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Embedding Scenario Analysis and Application in Delta Planning Processes in Bangladesh

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CEGIS

WARPO পানি সম্পদ পরিকল্পনা সংস্থা

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Brief description of the document

Summary of the results of Collaborative Applied Research Project 6 (CAR6) under Nuffic-NICHE BGD 155 Project: Scenario development in Integrated Water Resources Management: Coping with the Future Challenges in Bangladesh. The main objective of this research was to explore how scenario analysis and application in delta planning could be embedded in institutions in Bangladesh, on a continuous and enduring basis.

'We are shifting from predictions to scenarios' (Umme Kulsum Navera, Research Coordinator Nuffic-NICHE BGD 155, project meeting 26 November 2016).

'Scenarios are narratives of alternative futures. The moment you box them you enter the world of planning' (Anonymous interviewee, November 2016)

Acknowledgements We are grateful to all interviewees for sharing their wisdom with us on the use of scenarios in delta planning in Bangladesh, and how this could be institutionally embedded. Photos were kindly provided by Kousik Ahmed and the authors.

Disclaimer:

The majority of interviews and discussions that informed this research took place from August to December 2016. The Bangladesh Delta Plan was still under development and little experience has been gained with scenario delta planning. This research is undertaken in the context of Nuffic-NICHE BGD 155, independently from the Bangladesh Delta Plan.
Findings of this report should therefore be considered as explorative, highlighting different personal opinions of interviewed experts and authors on embedding scenario delta planning.
The report is mainly written for discussion purposes instead of presenting firm conclusive insights how institutional embedding of scenario delta planning could be secured.

Contents

Abbreviations

BAU	Bangladesh Agricultural University
BDP	Bangladesh Delta Plan
BWDB	Bangladesh Water Development Board
BUET	Bangladesh University of Engineering Technology
BWDB	Bangladesh Water Development Board
CAR	Collaborative Applied Researches
CEGIS	Centre for Environmental and Geographic Information Services
ECNWRC	Executive Committee National Water Resources Council
ESPA	Ecosystem Services for Poverty Alleviation
GED	General Economics Division of the Planning Commission
IWRM	Integrated Water Resources Management
LGED	Local Government Engineering Department
NWMP	National Water Management Plan
NWRC	National Water Resources Council
WARPO	Water Resources Planning Organization

Foreword

Scenario development is an important activity in the adaptive planning process in the delta as it offers an approach to cope and prepare for an unknown future. In the Nuffic Niche 155 project "Scenario Development in Integrated Water Resources Management: coping with future challenges in Bangladesh" we tried to focus on capacity development to develop and use future scenarios, though we had limited collaboration with the Bangladesh Delta Plan (BDP) process. However, four knowledge institutes, namely BUET, BAU, WARPO and CEGIS, supported by UNESCO-IHE, Wageningen UR and Deltares, have made a review of the issues and driving forces in the delta and engaged in developing scenarios in flooding, water use in agriculture, sedimentation and land use. This scenario exercise enabled the participants of these agencies to improve their understanding about longer term planning. The activities of the Niche project took place separately from the Delta Plan formulation, with cross linkages to discuss and learn from each other.

In order to ensure that the scenario knowledge accumulated through the exercise of CARs are (strongly) embedded within the different institutions for future practices we explore in this research options to embed and apply scenario analysis for delta planning on a continuous and enduring basis in Bangladesh.

Such embedding should have been closely linked to the activities for the development of a Bangladesh Delta Plan, yet this was to date only partially achieved. The Delta Plan project website also explicitly states that "The Delta Plan is more than just a one-time planning exercise and aims to provide the foundation for permanent delta governance in Bangladesh through the outlining of a delta framework". This Niche 155 research report specifies tasks of scenario delta planning and contains recommendations to make scenario delta planning continuous and enduring. This report is therefore relevant for those discussing how to embed Delta Plan activities in the institutions in Bangladesh.

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Executive summary

The objective of this research is to explore how scenario analysis and application in delta planning could be embedded in institutions in Bangladesh, on a continuous and enduring basis.

By reviewing the National Water Management Plan, the 5 Year Plan and the Bangladesh Delta Plan it can be concluded that different institutions have different notions of scenarios. To clarify the various types of scenarios, we introduce a classification of three types of scenarios: predictive scenarios aim to make an attempt to predict what is going to happen in the future (e.g. 5 Year Plan), explorative scenarios explore situations or developments that are regarded as possible to happen (e.g. BDP), and normative scenarios aim to specify how a specific target can be reached (e.g. Bangladesh reaching status of middle-income country through a series of 5 Year Plan's).

The classification and examples of scenario use in Bangladesh make clear that scenario delta planning using external scenarios is for the moment in an initial stage. One in which different institutions have different notions of scenarios, and the explorative scenario thinking of the BDP is not broadly embraced yet.

Due to the top-down planning system of Bangladesh, high level decisions and commitment are essential for institutional embedding of scenario delta planning. To specify what should be embedded in institutions in Bangladesh, 15 tasks of scenario delta planning are discussed in this report. The tasks are related to uptake in the planning system, development and revision of scenarios, connection between scenarios and strategies/measures in planning, research and capacity building.

Finally, recommendations are provided as to how scenario analysis and application can be made enduring. Scenario planning should be linked to the planning cycle of the 5 Year Plans. In addition, mandates and responsibilities regarding scenario development, use and update should be made clear. And the capacities of students and professionals should be developed as Bangladesh is shifting from the use of predictive scenarios (blue-print planning) to explorative scenarios.

In a later stage focus group discussions may be planned to discuss the findings of this study and the allocation of responsibilities in these tasks between GED, WARPO, BUET, BAU, ministries, Centre for Policy Dialogue and others.

1. Introduction: use of scenarios in Delta planning in Bangladesh

The history of water master planning in Bangladesh started in the 1960s when in 1964 a 20 year master plan was developed popularly known as the EPWAPDA plan, which was informed by the Krug mission of 1956 and its report. The master plan put priority to large-scale flood control, drainage and irrigation projects to increase agricultural production in the hunger stricken country. In 1972 the International Board of Rural Development (IBRD) mission reviewed the plan and advocated the use of low-cost, small to medium sized projects instead of large flood control and drainage projects. This resulted in the mid70s in a rapid rise of both groundwater and subsurface abstraction, resulting in growing food production. At the same time, awareness was rising for the impact of the water sector on environment, fisheries, domestic and industrial water supply and salinity management[1].

In response to this attention for environment, agriculture and industry, a first attempt to holistic master planning started in the 1980s. In 1987 National Water Plan I (NWP I) was completed, a 20 years perspective plan, and then in 1991 NWP II was prepared for water resources development. Catastrophic flooding during 1987-1988 shifted priorities from National Water Planning to a new planning activity, known as the Flood Action Plan (1991-1996).

All these planning efforts culminated in the **National Water Management Plan** (NWMP) which was prepared in 2001. The NWMP consisted of short and medium term sub-plans and included a perspective plan for 25 years. The NWMP is an integrated water plan in which ~35 agencies under 13 ministries are involved. WARPO was established in 1992 with the mandate to prepare National Water Plans and oversee the implementation of projects that are related to water after NWP II ended. Implementation of the NWMP has been challenging for various reasons such as limited political support, financial resources and sufficient leadership and ownership by other leading planning agencies.

The most recent effort on water centric integrated master planning is the **Bangladesh Delta Plan** (BDP), expected to be completed December 2017. The BDP focuses on food security, water security and economic growth. With the BDP, Bangladesh master planning is beginning to shift from projections and predictions –so-called blue-print planning- to a longer time planning of 50 to 100 years in which uncertainties are acknowledged and multiple future scenarios are applied to assess the effectiveness of strategies under different scenarios, and as such test the robustness of strategies. Formulation of the BDP is coordinated by the General Economics Division (GED) of the Bangladesh Planning Commission under the Ministry of Planning, implying a shift from water-oriented master planning under the stewardship of the Ministry of Water Resources to water-oriented macro-economic planning under coordination of the Planning Commission.

[1]Source: https://agricultureandfarming.wordpress.com/2013/06/09/water-resources-planning-organization-warpo-bd/, accessed on 19-01-2017

Around the world, **scenarios** are stories (or narratives) set in the future, which describe how the world might look in, say 2050. They explore how the world, a region or country or region would change if certain trends were to strengthen or diminish, or if various events were to occur. It is used to develop policies and strategies that are robust, resilient, flexible and innovative. Examples of scenarios used in planning are not only the BDP, but also assessment reports of the IPCC and UN Framework Convention on Climate Change, the Dutch Delta Plan, and the Mekong Delta Plan.

The **objective of this research** is to explore how scenario analysis and application in delta planning could be embedded in institutions in Bangladesh, on a continuous and enduring basis. It is relevant to explore such embedding as scenario analysis and application have a central role in the BDP formulation, and the BDP aims to be more than a one-time planning exercise. However, as the concept of scenario analysis and application is new, more insight is needed what precisely scenario delta planning entails, who should conduct the various tasks, and what sort of capacity development is needed. The report focuses on both the NWMP and the BDP, as both are recent, long-term, integrated planning efforts related to water and development in Bangladesh, thus offering valuable insights for institutional embedding[2].

This report is organized in 5 Sections. In Section 1 the history of water master planning is discussed as well as the need to conduct this research. The methodology which informed this research is explained in Section 2. Findings are discussed in Sections 3 and 4. In Section 3 the background and use of scenarios are presented, in addition to a brief literature review on the use of scenarios in Bangladesh planning. In Section 4 findings on the NMWP, the BDP and institutional embedding are covered, next to roles and tasks to embedding scenario analysis and recommendations to make it enduring. Lastly, the implications of the report's findings and conclusions for institutional embedding are discussed in Section 5.

[2] Although we acknowledge that scenarios received little attention in the NWMP (see Chapter 3), the NWMP case is insightful for this study, as it can be considered as a previous preceding ambitious integrated master plan which had to be implemented and embedded in institutions.

2. Methodology

Literature review To understand what scenarios are, and how they have been applied in Bangladesh several reports were read. They have been used throughout the report and are listed in the Reference list for further reading. We refrain from inserting specific references in the text for the sake of readability.

Interviews Following a selective sampling strategy, Tahmidul Haq Saikat and Chris Seijger, in some cases supported by Catharien Terwisscha van Scheltinga and Kousik Ahmed, interviewed water professionals about embedding scenario analysis and application in delta planning in Bangladesh. Professionals were selected on their affinity and involvement with scenarios in delta planning. Some were clearly involved with the BDP and some were not. This resulted in 28 interviews with interviewees from Bangladesh and the Netherlands. See Annex A for an overview.

Each interview covered three topics: (1) the current institutional setting of scenario planning in Bangladesh, (2) options to embed scenario planning, (3) continuous and enduring embedding. The interview guide consisted of open and closed questions (see Annex B). To ensure that data collection in Bangladesh and the Netherlands would be similar, joint interview guides were prepared. The guide was tested in one interview. The test interview mainly confirmed the relevance of the interview topics and questions and resulted in minor modifications on which institutes to include. After an interview was completed a summary was sent to the respondent for feedback.

Analysis The interview summaries were analysed in an analysis format which distinguished between current setting, options for embedding and continuity. Oversight was created by clustering the data, for instance to perspectives on involvement of a particular institution or ideas how to strengthen capacities for scenario delta planning.

Based on an analysis of 13 interviews a Power Point presentation was prepared and discussed by Saiful Alam, Tahmidul Haq Saikat and Chris Seijger. The Power Point was presented in the Niche 155 Project Meeting of 26 November 2016. Based on subsequent discussions, it was decided to not only focus on the BDP and also include insights from implementing the NWMP. In addition, it was decided to focus less on key options for institutional embedding but instead focus on tasks involved in scenario delta planning. The findings in this report are based on 28 interviews. In a later stage a separate seminar will be planned to be held to discuss the findings of this study with key organisations involved in the use of scenarios.

3. Scenario planning and scenarios in delta planning in Bangladesh

Based on the literature review and interviews, it becomes apparent that scenarios exist in many forms and are used for many purposes. This section provides clarifications on the different definitions of scenarios, a scenario typology and various applications of scenarios in delta planning in Bangladesh.

3.1 Clarifying scenarios and scenario planning

A general explanation on scenario planning is provided in the Textbox below.

Textbox 1. Clarification on scenario planning

What is scenario planning?

Scenario planning is a futures technique used for medium to long-term strategic analysis and planning. It is used to develop policies and strategies that are robust, resilient, flexible and innovative. Scenarios are stories (or narratives) set in the future, which describe how the world might look in, say 2050. They explore how the world would change if certain trends were to strengthen or diminish, or if various events were to occur. Normally between two and five scenarios are developed, representing different possible futures, associated with different trends and events.

Within water management, scenarios often have an explorative character, which means that they are used for 'stress testing' of the chosen options. As such, they are context scenarios and do not include any policy changes. These scenarios are used to review or test a range of plans, strategies or policy options: the conclusion generally being that different plans are likely to work better in different scenarios. If a strategy is robust, it means that the strategy works well in all different scenarios or futures.

A typology of scenarios is discussed in Figure 1.

Source: Foresight Horizon Scanning Centre, 2009.

Scenarios can be applied in different ways, depending on how users may want to think about the future. Throughout this report we classify the use of scenarios in planning in accordance with the following typology (See also Figure 1). Examples of the different scenarios are provided in Table 1.

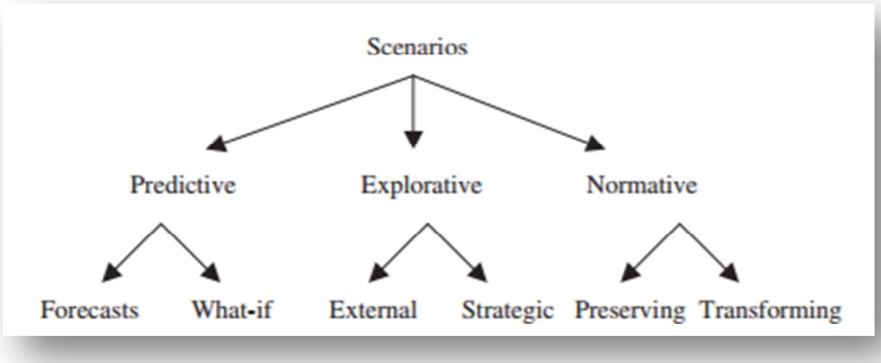


Figure 1. Scenario typology with three categories and six types. Source: Börjeson et al, 2006.

1. **Predictive scenarios** aim to make an attempt to predict what is going to happen in the future. Predictive scenarios are often used for scenario studies that do not look into a very far future (5-20 years). Predictive scenarios are primarily used to plan and adapt to situations that are expected to occur. When used for a longer horizon of 50-100 years, they are usually used as 'reference scenarios' or long-term prediction of the base case (continuation of current trend). They may use forecasts, to explore what may happen when the likely development unfolds. Alternatively, what-if scenarios can be developed, exploring what will happen on the condition of specified events. Probabilistic scenarios and policy package scenarios are both examples of what-if scenarios.
2. **Explorative scenarios** aim to explore situations or developments that are regarded as possible to happen. They are used when looking at a long term-horizon that allows for structural changes. Two types of explorative scenarios are identified, external and strategic explorative scenarios.
    a. External scenarios are developed to answer questions on what can happen to external factors beyond the control of relevant actors, such as climate change or global economic growth. The scenarios are policy free, and provide a framework for the development and assessment of strategies and policies, for instance to find strategies `that are robust across a range of possible future developments.
    b. Strategic scenarios aim to describe a range of possible consequences of strategic decisions. They focus on internal factors (factors that can be possibly affected by relevant actors) and take external aspects into account. The scenarios describe how the consequences of a decision can vary depending on which future development unfolds, and as such can serve as inspiration for policy makers.
3. **Normative scenarios** aim to specify how a specific target can be reached. The scenarios focus on certain future situations or objectives and how these could be realised. Two

sub-types exist: preserving scenarios, focusing on how the targets can be reached by adjusting the current system; transforming scenarios are applied when trend breaks are needed to achieve a target. Transforming scenarios often have a longer time-perspective of 25-50 years and apply back-casting methodologies.

It should be noted that the scenario typology is not static, and in practice mixing may occur in between types of scenarios. For instance BDP scenarios are external scenarios but also include policy-choice information on the preferred type of economic product. Likewise, the Dutch Delta Plan is driven by a normative preserving philosophy in which the delta is mostly preserved as it is.

3.2 Use of scenarios in Bangladesh delta planning

We will now turn to Bangladesh delta planning to explore which different uses of scenarios have taken place. The planning efforts discussed are the NWMP, Bangladesh Delta Plan 2100, the 5 year master planning by the GED, and the ESPA delta research project.

3.2.1 National Water Management Plan project

This project was launched to implement the National Water Policy (1999). The Plan aims to contribute to (1) wise use of Bangladesh' water resources, (2) safe and reliable access to water, (3) clean water in sufficient and timely quantities for multiple purposes. The plan assumes population growth up to 218 million by 2025, and GDP would increase annually by 6-7 percent till 2025. One water demand scenario is formulated, covering dry and monsoon seasons up to 2025. Furthermore, two scenarios have been developed when the targets for water supply and sanitation are reached: a Base Case 2010 and an Alternative Scenario 2025. In the plan, these two scenarios were linked to investment and funding requirements and thus could be used for financial planning of water-related investments.

Type of scenario These scenarios have a more predictive character. They looked at the short to midterm time-horizon and describe a continuation of the business as usual. These type of scenarios are usually referred to as 'reference case scenarios', not including deviating but plausible outcomes. As such, the purpose was not to stress test measures under different outcomes, but to set out a strategy for the future. The scenarios included policy options as they specify how much has to be invested in the Base Case and Alternative Scenario.

3.2.2 Bangladesh Delta plan 2100 The Bangladesh delta scenarios were developed to assess to what extent preferred strategies – which are the result of policy choices– contribute to meeting the Vision and Goals for the Bangladesh delta in different plausible future outcomes. Those strategies that perform well in all or most scenarios are considered robust and thus 'no regret'. Explorative scenarios were developed using the 'two-axes' method, in line with the original method used by the IPCC and the Dutch delta scenarios. The method generates contrasting scenarios by placing high-impact high-uncertainty factors on the two axes. This results in four spaces that are developed into scenario narratives. Building blocks for the scenarios were provided in a participatory process including a two day scenario workshop at GED with nearly

100 participant[3]. The high impact and high uncertainty factors for achieving the long term vision have been jointly defined as socio-economic development and future water conditions, which combine water variability, climate change and upstream developments. The four scenarios consist of narratives and data on future population growth, economic growth, water conditions (interventions upstream, cyclones, rainfall etc.) and changes in land use (see Annex C). In a later stage it was decided that the scenarios were supplemented with two additional scenarios: one 'business as usual' and one more positive scenario. Figure 2 shows the main premises of the six scenarios for economic growth, water conditions and population.

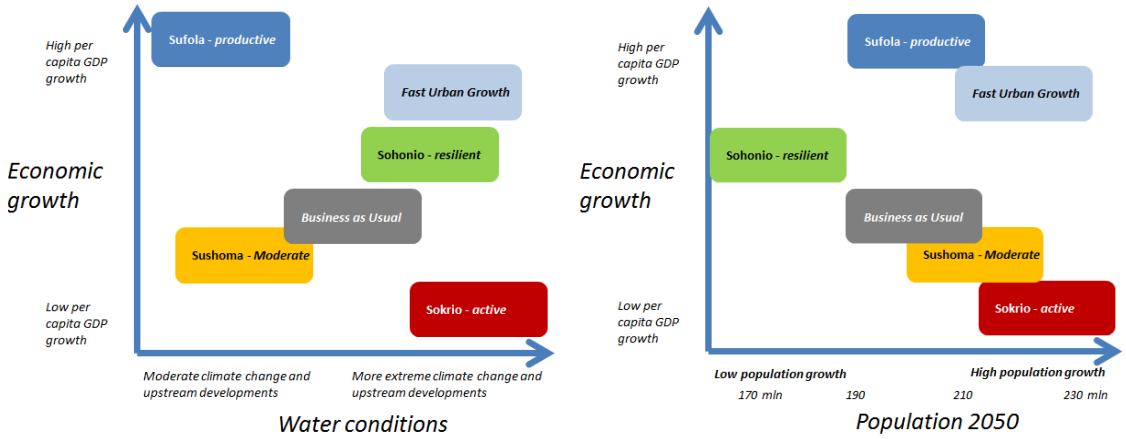


Figure 2. Main premises of the six scenarios for economic growth, water conditions and population.

Type of scenario These are explorative external scenarios, as they do not include policy choices but are used to evaluate the robustness of various proposed strategies, robustness being the extent to which they perform well in the different scenarios.

3.2.3 Seventh (GED) 5YearPlan

The political vision for Bangladesh is to become a middle income country by 2021 (Vision 2021). Five year plans are formulated to realize this vision. The Seventh 5 Year Plan (2016-2020) is formulated on one scenario for GDP growth (p. 36) and macro-economic sectoral growth (p. 54). Three (slightly differing) scenarios are presented for tax-GDP trends (p. 122), and population growth (p. 522).

Type of scenario This scenario is a predictive scenario. No different futures are formulated, instead one reference case scenario, or trend continuation scenario, isformulated.

[3] The participant list shows 96 participants of: ADB, BAU, BADC, BDP, BUET, BWDB, CEGIS, Design Planning and Management Consultants, Department of Environment, EKN, FAO, GED, HAOR, International Water Association, IWM, JRC, Mott MacDonald, ULAB, UNDP, WARPO.

3.2.4 ESPA Delta research project

The ESPA Delta research project [4] (2011-2016) aims to provide policy makers with the knowledge and tools to enable them to evaluate the effects of policy decisions on people's livelihoods. The scenarios focus on food production and ecosystem services. The scenarios are directly used to design cropping strategies on a district level in the coastal area of Bangladesh. In addition, policy scenarios have been developed for low, middle and high growth.

Type of scenario The ESPA scenarios fit the category of explorative strategic scenarios as they include policy options.

Participants discuss key drivers and uncertainties in BDP scenarios.

[4] The ESPA programme is funded by the Department for International Development (DFID), the Economic and Social Research Council (ESRC) and the Natural Environment Research Council (NERC), as part of the UK's Living with Environmental Change Programme (LWEC).

3.2.5 Conclusions on the use of scenarios in Bangladesh delta planning

It can be concluded that different notions of scenario delta planning exist in Bangladesh. In the BDP, scenarios are used to ultimately evaluate strategies. In the NWMP and 5 Year Plan, scenarios are used to model/predict future developments to achieve a set target on water demand or GDP growth. In the ESPA project delta scenarios include policy options and strategies and are as such directly used to formulate strategies. Both BDP and ESPa project thus rely on explorative scnearios. Moreover, during the interviews additional national and international examples of scenarios in delta planning were mentioned.

- The UNDP formulated two scenarios, a baseline scenario for 2030 and an adaptation scenario for 2030. The scenarios have been formulated to assist developing countries to assist in prioritizing and sequencing adaptation programs of the water sector into development plans and budgets.
- CGIAR developed together with Oxford University in the research program on Climate Change, Agriculture and Food Security (CCAFS) scenarios to evaluate climate and agriculture policy options.
- CEGIS has also developed in relation to the BDP two separate scenarios of a business as usual and high growth scenario.

Due to these different applications and interpretations of scenarios in delta planning it is important to be clear on the type of scenario and scenario planning. Table 1 shows how the various examples of scenarios discussed in this report fit in the scenario typology of predictive, explorative and normative scenarios. The table illustrates once again that predictive scenarios were the standard in Bangladesh, yet with BDP a new typology of scenario planning is introduced.

Table 1. Overview of how scenarios are used in different initiatives.

Scenario type	Example	Synonyms mentioned in interviews
Predictive	National Water Management Plan, Seventh 5 Year Plan, CEGIS scenarios.	Point-based planning, blue print planning, what-if, policy packages, reference scenarios.
Explorative – external	Bangladesh Delta Plan, CGIAR-CCAFS, Dutch Delta Plan*, IPCC, UNDP.	Scenario planning, robust strategies.
Explorative – strategic	ESPA Delta Research Project, Mekong Delta Plan**.	Strategic choices, strategic delta planning
Normative – preserving	Regional planning efforts that start with a group of targets concerning environmental, social, economic and cultural factors.	-
Normative-transformative	-	Back-casting

* Dutch Delta Plan is driven by a normative preserving philosophy in which the delta is mostly preserved as it is.

**In the Mekong Delta Plan, the agro-business industrialisation scenario is selected as preferred scenario and strategies are developed in line with this scenario.

4. Findings: Embedding scenario delta planning

Given the ambition of the Bangladesh Delta Plan to move beyond a one-time planning exercise it is essential to explore how this new type of delta planning, scenario delta planning using external scenarios, can be embedded in the institutions in Bangladesh on a continuous and enduring basis. Different users should have access to the scenarios, the information included in the scenarios, and scenarios should be updated regularly. Yet before jumping to embedding new tasks of scenario delta planning in institutions, it is relevant to explore how a previous ambitious integrated master plan was implemented and anchored in the institutions. Looking back at the NWMP may provide valuable lessons about the functioning institutions in Bangladesh in the context of scenario delta planning efforts as undertaken in the BDP. It is noted that the formulation of the NWMP was done under the Ministry of Water Resources, while the BDP is done under the Ministry of Planning.

4.1 Lessons learned on integrated master planning NWMP

The NWMP was an integrated water plan, in which about 35 agencies under 13 ministries were involved. WARPO coordinated the development of the NWMP. The mandate of WARPO has been specified in a number of legislations. First, the Water Resources Planning Act (1992) enabled WARPO to prepare for National Water Plans following IWRM principles as outlined in the National Water Policy (1999). In addition, the Water Resources Planning Act (1992) stipulated that WARPO should guide implementation of water related projects by different agencies.

In addition to IWRM, the Coastal zone Policy (2005) also stipulated that WARPO is responsible for monitoring Integrated Coastal Zone Management in the coastal areas. Finally, the Bangladesh Water Act (2013) provides WARPO the legal mandate to prepare the National Water Resources Plan (NWRP), and act as 'clearing house' for any project implementation that is related to water. In a similar function, the Department of Environment would conduct Environmental Impact Assessments for these projects. Lastly, WARPO is responsible for implementation, which is providing technical clearance of any intervention, and provide permits for water abstraction and regulate the construction of infrastructures in the water system. Both the National Water Policy (1999) and the Water Act (2013) stipulated that implementation of the NWMP needed coordination by WARPO through the National Water Resources Council (NWRC) and its Executive Committee (ECNWRC).

Despite these legislations, implementation of NWMP projects and strategies did hardly succeed as envisioned. At least four factors have contributed to this challenging implementation. First, political support for the NWMP was very low. The Ministry of Water Resources and Planning Commission did show little interest in the NWMP, resulting in fragmentation across ministries of different sectors. Second, financial resources of development partners were not secured. As a result projects envisioned in the NWMP could not be funded. Third, support within the Ministry of Water Resources for the NWMP was not strong enough: WARPO was a newcomer compared to the implementing agency BWDB. BWDB continued to man WARPO and continued its project-based planning that lacked strategic oversight and integration with other sectors. The setup and WARPO were not changed to implement the NWMP. This meant that

very limited people and financial resources were allocated to WARPO, resulting in a weak implementation of the NWMP. Fourth, by positioning WARPO under the Ministry of Water Resources, WARPO could not act appropriately on its role of coordination and implementation as other governmental agencies did not perceive WARPO as a neutrally operating entity. Furthermore, staff of the various other ministries involved were not appointed within WARPO to ensure professional strength and institutional linkages.

These four factors caused the implementation of the NWMP to be challenging. The authors of this study translated them into four lessons to develop an institutional setting in which scenario delta planning can be conducted effectively:

1. **Political support** is needed from end-users of scenarios, which is in the case of the BDP (ultimately) various ministries with master plans and implementation agencies which determine project designs.
2. **Financial resources** for implementation of projects fitting key principles of the BDP should be secured early-on to avoid disinterest from governmental agencies.
3. The BDP represents a **shift away from blue-print planning** to strategic planning and coping with uncertainties instead of predicting futures. It is thus relevant to identify which agencies are still representatives of the blue-print planning, and who may have to adapt to a new kind of planning style and more integrated projects. And to support this process by capacity development.
4. **An operating entity accepted by all** is needed that can be accepted by various ministries and implementing agencies to support, coordinate and implement the NWMP and Bangladesh Delta Plan. This entity should gain trust of the various ministries and implementing agencies.

4.2 Current institutional setting of scenario delta planning in BDP

Until the Bangladesh Delta Plan started, scenario delta planning was hardly undertaken. In the NWMP, scenarios were developed for future situations of water resources (e.g. flows of transboundary rivers, rainfall, ground water flows). External factors such as climate change are often not considered. Based on alternative options and a combination of scenarios the most suitable scenario is selected for implementation in IWRM, in a point based planning manner.

As discussed in Chapter 3, institutions in Bangladesh are shifting with the BDP from planning on statistical and numerical evidence to planning on uncertainties. To date scenario delta planning has not received much attention, and the role of different institutions has not been established yet. Time and capacity development is needed to make people, and the institutions in which they work, more familiar with the use of scenarios in delta planning.

In developing scenarios in the BDP, various interviewees shared their perspective on the roles of the different institutions. The Textbox below provides an overview of the expressed opinions. Based on these opinions, it can be concluded that institutions have different notions of scenarios, yet that a list of governmental and research organisations is involved in developing and applying scenarios.

Textbox 2. Emerging roles of different agencies regarding scenario development and use

- WARPO: mandate to coordinate and implement the NWMP. This is not going well. They don't get much opportunity to work on this topic and have limited people. Responsible for macro water resources planning and policies. Scenarios in the NWMP reflect a point-based planning style.
- GED: the planning commission, responsible for 5 year planning and in charge of the point based planning of scenarios in 5 Year Plans. They are the monitoring and planning organisation. Coordinator of the BDP. They also supervise the use of other scenarios for Bangladesh, e.g. CCAFS and UNDP. Have embraced the ideas and notions of integrated BDP scenario planning best, although they don't have the multidisciplinary set-up and knowledge to implement the BDP. GED seems to be making a shift from point based planning (in 5 Year Plan) to uncertainty based external scenario planning (BDP).
- CEGIS and IWM are independent trustees who provide technical support. Have promoted other type of scenarios (more statistical, Monte Carlo analyses) that are very different from the external BDP scenarios.
- IWM: they translate climate scenarios to impact for water management. An example is the impact of climate scenarios for salinity intrusion in the coastal region of Bangladesh.
- CEGIS: They are partner in the NICHE 155 project, responsible for sediment scenarios. They have created their own scenarios in relation to BDP, business as usual and high growth scenario.
- BUET: the climate cell of IWFM translates climate scenarios to water management. BUET does not have the sophisticated/expensive software IWM has. They could do more need-based research. Also lead partner on Bangladesh side within ESPA delta project, that has developed policy scenarios of low, middle and high growth.
- BAU: Not closely linked to planning at the national level. In the NICHE 155 project working on water- and food-related scenarios. They could do more need-based research, for instance in relation to scenarios and agricultural development.

In the BDP the scenario planning has so far been a new and innovative step. Building blocks for the scenarios were provided through a process with among others two one day scenario workshops at GED, and in both the workshops over 100 people from a wide background participated [5]. In a later stage, an expert team from GED, WARPO, IWM and CEGIS commented on the scenarios.

At the time of this study, linking the BDP scenarios to decision-making is work in progress. The BDP team and the GED have applied the scenarios to assess robustness of strategies to come to an investment package for the World Bank. Currently an investment package of 50 billion USD$ is under negotiation by the Government of Bangladesh and the World Bank. One reason to extend the BDP project with an extra year to December 2017 is that the investment packages were not linked sufficiently to the developed scenarios. During the extended period of BDP the meta-model, developed by the Bandudeltas consortium, will be used to evaluate whether the investment packages are robust for the upcoming decades.

To summarise, the use of scenario delta planning using external scenarios is for the moment in an initial stage. One in which different institutions have different notions of scenarios, and the scenario thinking of the BDP is not broadly embraced yet as highlighted by the statements in Textbox 2. The BDP workshops explained in a step by step manner the background, development and use of scenarios to a wide group, but in order to apply scenarios in a wider manner, further capacity development is required. In the NICHE155 project BUET, BAU, CEGIS and WARPO enhanced their capacities on scenarios and different uses, yet their role in applying scenarios in decision making (scenario delta planning) remains to be explored.

[5] The participant list shows 96 participants of: ADB, BAU, BADC, BDP, BUET, BWDB, CEGIS, Design Planning and Management Consultants, Department of Environment, EKN, FAO, GED, HAOR, International Water Association, IWM, JRC, Mott MacDonald, ULAB, UNDP, WARPO.

4.3 Tasks to embed scenario analysis and application

To answer the question how scenario delta planning can be embedded in the institutions another question has to be answered first. What are the key tasks associated with scenario delta planning? Based on the responses of the experts, a long list of tasks was prepared. An initial list was presented in the Niche 155 project meeting of 26 November 2016. Over subsequent discussions between the authors the list was revised and clustered into 4 categories.

Figure 2 and Table 2 summarise 15 tasks of scenario delta planning, summarized in 4 clusters. We elaborate the clusters and tasks below.

Uptake in planning system of Bangladesh In the top-down planning system of Bangladesh a first key cluster of tasks is devoted to a firm uptake of the use of scenarios in the national planning system. Ministries and local implementing agencies may potentially use scenarios for plan- and strategy-formulation, yet they will require a mandate or guideline to do so from a high-level institution in the central government. In addition, with so many 'new' users dialogue should be facilitated between them to learn how scenarios could be applied, and what to do when trade-offs arise between ambitions of various governmental agencies. Lastly, data underlying the scenarios, and the scenarios themselves should be made broadly available, to stimulate the use of approved scenarios across the planning system, and to advance transparency on the data used.

Scenario development and revision The scenarios as developed by the BDP are never finished and require regular revision and updates. Research institutes and universities could contribute relevant knowledge and data to make the scenarios more fit for the Bangladesh context. As a lot of data is collected in Bangladesh, one agency could verify the data and put stamps on which information can be officially used in the scenarios (e.g. projections sea-level rise, agricultural output, population growth.). Furthermore, the scenarios could be downscaled from national to regional maps to make them more relevant for regional planning efforts. In addition, due to the fairly new approach of external scenarios in decision-making, tools and methods could be developed to support such scenario planning and analysis. An example would be the development of a meta-model or qualitative analytical tools (e.g. visualisations). Finally, the key conditions, trends and narratives in the scenarios should be monitored to explore how the country develops in the light of the scenarios, and when major changes are measured after 5-10 years (for instance in degree of population growth or sea level rise), the scenarios should be refined so that they can act again as a set of possible futures beyond control of the relevant actors.

Connection scenarios strategies The scenarios are of limited use when they are not linked to strategy formulation and evaluation. Oversight is therefore needed how scenarios are applied in planning, if possible in how the 7th 5 Year Plan (2016-2021) is operationalized and ultimately in the 8th 5 Year Plan (2021-2025). Due to the integrated scope of the scenarios, strategies may also become more integrated (for instance linking infrastructure with environmental aspects). And by applying scenarios the strategies may need to be refined to make them more robust and flexible. As this link between scenarios and strategies is relative new, coordination and support is needed to assist planners in the creation and revision of integrated strategies. Lastly, and perhaps most importantly, an entity should evaluate the preferred strategies for 5 Year Plans and ministerial plans using the scenarios.

Research and capacity development Due to the initial stage in which external scenarios are developed and applied, research and capacity building is needed to improve the quality of the scenarios and the ability to develop and apply them in planning. Research programs could be initiated to refine and broaden the scenarios, by adding in more data and making them fit for regular use. As students and professionals are currently trained in predictive scenarios (blue-print planning), they should be trained in the concepts and tools of external scenarios that characterise scenario delta planning (see also recommendation 4 in Section 4.4). Finally, there are lessons to be learned from other countries that apply scenarios in decision making (e.g. the Netherlands, UK), such lessons can be learned through international networks such as Global Water Partnership and Delta Alliance.

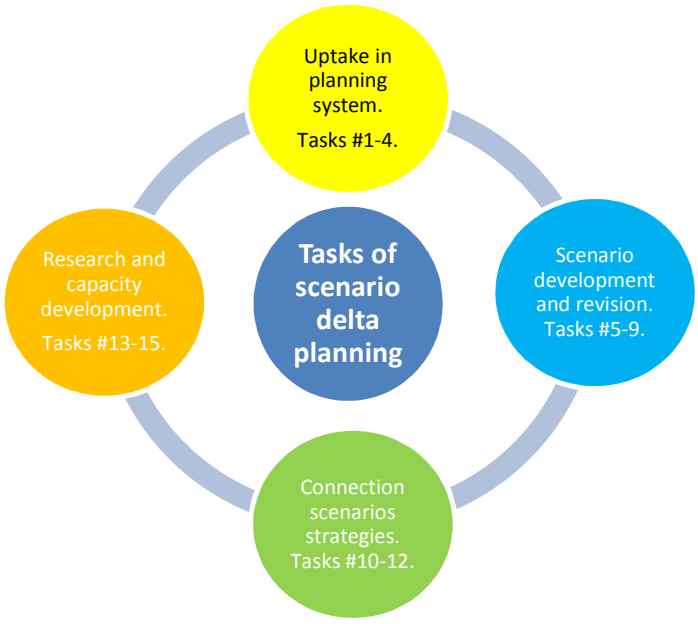


Figure 3. Clusters of tasks in scenario delta planning.

Table 2. Main tasks involved in scenario delta planning

Uptake in planning system of Bangladesh	**1. Come** with a guideline on using scenarios at initial stages of planning.
	2. Facilitate dialogue across involved ministries, planning agencies, other key stakeholders.
	3. Let ministries incorporate scenarios in their plans.
	4. Share data and information of scenarios, make it broadly available.
Scenario development and revision	**5. Contribute** relevant knowledge and data to the scenarios.
	6. Downscale from national scenarios to regional maps.
	7. Put stamps on which information can be officially used in scenarios.
	8. Monitor how the country develops on key conditions, trends and narratives in the scenarios.
	9. Provide tools and methods for scenario planning and analysis.
Connection scenarios strategies	**10. Oversee** how scenarios are developed and applied in planning (5 Year PL).
	11. Coordinate creation and revision of integrated strategies.
	12. Evaluate preferred strategies for the 5 year plans using scenarios.
Research and capacity development	**13. Conduct** research to make the scenarios fit for regular use.
	14. Educate students and professionals in concepts and tools of scenario delta planning.
	15. Learn from examples in international networks.

Major questions for further discussion Although interviewees also shared opinions on who should do these tasks it is in this stage too premature to share insights who should do which tasks. Therefore discussion is needed between governmental institutions. Nonetheless from the findings presented in this Chapter some key questions for discussion can be extracted, namely:

1) **How to have a broader group of institutions involved in scenario delta planning?** Currently the scenarios have been mostly developed and applied by the BDP consultant team and the GED, whereas GED may not have sufficiently trained multi-disciplinary professionals for implementation. In developing the scenarios, stakeholders were included (as explained in 4.2) and steps were explained how to come to the scenarios. Yet when the ambition is to incorporate scenario delta planning in the planning system of Bangladesh, more end-users should be involved in the use and update of the scenarios, in line with their mandates. Besides the Planning Commission, organizations such as WARPO, different line ministries of industry, agriculture, water, could be involved, as well as implementing agencies such as BWDB, LGED, and knowledge institutions (academia, applied research) like BUET, BAU, CEGIS and IWM. In addition, involved organisations should commit themselves to using a shared set of scenarios as currently many scenarios are floating around, adding to confusion (e.g. CEGIS scenarios, UNDP, BDP, ESPA Deltas).
2) **How to increase collaboration between two organizations with tasks on planning in integrated water management, GED and WARPO?** The GED has an important role and according influence due to their macro-economic planning and the 5 Year Plans. WARPO has the required background for macro planning and does possess the technical water knowledge and experience in integrated planning to work with other sectors and ministries. Collaboration seems logical, yet how to do this? Which tasks should be given to GED and which ones to WARPO, and how to secure an on-going constructive dialogue?
3) **How to set incentives for data sharing?** The scenarios have a broad scope, and BDP strategies are expected to be integrative in their scope as well. Yet the broad scope also means that data from different domains is needed (e.g. industry, economic growth, population growth, water, forestry, fishery etc.). This implies that much more data should be shared between institutions, and that data should be made broadly available, which is presently not the case. For instance consultants involved in the BDP are reluctant to share their maps and projections and make them widely available. A change is needed from data management per organization, to sharing data and data availability. WARPO has the mandate to collect, manage and disseminate water sector planning related data and also to 'clear data' for use in planning[6].
4) **How to develop the necessary capacity?** Other, more general issues relate for instance to ensuring that capacities (human and financial) are sufficient to carry out scenario delta planning, implement strategies through projects and conduct research and training in institutions.

It is expected that once the BDP is approved, the Delta Commission and Delta Act will address these questions as well. Yet as the NWMP has shown it is not enough to anchor mandates and

[6] For instance the National Water Resources database is a central hub of all water related-data and analysis, and is used for water resources planning and management.

responsibilities in legislation, and this is a point of concern. In the end it comes down to how a planning system functions in practice, and therefore these questions remain relevant and should be discussed constantly to find common ground between the institutions that comprise the planning system of Bangladesh. As the NWMP is currently being updated, and, with the Water Act in place, linkages between both NWMP and BDP provide extra opportunities for collaboration across organizations involved.

In sum, a lot of tasks are associated with embedding scenario delta planning in the planning system of Bangladesh. Moreover, as scenario delta planning is a shift away from current blue-print planning, this implies that institutional embedding is a complicated and challenging task due to vested interests, and that extra capacity development is needed to facilitate refinement and use of scenarios in decision-making. Given the context of a top-down planning system, it becomes important to have high-level support and a mandate to conduct scenario delta planning, from uptake in the planning system to scenario development and revision, and making the connection between scenarios and strategies. Although it is too early to assign specific institutions to the organisations, in this paragraph key questions are identified that should be addressed when embedding scenario delta planning.

4.4 How to make scenario analysis and application enduring

In this paragraph, we provide a selection of 4 recommendations provided by various experts to make scenario analysis and application more continuous and enduring. It should be noted that these recommendations were presented in the Niche 155 project meeting, but not cross-checked between the various respondents or discussed with any of the government agencies involved. Preferably these recommendations are discussed in follow-up meetings between GED, WARPO, BUET, BAU, ministries, and others.

1. **Link scenario planning to the planning cycle of the 5 Year Plans**. Not only does that give a mandate to integrate data of key conditions and trends across master plans, it also ensures that the scenarios are applied every 5 years thus making it a regular, returning effort, of which the data used and the results are widely available. The scenarios should be updated one year before the 5 Year Plan is developed, so that the scenarios are ready for use to assess plans and strategies in the 5 Year Plan. To achieve this link with 5 Year Plans, a dedicated support program is needed for the next 5 Year Plan to ensure that plans and strategies are actually compared to the scenarios. In addition, a research and monitoring program is needed to collect data on conditions and trends in the scenarios, e.g. growth in population, GDP, water availability, sea level rise, regional collaboration/competition.
2. A **Delta Commission should make the mandates and responsibilities regarding scenario development, use and update clear.** It is important to specify the mandates and responsibilities in relation to scenarios, as the integrated scenarios offer an opportunity for collaboration across ministries and vertically by line ministries. Broad application of the scenarios in planning can contribute to integrated planning and implementation at the regional level. At the time of this research it is unclear which mandates, and responsibilities are precisely institutionalized as a Delta Act will stipulate the mandate of a Delta Commission. It is expected that a Delta Commission should serve as watchdog on the heritage of the formulation of the BDP, with regular updates, initiating research on drivers, impacts and uncertainties, and engage in implementation of the BDP through the various ministries involved.
3. **Streamlining communication and outreach will advance the uptake and application of scenario delta planning.** A 5 minute movie clip could be developed that explains the essentials of scenario delta planning. In addition, the scenarios and their associated data should be made widely available on websites of the Government, planning institutions, donors, and universities. The broader the scenarios are available, the more likely it is that the same scenarios are used by governmental agencies, instead of institutions beginning to develop new external scenarios.
4. If a political decision will be taken to implement the BDP, **capacities of professionals and students should be developed in scenario development.** Currently, professionals and students are trained in blue-print planning (predictive scenarios, what-if planning), which is different way of thinking from the multiple external scenarios and finding robust strategies. Students and professionals should be made familiar with this new type of delta planning. **Professionals** should be trained in the 'key concepts' so they understand how scenario delta planning works, and how it is applied by the GED in the Seventh 5 Year Plan, how it is revised in the NWMP, and potentially could be applied to other master plans. A range of professionals should be trained as scenarios could be potentially relevant to many

professionals, e.g. government officials, engineers, agronomists, technical consultants. In addition to training, learning is another important instrument for capacity development. Formal moments could be organised to share feedback and learn from previous workshops in which scenario planning (or parts of it) were applied. **Students** could learn about scenario delta planning in their master courses, yet as a recent labour market study points out that universities have little interest to produce engineers with multidisciplinary knowledge and skills.

See Textbox 3 for initial ideas that could be incorporated in trainings and courses for scenario development and application.

Textbox 3 What to incorporate in trainings and courses for scenario development and application?

1. Multiple types of scenario planning exist, there is not one best solution (See typology in Chapter 3 on predictive, external and transformative scenarios). Pay attention to origins, strengths and weaknesses of different scenarios and their use in planning, policy and research. For instance the external scenario planning of the BDP goes already back to the eighties in which Shell applied external scenarios to position itself for an uncertain future. A limitation of scenarios is that they cannot help pragmatically in deciding what to do next.
2. Pay close attention to the link between scenarios and decision making. How are scenarios used in decision making? This has to be made explicit to show the added value and practical use of scenarios.
3. Reflect on the BDP and NWMP, learn how scenarios have been used in these large integrated planning efforts.
4. Pay attention to the writing of narratives and the 'power of imagination'. Writing narratives, being creative, and not directly referring to policies is difficult, and capacity should be developed for this skill. Let students or professionals write narratives, so they train this skill.

As the Niche 155 project is about to end, it is important for reasons of continuity to communicate these recommendations to WARPO, GED, BDP team, Water 2030 IFC World bank, Nuffic Niche Delta CAP, Urbanising Deltas of the World research projects, and other relevant efforts that are linked to follow-up of the BDP. An overview of relevant training material will be provided in a separate report of CAR 6B 'Scenario development in adaptive delta management training and curriculum material'.

Explaining scenarios in BDP meeting

5. Discussion and Conclusions

The objective of this study was to explore how scenario analysis and application in delta planning could be embedded in institutions in Bangladesh on a continuous and enduring basis. From this study it becomes apparent that scenarios and integrated master planning are not a completely new phenomenon in Bangladesh, though the development and use of external scenarios is not common practice. The NWMP was an integrated master planning effort from which it becomes clear that not only high-level political support and financial resources are needed, but also commitment from other end-users in planning and implementation such as various line ministries, implementing agencies and knowledge institutes. In addition, different types of scenarios have been applied already in Bangladesh, mostly predictive scenarios. Nonetheless, the external scenarios, including the aspect of uncertainties, as developed and applied by the BDP and UNDP, represent another type of scenario delta planning which has not been practiced before in Bangladesh. Potentially, that is, when the political decision is made by the Government of Bangladesh to implement the strategies of the Bangladesh Delta Plan, this new form of scenario planning represents a big change from current blue-print planning towards planning incorporating uncertainties, thus making it worthwhile to explore how it can be anchored in institutions in Bangladesh on an enduring basis.

The current institutional context of Bangladesh was analysed by looking at both the NWMP and the role of institutions in scenario development of the BDP. This has improved the understanding on developing and implementing integrated plans with a longer-term horizon. So far there has been little incentive to integrate master plans and strategies across ministries and across sectors, for instance, agriculture, industry, water resources and environment. BDP has initially focused on GED as end-user of scenario delta planning, yet scenario delta planning requires involvement, commitment and capability of the bigger planning system that is potentially affected by planning and implementation of the BDP. In addition it became clear that many different notions of scenarios and scenario delta planning exist. We have attempted to clarify this by indicating which sort of scenarios can be used in planning and providing examples of predictive, explorative and normative scenarios in delta planning.

Furthermore, by specifying 15 tasks involved in scenario delta planning, this report has clarified what should be embedded in scenario delta planning. Tasks range from uptake in the planning system to updating and downscaling scenarios and linking them to strategies and research and capacity development. With the list of tasks, discussions can become more focused on which institutions should precisely do what in connection to scenario delta planning. To inform this discussion, some tentative key questions have already been formulated that relate to involving a broader group of institutions, collaboration between GED and WARPO, and data sharing. A Delta Commission and Delta Act are expected to address these issues, and we regard them as highly relevant, and think that they should be discussed constantly to find common ground between the institutions that comprise the planning system of Bangladesh.

Lastly, we explored how scenario delta planning can become more continuous and enduring. By linking scenarios to the 5 Year Plans for evaluation of strategies, scenarios can become a vehicle for integration across master plans as well as revision of dusted-off proposals from

implementing agencies. When a political decision is taken to implement the BDP, a next step will be made in the shift from blue-print planning to planning that copes more explicitly with uncertainty. This political is accompanied by huge capacity development needs as changes are needed in the planning and implementation system of Bangladesh, from ministries and knowledge institutes to implementing agencies. We have collected in this report some first ideas on what should be covered in building capacities for scenario delta planning. Learning lessons from past Bangladesh experiences is regarded essential over learning from international examples, as it creates a better understanding of the context in which scenarios are, or have been, developed and applied, and how they are linked to strategic choices and local implementation through projects.

Despite generating these insights, this report is also limited in several ways. First, the topic of institutional embedding of scenario analysis and application is highly dynamic. Many discussions at various levels are held on for instance the investment packages, completion of BDP, institutional strengthening of WARPO in light of operationalization of the Water Act and through Water2030 IFC. As a result new insights were gained over the course of this study that also altered the scope of this study. In addition, the word 'scenario' has many connotations, and although the BDP may have a clear understanding on scenarios, this is not widely shared by the interviewees. As a result it was difficult to focus on one particular kind of scenario delta planning and we decided to cover both IWRM (NWMP) and BDP. Furthermore, it was at the time of this study not yet feasible to discuss options for institutional embedding in a systematic manner. Although options were mentioned in interviews it was too premature and complex to include well-defined options in this study.

Based on the analysis presented in this report, we draw 3 conclusions on embedding scenario delta planning in institutions in Bangladesh:

1. **Many notions on scenario delta planning exist.**
   Across institutions in Bangladesh, many notions exist on what scenarios are and how they are linked to planning. This report aims to reduce confusion around these terms by presenting a scenario typology, explain how scenarios have been applied in recent Bangladesh planning efforts, and specify 14 tasks of external scenario delta planning as undertaken in the formulation of BDP.

2. **More institutions should get involved in scenario delta planning.**
   Some interviewees mention that institutions in Bangladesh are shifting away from blue-print planning (predictive scenarios) to coping with uncertainties (external scenarios). Yet to continue this shift, this report concludes that much more institutions beyond GED and BDP team should learn about scenario thinking, the connection to planning and how scenarios may re-orient existing project proposals. Dialogue and capacity development is therefore needed, and the tasks of scenario delta planning and issues to embed it institutionally should receive major and repetitive attention. This could go irrespective of the BDP, as scenario development and analysis is likely to be present in many more institutions such as ministries and WARPO in a broader and more integrated manner.

3. Embedding of scenario delta planning needs support of the Government of Bangladesh.

Institutional embedding of scenario delta planning is very much dependent on the ambitions and political support of the Government of Bangladesh and the Planning Commission. Their responses will very likely shape the institutional arrangement for use and application of scenarios in delta planning in Bangladesh. The next three years are in that respect critical to evaluate how scenario delta planning will be embedded. To monitor the embedding, four aspects can be evaluated in the coming 3 years:

a) a monitoring and research program that informs the BDP scenarios,
b) line ministries incorporate external scenarios in their master plans,
c) line ministries incorporate external scenarios in the Eighth 5 Year Plan, and have strategies evaluated in the scenarios,
d) The use of scenarios in NWMP is revised, relying less on predictive scenarios and instead use also explorative and normative scenarios.

References

Alam, M., A. Rahman, S. Alam, 2014. An investigation of national water resources database, Bangladesh. Asian Journal of Applied Science and Engineering 3(2), 129-144.

BanDuDeltas 2100, 2016. Bangladesh Delta Scenarios: Process of scenario development and draft scenarios for the BDP 2100. http://bangladeshdeltaplan2100.org/wp-content/uploads/2016/02/BDP-Scenario-report-final-_18-11-2015-Final-Edit-WO-081220151.pdf

Börjeson, L., Höjer, M., Dreborg, K., Ekvall, T., Finnveden G., 2006. Scenario types and techniques: towards a user's guide. Futures 38, 723-729.

DFID, 200?. Water Resource Management in Bangladesh: a Policy Review. Livelihood-Policy relationships in South Asia. Working Paper 1.

EPWAPDA, IECO, 1964. Master Plan. East Pakistan Water and Power Development Authority, Dhaka, Bangladesh and International Engineering Company Inc., San Francisco, United States.

ESPA Delta Project website, http://espadelta.geodata.soton.ac.uk/

Foresight Horizon Scanning Centre, 2009. Scenario Planning. Government Office for Science, London, United Kingdom.

General Economics Division, 2015. Seventh Five Year Plan (Final Draft), Planning Commission, Dhaka, Bangladesh http://www.plancomm.gov.bd/wp-content/uploads/2015/11/7FYP_after-NEC_11_11_2015.pdf

Haque, C.E., 1997. Hazards in a Fickle Environment: Bangladesh. Advances in Natural and Technical Hazards Research. Springer Science+Business Media, Dordrecht, the Netherlands.

Huq, 2016. Labour Market Study Competence Needs of Water Professionals in Bangladesh. Nuffic-NICHE BGD 155 Project.

Ministry of Water Resources, 2001. National Water Management Plan: Volume I. Water Resources Planning Organisation, Dhaka, Bangladesh http://www.buet.ac.bd/itn/publications/sector-documents/documents/nwmpv20041.pdf

Ministry of Water Resources, 2001. National Water Management Plan: Volume II. Water Resources Planning Organisation, Dhaka, Bangladesh http://www.plancomm.gov.bd/wp-content/uploads/2015/11/7FYP_after-NEC_11_11_2015.pdf

Navera, U.K., Werners, S., Cauwenbergh, N. van, Terwisscha van Scheltinga, C., Alam, S., Sarker, M.H., Adham, A.K.M., Mostafa Khan, S., Heun, J., and Akter, J., 2015. Assessment of trends and major drivers of water policy to inform scenario development for integrated water resources management in Bangladesh. Delivery Report CAR1 in Nuffic-NICHE BGD 155 project.

UNDP, 2011. Capacity Development for Policy Makers to Address Climate Change in Bangladesh: Executive Summary. http://www.undpcc.org/docs/Investment%20and%20Financial%20flows/I&FF%20reports%20and%20suppl%20information/Bangladesh/Bangladesh_IFFSummary_24_04.pdf

Wageningen UR, 2014. Scenario Development in Integrated Water Resources Management: coping with future challenges in Bangladesh. Nuffic-NICHE BGD 155 Project.

Werners, S.E., van Cauwenbergh, N. (Eds.). Fertile waters: scenario development for water management in Bangladesh (Summary). Summary CAR1 in Nuffic-NICHE BGD 155 project.

World Bank, 1996. Improving Water Resource Management in Bangladesh. Policy Research Working Paper 1569. World Bank, South Asia.

Annexes

Annex A. Anonymous overview of conducted interviews

General Economics Division (GED), Planning Commission, Ministry of Planning
Water Resources Planning Organisation (WARPO), Ministry of Water Resources
Bangladesh Delta Plan (BDP) team
Local Government Engineering Department (LGED)
Bangladesh Delta Plan (BDP)Bangladesh Institute of International & Strategic Studies (BIISS)
Institute of Water and Flood Management (IWFM), Bangladesh University of Engineering Technology (BUET)
Department of Water Resources Engineering (DWRE), BUET
Bangladesh Agricultural University (BAU)
International Centre for Climate Change and Development (ICCAD), Independent University
BRAC, NGO development organisation dedicated to alleviating poverty
Bangladesh Centre for Advance Studies (BCAS), independent institute working on sustainable development
Center for Environmental and Geographic Services (CEGIS), research institute
Institute of Water Modelling (IWM), research institute
Wageningen Environmental Research, research institute
UNESCO-IHE, institute for water education
Deltares, research institute

Annex B. Interviewguide.

Starting questions

1. **What is your position in your organization, Are you involved in scenario development in BDP? how are you involved in scenario development and application in delta planning (if involved)?**

Current institutional setting of scenario delta planning Bangladesh

2. **What is the current practice in water resources planning? How uncertainties are addressed and taken in decision making?**
3. **How is scenario planning within IWRM currently organized within Bangladesh?**
4. **What are the different roles of the different institutions? (General role or in terms of water planning, supporting with services, research, implementation of projects that may be integrated with scenario analysis and development?)**
    a. **Water Resources Planning Organization (WARPO)**
    b. **General Economics Division (GED)**
    c. **Institute of Water Modelling (IWM)**
    d. **Center for Environmental and Geographic Information Services (CEGIS)**
    e. **Bangladesh University Engineering and Technology (BUET)**
    f. **Bangladesh Agriculture University (BAU)**
    g. **Others? (org. name……, contact person……...)**
5. **In what way is your institution involved in scenario analysis/ planning for IWRM in Bangladesh?**
6. **What sort of scenario analysis/ planning is this? Is this mainly focused on climate change / physical scenarios or also other types of scenarios (eg. socio-economic, land use, transboundary issues)**
7. **Are scenarios used in your institute/organization? (yes, no, in what way?)**
8. **Is it linked to decision-making in any manner? (yes, no, in what way?)**
9. **With which frequency is scenario planning undertaken?**
10. **Do you have any expert/trained staff in your organization who have knowledge/training on scenario delta planning?**
11. **Did you find any gaps/barrier in the current scenario delta planning of BD? How to enhance the use of scenario development?**
12. **What benefit do you see of doing scenario planning?**

Options to embed scenario delta planning in Bangladesh

13. How the scenarios are currently embedded?
14. What could be the improvements to embed scenario analysis/ planning in IWRM with regards to current institutional setting?
15. Which alternative institutional options do you see to embed scenario delta planning in Bangladesh?
16. From your opinion what should ideally be the role of the different institutes? What would be the role of-

a) Water Resources Planning Organization (WARPO)
b) General Economics Division (GED)
c) Institute of Water Modelling (IWM)
d) Center for Environmental and Geographic Information Services (CEGIS)
e) Bangladesh University of Engineering and Technology (BUET)
f) Bangladesh Agriculture University (BAU)
g) Bangladesh Water Development Board (BWDB)
h) Bangladesh Agriculture Development (BADC)
i) Name others?

17. **Which other institutes should be involved in scenario delta planning? What should be their role?**
18. **Which institute should lead and coordinate the scenario delta planning in BD for its sustainability?**

How to ensure it is continuous and enduring?

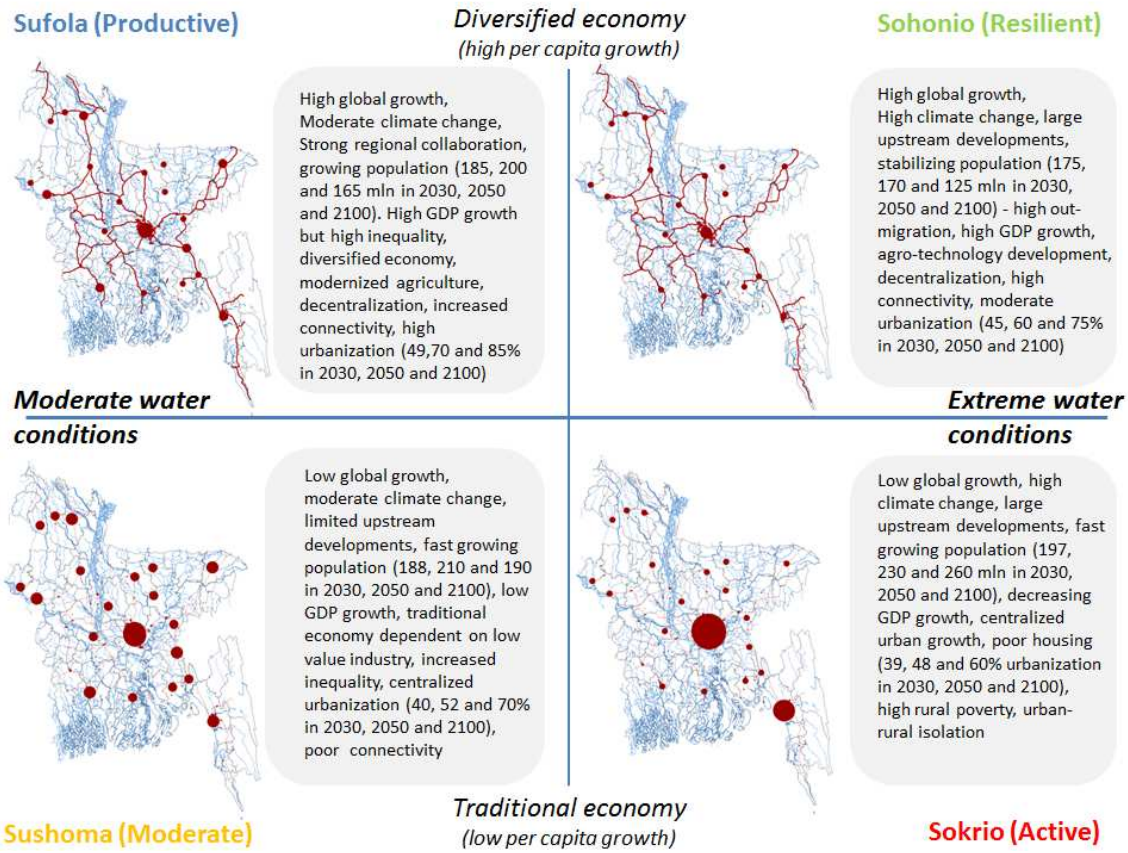
19. **What are your plans on the applications of scenario delta planning individually or organizational level? Do you foresee to work together with others?Whom? Any confirmed plans?**
20. What are the requirements to enable a continuous and enduring scenario analysis for IWRM and water resources planning? What do you need for continuing in the scenario and for IWRM and delta plan in the future?
21. What is important to develop to enable continuous basis? For whom?

- Training material / curriculum

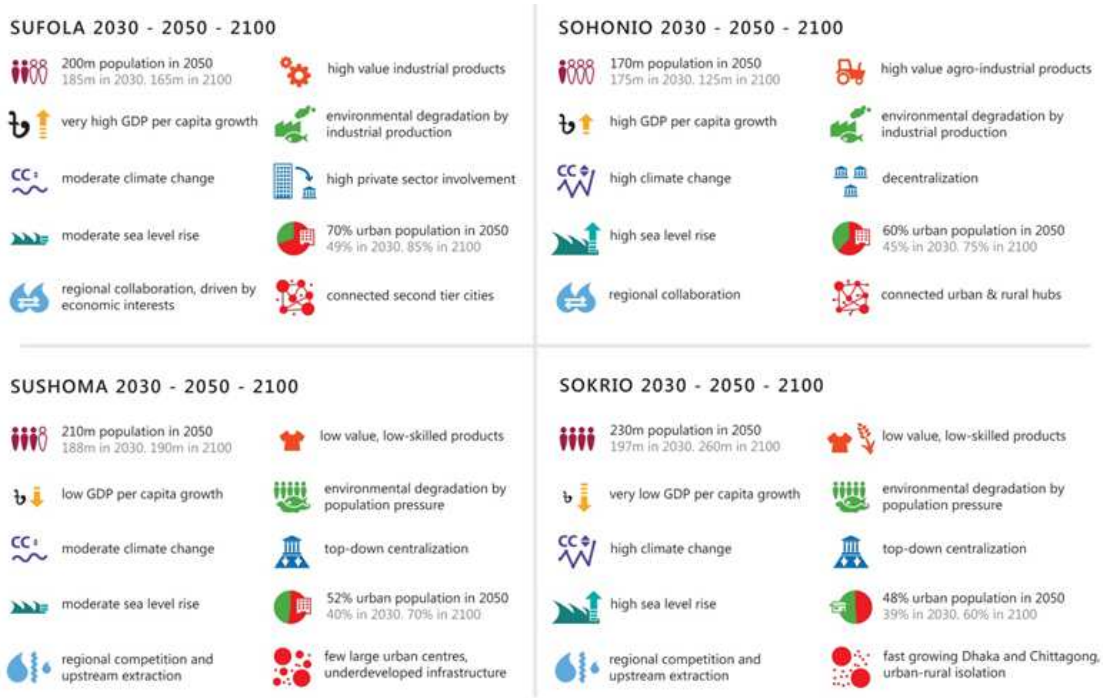
Closing questions

Is there anything you want to add to this interview?

Annex C. Scenarios developed in the Bangladesh Delta Plan.



Assumptions on key trends and conditions in the 4 scenarios



Partners in this project:

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(www.buet.ac.bd/wre/)
Bangladesh Agricultural University, Bangladesh
(www.bau.edu.bd/Department-of-Irrigation--Water-Management)
Water Resources Planning Organization, Bangladesh
(www.warpo.gov.bd)
Center for Environmental and Geographic Information Services, Bangladesh
(www.cegisbd.com)
UNESCO-IHE, Institute for Water Education, the Netherlands
(www.unesco-ihe.org)
Wageningen University and Research Centre, the Netherlands
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