA-Deltares on the development of the Delta. By participating in the workshop of Deltares, we were introduced to the concept of drawing on layers, which proved to be very valuable later on. Also, we learned how intense participants could discuss, and the comments of participants that they would like to receive information on the delta upfront. Furthermore, we discussed doing workshops in Argentina with Veronica Zagare and ADM workshops in general with Andrew Warren, and how to behave as a facilitator.

4.5 Workshop design

Based on the theory suggested in the design work of section 3.2.4, the set-up of the workshop is explained here. A detailed script is also provided of both of the workshops in Appendices W.1 and W.2.

WORKSHOP 1 "APPROACH SCENARIOS"

The following main steps were done in order to implement the approach of actions as suggested by the theory presented by DAPP in Chapter 2. In Appendices R.1 and R.2, a detailed description per step is found. The reader interested in organizing ADM workshops is highly suggested to consult these Appendices.

1) Decision Context

1. The facilitator gives an initial presentation (10 min) which includes:
    a. Overview of activities of the day
    b. Rules for the workshop
    c. Area of focus of the workshop by presenting a map

2. Introduction game is played with a ball
3. Exercise for the system is done in which the participants are asked to describe the main dynamics in the case area; drawing are made on a map.
4. Vision game: by making use of a ball game, participants are asked to express their vision for the delta
5. Indicators are proposed to the participants, on which they can comment. Then the participants can formulate the objectives of these indicators, based on the vision they constructed in the previous step.

2) Assess vulnerabilities and opportunities

1. The participants are asked to specify the various uncertainties in the delta (e.g. climate change, economy develop, models)
2. The concept of tipping points is explained to the participants. The facilitators present overarching tipping point condition (e.g., water level), if no overarching condition is found, 'time' is chosen as the tipping point condition. Participants are asked when the system is considered to fail for this tipping point condition.
3. Scenario exercise: The previously constructed scenarios are presented; participants have a possibility to comment.
4. The participants are asked to construct the tipping points for each of the scenarios.

3) Actions

1. From a long list of actions, participants select actions which will lead to their objectives.
2. They are encouraged to select actions that will work in a sequence, therefore participants select the short term and long term actions, different strategies have to be made.
3. The participants classify actions per scenario
4. Participants select combinations of actions that always go together
5. Participants score actions, non-promising options are deleted.
6. Evaluate the vulnerabilities and opportunities *(if time available)*
7. The actions are drawn per scenario and in sequence *(if time available)*
8. Assess the timing of tipping point conditions in the different scenario's

4) Design an adaptive plan and evaluate pathways

1. Facilitator presents the concept of adaptive pathways by a PowerPoint presentation
2. Facilitator/ participants draw the different values of tipping points
3. Facilitator/ participants draw the different actions and discusses where the later drawn actions would start (by a preferable whiteboard with a marker or online Pathway generator)
4. Discussion on which combination of actions has a kind of effect, change action if needed
5. Evaluate the pathways and illustrate trade-offs on key criteria, opportunities, no-regret actions, Lock-ins, Timing of options, Sequences of options undesirable (especially costly)

5) Design an adaptive plan

1. Select the preferred pathway
2. Specify short-term actions and long-term actions
3. Specify preparatory actions needed to keep long term actions open
4. Evaluate the impact of preparatory actions
5. Specify enabling actions as zoning, improvement of regulation etc.
6. Specify signposts and triggers for a decision to be made — enough time for the preparation, installation and development of action should be available.

6) Evaluation exercise

1. Have participants fill out an evaluation form
2. Play a game with the ball in which participants are asked to reflect on the workshop. To give a closure, the facilitator thanks the participants, people clap, and a group picture is made.

WORKSHOP 2 "APPROACH ACTIONS"

The following main steps are done in order to implement the approach of actions as suggested by the theory presented by DAPP in chapter 2.

1) Decision Context (similar as with Approach Scenario)

2) Actions (similar as with Approach Scenario different sequence)

3) Design an adaptive plan and evaluate pathways

1. Facilitator presents the concept of adaptive pathways by a PowerPoint presentation
2. The present concept of adaptive pathways by a presentation
3. Introduce the tipping point condition, ask for the maximum tipping point condition
4. Evaluations of the tipping point timing for the actions
5. Facilitator/ participants draw the different values of tipping points
6. Facilitator/ participants draw the different actions and discusses where the later drawn actions would start (by a preferable whiteboard with a marker or online Pathway generator). Draw long term actions, ask per short term action, which could be followed by a long term action, evaluate immediately
7. Discussion on which combination of actions has a kind of effect, change action if needed
8. Evaluate the pathways and illustrate trade-offs on key criteria, opportunities, no-regret actions, Lock-ins, Timing of options, Sequences of options undesirable (especially costly).

4) Design an adaptive plan

1. Prepare different adaptive pathways
2. Select the preferred pathway
3. Specify short-term actions and long-term actions
4. Specify preparatory actions needed to keep long term actions open
5. Specify enabling actions as zoning, improvement of regulation etc.
6. Explain that the future might go different than today. Scenario exercise: introduction uncertainties, literature scenarios and creation of scenarios
7. Discuss per scenario how the timing would be of the actions.
8. Make a timeline for the scenarios. Discuss for two scenario's how the timing would be together with the tipping points, draw under the maps
9. Specify signposts and triggers for a decision to be made, since enough time for the preparation, installation and development of action needs to be present.

5) Evaluation exercise (similar to Approach Scenario)

5| Results

In this Chapter a comparison is made between the "Action Approach' and the 'Scenario Approach'. In the boxes below a main description of the four workshops can be found (See Appendix D.6 for the entire workshop description).

Scenario Approach: Workshop A

Location: INTA Delta, Campana
8 participants, Background: INTA 2x, province 2x, Large forestry producer 1x, smaller forestry producer 1x
ATP condition: Climate change

Figure 15: Workshop A

The general atmosphere of the workshop seemed to be positive but confused. A lot of knowledge was present about the location and use of the polders, and the dynamics of the delta. Also, many opportunities and vulnerabilities were identified. A clear show-off of knowledge took place. No strong contrasting views were present. Participants seemed very confused when drawing the pathways. The main cause for the confusion was climate change as ATP condition since it was also part of the axes. It was not possible to finish the workshop on time and do all the exercises.

Scenario Approach: Workshop B

Location: INTA Tigre
8 Participants, Background of participants: INTA 2x, province 2x, INA 3X , UNSAM 1X
ATP condition: Time

Figure 16: Workshop B

The participants were extremely critical on the methodology. It was difficult to separate the vision of the current system. They all had a scientific background. They seemed to find it difficult to see that the workshop was an iterative learning process; they did not want to change the results of a previous step in the next step. The participants gave a very detailed description of the current water system of the Paraná Delta and the associated problems. It was not possible to evaluate actions and do all the activities.

Action Approach: Workshop C

Location: INTA Delta, Campana
15 participants, of participants: INTA, province, Large forestry producer , smaller forestry producer , the union of the islands
ATP condition: Time

Figure 17: Workshop C

In general, the atmosphere of the workshop was very positive. It was the workshop with the most participants. A lot of time was spent on the decision context and evaluation of the actions; less time was spent on outcomes. A drawing was made of the action zoning. Furthermore, it was possible to create pathways and evaluate with scenarios. It was possible to finish all the steps of the workshop on time.

Action Approach: Workshop D

4 Participants, Background of participants: INTA 3x, INA 1x (Due to Sud-estate many participants could not come, others cancelled on the day itself)
ATP condition: Time

Figure 18: Workshop D

In general, the atmosphere of the workshop was positive. The participants were all from a scientific research institute. Due to a Sudestada, all other participants could not come. A detailed explanation was given by the participants on the current system. When analysing the ATPs, participants themselves suggest that uncertainties have to be taken into account when looking at the year 2050. Pathway development by each of the participants, improvement and discussion on each of the pathways. It was possible to finish all the steps of the workshop on time.

The results obtained by observations, critical incidents, pathways and surveys of each workshop are used to make this comparison. For the results per method a detailed Appendix is written. The reader is referred to appendices: Observation (Appendix D.4), pathways (Appendix D.2 and D.5) and critical incidents (Appendix D.3).

In order to compare the 'Scenario Approach' and the 'Action Approach' in the coming sections a comparison is made based on the criteria proposed in Section 2.3.3:

1) Policies constructed based on the timing of ATP and scenarios
2) Actions robustness and flexibility can identify lock-ins.
3) Formulation of different types of strategies
4) Comparison possible based on objectives
5) Triggers and signposts are highlighted
6) Understanding pathways
7) Participants will use ADM future work, stimulation of new ideas and discussion

For each criterion in the following sections, the results per workshop are categorized per approach. Furthermore, in the blue box at the end of each section a comparison between the two approaches is made. Finally, In the Chapter 7 (Conclusion) by means of a summarizing table the comparison on all criteria of the workshops is presented.

5.1 Criterion 1: Policies constructed based on the timing of tipping points and scenarios

5.1.1 Criterion 1"Scenario Approach"

Scenario Approach: Workshop A

Observation results highlight that the participants understood the concept of scenarios well since they were able to reason about the implications of scenarios logically and use the name of the scenarios throughout the workshop. However, the fact that actions can work in both scenarios was confusing. After a lengthy discussion, the participants agreed that the "atajerepuntes" would not work in all scenarios. The process of differentiating the actions per scenario is shown in Figure 19.

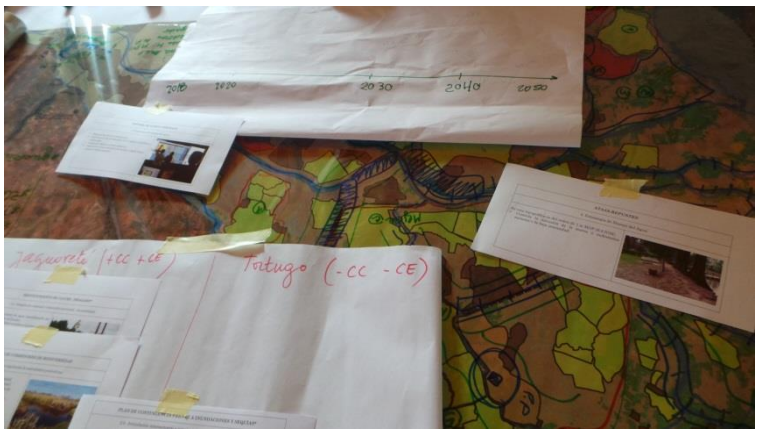


Figure 19: Selection of actions per scenario

The participants were confused by the concept of the tipping point condition. The following critical incident highlights this:

"The tipping point condition was a complicated issue to understand. Participants finally seemed to understand that it is the condition that shows when a catastrophe of the system can take place. However, they did not understand the point that a new action should be implemented. During the drawing of the actions, they seemed to forget again what a tipping point was. When the facilitator asked them until which moment the actions would work, and which actions would proceed, no reply was given. They did seem to understand what a scenario was since they were immediately able to use the concept when selecting actions".

The observation results also show that the tipping point condition 'climate change' was confusing for the participants, due to its similarity to the other conditions. The facilitators had selected this condition in advance of the workshop since not one specific tipping point condition seemed to fit to the Parana delta, and climate change seemed to be an overarching condition of the various uncertainties that could be found. In order to measure climate change, a qualitative scale was used, ranging from a moderate climate change (which is the tipping point condition at this moment) to extreme climate change. However, since the scenarios Jaguar and Tortuga were also built of by the axes climate change, this tipping point condition confused participants, while the scenarios were presented in years. The qualitative tipping point climate change, together with scenarios, is shown in Figure 20. The participants mentioned that they did not understand the difference between the two. Furthermore, they said that climate change is one of the many uncertainties in the Delta.

First, with the pathway generator, the selected actions were presented. However, when the actions could not be represented correctly by using the tool, the actions were drawn manually. It is clear that the pathways show several inconsistencies. For example, the dredging started only after the medium climate change; it is unclear why the dredging did not start earlier since the participants mentioned they desired to dredge already at this very moment. Possibly, it is because not sufficient financing is available right now.

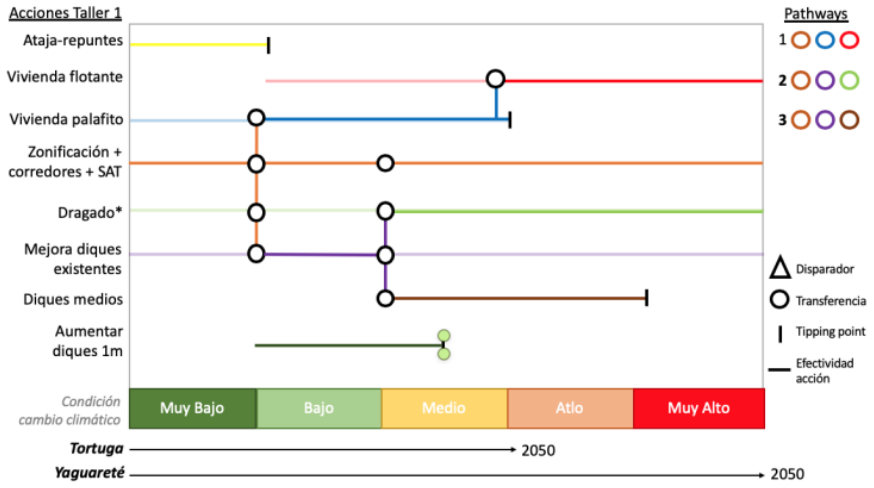


Figure 20: Pathways workshop A

Also, the combination of the tipping point with scenarios was confusing for the participants. This was confirmed by the following critical incident:

"The participants seemed overwhelmed when they had to take into account scenarios, when drawing the pathways. They had to give the tipping point conditions. When Sabrina removed the drawing of the scenarios, and they only used the tipping point, they were able to draw several pathways with the assistance of the facilitator and observer."

When the scenarios were removed to avoid any further confusion, the participants seem to understand the idea of a sequence of actions a bit better. Initially, they wanted to have all the actions implemented at the same time, and they were not willing to select actions that could work in a sequence. After the suggestion of the facilitator to place dykes in a later stage of the pathways, the participants agreed.

When analyzing the pathways constructed in the first workshop, it can be seen that the timing of tipping points is not used for the construction of pathways. Also, scenarios were removed in pathway construction for workshop 1 (not shown in Figure 20).

Scenario Approach: Workshop B

The observation results show that participants were immediately able to reason with scenarios, because they were able to logically discuss scenarios between them, and they used the names of the different scenarios throughout the workshop. For example, a participant said:

"No, this action cannot work in Jaguar since the flooding will be too high."

The participants were all researchers who had been working earlier with scenarios. One participant criticized the scenario's social components. Some participants initially confused a scenario with a vision. Also, the participants had issues when relating the concept of the tipping point to the needed change of action. As a participant mentioned:

> *"It does not have any point to structure actions in time-based on uncertainties. Here in Argentina, so many things can happen, we should focus on what is important now."*

The participants were pushed to think about a sequence of actions by the facilitators. Therefore, zoning was placed in 4 phases. But the participants did not see any need to put actions on tipping point conditions and said:

> *"If zoning is made, the other actions will follow from this"*

Therefore, they did not want to include additional actions after the tipping point condition was reached.

Furthermore, the timing of tipping points in relation to the different scenarios seemed not to be understood and confusing, as a participant mention:

> *"In a crisis, a new plan should be made. Therefore there is no point on linking actions to uncertainties."*

The dominant participants seemed to be convinced that all the actions had to be implemented together. Only, one participant agreed to the idea of applying multiple pathways but he was not active in the conversation. The discussion on pathways is presented in Figure 21.

Figure 21: Discussing of Pathways

When analyzing the pathways, we can assume that they have been helpful to create new insights and discussions, but that no actions were constructed based on tipping points (see Figure 22):

1. In the first pathway, medium-high dykes with service areas were followed by housing. The reason for putting these actions in sequence does not seem to be because of the changing tipping point condition, but because of the priority of actions.
2. The second pathway is the zoning. However, it is initiated by the medium dykes and service areas, which seems to be illogical.
3. The third pathway is only the zoning. The sequence of actions is logical; if one zoning is not sufficient anymore, the next zoning will happen.
4. The fourth pathway: The initial actions would be a study towards the effect of dykes, together with zonification. Depending on the results of the study, new dykes may be constructed. In this way, the pathway functions as a decision tree.
5. The fifth pathway: first SHM (hydrological monitor, to know the level of the water) will be implemented. Afterwards, the flexibility of flooded areas will be implemented. In this way, the SHM represents a preparatory action.
6. The sixth pathway is similar to the fourth pathway but without zoning.
7. The last pathway is dredging and ecological corridors. The participants mentioned that they already knew where they want dredging and ecological corridors; for this reason, it was needed to implement on short notice.

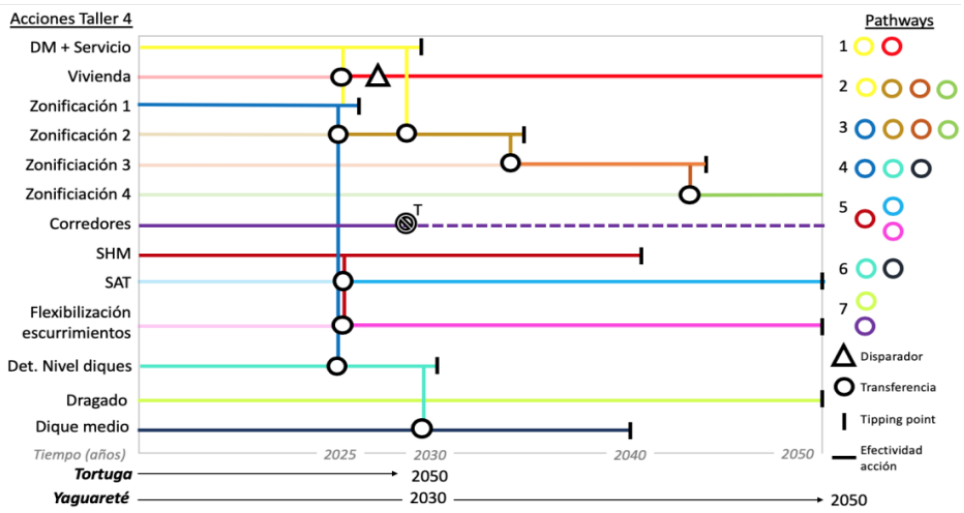


Figure 22: Pathways workshop B

When looking at the pathways, it can be seen that these were used to structure preparatory actions. Also, they function as a decision tree. They are not used by the theoretical concept of the tipping point condition; however, it gave them new insights. Participants were not willing to add additional pathways. During the drawing of the pathways, they seem to look for a general working pathway even though we encouraged them to make multiple strategies.

5.1.2 Criterion 1 "Action Approach"

Action Approach: Workshop C

Also, in this workshop, participants seemed to grasp the concept of scenarios very well. For example, to the participants of the local island population were asked how long their dykes could function without failing:

> *"The dyke will be able to function up to 52 years in Tortuga, but in the Jaguar due to the substantial climate change, the climate will be different, and the dykes will be less strong for a longer time. In this case, the dykes should be higher with better maintenance."*

Furthermore, the participants agreed on the importance of measuring in order to identify the scenario. Only the social components of the scenarios seemed to confuse participants; as they asked for further explanation, looked confused and did not refer to the scenarios social components in the entire workshop.

Observation results show that during the creation of actions, initially, participants only selected actions that have a positive influence and are needed right now. They mentioned that they do not want to construct dykes because these are not needed at this moment. Also, a participant commented that:

> *"In Argentina, activities will be done immediately if money is available and that no mentality exists of waiting with actions until more information is known."*

The following incident occurred:

When constructing actions in a sequence, participants asked: Why not simply implement all the actions at the same time? The facilitator could not explain this without explaining the concept of scenarios. The reason for making a sequence of actions is to wait with certain actions since you do not know in which scenario you are and the future is uncertain. The economic wise thing would be to wait until you know what kind of investments is needed so that the most economically wise decision could be made. But since the facilitator did not want to explain this yet, she only replied that you may have limited money and do not want to spend everything at the same time, and that thing becomes less expensive. However, then participants started to discuss the concept of climate change, and that different scenario should be highlighted, and that would be an important reason. We complimented them with thinking about scenarios and said it would be included after the break. After the break, when we presented scenario's, participants were able to connect these to tipping points immediately.

At first, the placing of actions on tipping points seemed challenging to grasp: actions were not chosen that they could be in a sequence. But when the scenarios were implemented later, they were easily understood and added to the pathways, presumably because the participants already came up with them themselves. Participants added the action of dykes to the pathways, in order to have actions in a sequence over time, and let the actions be determined by the tipping point conditions. Furthermore; the different functioning of actions in scenarios was discussed. See Figure 23 for the selection of actions.

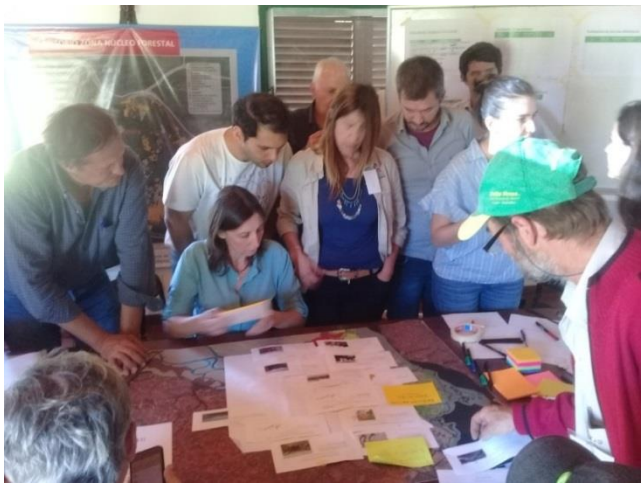


Figure 23: Selection of Actions

Logical pathways were developed showing a sequence of actions, with changes of actions on the tipping points, with multiple pathways reaching for its objectives. A significant action of importance, zoning, could not be drawn in a sequence. This is more of preparatory action. However, to introduce the pathway, thinking participants were encouraged to think about how long their original zoning would work, and when they wanted to have second zoning. The same could be seen with the atajerepuntes, when would they like to change the atajerepuntes to medium dykes and when to high dykes. In this way, the participants were able to understand the concept of the tipping point and construct dykes in a pathway. The pathways are represented in Figure 24.

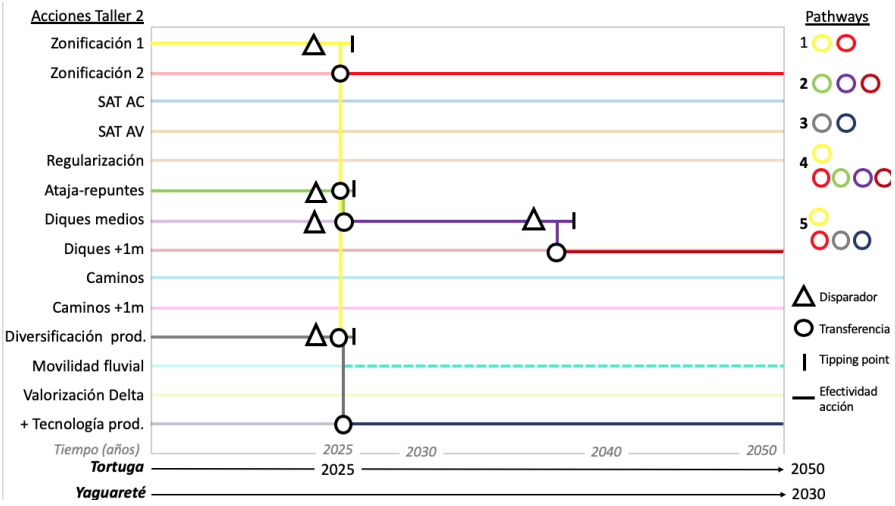


Figure 24: Pathways workshop C

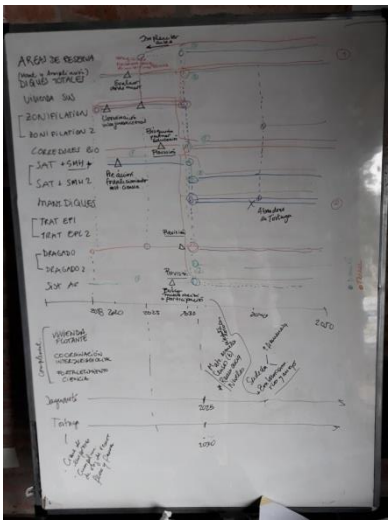
Action Approach: Workshop D

Observation shows that all chosen actions were suggested to improve the current situation, not to adapt to changing conditions in the longer term. The participants did not seem to think about the situation in the year 2050. It was difficult for the participants to give values for the timing of the adaptive tipping points. The participants mentioned that the action would work in the entire lifetime of the system. Therefore, the facilitators decided to discuss the concept of actions again, after the scenarios would be introduced. However, when analysing the tipping points, participants themselves suggested that uncertainties would have to be taken into account when looking at the year 2050. Similar as in workshop C, participants themselves came up with the need to connect adaptation pathways to scenarios. The participants discussed the implication of the different scenarios for the pathways afterwards. They agreed that action would stop to function properly at a particular moment. Still, the following critical incident was found:

"The participants agreed that climate change was present in the Delta. The participants seemed to understand that it was economical logical to wait with certain actions since we do not know how the climate will develop. In this way, they were able to create a sequence of actions. However, when asked to connect these changing actions to tipping point conditions, the participants looked confused and told us they did not understand."

The participants were stimulated to construct actions in sequence by the facilitators. When they drew the actions on the board, the facilitators asked them if the action would really work for the entire lifetime of the system, and if not a sequence of actions would be needed. For this reason, zoning was divided into two stages, as well as early warning systems, treatment of effluents, and dredging. When analyzing the pathways (See Figure 25) it can be seen that a large variety of pathways was constructed by the participants. The pathways consisted of participatory actions in combination with other actions.

However, no pathway was presented, showing actions in a sequence, with actions changing on the tipping point condition. Still, actions that would not work until 2050 were formulated as zoning, early warning system, treatment of wastewater, sustainable housing and dredging. It was agreed that a new action would have to take place when these actions did not function properly anymore. None of the pathways has actions placed in a sequence of tipping point conditions.



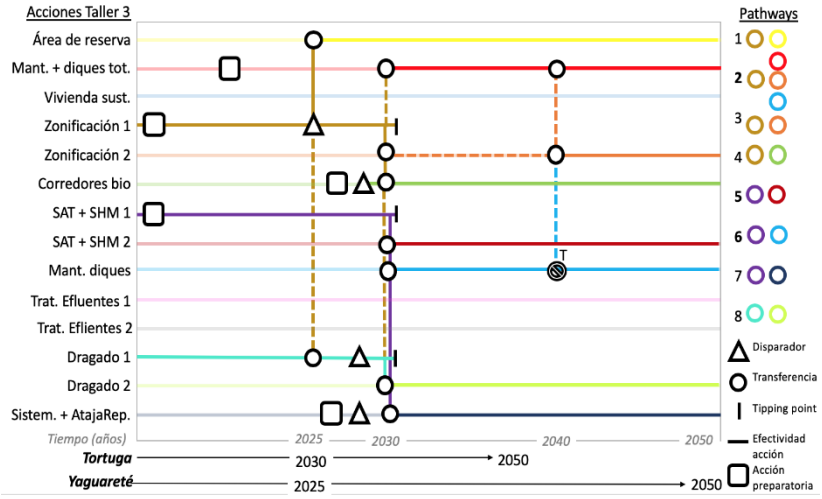


Figure 25: Pathways workshop D

Overall, it can be concluded that in the workshop A, illogical combinations of actions were made; a trend which was not present in other workshops. Both workshops B and C were useful in placing actions in a sequence for differentiating preparatory actions, and acknowledging other uncertainties and decisions to make. However, they did not change the actions based on tipping point conditions. Workshop 2 presented pathways that showed actions on changing tipping point conditions that could be compared because they showed two strategies reaching for the same objectives. Due to the inclusion of the scenarios, the pathways were very much improved. This finding seems to suggest the benefits of the 'Action Approach'.

As is shown in the 'Scenario Approach' pathways are not constructed based on the timing of tipping points, and the combination of scenarios and tipping points seemed to be very confusing. Participants seemed to understand the concept of scenarios before the workshop. However, scenarios are not used for the construction of the pathways. In the 'Action Approach' without explaining the concept of scenarios, the concept of tipping points is very confusing for the participants. They themselves came up with the concept of scenarios, and when they are later introduced to the concept, they use the concept in a natural way. Scenarios are used to improve the pathways, and these are constructed on tipping points.

5.2 Criterion 2: Actions look at robustness and flexibility and identify lock-ins.

5.3.1 Criterion 2: "Scenario Approach"

Scenario Approach: Workshop A
As the critical incident shows, participants had difficulty making flexible plans:

"During the selection of actions, participants had created difficulty to select a sequence of actions. They preferred to select actions that would work already on the situation right now".

All the actions selected (see Figure 26), were chosen on priority, not in order to support a robust or flexible strategy. The participants were pushed by the facilitators (see figure 27) to add the medium dykes (which are similar to the current dykes in the forestry nucleus) to the actions, in order to form a solution for extreme climate conditions. However, an increased dyke level of 1 m is not further included since the participants mentioned that an increase in the dykes was not really desired. But, an improvement of the current dykes was accepted, which seemed Inconsistent.

The pathways all started with a preparatory action, followed by improvement of the dykes, to be finalized by the actions floating houses, dredging, medium dykes. Only the last pathway seemed to be a logical following of actions. The other pathways were illogical. In both ways, pathways were not used to stress robustness and flexibility.

Figure 26: Discussion of Pathways workshop A

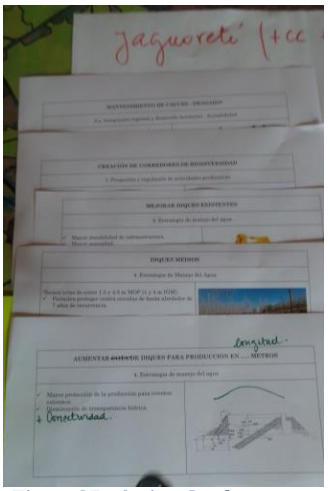


Figure 27 : Action Cards

Scenario Approach: Workshop B
Similar to workshop 1, the participants mentioned that only short term actions are needed in the delta. Furthermore, even in the most extreme scenario, they would never increase the number of dykes. The facilitators explained that if the Jaguar scenario would take place, the forestry producers could have less production or possibly no production at all since the dykes could break. The participants did not respond to this; they did not suggest any flexible options to ensure forestry production, even though forestry production was one of their objectives. The facilitators asked multiple times which actions should be implemented if the recent action would fail. Also, the participants were asked which actions to take based on the outcomes of the research, that they thought to be necessarily (e.g. impacts of dykes). The participants reacted that it would be illogical to think so far ahead in the future:

> *"A lot of uncertainty exists regarding the impact of the actions; we can only suggest initial actions; it makes no sense what so ever to plan so far ahead in the future. It seems better to respond when these events have happened. Also, in Argentina, no planning can be done for 10 years; a timeframe for 2 years is already very long."*

The exercise triggered their thinking about a sequence of actions, and which actions to do first and to do later. However, it was a way to prioritize the actions since there is not enough money for all actions (see Figure 28 for discussion on actions). When we encouraged the participants to select flexible actions, the following incident happened:

A lot of discussion takes place about the floating houses. Possibly since we had told the participants to only select 10 actions in order to make the pathways, we tried to explain that the actions would only be implemented in different combinations. Not all actions would be implemented at the same time; only different combinations of actions. This will give the paths and routes over time. At that moment, we showed a map of the different pathways. We said if they wanted, they could add more actions. However, the participants said that they were only allowed with 10 and wanted to stick to that number.

The topic of flexibility and robustness remained untouched; the same is confirmed when looking at the pathway map since only one pathway is selected.

Figure 28: Selection of Actions Workshop B

5.12 Criterion 2: "Action Approach"

Action Approach: Workshop C

By considering the forestry production and diversification of products, robust and flexible strategies were discussed. Pathways were used to identify flexible and robust solutions:

Zoning seemed to be a complicated action since actually making an ADM plan is part of zoning. For the participants, zoning seemed to be the solution for solving issues in the Delta. In order to make a flexible strategy, it was decided to re-evaluate zoning every 10 years.

The second pathway shows the increase of the dykes in new stages. The participants accepted the argument to make a policy of building dykes robust under different scenarios; it should be made possible to increase the height of the dykes.

After a thorough explanation, the concept of lock-in is made more transparent, and several lock-ins are discussed. For example, when it is chosen too only build dykes, the whole Delta will become dependent on this. Participants agree, and therefore suggest an additional strategy should be formulated as well, such as an investment in technology. The third pathway represents a diversification of production (in

order to increase production, without establishing dykes), followed an increased technology for the productive sector. It was also discussed that waiting with improved technologies until diversification of production did not function properly anymore, seems to be logical since an investment in technology (see Figure 29 for discussion).

Figure 29: Discussion workshop C

Action Approach: Workshop D

The pathways seemed to be used as a way to structure actions, regarding which preparatory actions need to be done first, in order to make a more structural measure. No actions were selected that could lead to a sequence over time. The participants only put actions in a sequence because some actions are urgently necessarily for now, and actions that also could wait a bit longer (and there is only limited money available).

The different participants developed several pathways. The actions proposed by the participants are very reactive. We tried to stimulate the participants to add new actions when their initial action did not work anymore. After pushing off the facilitators, the participants added dyques totales after the atajerepuntes that did not function any more; in this way, they were able to construct a robust pathway. Also, zoning was divided into two stages, as well as early warning systems, treatment of effluents, and dredging. The participants agreed that lock-in can take place due to zoning, workshop 3 scenarios helped for differentiating the signposts

As the results show in the 'Scenario Approach' Actions that are selected are mostly related to preparatory actions. Issues of robustness and flexibility are not addressed. In the 'Action Approach' scenarios helped to discuss more flexible and adaptive strategies.

5.3 Criterion 3: Formulation of different types of strategies (stakeholder preferences)

5.3.1 Criterion 3: "Scenario Approach"

Scenario Approach: Workshop A
As can be seen, when analyzing the pathways constructed in Workshop A, no clear strategies were formulated.

Interestingly, at the beginning of the workshop, various strategies were discussed when the participants had to construct their vision . As one respondent mentioned:

> *"And a certain moment, all the infrastructure in the Delta will collapse, and we have to enhance this process. We should break down the dykes since we should give back the Delta to nature."*

Another respondent replied:

> *"No! We have to protect our current polders, the production in the Delta is the heart of the Delta."*

However, after formulating common objectives, the participants did not discuss any different strategies anymore

Scenario Approach: Workshop B
Since the participants only wanted to discuss one pathway, it was not possible to formulate various strategies. The participants mentioned that they did not find it useful to show multiple pathways to represent several strategies. For them, the value of pathways was to show which actions had priority and which action had to be implemented later.

On the other hand, during the action selection, different strategies were discussed. Participants mentioned that they would not implement more dykes unless research would have proven differently. Furthermore, strategies for selecting adaptive measures, as comparing floating houses with Palifito's were extensively debated. Some participants pointed on the harmful consequences of the floating houses, while others mentioned that these could be the solution for the Delta.

5.3.1 Criterion 3: "Action Approach"

Action Approach: Workshop C
Two different types of strategies can be found when investigating the pathways: (1) the increase of dykes in the delta and (2) increase of productivity of the forestry sector by improving the type of trees, technology etc. Both strategies aimed at increasing the profit of the forestry sector, but they showed different stakeholder preferences to reach this objective.

Action Approach: Workshop D
When analyzing the pathways constructed in workshop D, and considering the debate that took place on action development the following strategies can be found: (1) a strategy aiming to give most value to the natural aspects of the delta such as by placing reserves and (2) a strategy focused on the productive aspects of the delta by increasing dykes etc.

As the results show in the 'Scenario Approach' no well-functioning different strategies are found. In the 'Action Approach' different strategies are discussed by participants to reach the objectives

5.4 Criterion 4: Comparison possible based on objectives

5.4.1 Criterion 4: "Scenario Approach"

Scenario Approach: Workshop A

When analyzing the comparison of the pathways, it can be seen that the pathways did not aim to reach the previously constructed vision. Furthermore, even though Figure 30 shows a comparison, in reality, the pathways could not be well compared on the objective-based thresholds. Thi is because, as highlighted in the previous paragraphs, the third pathway was not set up logically.

Pathway	Producción	Calidad de Vida	Áreas de reserva	Costo
2	+++	++	+	$$$$
3	+++	+++	-	$$$$$

Figure 30: Evaluation of Pathways workshop A

Scenario Approach: Workshop B

Due to the fact that only one pathway was created, no comparison of pathways was possible (see Figure 31). The selected pathway will increase the production, as well as the quality of life and the areas of the reserve, but also me the most expensive. A comparison of the pathways on the participatory constructed objectives was not possible due to a lack of time.

Pathway	Producción	Calidad de Vida	Áreas de reserva	Costo
Todas las acciones juntas*	++	++	++	$$$$

**Los participantes indican que todas las acciones deberían realizarse de forma simultánea y por ello las evalúan como una única ruta.*

Figure 31: Evaluation of Pathways workshop B

5.4.2 Criterion 4: "Action Approach"

Action Approach: Workshop C

Similar objectives can be seen in both pathways, 4 and 5W but with different actions. When comparing the pathways, the pathway that included actions of technology and zoning performs better than the pathway that focuses on dykes.

In this way, the approach of DAPP gave value since it enabled for a comparison of different strategies. The pathways could be compared on the objective-based thresholds, however, were not able to reach all thresholds, such as the quality of life. The evaluation of the pathway based on the different objectives can be seen in Figure 32.

Pathway	Producción	Calidad de Vida	Áreas de reserva	Costo
2 	++/-	0	0	$$$
4 	++	+++	+++	$$$
3 	+++++	++++	++	$$$$
4 	++++++	+++++	+++	$$$$

Figure 32: Evaluation of Pathways workshop C

Action Approach: Workshop D

The participants did not select actions that could lead to significant improvement of the system in order to reach their objectives. When evaluating and comparing two different pathways, the participants were able to discuss the consequences of different pathways (see Figure 33). The pathways could be compared on the objective-based thresholds, however, were not able to reach all thresholds. The pathways that were compared were: pathway 2 (zoning 1, maintenance of dykes, construction of dykes, together with zoning 3) and the combined pathway of 5 and 6 (early warning system and maintenance of dykes).

Both pathways had equal benefits for production and the quality of life. However, the first pathway had a better influence on the areas of the reserve because of the zoning. This pathway was also more costly than the other pathway.

Pathway	Producción	Calidad de Vida	Áreas de reserva	Costo
2 	++++	++++	+++	$$$$
5 +6 	++++	++++	+	$$

Figure 33: Evaluation of Pathways workshop D

As the results show in the 'Scenario Approach' objectives are not taken into account when constructing the pathways, comparison is difficult. In the 'Action Approach' strategies developed aim to improve the objectives.

5.5 Criterion 5: Triggers and signposts are highlighted

5.5.1 Criterion 5: "Scenario Approach"

Scenario Approach: Workshop A
Triggers highlighted in workshop A by the participants were 'retention time of water in the field', 'frequency of floodings', and 'frequency of the rain'. The triggers were not highlighted by the participants in the ADM map.

Scenario Approach: Workshop B
The participants were asked by the facilitators how they can differentiate, in the future, in which scenario they are. They replied to know in which scenario they are based on the ecosystem, climate change, and the changing economy should be measured. To study if there would be a context of economic growth, the following specific indicators should be researched: employment, productive area and price of wood. To understand which phase of climate change they would be, the level of floods and the frequency of droughts should be measured by means of a hydrological monitoring system. The trigger could be the monitoring of the number of houses in the Delta. An exact number of a trigger value is not given.

The participants reflected on using signposts for differentiating the scenarios; however, did not add triggers in the pathways, except in the pathway of creating housing (Vivienda).

5.5.2 Criterion 5: "Action Approach"

Action Approach: Workshop C
Triggers were discussed twice, before and after the explanation of scenarios. The concept of triggers and signposts seemed to be well understood by the participants after the concept of scenarios was introduced. Also, new triggers and signposts were added than. As can be seen from the pathways, signposts were highlighted for every pathway:

1. Pathway 1: The signposts are technology and economy. The land use change could be a trigger.
2. Pathway 2: The signposts are a type of production and the economy. To understand the current economic potential, the area between dykes can be measured. The Trigger value is the water level in the Paraná (in Puerto Iguazu) and the Rio de la Plata (an increase the level of 0.5m would be a trigger).
3. Pathway 3: The signposts would be climate change, an increase of the value of the land, survey for productive sector regarding the type of production, in order to know when to change to new technologies. Other social indicators are highlighted as the death rate of animals, income of people and the back cast of agricultural emergency (these are the years that are difficult for the producers due to flood loss, droughts etc., in these years the producers do not have to pay taxes to the government).

Furthermore, after analyzing the triggers and signposts, the pathways are improved.

Action Approach: Workshop D
Signposts and triggers were discussed for all the pathways together, not per pathway. The question was asked to the participants how they could know in which scenario they would be. Based on this question, the participants agreed on the need for monitoring. They discussed several signposts: Number of enterprises that close (economic crises), monitor of biodiversity.

The following detailed signposts were established:

Social:

- People in school (in order to know how many people are in the delta and the age distribution), national census (this is done once in 10 years),
- Number of the boats (indicator for fluvial transport and economic development)
- Income
- Urbanization rate

Physical system:

- The return period of the events
- Water level
- Frequency of Sudestada

The actions of dredging, natural corridors and atajerepuntes, were changed in the pathway map after discussing the concept of signposts and triggers. The actions were placed on their tipping point.

As the results show in the 'Scenario Approach' trigger values were not drawn, but signposts could be differentiated for some pathways. In the 'Action Approach' no triggers are drawn as well. Signposts are discussed when the pathways are developed and improved after the discussion of the scenarios.

5.6 Criterion 6: Understanding of pathways

In order to form a basis of the understanding of the methodology, pre-surveys were distributed to the participants. It turned out that for each of the workshops, the results were highly similar. Therefore, these are discussed here together. Most participants agreed that it would be needed to plan actions in different phases; some actions would be more urgently desired than others. As a participant mentioned:

> *"We need to prioritise our actions, and do what is most urgent right now."*

Furthermore, most participants disagreed that only one development path existed for the Paraná Delta; the main argument was that different visions could be found for development.

> *"We need to develop many things in the delta, and many people have different opinions about this "*

However, some respondents highlighted that only one correct development path could be found:

> "*The only correct path for development is sustainable development taking the ecology of the delta into account."*

Different responses were given regarding the question if an uncertain future should be acknowledged when planning actions.

> *"The planning of the delta should take turbulent politics, climate change, economic fluctuations and social system change into account."*

> *"People in the Delta need a change of way of thinking so we can improve the conditions there."*

Others mentioned:

> *" We should make arrangement now, such as by legislation, to prevent uncertain futures."*

From the answers of the other participants, it seems that they had not understood the question well .

The statements seemed to imply that most respondents thought that development should take place in the delta, but the concepts of uncertainties, scenarios were not mentioned. The only reason for prioritizing actions was based on the urgency of the action.

5.6.1 Criterion 6: ''Scenario approach.''

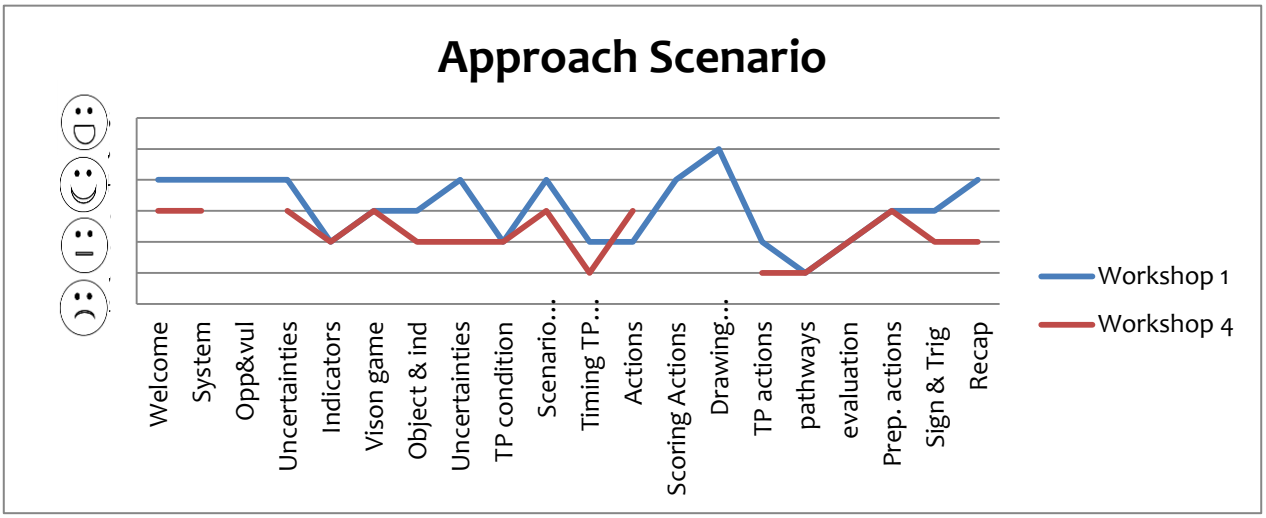


Figure 34: Smiley graph Approach Scenario

Scenario Approach: Workshop A

The observation results show that at the end of the workshop, participants were tired and overwhelmed. Some participants mentioned the scenarios could be used for pathway generation, but others did not yet understand this fully. As can be seen from the smileys graph (Figure 34), the atmosphere changed in all aspects that involve tipping points and dynamic adaptive planning. This seems to suggest that participants had difficulty understanding the approach.

A high non-response could be found in the survey data, due to which comparison on learning could not be done. Participants had to leave quickly and did not send their surveys afterwards by e-mail. The high non-response may explain the lack of understanding or lack of interest in the method.

Scenario Approach: Workshop B

The participants seemed confused when they were asked to draw different types of pathways. A lot of time was spent on the selection of the actions; no time was left anymore for drawing or comparing the actions. Also, here, participants had great difficulty, and the atmosphere changed regarding all aspects that involve tipping points and dynamic adaptive planning (see smiley graph in Figure 34). At the end of the workshops, the participants seemed tired and overwhelmed since they did not longer pay attention. They did not draw pathways based on tipping points; they mentioned that they could do it, but that they saw no point of use of it for Argentina

> *''First, we should prioritize the actions we need right now, like zoning. Then from the zoning, the other actions will logically follow.''*

The participants were asked to select additional actions; the participants seemed annoyed and did not want to select new actions again.

Similar as in workshop 1, a high non-response could be found in the survey data, due to which comparison of the database on the survey could not be done. Participants had to leave quickly and did not send their surveys afterwards by e-mail. The high non-response may explain the lack of understanding or interest in the method.

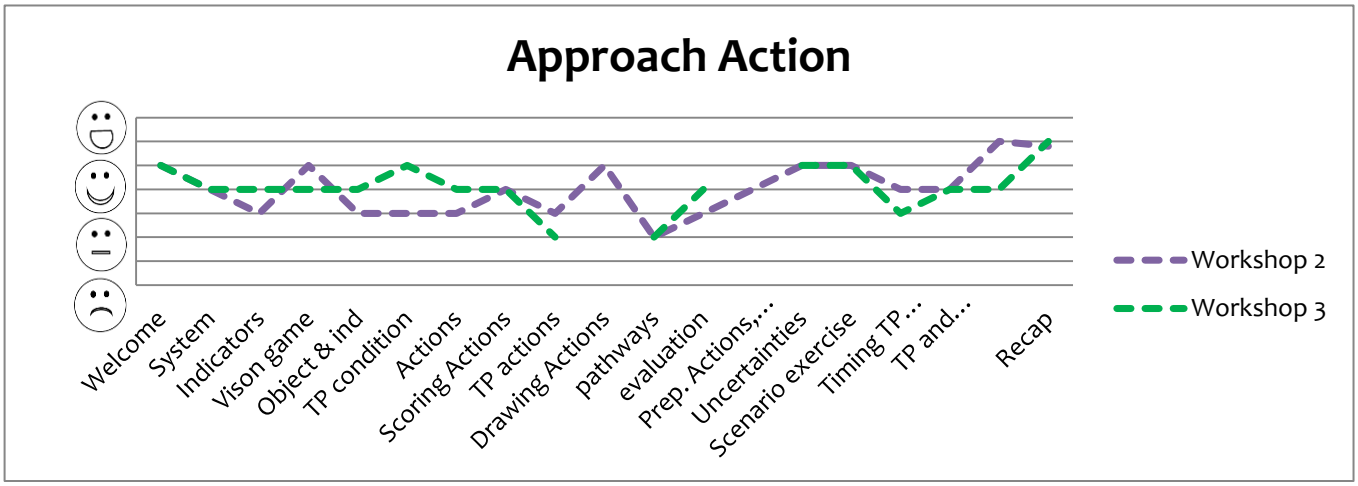


Figure 35: Smiley graph Action Approach

5.6.2 Criterion 6: "Action Approach"

Action Approach: Workshop C

During the workshop, the participants seemed to understand the idea of dynamically changing actions for reaching objectives, and the need to keep actions open, as can be seen from the smileys graph of the Action Approach (Figure 35). When looking at Figure 35, it can be seen that initially, the participants were very confused about the use of tipping points. Also, the facilitators had difficulty explaining the concept of tipping points before explaining the concept of scenarios. However, the participants themselves came up with the idea of connecting adaptation pathways and tipping points, as mentioned in the previous sections. Then, when they were introduced to the concept of scenarios, they were able to easily combine the idea of scenarios and uncertainties with the pathways. They also understood the concept of dynamic planning better.

The final survey confirms that the participants understood the method. It was shown that the participants agreed that it was possible to plan the future. Some participants highlighted that even though different scenarios could take place; at least a plan for the delta should be made. This is one of the main concepts of ADM. As participants mentioned:

> *"It is possible to plan, but then scenarios need to be included."*
>
> *"Because there are many possible ways the future can develop, we can take these into account when we make our plans."*
>
> *"Many different paths for development exist; we need to adjust our paths, to flexible reach our objectives continually."*

Furthermore, participants highlighted that they learned the need for planning a Delta

> *"Without making plans to accomplish our vision, we cannot have a good future, we need a positive change, and create our future in a new way.'*
>
> *"I knew very little about these ideas for planning, but now I think it is advantageous to include scenarios in my future plans."*

Action Approach: Workshop D
In workshop D, the participants seemed to understand the idea of dynamically changing actions in order to reach objectives, and the need to keep actions open. In comparison to workshop C, participants had less difficulty understanding the concept of tipping point as can be seen from the smiley graph in Figure 35. Also, here the participants themselves connected scenarios with tipping points, and after that moment, they were able to reason with the concept of tipping points relatively well.

The final survey seems to confirm that the participants understood the method. In the third workshop, participants highlighted that it was possible to plan the delta before 2050, given various ADM arguments:

"It is very needed to plan the Delta; without planning, we maybe will lose many valuable ecosystem services."

Another respondent mentioned:

" It is possible to plan; we would need a change of thinking of the government and our culture."

"I have learned many new ideas regarding planning."

As the results show in the 'Scenario Approach' the participants have great difficulty to understand concepts and are tired and overwhelmed. In the 'Action Approach' the participants seem to understand the idea of dynamically changing actions for reaching objectives, and the need to keep actions open

5.7 Criterion 7: Participants will use ADM future work, stimulation of new ideas and discussion

5.7.1 Criterion 7: "Scenario Approach"

Scenario Approach: Workshop A
The observation shows that the participants criticize the methodology for being pessimistic:

> *"The methodology only thinks about the actions when the system will function poorly, while we are optimistic people."*

Even though the participants were a bit overwhelmed, they mentioned that they liked the aspects of participatory planning. It was an entirely new way of working for them, and they were curious to play more of these serious games in their future work.

Scenario Approach: Workshop B
The participants seemed not to take the exercise of drawing pathways in small groups seriously. When we asked them why they were laughing, they explained that the approach could not be useful for the Paraná Delta, since all the actions had to be implemented right now, at the same time.

The facilitator tried to explain that some actions could be implemented when another action does not work anymore. However, the participants replied that this was not the case in Argentina. The participants agreed that it was not useful in Argentina to be thinking long term:

> *"In Argentina, the government is constantly changing; there is no point to do any planning for more than 5 years. The approach sounds very nice, but it will not work for us."*

In the fourth workshop, only one respondent answered on the interview, showing his scepticism on the use of the approach of ADM we suggested for the Delta, with the chosen actions.

5.7.2 Criterion 7: "Action Approach"

Action Approach: Workshop C

The results of the surveys show that the participants mentioned that the workshop:

1. Helped them to think about the need for planning.
2. Pointed out the need to incorporate various stakeholders .
3. Stimulated them to work participative style in planning process.

The participants all confirmed in their surveys that they enjoyed the workshop, as a respondent said:

> *"I really liked the way how the workshop was set-up. With all the participants playing actively in the games. You gave an excellent urbanistic vision. It was a really nice day. Congratulations!"*

Also, participants mentioned they liked the interdisciplinary character of the work and the inclusion of multiple types of stakeholders:

> *"The methodology is nice because it is so interdisciplinary, and it includes all these different types of people that can learn from each other."*

Still , many participants replied that they found the methodology quite complicated and intense. Almost all respondents mentioned that the day was too full of activities to process all the information. As a respondent mentioned:

> *"I need a bit more time to process the information; it was a lot of steps in one day. It could have helped to spread the work in multiple days.*"

Figure 36: Round-off Workshop C

Furthermore, many respondents asked how the next steps could be implemented in the planning of the Paraná Delta:

> *"I would really like to use this approach in further steps of the development of the Paraná Delta. How can we do this?"*

The round-off of the workshop is shown in Figure 36. Participants highlighted that the workshop seemed to have made changes in peoples thinking as action research suggest, as an architect mentioned:

> *" I would like to thank you for organizing this workshop, so many things are happening here in Argentina, and so many things go wrong, but by attending today, I got the feeling I was able to be in charge of my own life. Sometimes we tend to forget that here."*

Action Approach: Workshop D

The participants highlighted that the workshop helped them to think about structuring actions in time. They highlighted that they were going to implement the learned concepts in their own work, and they felt very positive to be part of the workshop. Most of the criticism was related to the high amount of activities in one day.

"I really like the methodology, and I'm going to use it in my future work for the planning of the delta, but it was really too much and intense to learn everything in one day."

Furthermore, a participant mentioned:

> *"I would like to spend more attention to the interactions between the dynamic pathways."*

Furthermore, participants liked to exchange of the various visions:

> *"The exchange of the various visions was very enriching."*

The participants highlighted to be willing to use the results in their future work:

> *"I'm going to work more on changing my own activities."*

As the results show in the 'Scenario Approach' participants showed that they liked the participatory working style, but doubted if the approach would work in future studies. Planning two years ahead is the maximum that is possible in Argentina. The method stimulates discussion on actions.. In the 'Action Approach' Many different views are exchanged, the strategies proposed aim to show these different views. The participants mentioned they liked the development of strategies under uncertainties, also in future

6| Discussion & Reflection

The study involved the investigation of the place of scenarios in participatory ADM for the Paraná Delta, Argentina. In the first workshop the initial hypothesis is discussed. In the second section, the limitations of the study design, as well as their potential influence on the validity of the results, are debated.

6.1 Hypothesis

In this section, a reflection is given on possible background motivations for the results answering the main question. In Section 7.1, it will be shown that the initial hypothesis does not seem to hold up. In Section 8.2 . a new hypothesis is suggested.

6.2.1 Initial hypothesis

The initially established hypothesis was that the 'Action approach' would work better than the 'Scenario Approach', due to cultural motivations. However, even though the participants highlighted that they found it difficult to plan long term and create a long term vision (Hofstede et al., 2010) due to the ever-changing politics in Argentina, this seemed to affect both approaches equally. The creation of scenarios did not seem to be specifically affected by cultural implications. This is confirmed by the study of Carstens et al. (2019) in Sweden, concluding that uncertainties were used to justify static, instead of adaptive solutions. Cultural and institutional influences did play a role in the type of actions that the participants suggested. They highlighted that short term actions had to be implemented; long term actions would never work since the government policy in Argentina is changing very often. Why the 'Action Approach' seems to be functioning more appropriately for the given case study is explained below.

6.2.2 Experimental learning

An explanation of why the 'Action Approach' seemed to score higher on all criteria than the 'Action Approach' could be of learning styles. The 'Action Approach' applies ideas of experiential learning; it proposes a constructivist theory of learning in which knowledge is created by the learner (A. Y. Kolb & Kolb, 2005). In the 'Scenario Approach,' the participants received a lot of information at once. They have explained the concept of scenarios, they had to create actions keeping scenarios in mind, and from this, they had to create pathways. This seemed to make the participants overwhelmed. While the "Scenario Approach' seemed to use the 'transmission model' in which pre-existing ideas are transmitted to the learner, so-called experiential learning (A. Y. Kolb & Kolb, 2005). Contrarily, in the 'Action Approach', participants were explained the theory step by step, improving their former work

such as actions and pathways. Even though the concept of scenarios was not explained to the participants, they themselves linked this concept to adaptive delta planning.

Experiential learning can be defined as 'learning through reflection on doing'(de Byl & Brand, 2011, p. 1003). Experiential learning theory (ELT) is first introduced by Kolb (1984, 2014). The work of Kolb and Kolb (2005) shows the preferred four modes of a learning cycle in experiential learning the learning should have to adsorb information: Learning Style Inventory (LSI):

1. Firstly, the learner should be aware of the immediate concrete experience (CE)
2. Followed by observation and reflection of this concept (RO)
3. Then a formation of abstract concepts (AC) and generalizations take place
4. In the final phase, the hypothesis is tested to create new experiences and active experimentation (AC).

This process is continuously reiterated; once the new behaviour and knowledge are implemented, a new learning process can occur (Kolb & Kolb, 2012; 2005). The process is visualized in Figure 37. Games can be used to create an initial experience (de Byl & Brand, 2011). In DAPP in Argentina, this could be translated into a first experience of working with actions and scenarios in earlier work or by means of a game. The Sustainable delta game (Warren & Haasnoot, 2018) that was also used in Argentina once for a stakeholder workshop and once for students, and both times positively evaluated, could be a possibility for experience. Also, due to earlier work of other organizations in the Paraná Delta, stakeholders already seemed to know the concept of scenarios.

The process is shown as an idealised learning cycle. However, individual people develop their preferred learning modes (Joy & Kolb, 2009). For a detailed overview of the case, the reader is referred to Appendix B3.

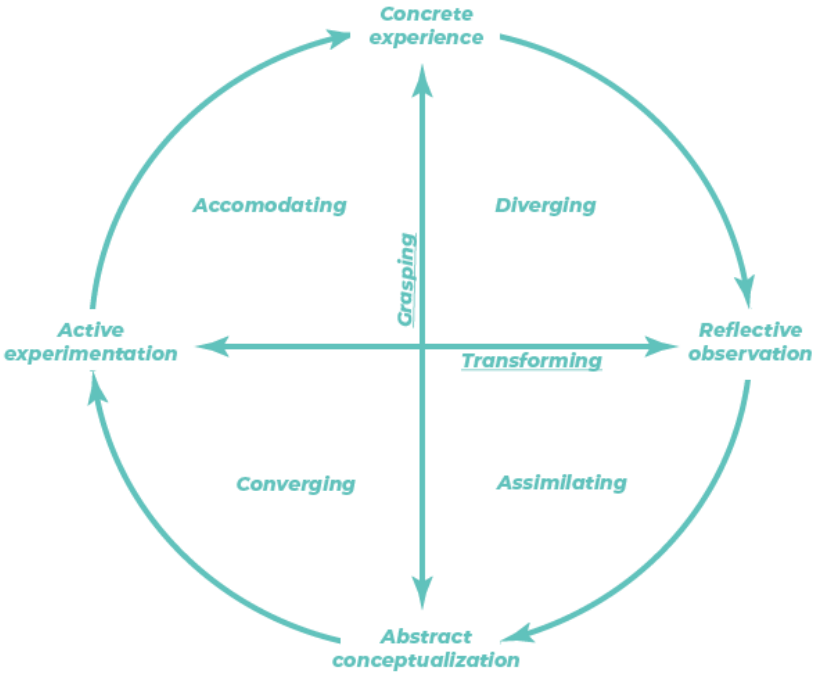


Figure 37: The experiential learning cycle (Joy & Kolb, 2009, p. 71)

6.2 Research set-up

Several comments regarding different components of the research set-up can be made; these are evaluated in this subchapter. For a detailed overview of limitations, the reader is referred to Appendix B4.

6.2.1 Case study design

A possible limitation on the case study design is the available amount of data for the comparison. However, a similar amount of cases was presented in Carstens et al. (2019) and Zandvoort et al. (2017), which studies give valuable insights into the participatory usage of ADM. However, if the results of this case would be generalized, it would be a limitation since cultural influences can play a role. Furthermore, the unequal composition of the stakeholder for the workshops could be criticized. Even though a detailed stakeholder analysis was performed; not all participants could come on their designated day**.**

As Carstens et al. (2019) highlight in their DAPP-light method, it is difficult to include a sufficiently high number of participants and experts. In this light, the large number of decision-makers and experts that participated in the workshops was very successful. Also, participants had difficulties in making pathways since they were afraid of what the consequences of their results would be. Selecting stakeholders with less direct influence on the policymaking in Argentina could have been beneficial, but then the stakeholders would have felt less associated with the framework. This can be observed in my case as well since in the 'scenario approach', it took longer than 'Action Approach', and not enough time was available to complete the whole workshops. Furthermore, the participants in the 'Action Approach' highlighted that they found the workshop intense and that they wished less time was available. More time would have put less stress on the workshop if the participants had known DAPP in advance, the workshop could be tested more fairly. Also, the workshop was set-up as an entire cycle of DAPP; this meant that in reality, more time was spent on system drawing and action generation. The participants were still highly active in these phases. Less time was available for the later steps. Furthermore, some participants were already familiar with the concept of DAPP, while others heard about planning in general for the first time. The people that were aware acted more dominant.

6.2.2 Research methods

When reflecting on the pathway comparison, it is possible to pathways which I considered by the criteria as illogical, might have made perfect sense for the participants and therefore can be misinterpreted. By discussing with the workshop team, this was aimed to overcome.

A limitation of the method of observation could be that subjectively and mistakenly the way a person is behaving to the situation is assigned (Winstanley, 2010). In this research, it is aimed to be addressed this issue by having two observers, combining the observation forms, and discussing the observations afterwards with the facilitator: inter-observer consistency (Bryman, 2016).

The main limitation of the observation, in this case, is that I also had to perform facilitation functions seemed to be that when necessary, I assisted in facilitation and thus only the note maker could only observe. However, he did not seem to understand the idea of ADM and therefore misinterpreted the data. By discussing the observations immediately with the entire workshop team, these limitations were aimed to overcome.

As shown in the results chapter, a high non-response could be found in the surveys for the "Scenario Approach." Of the 20 participants of the 'Action Approach', 15 gave a response, and 5 a non-response, since they already had to leave and forgot to send their survey later. Of the 16 participants of the 'Scenario Approach' 1 gave a response, and15 a non-response. The 1 response was sent in later. The

non-response seems to give a valuable insight that the participants did not seem satisfied after the workshop, possibly frustrated and that they did not fill in the survey. Due to the strong non-response, the comparison of results of the surveys is less valuable, making its contents challenging to use in the analysis. Therefore, in the results, surveys are only used as illustrative support for the other methods. However, the results of these methods are still valid without the survey results.

A drawback is that critical incidents theory (CIT) relies on observers to recognize, remember, and report these incidents accurately (Witteveen & Enserink, 2007). This is addressed by immediately after the workshop describing the critical incidents with the entire team, of different cultures.

6.2.3 Scenarios

For the construction of the scenarios, the ATPs were defined by expert judgement. Using detailed model-based support to construct the ATPs can potentially improve the scenarios. The motivation for not using a model-based assessment is to avoid focus on the modelling during the workshop and give participants a possibility to truly understand the creation of ATPs themselves.

6.2.3 Action research

A limited approach to action research was implemented. As action research suggests (McNiff, 2013; McNiff & Whitehead, 2009), I aimed to empower the participants to use ADM in their future work by providing training on ADM during the workshop. Finally, I aimed to provide a research design for the participants to use in their own work, such that they could become experts on ADM themselves.

However, it was not the aim of the participatory work, developed together with the participants, to produce directly usable pathways. Action research suggests that participatory work should lead to directly usable outcomes (Bryman, 2016). Furthermore, action research is done with participants, never on them (Herr & Anderson, 2005).

In my research, even though I designed my problem statement with participants, I analysed their behaviour and their reaction to the approach ‘on them’. Furthermore, even though I reflected and learned of the changes I made in the workshops, I did not perform a detailed evaluation of how changes impacted the final results, such as suggested in educational science (Kitchen & Stevens, 2004, 2008; Herr & Anderson, 2005)

I believe that the use of this limited type of action research can be justified since it was needed to commit participants to the research and also improve the quality of the workshops. I also believe it was a suitable decision not to fully engage in action research by engaging more strongly with the participants. Since, it would have been challenging to compare the two approaches, without influencing the outcomes myself. Therefore, as action research suggests in the next section, I will evaluate my main influences.

6.2.4 Influence of researcher

What can be observed in all workshops is that the facilitators actively steered towards adaptive pathways in which actions designed based on adaptive tipping points. However, in all cases, the facilitators seemed to push equally. Therefore, this influence does not seem to be an influencing factor in the final comparison of the workshops.

Important to note is that earlier participatory work by other ADM organizations seemed to play a role, and make participants already sceptical on the use of ADM at the beginning of the workshop. It was also challenging to invite suitable participants for the workshops due to this earlier experience.

Another issue was the ATP condition chosen by the researcher in workshop 1 of 'climate change' which was highly confusing for the participants. Still, the idea of tipping points seemed to be the main reason for confusion, not the condition climate change. But in future work, one tipping point condition for all the workshops could be advised.

Several changes were made in the workshop format. For example, after the first,workshops the exercise, the opportunities and scenarios were left out. This did not significantly seem to influence the results since also in the first workshop; no time was available to reflect on the opportunities and vulnerabilities. Furthermore, it was decided after the second workshop to let the participants draw the pathways themselves. This seemed to work well in the third workshop, while in the fourth workshop, participants were not willing to construct pathways themselves. This workshop decision thus did not seem to influence the general comparison between the workshops.

When during the first two workshops that participants did not select actions that could be placed in a sequence, manually new actions were made for the participants. In the last two workshops, these actions were also implemented as official cards. However, in practice, the discussion on these cards was similar.

When evaluating the changes during the workshops, a comparison between the two approaches is possible because the changes do not significantly influence the outcomes of the workshops. The only point of attention is the varying tipping point condition between the workshops.

Conclusion & Future

7| Conclusion

In this chapter, conclusions are provided for the overall work. First, conclusions are presented for the sub-questions after which the central question of this study is answered.

7.1 Conclusions to sub-questions

This first section will address the sub-questions that were developed support to answer the main research question in the research definition. The structure of this section follows the identified sub-questions, found in Chapter 2.4.

A. In what ways can scenarios be used to support ADM?

1. What are the claims of adaptive delta management?

The Delta Program (2015) formulated ADM as looking ahead at the tasking we face, taking the most (cost-) useful step-by-step measures based on those insights, and leaving options open to be able to respond in a flexible manner to new insights and developments (while being both practical and alert). Furthermore, they mention that adaptive delta management links water tasking with other ambitions such as nature and construction (Delta Program, 2015; Delta Commissaris, 2011, 2018).

2. Given the various published applications and scientific foundation of ADM, how does the use of scenarios differ across these applications?

ADM seems to be increasingly applied in a variety of contexts, as for example the Thames Estuary 2100 study in the UK, The Bangladesh Delta Program, the Dutch Delta Program, the Jakarta Coastal Defense, Vietnam, Myanmar and Australia. In all these cases, scenarios are used in a different timing, and with various uncertainties. Furthermore, ADM builds upon a variety of scientific foundations (see figure 3), that use a different level of uncertainties and a moment in their ADM cycle in which they introduce the concept of scenarios. Furthermore, several studies of participatory applications can be found as in Portugal, Big Hole Valley, Australia, New Zealand and Sweden. These participatory approaches also have different ways to use scenarios (e.g. as visions or explorative) and also apply scenarios in a different phase of their process ways: after the development of actions, as visions, at the beginning of the workshop, but without formulating adaption tipping points, after actions, goals and triggers, at the beginning of the ADM process, or in a "what-if" analysis.

3. What is the role of scenarios suggested by literature?

Scenarios play a significant role in the exploratory phase of Dynamic Adaptive Pathways (DAPP) to assess if strategies would work in different futures (robustness), and also to identify actions to enable certain developments (flexibility) (Loucks & van Beek, 2017). Furthermore, scenarios are used to envision future opportunities and vulnerabilities, on which tipping points can be distinguished. Due to the significant role of scenarios to analyse vulnerabilities and opportunities, and thus creating the adaptation tipping points, it seems to be a logical decision to use scenarios at the beginning of the DAPP cycle.

4. Which institutional and cultural characteristics are suggested by literature to affect the applicability/efficacy/utility of scenario planning for a participatory application of ADM?

Timmermans et al. (2015) highlight the importance when making methodological choices in ADM in cultures that score on the extremes of the long term orientation and uncertainty of Hofstede et al. (2010). An approach, such as in adaptive policymaking or IWRM in which scenarios are introduced in a later stage of the research, is expected to function more appropriately in participatory studies in cultures scoring low on certainty and future orientation. Therefore, it is discussed if also with participatory DAPP scenarios should be introduced in a later stage of the framework. This hypothesis is also supported by practitioners of ADM.

B. How can a comparative analysis be set-up for comparing 2 ADM approaches for the chosen case?

1. How can a comparative analysis be done for participative action research with a limited number of cases?

I have compared two types of cases in order to investigate the most suitable place of scenarios in the DAPP cycle. The first case is the "Scenario Approach" in which the scenarios are used at the beginning of the DAPP cycle; the second case is the "Action Approach" in which the scenarios are implemented after the establishment of the adaptive pathways. The theory used to design the case was the analytical framework of DAPP (Haasnoot et al., 2013). Both cases were structured according to this framework, only the place of the scenarios varied. Data was gathered by means of triangulation, and the cases were compared on pre-defined criteria. The different research methods are observations, surveys, critical incidents and an evaluation of the outcomes of the research. By using this variety of methods more significant insights could be made with a limited amount of cases.

2. What are the criteria for the comparison of two ADM methods?

In other to compare the data evaluation is performed on criteria that are set-up based on literature. In Table 3, a combination of all criteria is shown together with the results.

3. How can two different approaches in ADM be translated to practice for the given case study?

The initial workshop design for both methods was based on the establishment of a design based on DAPP, translated into practice, based on a reiteration on the design choices with multiple experts. The workshop design was set up in a script format (Appendices W.1 and W.2), in order to present insights into the study and give reproducibility in the research. In the workshop, many participatory exercises as games and drawing of the current and future system were applied to encourage participants to participate creatively. Scenarios presented based on a scenario logic with driving forces of climate change (moderate or severe), and economic growth (decline or increase). Scenarios were given the name of the animals in the delta: Jaguar, Turtle, Carpincho and Deer. Participants seemed to be able to relate to the scenarios. Stakeholders were selected based on participatory stakeholder analysis. Due to the high range of uncertainties that can be found in the Paraná Delta (Sud Estada, Paraná River discharge, Rainfall, Climate change effects, River Uruguay, presence of government, economic growth, housing, price of wood), which are all relevant for the system, the overarching tipping point condition could not be determined. Therefore, it was decided to take the tipping point condition as time, which is suggested as many uncertainties can be found. In order to translate the two ADM approaches to practice the work was set up by using a moderate action research approach to teach participants about ADM.

C. What insight does method 1 and method 2 give for the application of ADM for the case?

1. Which results can be found by applying ADM on the case with method 1 for the selected criteria?

2. Which results can be found by applying ADM on the case with method 2 for the selected criteria?

The two approaches are compared on criteria shown in the following Table 7.

Table 7: Comparison of results 'Scenario Approach' and 'Action Approach' on criteria

Criteria	'Scenario Approach'	'Action Approach'
	Quality of pathways	
1. Policies constructed based on timing of tipping points and scenarios	Pathways are not constructed based on the timing of tipping points, and the combination of scenarios and tipping points seemed to be very confusing. Participants seemed to understand the concept of scenarios before the workshop. However, scenarios are not used for the construction of the pathways.	Without explaining the concept of scenarios, the concept of tipping points is very confusing for the participants. They themselves came up with the concept of scenarios, and when they are later introduced to the concept, they use the concept in a natural way. Scenarios are used to improve the pathways, and these are constructed on tipping points.
2. Actions consider scenarios, by looking at robustness and flexibility, can identify lock-ins.	Actions that are selected are mostly related to preparatory actions. Issues of robustness and flexibility are not addressed.	Scenarios helped to discuss more flexible and adaptive strategies.
3. Inclusion of multiple different types of strategies	No well-functioning different strategies are found.	Different strategies are discussed by participants to reach the objectives
4. Comparison possible based on objectives	Objectives are not taken into account when constructing the pathways, comparison difficult	Strategies developed aim to improve the objectives. However, they are not fulfilling all objectives; comparison is possible of strategies on objectives
5. Triggers and signposts are highlighted	No triggers are drawn. Signposts can be differentiated for some pathways.	No triggers are drawn. Signposts are discussed when the pathways are developed and improved after the discussion of the scenarios.
	Reaction of participants	
6. Understanding pathways	The participants have difficulty understanding concepts and are tired and overwhelmed.	The participants seem to understand the idea of dynamically changing actions for reaching objectives, and the need to keep actions open
7. Participants will use ADM future work, stimulation of new ideas and discussion	Participants showed that they liked the participatory working style, but doubted if the approach would work in future studies. Planning two years ahead is the maximum that is possible in Argentina. The method stimulates discussion on actions.	Many different views are exchanged, the strategies proposed aim to show these different views. The participants mentioned they liked the development of strategies under uncertainties, also in future work.

3. How do the results differ when comparing method 1 and 2?

When comparing the 'Action Approach' to the 'Scenario Approach', it can be seen that even though at the initial start of the workshop the concept of adaptive pathways seemed more challenging to explain without introducing the concept of scenarios, the approach seemed to score better on all proposed criteria. In both approaches scenarios seemed to be well understood; however, in the "Action Approach", they were actually applied. In the "Scenario Approach" participants seemed to be very confused, while in the "Action Approach" even though participants had difficulties regarding understanding all steps, and the workshop was very intense, they liked the approach. They also suggested to use the approach in their future work, and stressed how important it was to use scenarios in their future vision. Still it seems doubtful whether all participants can actually apply adaptive pathways in their work.

D. How do the expectations regarding theory match with the response of the participants to both methods?

1. What is the theoretical assumption of the results of method 1 and 2?

The hypothesis was that 'Action Approach would work better than the 'Scenario Approach' since Argentina is associated with a culture score low on the long term orientation and uncertainty in culture dimension of Hofstede et al. (2010). Therefore, the assumption was that participants had trouble constructing tipping points taking scenarios into account. However, even though the participants highlighted that they found it difficult to plan long term and create a long term vision, due to the ever-changing politics in Argentina, this seemed to affect both approaches equally. The creation of scenarios did not seem to be specifically affected by cultural implications. However, the "Action Approach" scored on all criteria still significantly stronger than the "Scenario Approach."

2. How can the difference from theory be explained?

In the workshops, the main difference seemed to be the way the participants were learning. In the 'Scenario Approach,' the participants received a lot of information simultaneously. This seemed to make the participants very much overwhelmed. While in the 'Action Approach' participants were explained the theory step by step. The 'Action Approach' seemed to apply the ideas of experiential learning in which knowledge is created by the learner, while the "Scenario Approach' seemed to use the 'transmission model' in which pre-existing ideas are transmitted to the learner.

3. What are the limitations to the study?

The following limitations can be identified:

- Leaving out opportunities and vulnerabilities
- Lack of computational support to identify tipping points
- Lack of experience of facilitators on ADM and improvement of the workshop products during the workshop process
- Difficulty in determining tipping point conditions
- Limited time
- Some participants already had experience in adaptive thinking, while for other participants, this concept was new. This gave dominance of the people who already had experience.
- Number of cases not applicable to draw general conclusion for other cultural settings.

7.2 Answering the main research question

The answers to each sub-question can now be used to answer the primary research question, repeated here:

Main research Question
When should scenarios be used in the participatory ADM cycle, in the institutional and cultural context of Argentina?

The analysis shows that when comparing the 'Action Approach' to the 'Scenario Approach' at the start of the workshop, the concept of adaptive pathways seemed more difficult to explain without introducing the concept of scenarios. While in the end, the 'Action Approach' gave more usable pathways and the participants seemed to understand the methodology better. This outcome is different from the initial hypothesis, which stated the 'Action Approach' would work better because people would have difficulty in assessing different scenarios of the future in the culture of Argentina. However, participants seemed to understand the scenarios explained well in both the 'Action Approach' as the 'Scenario Approach'. It may be explained because the 'Action Approach' applies principles of experiential learning. Still, cultural and institutional influences seem to play a role, since the participants mostly constructed short term actions to improve the current system, which they contribute to the situation of Argentina.
In conclusion, when applying ADM in a small scale workshop in the Paraná Delta, scenarios should be introduced after a first construction of the pathway map (not before). This enables a learning possibility for participants; it creates a (more) positive atmosphere and better pathways in the end.

7.3 Reflection on contribution to academic debate

A reflection can made how the results presented in this study can contribute to the Academic debate. The study may impact ADM in general, DAPP and studies in which workshop design are used, in the following ways:

- The presentation of a literature review of the different application of ADM and their place of scenarios in their frameworks shows the non-consistent use of scenarios. The need for researchers to reflect on their decision for using scenarios in a particular step in their process is highlighted.
- The investigation of the use of scenarios for practical application of ADM is studied. I showed that the position of scenarios influenced the success of ADM for practical studies. Therefore, this study is stimulation for the set-up of participatory ADM approaches that transparently show their workshop design and choices made, in order to provide more knowledge on a successful application of participatory ADM.
- The study highlights the need to look at process aspects of participatory applications of ADM, such as experiential learning.
- The study highlights that the influence of culture can be more complicated than presented in literature, such as that it is part of the learning process. Therefore, it is recommended that new studies address the influence of culture for ADM while including experimental learning.

- This study gives a presentation of issues to consider when applying DAPP for participatory purposes and compares its findings with other studies on DAPP applications. It aims to discuss the implications of DAPP and its need for modifications of the framework.

7.4 Reflection on the societal relevance

Barnett et al. (2014) showed in their investigation to the application of a local adaptation pathway in Lakes Entrance, Australia that the pathways helped to bring consensus among different stakeholder groups and form a beginning of a long process of adaptation. What is the societal relevance of this study? In this section is highlighted which societal relevance the study has.

First of all, the study may form part of a basis for the creation of an ADM plan for Argentina. The Argentinean government has shown interest in the application of ADM in their work. This study highlights and suggests possible adaptations for the framework for the Paraná Delta. Furthermore, it describes the issues of the Paraná Delta in an ADM approach. In this way, the study can be used as a base for future work.

Secondly, regarding the relevance of this study for ADM approaches over the world, the study suggests awareness of the need for adapting the scientific framework to a workshop format, by including ideas of experiential learning. Furthermore, the study design of the Adaptive Approach gives the first idea for facilitators over the worlds that are less familiar with the scientific work of DAPP. The study design can be investigated and adapted for other cases.

Finally, the thesis already has impacted social change in the Delta in the following way:

- In the evaluation of the workshop, participants mentioned that participating in the workshop empowered them to change the system themselves
- It gave a platform to discuss the development of dykes, that was situated towards cooperation, instead of having a strong development on environmental focus. The same was found in Portugal, where the strong participative focus in the Portuguese participative case made the participants cooperate well (Zandvoort et al., 2017)
- Local inhabitants were included in the workshops together with policymakers. This made policymakers aware of the local issues, and the local inhabitants were given ideas on how to adapt their local system.
- Application of ADM already implemented in the work of architects after participating in this workshop.
- The direct cooperation with Argentinean student, highly active in the secretary of water resources in Argentina, and thus influencing the policy there.
- Cooperation with many stakeholders in the Delta, and researchers interested in the approach. The participants showed they would use the adaptive ideas in their future work.

8| Future directions

This chapter will give an overview of future directions of this work. I present a list of all the future work I suggest, which includes an improvement of the current study, recommendations related to experiential learning and recommendations of DAPP. Also, I present some other ideas I got from doing this research.

8.1 Improvement current study design

Decisions regarding the research design are discussed in chapter 8.1. In the initial design, decisions already the economic and social situation in Argentina and the limitations in budgets and time restrictions into account. Furthermore, during the research, adaptations to the initial research set-up had to be made. In this section, different studies are proposed aiming to improve the current study based on arguments provided in the discussion section.

8.1.1 Practical suggestions current study design

From the discussion points in Chapter 8.1, it will be evident that other improvements to the current study design could be considered. Therefore, I propose an improved version of the current study, in order to even establish a greater certainty in its results. I have thought about the following items for improvement if the same study would be applied in another case:

- A clear distinction between the observer and the facilitator roles. The observer should know about adaptive delta management but is distant from the study design in order to perform impartial observation, without having activistic social motivations.
- The organisation of a variety of practice workshops, instead of one, in order for the facilitators to become familiar with DAPP
- Participation of facilitators in the organisation of many other workshops in the selected study area in order to improve chairing capabilities. Now, we participated in a variety of workshops in the Paraná Delta, of which one we also performed organising functions.
- Furst a training on DAPP before starting the actual research
- The selection of an independent and qualified note keeper is suggested.
- Use of a different invitation system, that precisely places each stakeholder in a workshop, without other participants representing that stake, even if the stakeholders like to change to another date.

8.1.2 Scientific suggestions current study design

Several suggestions can also be made regarding the improvement of the scientific quality of the current study design, in order to achieve greater certainty in its results:

- In-depth interviews with participants before and after the study to investigate learning due to the workshops, instead of surveys.
- Improvement of scenarios by, for example,using quantitative simulations to present climate change.
- A more significant number of cases is to be recommended in order to be able to generalise the results, to set up the research in other areas nad cultures as well.
- An additional evaluation step regarding the quality of the pathways by using the consensual assessment technique, in which experts are asked to judge the final outcome of the study (Van Vliet, Kok, Veldkamp, & Sarkki, 2012).

8.1.3 Application in different cultures

In this study, the cultural influence on participatory ADM still does not seem to be fully understood. A cultural influence seemed to be present when participants had to consider long-term planning. However, culture did not seem to play a role in the use of scenarios. Furthermore, the culture of the participants seemed to be different from the culture of the government that was strongly affecting their choices. Since people had to live with the highly varying government, even though they maybe wanted to make long term planning and understood it was needed to improve their circumstances. This might be explained by that the political system is more hierarchical, than the actual culture. This seems to be suggesting that the influence of culture on participatory ADM is more complicated than initially assumed. Therefore, I suggest investigating the influence culture by comparing the findings of this study with the results of similar workshops in different countries. Notably, a first study could be making a comparison with a similar study design in the Netherlands, in which the methodology was created. Therefore, I would suggest considering culture as a more complicated aspect regarding the results of the research, instead of comparing the results only on long-term and uncertainty axes of Hofstede, Jan Hofstede and Minkov (2010). Also, culture might be a secondary influencing factor for the success of one workshop approach. For example, understanding the cultural influence on learning could be interesting.

8.1.4 Research on experimental learning

In Section 7.1, it is suggested that experiential learning may be a significant influencing factor for a successful participatory DAPP application. In current DAPP research, this dimension of design for learning purposes often seems to be disregarded. The design and testing of a DAPP workshop based on learning studies seems to be a valuable direction for future participatory DAPP research. In order to set up a successful DAPP participatory workshop design, it is advised to construct such a workshop together with educational experts. A possible suggestion could be to include experience and reflection stages (A. Y. Kolb & Kolb, 2012).

Asking questions if the participants thought themselves about scenarios, if not encourage them by questions to come up with the concept. The ‘open to outcome questions’ presented by Jacobson and Ruddy (2004) for facilitators in experiential learning may form a solution here. Their questions are the following(Jacobson & Ruddy, 2004):

- Did you notice?
- Why did that happen?
- Does that happen in life?

- Why does that happen?
- How can you use that?

By including these questions when the participants already discuss the concept of scenarios during the action stage, possibly a more significant learning experience can be achieved. If the concept is not brought up by the participants themselves, the questions can help in the what-if analysis. Even though a good facilitator may contribute to the learning experience, the most important aspect seems to be a reflection (D. A. Kolb, 2014). Relevant experience also seems to be found in transition studies (Loorbach, 2010; Loorbach & Rotmans, 2010)

Furthermore, it seems relevant to investigate if it is useful to divide participants beforehand in groups, based on their learning styles (A. Y. Kolb & Kolb, 2012). Participants could be easily being divided into learning styles based on available online tests. However, someone's personality might be of influence in the success of a participatory study, besides its learning style. Therefore, it seems useful to make a reference study in which participants are divided based on group personality.

Also, in a variety of cases, , culture seems to be a strong influencer in the way people process information (Earley, 2004), and the suggestion is made that cultures can influence learning processes(Reynolds, 1997). Individuals from Brazil and Italy had the most concrete learning styles, with active experimentation while for example Germany and Singapore had the most abstract learning styles. This can be a motivation for the preference of the participants to work in the 'Action Approach' in which steps were made concrete by activities, while the 'Scenario Approach' seemed to be more abstract by presenting many concepts (Joy & Kolb, 2009). Argentina seems to share many cultural characteristics with Brazil and Italy (Hofstede et al., 2010)Therefore, it should also be a variable to consider when setting up the research.

8.2 Studies for DAPP

Based on the discussion provided in chapter 10, as a reflection of DAPP, I would like to propose several studies that discuss the complex reality of the Paraná Delta. First of all, I will present different points of attention for these studies. Then I will suggest that a comparative analysis of different frameworks would be most suitable, in order to suggest an improvement in the framework.

Firstly, I have noticed that stakeholder management is not as static as suggested by most stakeholder analysis. Doing a stakeholder analysis in the Paraná Delta was a continually changing, turbulent and chaotic process. Due to different interests, dynamics, and competitions between stakeholders, relevant stakeholders were continually changing. Furthermore, I was part of this complex system, created more complexity, gave more power to stakeholder, or limited power. The work of Ertsen (2015) seems to be relevant in describing such a turbulent actor network. A description of this chaotic process and how to handle this for policy analysis seems to be an exciting aspect to study in future work. Also, as highlighted in the ethical considerations it might be beneficial for the Paraná Delta to adapt the DAPP framework to make full use of upcoming policy windows in order to maximise on the short term, and it can still be adaptive for long term planning. Then, also it should be essential to include the current need to improve the system (if it is not functioning correctly already) and setting objectives for the need for the current improvement of the system while linking this to long-term opportunities and vulnerabilities.
Moreover, the various amount of uncertainties highlighted in the Paraná Delta could not be analysed by using DAPP and making the selection of the tipping point condition a highly complicated process. An

inclusion of Decision trees in the DAPP framework could be used to limit uncertainties in the application of DAPP (Ray and Brown 2015).Also, the use of a case of DAPP that is connected to the outside world seems to be very complicated for participatory purposes. When a feedback process is present with the world outside the boundary condition of the case, it seems difficult to purely see the changing boundary conditions as a scenario, and explain this to participants. Research how to implement such boundaries conditions also seems useful for participatory purposes. Finally, the participants seemed to have great difficulty in agreeing upon KPI's and objectives. An investigation what causes or influences this difficulty (for example cultural factors), or how this objective formulation can be improved in participatory ADM seems to be relevant.

For that reason, I would like to suggest a comparison of a new type of DAPP approaches as flexible adaptation pathways (Rosenzweig et al., 2011), transition management (Loorbach, 2010) and pathway thinking (Wise et al., 2014) which take complex (actor) systems into account. Furthermore, I suggest improving these frameworks regarding the use of dynamic actor networks, policy windows, improvement of the current system, a feedback effect with the boundary conditions, the incorporation of many uncertainties and the agreement on objectives. Finally, it will be a challenge to translate this to an applicable format for participatory purposes. My last suggestion would be to investigate a specific format for DAPP research into ethical implications upfront since this is often now overlooked, such as discussed in chapter 8.

8.3 Other ideas

In this study, I came across a variety of cultures, like professional cultures in the Netherlands in Argentina, university cultures in the two countries, the cultures in the Argentinean governmental institutes and organisations. The diversity of these contexts made it challenging to set up research. Furthermore, I cooperated during the entire process with an Argentinean student. An evaluation regarding the set-up of research in such an environment seems to be relevant for other (young) researchers that would like to explore research in a dynamic environment.

9| Personal reflection

9.1 Reflection on beliefs and values of research

As suggested in Action research I will reflect here on my initial beliefs and values. At first, my belief was that the "Action Approach" would work better, since people would find it very difficult to think about the future in Argentina. This idea derived from the work of Hofstede et al. (2010), my own experience of the turbulent political and economic life in Argentina and the fact that it seemed unrealistic for people in Argentina to prefer long term planning taking uncertainties into account. One could argue that I steered towards this outcome myself. To limit my own bias and steering, I arranged an additional notekeeper (who was not aware of my hypothesis). Also, when keeping the action research thinking I did my entire best in both workshops to teach the participants about ADM. Furthermore, I wrote down my biases during the process and discussed these in honest conversations with Sabrina. Furthermore, I very critically analysed the reasons why the "Action Approach" seemed to be more successful, with the entire team and by using the different research methods. The surprising outcome was that cultural influence seemed to be less critical than I initially expected. In this way, I believe I successfully prevented my own steering for a particular research outcome.

Furthermore, I expected a very dynamic group, after being present at earlier participatory work on the Paraná Delta. Therefore, we decided to set-up relative small workshops with a maximum of 15 participants. Also, I expected people to have heated arguments with each other, which I had seen in other workshops, and therefore we spent time on rules and regulations in order to promote a relaxed workshop flow. I also expected participants to be motived, and for this reason, I included many games since I thought participants would react enthusiastically. In most of the workshops, participants seemed to like this, while in the last workshop I overestimated the enthusiasm of the group. I also expected participants to attend the workshops due to their interest in water management in the Netherlands, and therefore I stressed the usage of DAPP for the Dutch Delta Plan.

During the establishment of the set-up of the work most participants were positive about participating in the workshops. However, some seemed to have a different vision on our professional quality as woman engineers. I expected that this could be a problem during the workshops, however luckily it did not seem a real issue, and even though maybe at times we were taken less serious by some men, we did not encounter any direct sexism.

9.2 Reflection Ethics

As McNiff and Whitehead (2009) highlight, it is vital to reflect on ethical considerations in social research. In this section, an ethical reflection is presented. Also, I discuss questions that have been stuck on my mind after this research regarding this study and action research in general. I hope by giving a

valid reflection, to be able to use these thoughts for my future work for myself and maybe even inspire the readers of this thesis.

My first thought relates to the fact that participants, who participated in the "Scenario Approach" are less likely to participate in ADM in future work. Of course, if I would not have compared it with the "action approach' we would never have known, that the 'Action Approach' would work for them as well. But it still feels uncomfortable that by participating in my workshops, some participants are less willing to use ADM in their own future work.

Secondly, is it ethical to teach people a methodology, give them the feeling of empowerment, without a final project after that? Initially, I thought an ADM study would follow up on my work. However, this is not clear right now. On the other hand, the empowerment of the participants seems to construct several bottom-up approaches in the Delta already.

Thirdly, I assume that the main reason participants agreed to be involved in the workshop was to 'learn about the Dutch approach'. However, there does not seem to be one Dutch approach. I did not want to spend too much time explaining this, but should this not be made clear to the participants? I did tell honestly in by means of the invitation and in the workshops that were using DAPP, which was used in the Dutch Delta Plan.

Furthermore, the participants participated in the research in order to be empowered to teach ADM for their work. As discussed in the section on action research (8.1.3), it was not my core purpose to empower the participants. As actions research suggests if the research had to be set-up together with the population, in order to empower them to use the method afterwards, maybe I ought to set-up my study more as training. However, due to the strict timetables of my participants, I was already satisfied that I could organize full day workshops.

As a final thought, does it even make sense to push participants to think long term, if they can barely survive in the short term? Of course, a long term plan is necessary in order to face future threats. However, the system in Argentina just seems to work very differently. When a policy window opens up, it seems useful to take full advantage of this policy window and immediately take strong action, since the subject is on the political attention. Who am I to teach participants that it is better to wait taking action when actually it is against their own interest? Of course, one could argue that actually DAPP helps to keeps options open and prevent lock-in. However, in the framework taking full advantage of a policy window, even though it might limit to reach the objectives defined in the end, does not seem to be possible.
As could be seen after this discussion on the ethical dimension, not a hard critic can be given. I also discussed ethical implication upfront with supervisors and the Argentinean student. Still, I believe an ethical reflection in DAPP research is very valuable. Therefore, a possible suggestion would be to do an in-depth ethical analysis before the research, and evaluate which alternative design options are available for the research.

9.3 Reflection on personal development

Figure 38: Measurement of river profile after a dyke breach

Now that I am closing off the 1 year and 3 months of the two theses, I can look back on the process and reflect on my personal development over this period. It was a challenging, learnful, but enjoyable experience. Would I do it again? Yes! Would I do it differently, definitely! All over, I am grateful for having the experience of these two theses both on an intellectual and personal level. From the beginning it was my intention to do research which would form a bridge between engineering and the real social world. However, bringing these ideas into a research project proved not always to be easy. I realized that not everybody both in Argentina and in the Netherlands got enthusiastic about my aim to connect society and engineering so strongly. Like one supervisor said:

> *"Why would you go to the field and talk with all these people if you can calculate everything behind your computer?"*

And in reality, of course, this gave some issues. The practical situation was completely opposite from what I initially expected in Argentina, since no foundation for my research seemed to be present. There was not a network of stakeholders available which I could approach, not a set of data available of the dykes. This meant that I had to start from scratch.

I started to talk to people I considered of interest for my research, invited myself to workshops on the Delta, wrote, texted, called so many people in the field as possible before I could start the actual work. Many people were kind, talked about their water issues, giving me many insights on what to research. After my conversations with so many organizations, and also with adaptive delta management experts, I realized I could organize a series of workshops myself (together with an Argentinean student I had met

at the end of her studies). Furthermore, together with the water institute of Argentina, I set up a modelling campaign. I decided to adjust my research in order to get an overlap and find data that could be useful for both of us, so we could have a fruitful cooperation. The whole time I was looking to find people with similar interests, to set up cooperations, and into making my research a success. Back in the Netherlands, finally really knowing what I wanted to do, I started to approach funds and looked at original ways to use my money.

But after this initial set-up phase I had to remain creative, social and focused in Argentina... During one day of measurements, when I could not reach my measurement area, I could luckily borrow a canoe to still be able to reach my destination. During an island festivity day (which I wanted to attend in order to be able to speak to local people), a strike took place, and I had to wait 6 hours in line for the public boat, and finally by hitchhiking I was able to attend the festivities for one hour. However, during that hour I got the most interesting insights, of how local women have difficulties living in the delta, and of the kind of difficult situations they were facing. I got robbed while I was in a meeting with my Argentinean supervisor. Also, I had to change houses multiple times, camped in an experimental station with local researchers, freezing in the cold. And then the Spanish language! First I spoke a very limited Spanish, but when I realized all my participatory work had to be in Spanish, I took every evening extra Spanish classes, and eventually, I was able to understand the Argentinean accent. Another problem was formed by the stakeholders that initially were supposed to come to my workshops. Due to a conflict outside my domain, they were not interested anymore in working with Dutch parties. Luckily, I went to do measurements and made field visits, where I could meet and talk to local people and with agriculture organizations. I encouraged them to participate in the workshops and they suggested other stakeholders to me. In the end, I was able to interview more than 50 people in Argentina, I organized 5 workshops where more than 50 people also attended, and I participated in different research activities and workshops speaking with many others.

Looking back, I can say that I'm proud of all the work I have done. The most important thing I have learned is that it is not possible to plan everything from the start to the end or to do risk analysis on all subjects: in the beginning when something went wrong, I used to reevaluate the problem more than a 100 times. Maybe I did it because I was afraid of what the supervisors in the Netherlands could say if they would evaluate to the non-technical components of the research. I have learned that sometimes I have to let it go, since I cannot do everything perfectly, I should not always be "an optimizer"; a "satisfier" could do as well. For all the things that turned out to be difficult, I discovered that I was creative enough to find solutions! I am also very happy with the results of the organization of my work: cooperation with people of all kind of different institutes, from different working cultures and nationalities in working situations. This was so inspiring, but at the same time quite tough as well. People reacted sometimes very directly, maybe even a bit rude or mean about my work, and these negative attitudes were quite shocking for me. Maybe some people did not appreciate my attitude to actively involve stakeholders, or did not appreciate my thinking about ontologies, or about modelling. I felt the need to adapt my research plan throughout the process.

I think I was so afraid to receive criticism on my scientific thinking, that I became too perfectionistic, trying to find proof of everything in literature which took quite some time during the last months of my studies. I realize that I should have trusted my sources and myself better from the beginning of the process. So at the end of the theses, I realize that if I start to approach new ideas, or different ideas, I can expect people to have different and critical opinions. I realize now that people will react differently and that it is up to me to make my ideas as clear as possible for them without fear for criticism. And I do realize now that criticism does not have to say anything about how they see me as a person. Or if

they don't like me, I should still be proud of my own ideas, my way of thinking, and related to subjects of my research: being full of strength showing how I believe that engineering and the social world could be connected.

In sum, I believe this research has taught me to believe in my own strength, accept that things can go wrong, that I should not try to control everything, but that I should stay calm and think in possibilities while enjoying the research I am doing. I did my research in quite an experimental way in which engineering was connected to social studies and philosophy. This was what I intended to do from the beginning from my studies (Bachelor time in Leuven) and I found it not an easy project to do. I am happy that in the end of my studies I found in Dutch newspapers twice a top scientist, Prof. Louise Fresco, chairwoman of the University of Wageningen and Jan Mengelers, former chairman of the TU Eindhoven, saying that the study of technical engineer in the near future should cover for 20 percent social and liberal arts, and that the pure beta studies should not exist any longer. Both are stating that "the future engineer should be both an alpha, beta and gamma in one"(see: NRC[5] of FD[6]). I hope to take the valuable lessons from these very interesting studies with me to my next phase in life!

[5] https://www.nrc.nl/nieuws/2019/05/06/ena-niet-afschaffen-maar-verbeteren-a3959201

[6] https://fd.nl/economie-politiek/1301592/moderne-ingenieur-is-beta-alfa-en-gamma-ineen

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