Integrating science, modelling and stakeholders through qualitative and quantitative scenarios

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Integrating science, modelling and stakeholders through qualitative and quantitative scenarios

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Executive Summary

The key function of the scenario development process in the ESPA Deltas project is to link the concerns and priorities of relevant stakeholders with the integrated models. Once the bio-physical models have been integrated, these will be combined with the poverty / health outputs of the project. In order to fully facilitate the connection between stakeholders concerns, and the available modelling capacity, two separate stages had to be put in place for ESPA Deltas: the first, to qualitatively describe what the future might look like in 2050; the second to translate these qualitative descriptions into the quantitative form required by the numerical models.

The approach that was finally adopted for the project takes as its basis the SSPs as elaborated as part of the preparations for the IPCC's 5th Assessment Report, and to produce an extended SSP downscaled and refined for Bangladesh, and in particular, the southwest of the country.

Three rounds of stakeholder workshops, following an extensive series of interviews, was used to produce a very detailed outline of how the main issues of concern might look in three varying, and not necessarily sustainable, futures, making use of the most up to date detailed models available across multiple bio-physical and social sectors.

A number of useful conclusions can be derived from the scenario development exercise in the ESPA Deltas Project. Separation of the climatic elements from the socio-economic sections scenario projections – i.e. the RCPs from the SSPs – can provide a useful framework for downscaling the latter in a way that allows temporal differences between the two to be ironed out. Stakeholder input, using the methods adopted here, allows the top-down focus of the RCPs to be aligned with the bottom-up approach needed to make the SSPs appropriate at the more local scale, and also facilitates the translation of qualitative narrative scenarios into a quantitative form that lends itself to incorporation of biophysical and socio-economic indicators.

There was a great deal of value in conducting the meetings independent of the immediate need

to fulfill project objectives. Stakeholders were often pleasantly surprised to see that workshops continued over time. There was a general level of acceptance on the part of those attending workshops that the approach being taken was credible and addressing the correct issues, even though there might be a strong element of disagreement over potential solutions or the magnitude of the problem.

The need for flexibility with respect to workshop outcomes and methods for achieving project objectives is paramount. The amount of time it takes to achieve the goals that have been set for a particular exercise may vary considerably from the expected timescale, and meeting schedules may need to be adapted very rapidly to take account of changing expectations. Timing is also an issue for stakeholders: it is difficult and potentially unfair to ask stakeholders to spend a lot of time going through large quantities of materials in detail. Other approaches may work better – for example, establishing a standing stakeholder expert group who could comment on technical detail, perhaps in return for a fee reflecting the degree of commitment needed.

Acknowledgements:

The authors of this working paper wish to gratefully acknowledge the contributions of many project partners and a number of stakeholders to the work described below. This has taken many forms, including providing information; elaboration and clarification of details; providing helpful comments on successive drafts of narratives or questionnaires; organization of workshops and meetings, conceptualization of the process and method; preparatory work; identifying individuals and sending invitations; and providing meeting and workshop venues, among many other things. Their assistance has been of great value in the scenario development process and we are grateful to have received it.

We would also like to thank all those who attended any of the stakeholder workshops and meetings held over the past three years. Without their contributions in time and effort, the project would not have been able to progress so far.

Contents

1 Introduction

Objectives of the scenario development process, stakeholder involvement and wider project context

The purpose of this working paper is to set out the process adopted by the ESPA Deltas project for the development of scenarios, along with its rationale, and will outline the crucial role that these scenarios play in the project. It will also provide details of how this has worked in practice, before going on to highlight the lessons learned and the extent to which the ESPA Deltas approach may be transferable to other contexts. It should be emphasised that the solutions used in the project have been driven by pragmatism – project objectives, physical and social contexts, stakeholder requirements and demands, and modelling capacity have all played a part in influencing the method followed. We will therefore not present a literature review in this paper for the time being, although it is envisaged that this will be incorporated in future related work.

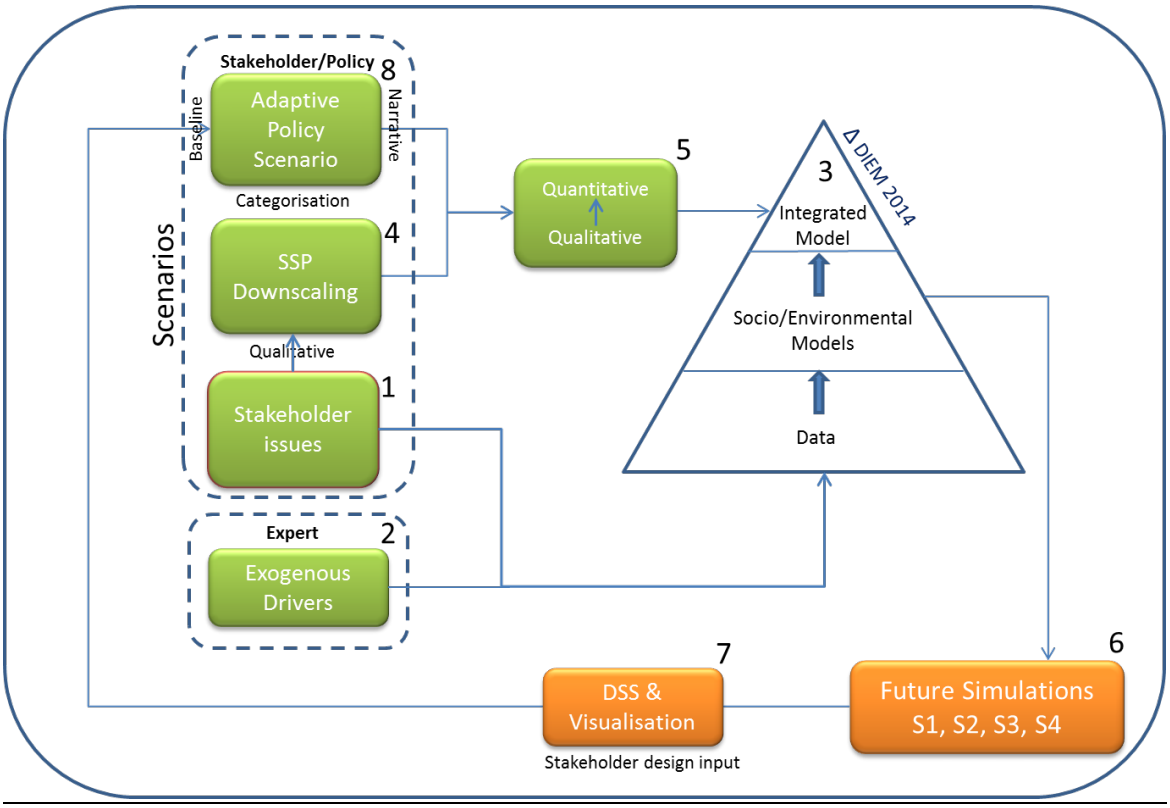
Holding two stakeholder workshops in Bangladesh is required as part of WP1 and WP4. Although the workshops have a number of functions (including establishing details of stakeholder needs, and project profile enhancement), the workshops help establish the backbone of the project, the development of scenarios. These form the bridge between work packages 1 and 4, and facilitate the principal method for involving stakeholders in the progressive development of the integrated modelling. The development of scenarios also link the issues that stakeholders have expressly said are important in Bangladesh and the case study areas in particular, with the integrated modelling. This ensures that the analysis undertaken through the scenarios and the integrated modelling will specifically address the issues of greatest importance to stakeholders, and by quantifying how these might look in the future through the 'Q2Q' process, ensure that the modelling work corresponds with stakeholder views. Concurrent efforts have been ongoing to better understand the limitations imposed by the various models on the potential to simulate all the issues identified by the stakeholders.

In addition to using scenarios to link the scientific research in the ESPA Deltas project with stakeholder priorities, scenario development allows responses to environmental and social changes over time to be explored in a way that accommodates the huge levels of uncertainty involved. The potential range of physical, climatic and socio-economic futures is infinite, and the sheer range of possibilities and the uncertainties that result, can impede planning and decision-making. Scenarios allow us to take the issues of concern and project how they *might* look in 2050, but can limit the level of uncertainty to a manageable level. Additional work in the physical modeling environment in WP5 allows further incorporation of climatic projections.

Stakeholder engagement is a crucial element of the scenario development process, and the method developed in ESPA Deltas has distinguished between a variety of groupings of stakeholders – including, for example national level decision-makers and those influencing decisions, and sectoral experts. The broad scenario development process is outlined below. The contact points between the different stakeholder groups and the scenario development have manifested themselves in a variety of ways, and are highlighted in **bold**:

- **Identification of issues of most concern in the study area – through individual interviews;**
- **Elaboration of these (c. 100 elements), and projection of how they might look in 2050 – by way of two workshops;**
- **Critical development of narratives designed to make these 100 elements more palatable – narrative project-led, but subject to comments, critical examination and approval by stakeholders at a further workshop;**
- Commencement of process to translate the narrative (qualitative scenarios) into modellable numbers (quantitative)
- Production of final narratives (**for approval during final round of stakeholder workshops**)
- **Presentation of draft quantitative representation of scenarios by way of dedicated questionnaires and an expert stakeholder workshop.**
- Incorporation of finalised quantitative assumptions into the integrated model

This process straddles WPs 1 and 4 in the first instance, but also WP6. The overall context for the development of scenarios in the project may be represented as follows:



1.1 Procedural outline

Discussions went on for around a year in order to determine the best approach to scenario development in the project. Following debates at the consortium meeting in Southampton in June 2013; the UK partners meeting in Dundee in September; and a dedicated scenarios meeting in Southampton at the beginning of October, the methodology was agreed and dates for the stakeholder workshop set for 22-23 October 2013. The methodological approach selected for the development of scenarios reflects discussion around a number of key issues:

- The extent to which stakeholders would be given carte blanche to choose their own scenarios for the future. Maximum stakeholder autonomy would be achieved if stakeholders were given free rein to choose the characteristics of the futures they wanted to project. However, this autonomy would come at the cost of time – choice of scenario from a potentially infinite number, and their elaboration and development, requires a great deal of time. Access to Bangladesh was also comparatively restricted at the time, as a result of political instability, and this meant that it would be extremely challenging to successfully arrange the meetings needed to develop the scenarios. A decision was taken across the project to present stakeholders with a finite choice of futures (4 were originally envisaged, though this was reduced to three in consultation with local partners).
- A related issue addressed the question of whether or not stakeholders would be presented for evaluation only those future projection elements that were modelable. This question stemmed from the appreciation that there was simply no point in having stakeholders consider issues that the project could not hope to incorporate in its modelling efforts. Given the relative restriction placed on stakeholders with respect to choice of scenarios, and the possible scope for reinterpretation of model attributes in the light of stakeholder preferences, it was decided that stakeholders would consider all elements they thought were relevant, and the project would then identify those that were not thought to be modellable, try to produce work-arounds or alternative proxies that might be used instead, before going back to the stakeholders with a list of those elements that were beyond the capability of the project to model.
- The final issue that prompted discussion was that of the conceptual approach to take. Initial debate centred upon the use of the axial approach used in the IPCC SRES scenarios (IPCC, 2000), but this was eventually discounted. Reasons for this included the fact that the SRES approach was about to be superseded by the imminent publication of the IPCC 5th Assessment Report, and publication had already taken place of the broad scenario approach to be taken by the IPCC (Moss *et al*, 2010).

Issues identified by stakeholders:

Since the first full consortium meeting in Dhaka in May of 2012, an extensive series of individual interviews were conducted by project partners with a view to identifying the issues (management, technical and governance) that stakeholders believed were of greatest importance to Bangladesh and to the project case areas in Khulna and Barisal. These were summarised in the WP1 Fast Track report[1] as follows:

- Food security
- Salinization
- Riverbank erosion and sedimentation
- Human-induced challenges to flow / freshwater availability
- Arsenic
- Changes in livelihoods
- Human-wildlife conflict
- Barriers to accessing ES in the Sundarbans
- Migration
- Shrimp vs. crop
- Upstream/international issues / freshwater availability
- Location of biggest embankments (sea dykes) / coastal defence
- Availability of land
- Extreme weather events
- Unpredictability of weather

[1] Allan, A. A., Lim, M., Islam, N., Huq, H. (June 2013) Livelihoods and ecosystem service provision in the southwest coastal zone of Bangladesh: an analysis of legal, governance and management issues, ESPA Deltas Working Paper #1, University of Dundee, UK, source: <www.espadelta.net>.

The above list is something of a synthesis of the issues identified,[2] drawing together and summarising a more extensive list of more specific issues for the sake of conciseness. In order to better facilitate the integration of these issues with the development of narrative scenarios, these were further consolidated and combined into four very broad groups:

1. Natural Resource Management
2. Food Security
3. Poverty / Health / Livelihoods
4. Governance

Within each group, the individual issues that had been raised in the context of the interviews mentioned above were provisionally highlighted and combined with additional more detailed issues identified during the progress of the stakeholder workshops. This produced a consolidated list as follows:

- Natural Resource Management
  - Salinity
  - Riverbank erosion and sedimentation
  - Land-use
  - Coastal defence
  - Extreme weather events
- Food Security
  - Access and availability
  - Nutrition
  - Crop types /diversification
  - Excessive and unplanned use of fertilizers
  - Household equity
  - Food prices
  - Seasonality
- Poverty / Health / Livelihoods

[2] See Interview transcriptions appended to WP1 Fast Track Paper, *id*.

- Migration
- Remoteness
- Pollution/Sanitation
- Changes in livelihoods (e.g. crop to shrimp)
- Barriers to accessing ES in the Sundarbans
- Arsenic
- Disease
- Frequency of natural disaster

- Governance
  - Coordination (sectoral and geographical)
  - Local elite
  - Capacity
  - Implementation and enforcement
  - Corruption
  - Lack of participation and marginalization of the poor

It should be noted that the list above is not identical to the list of issues incorporated in the WP1 Fast Track document. This is because of the process of summarising and consolidation that has inevitably taken place in order to ensure maximum project interfacing. It is also the result of additional issues being identified during group discussion in the stakeholder workshops and the streamlining required by the project modelling capacity.

2 Method:

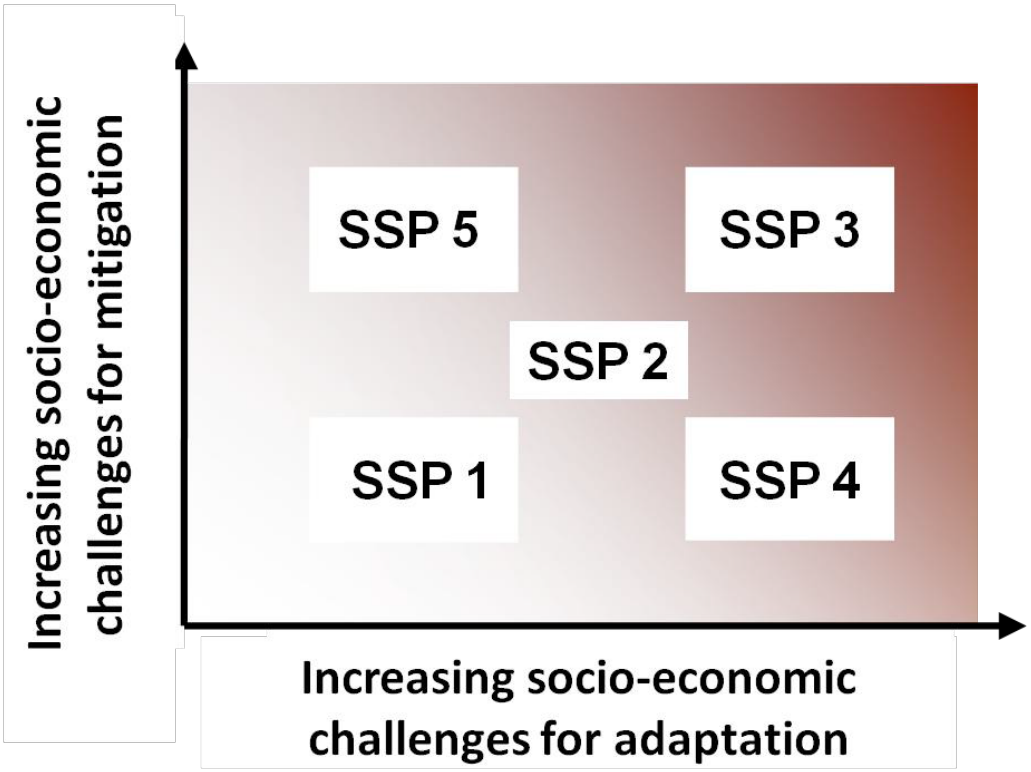
2.1 Scenario development:

The key function of the scenario development process in the ESPA Deltas project is to link the concerns and priorities of relevant stakeholders with the integrated models. Once the bio-physical models have been integrated as part of WP5, these will be combined with the poverty / health outputs from WP3. Following this consolidation, the Δ DIEM integrated model framework currently under construction in WP4 will be used to run these

consolidated elements, with an emulator method planned to run repeated simulations of the various futures projected under the scenarios.

In order to fully facilitate the connection between stakeholders concerns, and the available modelling capacity, two separate stages had to be put in place: the first, to qualitatively describe what the future might look like at the scenario time horizon; the second to translate these qualitative descriptions into the quantitative form required by the numerical models.

The approach that was finally adopted for the project takes as its basis the Shared Socioeconomic reference Pathways (SSPs) as set out by Arnell *et al* (Arnell, 2011) as part of the preparations for the IPCC's 5th Assessment Report, the finalisation of which remains under intensive development. These scenarios, of which there are five, have been drafted at a global level with two axes in mind – socioeconomic challenges to adaptation, and socioeconomic challenges to mitigation (*id*.,20):



Arnell et al, 2011.

Each SSP was fleshed out late in 2011[3], with the following titles:

- SSP1: Sustainability
- SSP2: Middle of the road
- SSP3: Fragmentation
- SSP4: Inequality
- SSP5: Conventional development

The scenario elaboration approach in the ESPA Deltas project effectively produces what Arnell et al call 'extended SSPs' (Arnell et al, 2011) because it takes what is a global approach unsuited to direct application at the national level, and through the addition of more locally relevant characteristics, facilitates the downscaling of the SSPs. As the project research is neither focused on nor addressing the mitigation of greenhouse gas emissions, we chose to exclude SSP5 from the outset, leaving four outline scenarios in principle.

In order to effect the translation of these very broadly crafted scenario narratives to Bangladesh, and at the same time take account of stakeholder priorities, these remaining four scenarios were incorporated into a matrix with the issues identified by the latter:

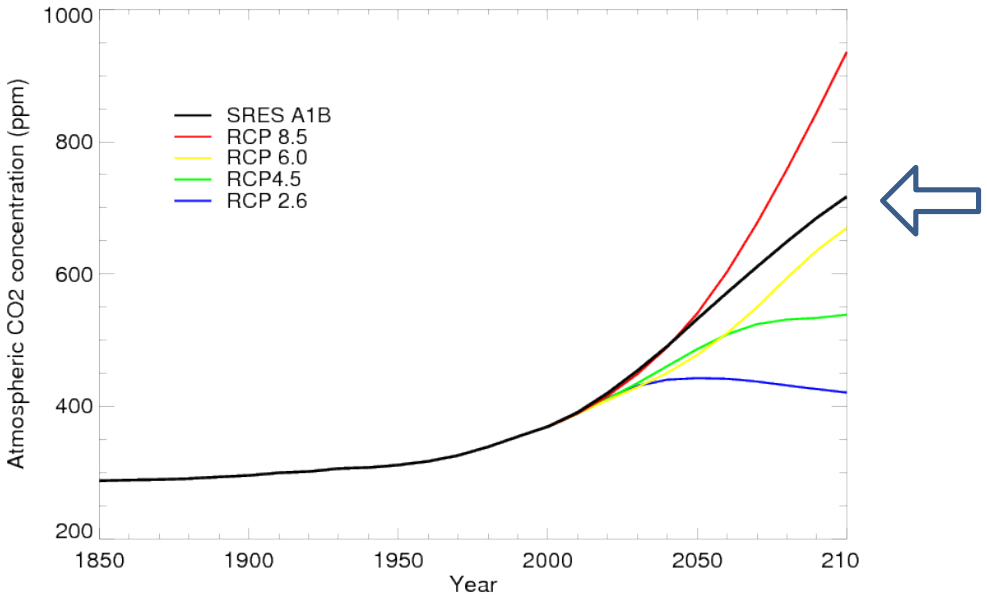
	Natural Resource Management	Food Security	Poverty / health / livelihoods	Governance
Sustainability				
Middle of the road				
Fragmentation				
Inequality				

[3] O'Neill, B.C., Carter, T.R., Ebi, K.L., Edmonds, J., Hallegatte, S., Kemp-Benedict, E., Kriegler, E., Mearns, L., Moss, R., Riahi, K., van Ruijven, B., van Vuuren, D. 2012. Meeting Report of the Workshop on The Nature and Use of New Socioeconomic Pathways for Climate Change Research, Boulder, CO, November 2-4, 2011. Available at: http://www.isp.ucar.edu/socio-economic-pathways

The other element of the IPCC scenario approach, the Representative Concentration Pathways (Moss et al, 2010) or RCPs, were not explicitly incorporated into the project scenario approach, as these will be included as part of the WP5 modelling work. In order to frame discussions by the groups at the first stakeholder meeting, however, it was imperative to provide outline climate projections. This prevented discussions being dominated by issues that could not be addressed at the meeting, and provided a credible compartmentalisation that helped stakeholders focus on the project scenarios. The physical boundary conditions included temperature, sea level rise, peak river flow, increase in variability of storms, and these provided the physical setting into which the narrative scenarios had to be read. The time horizon for the new scenarios would be set in the future at a point where the following factors were balanced:

- divergence between the various RCPs / GHG Emission scenarios under the SRES is relatively minor;
- within the timeframe over which policy choices in the present day might be expected to have an impact; and
- timeframes used in the projections and strategic planning literature at the local level. Bangladesh projections are usually set to 2050.

After debate, a time horizon of 2050 was selected for scenario development. It should be noted here that the downscaled climate modelling used in the project is based on the SRES, not the RCPs – this is because the project is using the HadRM3P model for the A1B GHG emissions scenario. The projections under this model sit somewhere between RCP6.0 and RCP8.5 in terms of global emissions and for global temperature response (Caesar et al, 2015).



From the available seventeen, three downscaled climate ensemble members representative of plausible and varied characteristics have been chosen, representing respectively the largest inter-annual rainfall variability (Q0); slight decrease in rainfall by mid-century followed by increase by century end (Q8); and increased precipitation and temperature (Q16). When combined with the three chosen SSPs, this means that there will be nine possible scenarios that can be run by the respective member models in WP5.

A schedule of meetings was established in order to achieve the scenario development objectives, along with work objectives to be completed between meetings:

1. Autumn 2013: first series of workshops to elaborate the stakeholder-identified issues, and downscale these to the Bangladeshi level for each of scenarios. This would essentially involve the completion of the matrix shown above.
2. Narrative scenarios would be prepared by project partners based on the completed matrix in 1) above.
3. A second workshop to be held in early to mid 2014 to a) comment on, and if possible approve, the narrative scenarios; and b) provide preliminary indications of

management / policy interventions that might be adopted in order to maximise scenario upsides and minimise their downsides.

4. Preliminary efforts to take place that would enable the qualitative scenario narratives to be translated into the quantitative form required by the models.
5. A series of workshops, potentially, to be held around August 2014 that would achieve agreement from stakeholders on this quantitative translation exercise.

The eventual schedule did not match the above exactly, and adjustments had to be made to the schedule of expected results. These will be described below.

3 Meetings - Qualitative

3.1 October 2013:

This first stakeholder workshop, which was held on 22-23 October 2013, had the following objectives:[4]

1. The final list of issues had never been presented in consolidated form to the stakeholder group, and in fact had only been combined as part of the WP1 Fast Track report. The meeting provided an opportunity to present the results of all the individual interviews to the groups as a whole. The first objective of the meeting was therefore to get feedback on the issues as consolidated, to get further elaboration on their details and to reach common agreement.
2. As will be described in the following section, the basis for the scenario narratives being used in the project has been drafted with a global context in mind. The second objective of the meeting was therefore to grasp these global narrative characteristics and translate them to the more local Bangladeshi context (and ultimately to the individual case areas).

[4] A full report of the first stakeholder workshop is available on the ESPA Deltas website at www.espadelta.net.

3. A crucial element following on from Objective 2) above was to ensure that this downscaling process was related directly to the issues approved as part of Objective 1) above, thereby tying modelling integration and prioritisation with stakeholder concerns.

Method:

Two separate stakeholder workshops were planned, to take account of sensitivities between stakeholders, each lasting one day. At the outset, the intention at the meeting was to have stakeholders complete the matrix above. This would necessitate them elaborating what each of the four chosen SSPs might look like in Bangladesh, and how these might be manifested in terms of the Issues. A plan to establish a baseline situation was scrapped as a result of time restrictions, Project partners still saw utility in going through the issues in this way: by re-naming the 'Middle of the road' SSP to "Business as Usual' allowed stakeholders to consider the current situation, and addressed one of the SSPs. It was also agreed that the Fragmentation and Unequal SSPs were too similar when downscaled to Bangladesh, and these were therefore merged, to give the following SSP structure:

	Natural Resource Management	Food Security	Poverty / health / livelihoods	Governance
Business as Usual (BaU)				
Sustainability				
Fragmentation and Inequality				

Boundary conditions were imposed at the workshops based on conservative simulations of the implications of human-induced climate change. These were set at:

- Time Horizon: 2050
- Temperature: +1^{o}C (later amended to 1.5^{o}C in the light of more detailed downscaling)
- Sea level rise: +0.25m

- Peak river flow into Bangladesh: +10%
- Uncertainty in arrival of monsoon: +10%
- Frequency and intensity of storms: +10%

In order to complete the matrix squares, the groups were asked to comment (and agree) on how the Issues (and the individual components of each) might look at the Time Horizon (2050) i.e. whether they would be improving or deteriorating. This might be based (for BaU) on an assessment of how the issue could be characterised at the present day compared to that of 1980 (i.e. roughly as far back in the past as we were asking them to look forward in the future) – the stakeholders would then be asked to consider if there were reasons why the trajectory since 1980 might or might not continue, and to take this into account in determining how things might be in 2050.

Findings:

The meeting was attended by a total of around 35 people. Completion of the matrix took very much longer than expected, even with clear boundary conditions. Consensus was achieved (or results agreed through votes), but the schedule had to be drastically amended in order to achieve completion of one matrix rather than the two versions that had been hoped for. Significant efforts were made to ensure internal consistency across categories.

Once agreement was reached, the groups were asked to assess the extent of the improvement or deterioration, using a three point scale from "+" to "+++", with "+" being slight and "+++" being strong. Stakeholder were also asked to identify, where possible, the elements of the other Issues where the impact of governance characteristics would be felt most. The result was as follows:

NRM	Food Security	Health/ Livelihoods/ Poverty	Governance
Salinity/freshwater - Freshwater ↓ +++ - Ingress salinity ↑ - Mangrove ↓ + **Flow dynamics/ riverbank erosion and sedimentation** - Mech: Accretion ↑ + - Erosion ↑ + - Water logging ↑ ++ and flooding ↑ ++ **Land-use** - Land-use change rate ↑ ++ - Rice production ↓ + - Shrimp production ↑ + - Floodplain fisheries ↓ +++ **Coastal defence** - Infrastructure ↑ + - Maintenance/Rehabilitation ↑ + - Mangrove/Forest ↓ + **Impact of extreme weather events** - Asset damage ↑ ++ - Loss of life ↓ +++ - **Conservation effort ↑ +**	**Availability and Access** - Rice (area) ↓ + - Rice (yield) ↑ + - Others (area) ↑ + - Others (yield) ↑ + - Storage ↑ ++ - Household storage ↑ + - Market access ↑ + - Farmer knowledge ↑ + **Water security** - Freshwater: - Quality ↓ ++ - Quantity ↓ ++ - Predictability ↓ +++ - Accessibility ↑ + **Nutrition** - Food habit ↑ + - Pricing (% income) ↓ + - Protein ↑ (+?) ☹ **Agriculture production systems/R&D** - Efficient Fertiliser Use ↑ + - R&D/ technology ↑ ++ - Crop diversification ↑ + - Subsidies ↑ + - Wheat production ↑ +	**Migration** - Net Migration (urban :rural ratio) ↑ ++ - Outmigration from project area ↑ ++ - Push ↑ ++ - Pull ↑ +++ **Remoteness/Communication/infrastructure** - **Infrastructure** ↑ + - Communication ↑ ++ **W.A.S.H** - Community ↑ + - Urban (formal) ↑ ++ - Urban (informal/ slum) ↑ + - Water: Sanitation ↑ + **Changes in livelihoods** - Diversification ↑ ++ **Utilization of ES** - Availability - Access - ↑ Private Sector: - Community ↓ ++ (access ratio) - Ag - Private/Community ↓ ++ **Disease**	**Coordination & collaboration (sectoral and geographical)** NRM benefits the most, 2) livelihoods 3) food security - Sectoral: ↑ + Geographical: - Transboundary ↔ - Bangladesh ↑ + **Power structure/Conflict** - Conflict ↓ - Intersectoral (e.g. fisherman vs. Farmers) ↓ + - Intra-sectoral ↓ ++ - Power structure ↔ **Human & financial capacity/Awareness/extension agents** - Human and financial capacity ↑ + (likely to have most impact on pollution, NRM ↑ +) - Awareness ↑ ++ - Local government empowerment ↑ + - Implementation and enforcement ↑ + - Law & Order/security (dakoits/pirates) - Fisheries ↑ ++ - Unauthorised inputs (pesticides, fertilizer etc.) ↓ +

- Biodiversity ↓ + - **Management (local involvement) ↑ +**	**Household equity** - Intra- ↑ + - Inter- ↓ + **Market dynamics** - Role of intermediaries ↓ + - Information technology (price information e.g. mobile phones) ↑ ++ **Seasonality** - Shift in traditional practices	- Non-communicable ↑ + - Water borne ↑ + - Vector borne ↑ + - Zoonotic ↑ + **Frequency and intensity of disasters** **Gender** - InFl DM ↑ + - Disaster Risk Reduction +Climate Change Adaptation ↑ ++ - Access to Natural resources / ecosystem services ↑ +	- Piracy ↔ - Lack of participation and marginalization of the poor - Participation ↑ ++ - Marginalization ↓ ++ **Role of NGOs/Civil Society/Private sector/farmers' assn, public organizations** - NGOs/CSO ↑ + Private/Corporate/entrepreneurs ↑ ++ Transparency/Access to information/accountability - Transparency ↑ + - Access to information ↑ ++ - Accountability ↑ + - Land management/zoning and distribution - Land management ↑ + - Zoning ↑ + - Distribution ↔ - Transboundary (India, China) - Water ↓ ++ - Trade ↓ + Planning - Central ↑ + - Local ↑ + - Maintenance of existing infrastructure ↑ + - Rules & regulations ↑ +& local level policy ↑ +, local courts ↔ - Service delivery efficiency ↑ +

Conclusions from Workshop 1:

The list of issues was elaborated in great detail and effectively downscaled to the Bangladeshi context (and case study areas where relevant), although only for the BaU SSP, and that only once. A full narrative translation of the BaU matrix was planned before the next workshop, with additional narratives to be drafted by project partners for 'Sustainability' and 'Fragmentation and Inequality' based on the BaU base. There would be no need to repeat the exercise of producing the matrix for each of these additional SSPs, but the final narrative texts of each would have to be tailored to a greater extent to modelling capacity.

The other main lessons learned from this first meeting were the importance of the need to be flexible to accommodate changing stakeholder needs and uncertainty over the amount of time needed to complete the exercise. However, the level of detail achieved in the BaU matrix surpassed our expectations, and provided a comprehensive basis for translation into the integrated modelling framework.

3.2 May 2014:

Objectives:

The second workshop was held on 14 May 2014, and was hosted organised jointly by the General Economic Division of the Planning Commission, and IWFM at BUET. The main objective of the workshop, which was attended by one hundred people, was to critically assess the three detailed SSP narratives that had been drafted following the previous workshop in October 2013. The narratives needed to be stress-tested for credibility, internal consistency and for consistency between themselves – only the BaU narrative was based on stakeholder-derived information. The narratives had been subject to detailed comment and modification by project partners during the months preceding the workshop, and were therefore reasonably strong before they were presented.

The narratives effectively take all the elements of the matrix from the first workshop, and reproduce them in a more digestible form. In order to avoid replication of elements across the four categories in the matrix, the narrative re-frames these into six categories, taking relevant elements and creating a coherent story that combines local, regional and global drivers and highlights their impact for Bangladesh. This produces a greater alignment between the breadth of the matrix and the individual elements of the modelling and survey frameworks within the project. The six categories are as follows:

- Land use
- Water
- International Cooperation
- Disaster Management
- Environmental Management
- Quality of life and livelihoods

Additional aims of the workshop were to ask stakeholders which management interventions they might consider for maximising positive outcomes and minimising

negative ones in the projected futures; and to identify barriers that might impede or affect implementation of policy and management interventions. It was also planned that stakeholders would be able to add indications as to how to quantify individual elements and comment on the assumptions that had already been made by project partners. It was further hoped that they might advise on methods for incorporating the more qualitative elements in the physical modelling process, as many of the elements in the matrix from the first workshop were beyond the capability of the project modelling.

During the consultation period for the scenario narratives, the names had been altered slightly. 'Sustainability' had become 'More Sustainable', and 'Fragmentation and Inequality' had become 'Less Sustainable'. No assumption as to actual sustainability was made for any of the SSPs,: more or less sustainable was simply assessed against BaU, which was in itself not necessarily sustainable.

Method:

Attendees were presented with a copy of the draft consolidated scenario narratives (attached as Annexe 1 below), They were then split into three representative groups. Each was allocated one of the scenarios and given instructions (and some background) on how they should interpret the document and what they should do with it. Reports from the groups were made in plenary, consisting of identifying problems in their respective scenarios, highlighting potential policy or management interventions, and identifying barriers to policy implementation.

Findings:

The time available for these exercises was unfortunately drastically curtailed as a result of the workshop objectives being expanded to include the development of links between the Delta Plan 2100 and the ESPA Deltas Project. As a result it was not possible to fully address the barriers to implementation or management interventions. The time needed for groups

to examine in detail the scenario narratives further curtailed the amount of time available for discussion.

There was a tendency towards some groups holding discussions in Bengali, which forced out those (1 or 2) who were did not speak the language, pushing them into other groups. There was also a certain amount of confusion among some participants over the scenarios reflecting possible *future* situations rather than reflecting an interpretation of the existing position.

Although the groups were under strict instructions not to add further issues to the scenario narratives, it proved difficult to prevent this, especially with respect to the BaU SSP. We had intended that the issues that had been identified and elaborated upon in the preceding meetings should remain intact. The previous meetings had been as representative as possible, and the addition of new issues, or disagreement with the level of changes envisaged by the participants in the first workshop served only to muddy the waters. It was possible to question the extent of changes in the More and Less Sustainable SSPs, as these had been drafted within the confines of the project, but the BaU SSP reflected the views of stakeholders and was therefore was more sacrosanct than the others.

A full list of the group findings is appended in Appendix 3.

Conclusions of the second stakeholder workshop:

The scenario narratives stood up very well to the sustained critical assessment of one hundred experts. Many comments were made, and these were incorporated into the revised version of the narratives (appendix 1 below). The tasks of obtaining details of possible management and policy interventions, and the barriers to governance implementation, were less successfully completed, especially for the More and Less Sustainable SSPs. This could be because the BaU narrative was the most developed, and the efforts made during the first stakeholder workshop to ensure internal consistency made that narrative stronger than the others.

With respect to the barriers to implementation, there was a high degree of overlap in the list suggested by stakeholders, and a great deal of similarity with those identified as part of the broader WP1 work. The following general themes seem to emerge:

- Stakeholder involvement and lack of awareness
- Lack of cooperation / integration (both internationally and cross-sectorally)
- Level of commitment on behalf of donors and politicians (?)
- Lack of capacity (institutional, and including re. negotiating skills)
- Centralisation / decentralisation of decision making

With regard to the management interventions, these are potentially of great relevance to the research envisaged under WP6. However, from the list outlined during the May workshop, it seems that it will be very difficult to model most of the suggestions. In fact from the overall list of around 20 interventions identified, less than half of these might reasonably be considered candidates for modelling, due to restrictions in modelling capacity, ambiguity in interpretation or sheer scope of the intervention mentioned. The interventions that might feasibly be modelled, or at least partially represented in the model, include the following (with preliminary suggestions as to how they might be rendered modellable):

- Proper urbanisation policy – Not modellable, other than presumably reducing urban sprawl in LULC projections?
- Large scale mangrove management – presumably modellable to some degree in terms of extent and location?
- Bangladesh Climate Change Strategy and Adaptation Plan 2009 proper implementation. Only way it could be modellable is if individual project objectives were somehow incorporated.
- Mainstreaming poverty reduction in all development projects – pretty much the same as PECM but measureable through reduction in poverty? Assumes causal relationship that may not be there though.

- NSPS (National Social Protection Strategy)– proper implementation. Planning Commission - there are some specific indicators of poverty that could be modelled - see http://www.plancomm.gov.bd//upload/2014/NSPS.pdf.

In addition to the problems of interpreting the above in such a way as to render them modellable, serious difficulties are likely where some degree of spatial explicitness is desired. Ultimately, it would be very useful for the integrated model to represent the potential consequences of e.g. polder construction in specific locations [c.f. also useful with respect to the interface with the CEIP process too].

There was a generally lower level of consensus at the second stakeholder workshop than the first, although groups were still able to produce critical evaluation that was broadly agreed to by their members. A number of issues remained unresolved at the end of the meeting. These were:

- Sedimentation
- Groundwater use and impacts on the resource
- demographics

Efforts were made in the subsequent months to address these issues in conjunction with project experts. The finalised narratives appended below reflect these additional changes.

4 Quantitative:

Representation of the three future scenarios across the detailed biophysical models and the integrated model required quantification of the scenario narratives. Stakeholders were involved in this process to improve model inputs, as well as increase ownership of the model and the likelihood that the model will be used beyond the life of the project. Involving stakeholders in model development assists in better understanding the system; identifying knowledge and data gaps; and communication across sectors and organisations.

4.1 Method:

Quantification of the scenario narratives into model assumptions involved three steps: (1) Initial estimation of values within the project team; (2) individual stakeholder questionnaires; and (3) workshop based group stakeholder discussions. Details of the three steps are outlined below.

1. *Initial estimation within project team*

Model assumptions were initially estimated where possible within the project group to provide a starting point for discussion with stakeholders. This required evaluation of which assumptions were best based on available data only and hence taken to be fixed, and which were most important to discuss with stakeholders (bearing in mind that time restrictions would limit the potential for getting agreement on all assumptions). This required a reflection of the experience and capacity within the project group compared with those of the stakeholders. For example, climate projections for Bangladesh developed by the UK Met Office were not discussed by stakeholders, having already gone through independent testing within the Met Office and the project group. However, other assumptions such as land use changes and changes in agricultural practices could benefit significantly from stakeholder input. In some cases there was minimal information available within the project group, in which case stakeholders were asked for initial

values or to provide relevant sources of information. The final categories of model assumptions which were used for consultation with stakeholders were:

(1) Water resource management (surface and groundwater);
(2) Flood management of the delta;
(3) Fisheries;
(4) Mangroves;
(5) Agriculture;
(6) Aquaculture;
(7) Land cover;
(8) Access;
(9) Migration patterns;
(10) Employment;
(11) Literacy;
(12) Subsidies and loans; and
(13) Poverty metrics.

2. Individual stakeholder questionnaires

The thirteen categories of model assumptions were separated into a biophysical questionnaire (numbers 1 to 7 above) and a socio-economic questionnaire (numbers 8 to 13). The purpose of the questionnaires was to establish individual views on the model assumptions, and determine the range of possible assumption values. This can give an indication of the uncertainty in assumptions, and avoids responses being influenced by dominant group members. Participants were primarily identified through BUET contacts as well as some previous connections formed as part of the WP1 stakeholder interviews and attendees at earlier scenario workshops. The complete questionnaires are included in Appendix **, whilst a summary of the questions covered is shown below:

<u>Water resource management</u>

- Which dams are likely to be constructed by mid and end of century for the three scenarios;

- What major water transfers are likely to be constructed as part of the Indian National River Interlinking Project, and what the volume and seasonal patterns for the transfers would be;
- What drought indices would be most useful for presenting model results on changes in water availability;
- How would water extractions for domestic, industrial and agricultural uses change;
- How would effluent discharges increase into the future, and would the number of sewage; treatment plants also increase, with commensurate improvements in water quality;
- How will groundwater extraction change in both deep and shallow aquifers; and
- Whether or not subsidy programs are likely to be introduced to support groundwater extraction.

Flood management of the delta

- Change in polder height and maintenance

Fisheries

- How is fishing effort likely to change under different scenarios
- Whether fishing subsidy programs are likely to continue and how might they change

Land use

- What percentage loss to the Sunderbans is likely to occur due to encroachment
- How crop yields and salinity tolerance are likely to change with new varieties
- What increase in aquaculture area is likely to occur, and how much technological improvement is likely
- How different land cover types are likely to change for the whole study area and for different districts
- Whether a land zoning program incentives is likely to be introduced, and if so what types of legislation of incentives are likely to be used
- What planned projects exist for improving access through
- rail/road/bridge construction

Migration

- Which types of migration are likely to increase or decrease into the future
- What main factors are likely to influence changes in migration patterns
- To what extent policy and policy makers influence the drivers of migration

Employment

- What percentage of the population in the coastal zone is likely to be employed in the future under different scenarios

Literacy

- How the national and rural level of literacy is likely to change

Subsidies and Loans

- What current and planned future subsidies exist, and where to find information on these
- How are loan provisions in rural areas likely to change into the future, and whether loans will become more accessible to rural people

Poverty metrics

- Which different dimensions of poverty are considered most useful and relevant for Bangladesh
- Which dimension is used most commonly in the respondent's work
- What indicator of poverty they most commonly use, whether they consider this indicator to adequately represent poverty, and if not what the main shortcomings are
- What would be an ideal poverty indicator
- Which indicators to they think are most relevant to Bangladesh, and what the pros and cons of each are

Questionnaires were initially emailed to participants with follow up phone calls by BUET. However, there were limited responses with only three questionnaires returned.

4.2 Meeting – November 2014:

The workshop was held on 10 November 2014, and was attended by 20 participants from 12 different organisations who were not partners in the ESPA Deltas project, and an additional 10 participants from ESPA partner organisations who were not themselves involved with ESPA. A full list of the organisations represented is included in the Appendices below.

Given the poor response to the individual questionnaires, a decision was taken to set aside time at the beginning of the workshop to allow attendees to complete the parts of the questionnaires that were relevant to them. Given that the majority of questionnaires were therefore completed in a workshop environment, responses were not always independent with various degrees of consultation between participants taking place (despite explicit instructions being given that questionnaires were to be completed individually without consultation with colleagues).

Participants were also asked to complete a feedback form to evaluate whether they found the questionnaire and discussion to be a useful exercise. The four feedback questions asked participants how difficult they found the questions; whether the questionnaire changed the way they think about ecosystem services relevant to their sector; whether it changed their wider understanding of ecosystem services outside their sector; and any additional comments.

Individually completed questionnaires were then collected and filed by the organisers to prevent any changes during the group discussion.

Having obtained individual responses, participants were separated into three groups broadly based on expertise (socio-economic; water resources; agriculture/aquiculture/fisheries), and asked to repeat the questionnaire but develop a consensus view where possible. This process addressed multiple objectives:

- Most importantly to encourage discussion across different organisations about the challenge and complexity of understanding and managing ecosystems and wellbeing;
- To establish a 'best guess' view to use as a focal point in the scenario modelling; and
- To evaluate the social process of individual versus group responses, to identify whether the group response reflects the majority response of individuals, or whether it had been formed by a few dominant people.

Results

Individual questionnaires

Given the wide range of subject areas covered by the questionnaire compared with the number of participants, there were varying levels of response to different questions. For example, 18 participants answered at least part of a question on changes in migration patterns under future scenarios, whereas only one person provided information on changes to road and rail infrastructure. This was a reflection of the type of expertise within the group (for example there were no fisheries experts within the group), and the time available to answer all the questions.

Where participants were asked to comment on values previously estimated within the project team, in general there was reasonable agreement with what had been proposed, or with small variations. The greatest disagreement for proposed assumptions was for water transfer volumes and timing. Where participants were asked to provide values for different assumptions, in general there was reasonable agreement between respondents in terms of overall direction and magnitude of change, but with the specific value of change varying between responses. It was evident from some questionnaire sheets that there had been discussion between participants sitting near one another.

Group discussions

The socio-economic and fisheries/land groups provided group responses for all questions (except on access and transport). The water management group focused most of their discussion on dams and water transfers, with some response for drought indices and water demands. The remaining questions on water quality, groundwater and polder management were not covered due to insufficient time.

In general, group responses reflected some elements of the individual responses, whilst others introduced additional perspectives, or changed the majority view of individuals. For example, three of four respondents disagreed with the proposed level of future technological improvement for aquaculture, yet the group decided they agreed. In comparison, the discussion on dams resulted in the group deciding that some dam development could be beneficial for water security in Bangladesh where there was regional cooperation and consideration of

environmental impacts, hence reflecting the individual responses of only three participants. It is worth noting that some individuals may have responded for particular sectorial questions in the questionnaires and then joined a different sectorial group for the discussions.

During the discussions, there were a number of occasions where groups challenged the assumptions made within the project team. For example, they disagreed that projected water extractions would be the same for mid-century and end of century. However, the group did not provide suggested alternative assumptions, indicating instead the assumptions should be based on studies.

Participant feedback

Informal discussion with participants after the workshop suggests that they found the exercise interesting, useful and informative. For example, the discussion on poverty metrics in the socio-economic group highlighted to participants that there was general agreement between representatives from different organisations on what type of metrics were most useful. Participants from the water group indicated that they found it useful to discuss contentious issues of dam development and the construction of major water transfers across different organisations and government sectors.

One key outcome identified during the group summary session was that no flow based drought definitions currently exist for Bangladesh, yet they felt it would be useful particularly for negotiations on flow rules for the Ganges with India. The water group also identified sources of information that would be useful for the project, and provided useful feedback on clarification of scenario definitions.

Fourteen participants completed the feedback form, although unfortunately it was unclear who had completed it directly after the individual questionnaire and who had completed it after the group discussion. There was a range of responses on the level of difficulty in completing the questionnaire, with most giving a value of two or three with one being easy and five being difficult. Verbal feedback during the exercise indicated that a number of participants found the questions challenging. Half of the respondents indicated (four of eight) that the exercise changed their view of ecosystem services relevant to their sector. Comments indicated that

these changes included: the view of ecosystem services in a more inclusive and holistic manner; the incorporation of socio-economic values; and the connection between ecosystem services and national wealth. A greater proportion (ten of eleven) felt that the discussion contributed to their wider understanding of ecosystem services at least to some extent, through the quantification of real conditions and assumptions; the use of narratives, assumptions and scenarios; and discussion with economists about economic valuation of ecosystem services. Respondents also provided useful suggestions, such as consideration of government policies which may affect zoning of the coastal region, and information on international and internal migration.

Discussion and Conclusions

The expert workshop was considered to be incredibly successful both in terms of obtaining information on the quantification of scenario assumptions, and more importantly in terms of the group discussions which took place. Participants indicated that they found it useful to discuss these complex topics across institutions. Many agreed that the quantification of assumptions regarding future scenarios was challenging, hence highlighting the complexity of the issues being considered. It shifted some of the ownership and responsibility of the quantification to participants – where they disagreed with the suggested assumptions, they had the opportunity to provide values they felt were more appropriate. It was also important to recognise that in many cases such assumptions are largely guesswork given the significant uncertainties involved in projecting into the future. It is hoped that this process will improve the acceptance and validity of the models.

The identification of a lack of flow based drought metrics was a useful outcome for the water resources group, whilst the socio-economic group indicated that they found it interesting that they all generally agreed on the questions, despite different sectorial backgrounds and institutions. A number of participants also indicated that the found the process informative, and gave them new insights into different aspects of ecosystem services.

In terms of obtaining values for the scenario assumptions, the workshop was of mixed success given that some questions were answered by a number of participants, whereas others had

minimal response. This is likely to be at least partly due to the experience of the participants, with more participants from sectors such as water resource management compared with transport and infrastructure. It is also a result of the large number of questions, and having to combine the individual questionnaires and group discussion in the same workshop, which had not originally been intended. However, this was considered of secondary importance compared with the benefits obtained from the process. In general, the workshop highlighted which issues were of most concern to participants, where there was greatest uncertainty, and some suggested alternatives to what had been proposed by the project team. Based on both observations and comparison between individual and group responses, it was evident that the group discussions influenced the resulting outcome – either in terms of participants feeling their individual views were validated, or being open to different views. It was also observed that dominant individuals played a role in swaying the outcome, although the majority of participants appeared to be actively involved in the discussion.

The involvement of stakeholders in the quantification of scenario narratives and model development is considered critical in establishing acceptance of the model, improving model inputs, and aiding decision making through cross-organisational discussion around managing such a complex system. At the same time, it is acknowledged that in many cases stakeholders may not come to agreement on particular assumptions, or disagree on aspects of the model which cannot be changed in the scope of the project. There will hence be a trade-off in which expert views are incorporated and which are not.

5 Conclusions:

5.1 Concept and Method:

A number of useful conclusions can be derived from the scenario development exercise in the ESPA Deltas Project. The first is that the separation of the climatic elements from the socio-economic sections scenario projections – i.e. the RCPs from the SSPs – can provide a useful framework for downscaling the latter in a way that allows temporal differences between the two to be ironed out (van Ruijven et al, 2014). Stakeholder input, using the methods adopted here, allows the top-down focus of the RCPs to be aligned with the bottom-up approach needed to make the SSPs appropriate at the more local scale, and also facilitates the translation of qualitative narrative scenarios into a quantitative form that lends itself to incorporation of biophysical and socio-economic indicators.

Research continues into how governance might be incorporated into the SSP process and modeling, especially in the context of adaptation (van Ruijven et al, 2014; Biermann et al, 2009)). The results of the process described above highlight a large number of key governance-related questions, and their relevance to the success or otherwise of management and policy interventions intended to improve livelihoods and the ecosystem services that support them. The next step in the incorporation of the scenarios into the integrated modeling will necessitate identifying the areas where the impact of governance is likely to be felt. The scenario elements that have been identified and categorized in such detail will provide an excellent base from which to tackle this question.

Although on one level problems were experienced with respect to extracting all the information desired from the stakeholder meetings and workshops, there was a great deal of value in conducting the meetings from a more long term perspective. Stakeholders were often pleasantly surprised to see that workshops continued over time, and this perhaps suggested to

them that the project was serious in taking their views into account. There was a general level of acceptance on the part of those attending workshops that the approach being taken was credible and addressing the correct issues, even though there might be a strong element of disagreement over potential solutions or the magnitude of the problem.

The chosen SSPs have been incorporated in the modeling framework for much of the latter part of the integrated modeling exercise, and the categories adopted as part of the scenario narratives are fully incorporated in the next stage in the project, evaluating the impacts of different management and policy interventions on key indicators of poverty and health.

5.2 Procedural:

From a more procedural perspective, a number of key lessons have been learned throughout the process. The need for flexibility with respect to workshop outcomes and methods for achieving project objectives is paramount. The amount of time it takes to achieve the goals that have been set for a particular exercise may vary considerably from the expected timescale, and meeting schedules may need to be adapted very rapidly to take account of changing expectations.

Timing is also an issue for stakeholders: in retrospect, the amount of information we expected stakeholders to read and absorb was unrealistic. Because stakeholders were not able to analyze detailed scenario narratives or go respond to detailed questionnaires, we suffered to some extent from problems with managing our own expectations. Other approaches may work better – for example, establishing a standing stakeholder expert group who could comment on technical detail, perhaps in return for a fee reflecting the degree of commitment needed.

In future situations where this approach is taken, it would be wise to have stakeholders complete the matrices themselves, rather than having them complete one, and having the project members draft other scenarios without first having the relevant matrix. This would ensure that stakeholders exerted great influence over the final versions, but would also potentially ensure that subsequent issues with internal consistency would be minimized. It may

be that this is not possible, but if the lessons set out above are addressed, adequate time is factored into the planning process, and the workshop and meeting schedule arranged accordingly, transferability would be maximized.

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7 Appendices

7.1 Appendix 1 – Scenario Narratives:

Three scenarios have been prepared:

1. More Sustainable;
2. Business As Usual; and
3. Less Sustainable

More Sustainable Future:

Land use:

Cultivated areas continued to be dominated by rice, but diversification of crops, especially the more intense cultivation of cash crops, driven by better access to markets (local and international) and effective agricultural extension and educational outreach, has flourished. The environmental impact of shrimp cultivation has decreased substantially in extent due to the adoption of more sustainable techniques. Investment in agricultural research and development, along with adoption of more climate-smart agricultural techniques, has bolstered the use of high yield varieties and more salt-tolerant varieties because of the need to reduce the area under crops, in the interests of environmental protection and natural flood defence.

This pressure to reduce or at least maintain no more than existing levels of agricultural land has been helped by the general stabilisation in population numbers and continuing (if slightly reduced) rural-urban migration. The proportion of urban against rural populations has risen steadily, thereby increasing the need for greater intensification of agriculture, a process that has not been alleviated by the global market place.

Greater intensification of agriculture has lead to a slight deterioration in soil quality parameters. This has been offset by special development programs that have produced new crop varieties that are suitable for coastal areas and less hazardous to soil health. The proportion of chemical fertilizers and pesticides used has declined compared to organic manure and integrated pest management.

Coastal protection has been extended, mainly through the efforts of the Delta plan, using a mixture of structural and non-structural options. Better zoning and monitoring of land use change, has been beneficial, and the quality of land use management is now one of the key factors in the management of water use. Conflict over land use, including over ownership rights, has been very much reduced, due mainly to improvements in transparency and accountability through the land ownership cadastre and significant improvements to the local judicial hierarchy.

Water

Surface water flow patterns in the Ganges and Brahmaputra rivers have varied over time, the arrival of the monsoon has become less predictable and periods of drought extended due to the impacts of climate change. With better coordination between the states riparian to these rivers however, management of water resources in Bangladesh has been able to make progress. The application of efficient land and water management practices and effective enforcement processes in India have enhanced predictability and availability of flow into Bangladesh and reduced levels of industrial and nutrient pollution.

Similar progress has taken place in Bangladesh: advances in communications technology provide regulators with detailed knowledge of river flow, level and quality in real time, with sophisticated modelling ability aiding the regulation of water use management. Legal frameworks allow water use to be varied in response to changes in resource availability, social and environmental priorities, and the better balancing of periods of flood and inter-annual scarcity.

In line with the stronger economic situation in Bangladesh, water and sewage service provision have been extended, and the careful planning of urban expansion has greatly restricted water pollution and reduced the incidence of water-borne disease. This has increased riverine fish stocks and rural engagement with cultured and floodplain fish production has increased. Subsistence and artisanal fisheries have decreased. but commercial fisheries have conversely increased., though the impact of this has been reduced through improved national and international governance of fisheries which is now focused on sustainable coastal fishing. The successful achievement of the Millennium Development Goals, and subsequent iterations, has created a society where the vast majority of the population have access to piped water in their homes and improved sanitation facilities.-This has been aided through excavation of ponds and tanks for conservation of water and the use of local technology for water treatment, such as pond sand filtering.

This improvement in drinking water availability, combined with the use of deeper aquifers in many places has helped people avoid the problems associated with consumption of saline and arsenic-contaminated water. Steps have been taken to ensure sustainable use and management of ground water. There has been a major focus on conjunctive management of surface water and groundwater. Better monitoring of water table levels and groundwater / surface water interactions, and the ability to amend water use rights, is progressively improving the situation, although alternative supplies may still be difficult to apply. Adequate upland flow has been ensured in water channels through the construction of the Ganges Barrage that has helped preserve the coastal estuary ecosystem threatened by seawater intrusion.

With the rapid development of upstream energy generation facilities, sediment transport downstream has been curtailed. This remains a major issue for the health of the delta, but basin states are working together to formulate a solution under the terms of existing water use treaties. The increased focus on sediment has resulted in improved tidal basin management and increased navigation potential.

As part of the general improvement in the management of water resources, principles of subsidiarity have been applied such that local management of water takes better account of upstream and downstream needs. Cooperation between these has therefore improved, helped by the cross-sectoral management of water resources as a whole and effective compliance monitoring. Levels of conflict between users and sectors, and justiciable disagreements have consequently fallen.

International cooperation

Relations have greatly improved between Bangladesh and India, and between India and China, a process driven partly by the regionalisation of energy markets and the critical importance of hydropower as a fossil fuel replacement. Coordination of electricity generation at basin level, taking account of downstream impacts in terms of flood alleviation, augmentation of dry season flow, improved scarcity management and the sediment requirements of the delta, has sprung from a regional realisation that the benefits of cooperation can be spread equitably and strategically throughout the basin. Improved transport links between Chittagong and both Kunming in China and the north-eastern states of India, coupled with investments in the delta area by both upstream countries, have resulted in greater trade links between the three nations and more effective abstraction and pollution control in the upper reaches of the Brahmaputra and Ganges rivers.

Detailed multi- and bi-lateral treaties have been agreed by GBM basin states addressing water issues, closely linked to agreements on trade and energy distribution. Independent management authorities are in place, with detailed compliance and reporting requirements, and national legal and policy frameworks work to effect these agreements.

International fisheries agreements relevant to the Bay of Bengal have led to greater food security for coastal fishermen and improved enforcement has reduced levels of sea piracy .

Disaster management

With the gradual decentralisation of Bangladesh, drawing population from Dhaka to regional hubs, disaster management has also been further devolved, with disaster risk reduction being linked closely with adaptation. Disaster forecasting and preparedness is of world-standard quality, benefiting from advances in communication technology. The network of cyclone shelters, financed primarily by local and regional authorities and through private sector initiatives, has evolved such that the impact of increasing storm surges has been largely negated, with loss of life being maintained at relatively minimal levels. Adaptive agri- and aqua-culture systems have also helped to substantially reduce production losses during – and post-disaster and aided post-disaster resilience. Storage of local crops and livestock has been significantly improved, with effective local insurance schemes in place to ameliorate livelihood losses. Improved transport networks between urban centres has also had a positive effect in the response times of emergency and remediation teams. The successful and ongoing implementation of the Delta Plan has been advantageous for disaster impact reduction.

Environmental management

Mangrove forest cover has been maintained in the Sundarbans at the levels seen earlier in the century, augmented by active planting programmes that have taken place as part of the Delta Plan. The result has been an increase in terrestrial and aquatic biodiversity as the mangrove belt has expanded along the coast. The forest has benefitted from improvements

in water quality, but the balancing of livelihood maintenance for those living in the vicinity, and protection of biodiversity, remains problematic. Improvements in the economic situation for those living in the case areas has reduced the need to use the Sundarbans directly for their livelihood maintenance, but a significant increase in 'eco-tourism', some of it still unregulated, continues to complicate matters.

Soil and water health has increased overall, driven by improvements in water quality and the use of state-of-the-art agricultural techniques. Although salt water intrusion remains problematic, better surface/groundwater management and improved polder maintenance has helped to keep this in check.

Quality of life and livelihoods

Standards of education in the countryside have leapt exponentially, especially for females. This, coupled with agricultural intensification and the managed expansion of decentralised urban hubs, has perpetuated general levels of migration away from the countryside. The gradual erosion of the traditional village and regional hierarchies and power structures has opened up a wide variety of possible livelihood alternatives for those in the case areas. The principal agents of this erosion have been the astonishingly rapid development of mobile technology (providing greater visibility for those working against the law), more effective enforcement mechanisms resulting from economic development, and improvements in educational ability stemming from enforced mandatory standards.

As regards population structure, fertility and mortality rates have been declining for some time now, and, critically, levels of out-migration to regional urban hubs has gone down slightly. The consequence of this is that population levels have dropped very slightly from their 2014 levels, but the structure has changed since then such that there are proportionately significantly more aged over 65 and substantially fewer aged under 14.

The availability of credit has improved significantly, through a profusion of public and private providers, with reliance on local moneylenders non-existent. The availability of insurance for all has had significant impacts on the resilience of those in the case areas, reducing vulnerability to flood events, for example. Better access to local markets especially, combined with the diversification of crops, has improved the health of the population, although meat is very expensive and protein intake remains problematic for some. Incidence of hypertension has risen alarmingly as populations have grown more sedentary, with higher temperatures discouraging physical activity still further.

Levels of inter-household inequity have fallen in the case areas, as local remittances have increased, the gap between the richest elites and those on average incomes has narrowed with the crumbling of traditional social structures, and income levels for females have gone up (a process that has been mirrored at regional level, reducing income disparities more generally). This has also limited intra-household inequity, with male family members finding it progressively more difficult to maintain economic hegemony over others in their families. The number of NGOs has gone down over time, but their effectiveness has risen, in part

because they are more coordinated, and in part because they are better positioned to take advantage of mobile technology.

Business As Usual

Land use:

While the rate of change in land use has risen, there has been a gradual move to increased diversification of crops, for example to include more wheat and more vegetables, with continuing increases in shrimp production. Due to improvements in cultivation techniques (following decent hikes in the level of investment in R&D), more efficient use of fertilisers and pesticides, more targeted subsidy programmes and the use of high-yield varieties, yield per hectare for all crops has increased. Consequently, although cultivated areas given over to rice have decreased, overall production has risen.

Reductions in the level of resource conflict, between farmers and fish-farmers for example, along with the enhanced role of agricultural extension officers and more integrated rice/fish farming, provide positive contributions to increasing farm yield, along with higher levels of understanding of appropriate techniques on the part of farmers. Overall, these have the effect of cancelling out the detrimental impact of the changes in seasonality that have been experienced. Less helpfully, the combined effect of more intensive land use and patchy environmental management compliance has been an increase in land degradation.

The extent of coastal defence infrastructure has been enhanced, and natural flood barriers, such as the mangrove forest, have been slightly reduced in extent. Regulation of land use, including for flood plain and sectoral use zoning, has improved, as have levels of Central and devolved planning capacity.

Water

Improvements to the technology used for irrigation have been driven in part by a reduction in the amount of water coming down from India, with some reductions in predictability of availability and water quality. Predictability and availability are affected in part by increased river regulation in Nepal, India and China with water pollution levels being driven by a combination of lower flows and higher levels of upstream industrial pollution. These improvements in irrigation have been to some extent offset by a significant overall increase in the use of water for agriculture.

Reduced freshwater flow and greater use of water for agriculture coupled with sea level rise have heightened problems associated with saline intrusion in coastal areas. Despite this, provision of water to households, even in informal settlement areas, has improved to some extent with better service delivery efficiency and infrastructure maintenance, following investment in water and sanitation service provision pursuant to achievement of development goals.

As a result of the decreasing flow in cross-border rivers, accretion is increasing, with erosion also increasing in the upper reaches of the delta.

Cooperation between water users across and within sectors has improved as a result of the relative scarcity of water and amplified levels of demand.

International cooperation

Maintaining these levels of cooperation has not been aided by a deterioration in the extent to which basin states on the Ganges and Brahmaputra rivers are cooperating, both with respect to water and in relation to trade. This is one of the most significant drivers of the reduction in transboundary flows. China has retained its observer status with the SAARC, and efforts to accord it full membership have not yet succeeded.

Disaster management

Along with increases in the extent of coastal defence and emergency infrastructure (such as cyclone shelters), efforts have been made to better maintain these constructions. Storage of harvested crops is substantially better than in 2013, through initiatives such as cyclone-resistant households. The benefits from these improvements have been a drastic reduction in the loss of life as a result of cyclones, for example, but relative increases in the level of economic damage caused.

Environmental management

After decades of reasonably stable forest cover, the mangrove forest in the case area has suffered a small degree of encroachment. With reduced levels of water flow and increasing use of agricultural fertilisers across the country, for example, water quality has deteriorated to a certain extent, with governance capacity having improved to some degree but not sufficiently to control diffuse pollution. Improvements to reticulated water supplies have not been quite adequate to compensate for this, and consequently levels of water-borne diseases have risen slightly. Protection of biodiversity has been detrimentally affected by a government focus on economic development though efforts by civil society groups to remedy this have been stepped up.

Coastal fisheries have dwindled due to the use of illegal and destructive gear, defying the ban period by the fishers and catching of undersized fishes. Despite this over-fishing continues as enforcement is weak.

Quality of life and livelihoods

The means by which households in the case areas maintain themselves have diversified significantly since 2013, in addition to incorporating changes in cropping patterns. This includes substantial outward migration from the case areas, driven in part by rural pressures but more so by the economic attractions of urban areas such as Khulna, Chittagong and Dhaka. Population levels have remained largely static in coastal regions, though the population is ageing and the fertility rate has decreased. Long time upward trends in literacy rates have continued, with education levels much improved on their 2014 levels.

Income levels are affected positively by a downturn in the importance of intermediaries in production processes, driven in part by rapid developments in mobile information technology and communications, price transparency and market access. Household storage of food has also increased, alleviating periods of scarcity somewhat. As a proportion of income, food is cheaper than it was in previous decades, with better eating habits and protein intake. However, this is offset by a slight increase in the incidence of non-communicable diseases and conditions, such as hyper-tension, with vector-borne (and zoonotic) diseases also rising, mainly as a result of rising temperatures and climatic conditions.

Increased household income coupled with continuing problems with significant disparities in income has resulted in a drop in inter-household equity, although this is complicated by broad advances in the participation of marginalised groups in society. Community power structures of patronage still govern much of rural society, but increasing involvement of the private sector and of NGOs in local economic activities is changing the dynamic. Progress in the availability of mobile communications has made enhanced awareness of legal rights and obligations, and improved access to information to a great degree. Enforcement of these rights has improved slightly, in line with some advancements in local enforcement capacity (through better local government empowerment), though these are somewhat restricted by a lack of progress on the capacity of local courts to process claims. This is highlighted by the disturbing lack of progress on tackling dakoits, which continues to blight the lives and economies of those who rely on fishing in particular.

Less Sustainable Future:

Land use:

Areas that were formerly cultivated have been given over to a mixture of saltwater shrimp and to a lesser extent, rice, respectively serving the export market and local consumption needs of subsistence farmers. Freshwater prawn production has decreased. Saltwater shrimp production has taken increasingly large shares of cultivable land, pushing subsistence farm land into areas more vulnerable to inundation and less protected by coastal engineering infrastructure. More intensive rice cultivation is characterised by high levels of fertiliser use, although yields per hectare have not risen as fast as they might because R&D priorities have focused on producing shrimp for the richest nations.

Inter-sectoral cooperation (e.g. between fishermen and farmers) is on the decrease, and intra-sectoral conflict between the owners of industrial farming concerns (and their tenant farmers), and subsistence farmers is growing. Scarcity of available secure land and the difficulty in obtaining clean water for irrigation from reduced water resources exacerbates disagreements. Agricultural extension officers prioritise the production of exportable crops, leaving subsistence farmers struggling to take advantage of new techniques and subsidies, and subject to heightened levels of insecurity as seasonal cropping patterns change with the climate.

In addition to the encroachment of saltwater shrimp production, mangrove forests have been slowly sacrificed to commercial agriculture, salt pans and unplanned urban spread, as a result of a combination of the government need for hard currency, increasing soil and surface water salinity, and population migration from rural poverty. Vulnerability to flooding has therefore increased as natural barriers have been removed and existing embankments are poorly managed due to lack of financial resources and sectoral conflicts. While floodplain and land use zoning is in place, implementation levels are low because of a lack of enforcement.

Water

Water resources have decreased significantly as a result of a combination of a number of factors: the rapid development of constructed upstream for the purposes of energy production, flood alleviation and irrigation schemes; the impact of the now fully-implemented Inter-linking Rivers Project; and large-scale transfers from the Brahmaputra river in China to provide water for northern irrigation schemes and domestic consumers in Beijing. The efficiency of industrial agricultural irrigation is high, but this is heavily reliant on the unregulated use of groundwater (driven in part by energy subsidies that fuel pumping), necessary because of the lack of surface water flow and the need to access higher quality water untainted by polluted surface water.

The unfettered use of groundwater from the less saline shallow aquifers in the northern part of the southwest coastal zone, coupled with the rise in sea level, has hastened saline

intrusion of aquifers. The spread of unplanned urban settlements, especially in Dhaka, driven by population growth in the country as a whole and by out-migration from coastal areas, have adversely affected water quality downstream as a result of a lack of sewage treatment works. Early advances in achieving development goals have been undermined by this population growth. Although economic gains have to a certain extent continued, they have not been sufficient to counteract changes in population patterns and location.

Levels of cooperation between upstream and downstream districts have decreased within Bangladesh, mirroring the rise in inter-sectoral conflict between land and water users. As land use ownership patterns have moved to a greater proportion of tenant farmers, local water management institutions have found themselves toothless and ineffective, with longer term management decisions being compromised by short term priorities.

International cooperation

Cooperation in terms of access to global markets has increased in some ways, although exports are very much higher than imports. Cooperation at the more regional level has however deteriorated, with basin co-riparians in direct competition with each other, especially with respect to agricultural commodities. This has destroyed efforts to manage regional watercourses at the basin level, with corresponding impacts on the amount of freshwater flowing into Bangladesh. Remaining basin-level governance efforts are focused on maintaining flows needed for commercial agriculture and aquaculture.

Disaster management

Although there has been some increase in the extent of coastal defence and emergency infrastructure (such as cyclone shelters), maintenance efforts have concentrated on protecting agricultural investments. This has resulted in a creeping process of polderisation in downstream areas, although storage of harvested subsistence crops has increased at village level. These are seldom strong enough to withstand the pressures from cyclones and storm surges however. Loss of life as a result of these pressures remains low, but the disproportionately high numbers of female deaths means that impacts on livelihoods are drastic.

Environmental management

Water quality has been detrimentally affected by the relatively low surface water flows coming into Bangladesh and diffuse pollution as a consequence of the liberal use of fertilisers both upstream and in Bangladesh itself. This has been compounded by the effluent resulting from the expansion of unplanned informal settlements. Encroachment in areas previously covered by mangrove has continued, with commensurate effects on biodiversity and the capacity of supporting ecosystem services. Civil society efforts to combat loss of biodiversity have been dissipated by a lack of inter- and intra-sectoral coherence, although the incidence of poverty has been responsible for an increase in the numbers of CSOs. Fish stocks in coastal

rivers are under severe pressure, as are coastal fisheries, partly as a result of irresponsible shrimp farming methods and partly because of poor regulation and enforcement.

Levels of water-borne diseases have risen because poorer families have little alternative to using contaminated surface water for domestic use: groundwater levels have fallen below the limits of cheap pumps, and saltwater intrusion is common.

Quality of life and livelihoods

The embedded power structures characteristic of rural Bangladesh at the beginning of the 21st century have become even more entrenched as local elites take advantage of the economic gains to be made through the production of saltwater shrimp and the low cost of labour. Outward migration to urban centres within Bangladesh, particularly Dhaka, has risen as populations have grown and commercialisation of agriculture has reduced still further labour needs in rural areas. Ever expanding urban areas and low employment opportunities in cities mean that monetary transfers back to rural areas by migrant workers have reduced markedly, and migration out of Bangladesh to traditional remittance-generating regions has become more challenging as the traditional international migration destinations are now very much more selective about immigration because of the sheer volume of immigrant labour sources globally.

Population levels in the case areas have not changed drastically in recent decades, but this is only because higher fertility levels have been offset by stubbornly high mortality rates and the marked increase in outward migration.. Livelihood sources also have not changed greatly, though the number of older tenant farmers has risen, as people of working age have moved to industrial farms for employment, leaving the young and old behind. Remittances from family members who have moved abroad or to urban centres have diminished, but the capacity of the land to support the growing population, coupled with climate-driven changes in cropping cycles has meant that such migration has become a necessity. This is exacerbated by the outward movement of those whose livelihoods have been destroyed by storms. Those living in the largely unplanned informal urban settlements are often forced to live in a hand-to-mouth way, with only the luckiest progressing on to secure jobs. Family structures are less strong than they were 30 or 40 years ago, although family networks are of great importance in maintaining remittance levels at even their current level.

Those working in industrial agricultural operations enjoy greater security of income, although salaries are kept low by the constant need to keep Bangladesh competitive in a very difficult market. Subsistence farmers remain almost completely outside national and international markets, and are unable to take advantage of technological advances in mobile telecommunications. The main developing market for those engaged in business outside the major agricultural conglomerates lies in West Bengal, with cross border trade in the area between Kolkata and Khulna growing rapidly, a process aided by the gradual destruction of the sundarban mangroves. Electricity distribution networks are unreliable especially in coastal areas, an ongoing problem caused mainly by the poverty in the area and the high frequency of damage by storms. Food and protein scarcity in subsistence areas has become a

problem, leading to an increase in open water fishing by residents, despite the risks. The incidence of vector-borne (and zoonotic) diseases has risen, mainly as a result of rising temperatures and climatic conditions.

The erosion of family structures has, surprisingly raised levels of intra-household equity as earners of any kind have being more important, but inter-household equity has dropped as the split between subsistence and tenant farmers has deepened. More urgent efforts by NGOs and CSOs to help the very poorest have been beneficial in terms of encouraging broader civic participation, but the power differential between largely locally-focused groups and the large scale farming concerns has rendered the work of the former largely irrelevant. Earlier weaknesses in local dispute resolution and access to rights have multiplied with the involvement of local elites in wealth development activities. Creeping centralisation over a period of decades has left an emboldened local governance framework characterised by lack of accountability and transparency, and an absence of central oversight. Backlogs in local courts have fallen, but this is the result not of greater efficiency but of an increasing fatalism of the part of the aggrieved population.

The ability of the poorest to access lending facilities is very restricted as formal institutions are reluctant to lend. The poor remain reliant on lending at usurious rates by local lenders. The increased incidence of piracy further affects livelihoods, especially those of fishers, whose numbers are dwindling as stocks collapse and migration becomes more attractive.

7.2 Appendix 1 – Report of the First Stakeholder Meeting, October 2013:

7.3 Appendix 1 – Report of the Second Stakeholder Meeting, May 2014:

(NOTE THAT THE FOLLOWING CONTAINS ONLY THE CORPUS OF THE ABOVE REPORT: THE ANNEXES ARE OMITTED FOR THE SAKE OF SPACE – THEY CAN BE VIEWED IN THEIR ENTIRETY AT WWW.ESPADELTA.NET)

I INTRODUCTION

The second stakeholder workshop was held in Dhaka on the 14th May 2014. The scenarios element of the workshop took place in the afternoon, attended by around 70 people and was chaired by Andrew Allan and Prof. Shamsul Alam of the GED.

Attendees were presented with a copy of the consolidated scenario narratives before lunch (attached as Annexe 1 below), with an introductory lecture provided by both Andrew Allan and Emily Barbour, dealing respectively with the process and results so far, and the approach to translating the narratives into data that could be accommodated by the project models. Following a further introductory talk regarding session objectives by Dr. Michelle Lim after lunch, the attendees were split into three groups by simply going around the tables and numbering people from 1-3, going right to left. This was an effort to ensure that there was no institutional bias in any one group. Each group was allocated one of the scenarios and given instructions (and some background) on how they should interpret the document and what they should do with it. The only problem that did occur with the groups was that a tendency towards holding group discussions in Bengali forced out those (1 or 2) who were did not speak the language, pushing them into other groups. There was also a certain amount of confusion among some participants over the scenarios reflecting possible *future* situations rather than reflecting an interpretation of the existing position.

After the tea break, each group's appointed spokesperson presented their group's findings on a flipchart. Lack of time, and the presence of the State Minister for Planning, meant that there was no opportunity to go through the consolidated comments with participants. A great deal of debate was generated in each group.

II – THE SCENARIO NARRATIVES

The first stakeholder workshop took place in Dhaka in October 2013. Participants agreed to a consolidated list of issues of greatest concern to them (as outlined in the

WP1 Fast Track document), and proceeded to detail how individual elements of those issues might look under a Business as Usual scenario in 2050. This produced a list of almost 100 individual elements, along with an outline of the degree and direction of change expected.

The list was translated into a narrative summary for ease of comprehension, and preliminary efforts were made to identify which of the elements could feasibly be represented in the project modelling efforts. Two further narratives addressing the stakeholder-proposed elements were also subsequently drafted, representing More and Less Sustainable projections. The three resulting scenario narratives were largely inspired by the IPCC Shared Socio-economic Pathways process for the AR5 reporting cycle:

ESPA Deltas Scenario Title	IPCC SSP equivalent
More Sustainable	SSP1
Business as Usual	SSP2
Less Sustainable	SSPs 3 and 4

The draft scenario narratives were modified to take account of comments from project partners before presentation to stakeholders.

The aim of the workshop was to allow stakeholders to inspect the narratives and critically analyse them in terms of:

- Credibility and internal consistency
- Management interventions that they might consider for maximising positive outcomes and minimising negative ones; and
- Barriers to implementation of policy and management interventions.

It had originally been planned that the stakeholders would also be able to add indications as to how to quantify individual elements and comment on the assumptions that have already been made by project partners. It was further hoped that they might advise on methods for incorporating the more qualitative elements in the physical modelling process. The time available for these exercises was unfortunately drastically curtailed as a result of the workshop objectives being expanded to include the development of links between the Delta Plan 2100 and the ESPA Deltas Project.

III – MEETING RESULTS

The full version of what was written-up by each scenario group on their flipcharts is attached below. Much of what was provided by stakeholders, especially with respect to the Business As Usual narrative, raised issues that had not previously been mentioned (or not mentioned in the same form). This is

problematic in terms of the scenario development process as there was less consensus at the second stakeholder workshop than the first, and it is therefore more difficult to assume that new issues raised are ones that are of concern to all. While there was a reasonable level of overlap between the participants at each workshop, it is not clear how many of those who attended the first workshop were represented in each group at the second.

Because consensus was undermined to a certain extent by the group dynamics, the following issues remained unresolved at the end of the meeting. These are:

- Sedimentation
- Groundwater use and impacts on the resource
- demographics

III– PRELIMINARY ANALYSIS

Breakdown with respect to Interventions and Barriers to implementation

The following sections have extracted the relevant findings from the summary of stakeholder views presented in Annexe 2, and a preliminary assessment has been as to modelling viability. In the Barriers section below, general themes have been extracted with a view to coordination with the existing Barriers to Implementation report. This section also provides further detail on the issues raised, breaking down acronyms and providing a little more information on the measures / barriers identified.

It is unfortunate that the group discussing the Less Sustainable scenario narrative identified neither Interventions nor Barriers. However, the level of detail included by the BaU group may raise most of the relevant possible Interventions and Barriers, so hopefully this absence of detail will not prevent proper analysis.

Management Interventions: potentially modellable highlighted in yellow

- More Sustainable
  - Required to improve drainage
  - Allow room for flood
- Business As Usual
  - Upazila-based land use planning –
  - Proper urbanisation policy – Not modellable, other than presumably reducing urban sprawl in LULC projections?

  - Soil Resource Development Institute – following the agricultural land use plan of SRDI – Spatial database.
  - Enactment of Bangladesh Water act, 2013
  - Environment Conservation Act 1995, Rules 1997 –
  - Capacity development of local government
  - Ministerial / relevant agencies
  - Policy intervention – e.g. WWPo 1999
  - SAARC water forum (Nepal, if possible China)
  - SSC and TC
  - Large scale mangrove management – presumably modellable to some degree in terms of extent and location?
  - Physical intervention
  - Bangladesh Climate Change Strategy and Adaptation Plan 2009 proper implementation. Only way it could be modellable is if individual project objectives were somehow incorporated.
  - Capacity building of agencies
  - Poverty Environment and Climate Mainstreaming (PECM) –
  - Mainstreaming poverty reduction in all development projects – pretty much the same as PECM but measureable through reduction in poverty? Assumes causal relationship that may not be there though.
  - NSPS (National Social Protection Strategy)– proper implementation. Planning Commission - there are some specific indicators of poverty that could be modelled - see http://www.plancomm.gov.bd//upload/2014/NSPS.pdf.
  - SSIP (Supporting Sustainable and Inclusive Development (project between UNDP and GED -)..
  -
- Less Sustainable - **None Suggested**

The results of the stakeholder discussions on Barriers to Implementation were as follows:

Barriers to Implementation

- More Sustainable
  - Equal cooperation
  - Through increased manpower. Export – earnings – investment. Industrial development; economic development; soft power.
- Business As Usual
  - Proper mandate / linkage
  - Policy – implementation gap
  - Stakeholder awareness
  - Capacity of agencies (e.g. DoE) [something also here or related to intervention section – looks like OIP or CIP)
  - Capacity of LGIs
  - Centralisation
  - Negotiating sklls

  - Trade off
  - Sharing attitude
  - Development partners' commitment
  - Harmonization
  - Commitment
  - Capacity of agencies involved
  - Stakeholder involvement
  - Capacity building
  - Lack of awareness
  - Integrated approach
  - Localisation?
  -
- Less Sustainable - **None Suggested**

IV- CONCLUSIONS AND NEXT STEPS

There was a broad degree of acceptance of the draft narratives among the groups.

With respect to the barriers to implementation, there is clearly a high degree of overlap in the list suggested by stakeholders. The following general themes seem to emerge:

- Stakeholder involvement and lack of awareness
- Lack of cooperation / integration (both internationally and cross-sectorally)
- Level of commitment on behalf of donors and politicians (?)
- Lack of capacity (institutional, and including re. negotiating skills)
- Centralisation / decentralisation of decision making

With regard to the management interventions, these are potentially of great relevance to the research envisaged under WP6. However, from the list outlined during the May workshop, it seems that it will be very difficult to model most of the suggestions. In fact from the overall list of around 20 interventions identified, less than half of these might reasonably be considered candidates for modelling, due to restrictions in modelling capacity, ambiguity in interpretation or sheer scope of the intervention mentioned.

In addition to the problems of interpreting the above in such a way as to render them modellable, serious difficulties are likely where some degree of spatial explicitness is desired. Ultimately, it would be very useful for the integrated model to represent the potential consequences of e.g. polder construction in specific locations [c.f. also useful with respect to the interface with the CEIP process too].

7.4 Appendix 1 – Report of the Third Stakeholder Meeting, November 2014: