Conditions for Planning Support Systems – the case of the Dutch Delta approach in Bangladesh

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Abstract

Critical developments in developing countries, such as climate change and rapid urbanization, ask for a sustainable, integrated and participatory approach to planning. The Dutch Delta Approach (DDA) is such an approach that is currently being transplanted to a developing context. However, limited research has been conducted on the role of Planning Support Systems (PSS) in the transplantation of this knowledge abroad. In this paper, we review two case studies that apply the DDA in Bangladesh to gain insight into application of PSS in developing countries. We investigate how a planning approach developed in a Western context can be transferred to a developing country supported by a PSS and what the added value of the PSS is in this process. A main finding is that although literature research predominantly focuses on more conceptual conditions such as a suitable policy and planning context, empirical research shows that practical conditions such as data accessibility and proper facilitation are equally important for a successful use of PSS in the transplantation of the DDA.

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1. Introduction

In the PSS debate there tends to be a bias toward Western countries and cities. The vast majority of PSS studies reports on PSS applications in Australia, North America or Europe. Although China is recently receiving more attention (see examples in Geertman et al. 2013), countries in the east and south have generally not been focus of study so far – even though the rapid urban growth in these countries makes for a very interesting case for studying the application and potential added value of planning support systems to guide these developments.

In order to address this omission, this paper aims to gain a better insight into the conditions for successful application of PSS in developing countries. In doing so, it starts by observing two trends. Firstly, over 500 million people worldwide live in delta areas that are rapidly urbanizing (Overeem and Syvitski, 2009). These highly dynamic urban regions are teeming with economic activity and are constantly expanding. At the same time, they are becoming increasingly more vulnerable to the impacts of climate change. Rising sea levels, increased river discharge, extreme weather conditions, subsidence pose significant risks to the inhabitants of these regions – such as flooding, drought, increased incidence of water-borne diseases or salt intrusion in agricultural areas. An increasingly limited access to resources in combination with demographic and socio-economic pressures adds to the challenge. Developing countries are particularly faced with these critical challenges. Strategies need to be developed that allow for sustainable, climate-resilient development of these areas.

Secondly, urbanized areas are increasingly becoming 'smart cities'. Technologies are applied more and more to manage and plan cities. Cities are 'being instrumented with digital devices and infrastructure that produce 'big data' (Kitchen, 2013). A specific aspect of a smart city is the set of dedicated tools to support planning processes, often referred to as Planning Support Systems (PSS). Whereas their uptake has been considered disappointing over the last decades (Vonk 2006), the rise of the smart city might offer new potential. Particularly, when PSS are applied to support collaborative processes and incorporate local knowledge (Goodspeed 2014).

These two trends − the rise of growing yet fragile deltaic areas in developing countries and the increasing importance of the smart city – form the rationale of this paper. In its aim to achieve a better understanding of the conditions for successfully applying a PSS in developing countries, this paper focuses specifically on the transplantation of Dutch planning and water management expertise into the developing context. Its premise is that Planning Support Systems (PSS) can support both the transplantation

of water expertise (particularly the Dutch Delta Approach) and the incorporation of local knowledge into the sustainable delta decision-making process. This Dutch Delta Approach is an integral, adaptive approach to mitigate the risks and realise the potentials of delta areas that has been developed in the Netherlands. It enables sustainable and climate-robust development of urbanising delta areas by addressing both flood risk mitigation and water supply while taking into consideration future uncertainties (Delta Programme Commissioner, 2012).

However, in order to be able to apply this knowledge to developing countries it needs to incorporate local knowledge and expertise and take into consideration the specific cultural and institutional context of these countries. In this paper, we investigate how the PSS can support that transplantation by looking at the prerequisite conditions for and added value of a successful application of a traditionally Dutch PSS instrument in a developing delta area in Bangladesh.

The aim of this paper is to get a better insight into the conditions for successful PSS applications in developing countries. In doing so, the paper is structured as follows. Section two describes a brief literature review, in which the most important conditions for successful PSS applications are discerned. Next, section three describes the Dutch Delta approach and the way in which a PSS can have added value herein. These insights from the PSS debate and the Dutch Delta approach were empirically studied in two case studies in Bangladesh – section four reports on the findings – followed by reflections on these case studies in section five. Section six wraps the paper up by outlining the main conclusions and indicating directions for future research.

2. Theoretical perspective on prerequisite conditions and added value of PSS

PSS-oriented research has so far focused predominantly on western settings. This research has been conducted into both the so-called supply side and demand side of PSS, and particularly the mismatch between the two supposedly leading to its limited uptake (e.g. Geertman, 2006; Vonk and Geertman, 2008). This mismatch has been explained from three different perspectives. Firstly, the instrument approach, which focuses on the 'quality of the PSS themselves, specifically the extent to which PSS match up with the characteristics of the actual planning tasks and intended users' (Vonk et al., 2006, in Vonk and Geertman, 2008, p155) – see for instance the recommendations for intrinsic success factors by Geertman and Still-

well (2004). Secondly, the transfer approach, studying '[PSS] diffusion to planning practice' (Vonk et al., 2006, in Vonk and Geertman, 2008, p155). And thirdly, the user approach, which considers 'the acceptance of PSS by their intended users' (Vonk et al., 2006, in Vonk and Geertman, 2008, p155-156).

For the purpose of this paper, it is equally important to consider the appropriate context for applying PSS – in other words, the extrinsic factors that influence a successful uptake of PSS. The following factors were identified as observed extrinsic factors influencing the adoption of PSS by Geertman (2006):

- Content of the planning issue – i.e. adequate interpretation of the issue at hand, for instance through a clear problem definition, but also the extent to which the planning issue lends itself to quantitative-oriented analytical or modelling instruments;
- User characteristics – i.e. users' professional qualities and approaches, for instance whether they are more research-oriented or more design-oriented;
- Characteristics of the planning and policy process – including operational requirements (e.g. time available, nature and rate of participation) and non-PSS related requirements influencing the planning process (e.g. political, juridical or economic factors); as well as the orientation of the planning process – whether it is more socially oriented, politically oriented or more scientifically/intellectually oriented;
- Political context – influencing the required level of transparency and public accountability of planning- and decision-making process;
- Specific characteristics of geo-information, knowledge and instruments themselves – such as the availability, accessibility and/or utility of data (including inherent data biases) and the existence of 'irrational, dynamic, political, juridical, economic, and other more or less non-spatial factors' (Geertman, 2006, p869) that play an important role in the spatial planning practice but are difficult to incorporate into the PSS;
- Dominant planning style and policy model – i.e., the normative opinion on how planning should be approached as well as 'the way in which a policy agency […] transforms an identified problem […] into a politically sanctioned policy' (Geertman, 2006, p869).

Based on recent findings and earlier experiences in developing countries, two types of conditions can be added:

- The facilitation of the workshop in which a PSS is applied. Pelzer et al. 2014a, for instance, show the variety of available facilitation interventions in a PSS workshop.

- The physical setting in which a PSS is applied. Interviews with experts and our own experiences have taught us that concrete circumstances like the available internet connection and set up of the room are critical for successful PSS applications. This also includes the number of participants in a workshop.

Although the framework developed by Geertman (2006) provides a useful starting point for consideration of the critical context-conditions for successful application of PSS, it was derived from research conducted in the western, developed planning context; as were for instance the recommendations for intrinsic success factors derived by Geertman and Stillwell (2004). This bias, as mentioned previously, is observed throughout the PSS debate. For instance, in recent edited volumes about PSS, only a few studies report on PSS applications in the global south (see Geertman et al. 2013, Geertman and Stillwell 2009, Brail 2008, Geertman and Stillwell 2004, Brail and Klosterman 2001). A notable exception is a study by Biermann (2011), who focuses on PSS application in South Africa, but is limited to those factors influencing the 'design of the PSS instrument itself (intrinsic quality), rather than those influencing its uptake in practice (diffusion and adoption) (Biermann, 2011, p6). As argued by Biermann in this research, a 'significant success factor in the design of a quality PSS, particularly Spatial PSS, is the ability to respond to and accommodate a range of context specific dualisms' (Biermann, 2011, p6) – including not only economic and demographic dualisms, but also dualisms in differential levels of access to information technology and differential user skills and capacity levels.

In sum, insight is lacking into the conditions for successful application of PSS in developing countries. While this is already a notable omission in the debate, this paper adds another dimension. We explicitly aim to transfer (elements of) an approach to water planning – specifically, the Dutch Delta approach – to a developing context. Hence the question is not simply how a PSS can be applied in a developing context, but more specifically how a planning approach developed in a Westernized context can be transferred to a developing country supported by a PSS and what the added value is that the PSS can bring to this process.

3. Dutch Delta Approach – the added value of PSS

In addition to considering the necessary conditions for successful PSS application, it is important to consider what the added value of PSS can be. In the introduction, it was stated that the premise of this paper is that PSS can support the transplantation of water expertise (particularly the Dutch Delta Approach). This inherently implies that the application of PSS has an added value to the implementation of this approach. In order to address this premise, this paper will now provide a concise overview of the Dutch approach to water management by considering the Dutch Delta Programme, and on the basis of that, identify the potential added value of PSS to the guiding principles of this approach (cf. Pelzer et al. 2014b).

3.1 The Dutch Delta Approach

The Dutch Delta Approach has been developed in the Dutch Delta Programme. This national-level programme originated in 2010 to protect the Netherlands against flooding and ensure sufficient freshwater supply now and in the future. It is a collaboration between national government, provinces, municipalities and water boards that aims to address flood and water supply in an integrated manner, linking different scales and different time spans – from short-term to long-term.

Its organisation can be summarised by the so-called 5 D's. The Delta Act sets out the legal base for the Delta Programme to ensure continuity. The Delta Fund (of approximately 1 billion euro/year) provides the financial means for implementation of the recommendations that come out of the programme, together with budgets of the relevant Ministries. The Delta Commissioner is in charge of the preparation of the Delta Decisions which form the core of the Delta Programme – key decisions that set out a long-term direction for water management in the Netherlands. Each year, he proposes that year's Delta Programme to be submitted by the Cabinet to the Parliament as part of the national budget. The Delta Decisions are introduced in the draft 2015 National Water Plan in order to be implemented (see fig. 3.1) (Delta Programme, 2011, p46).

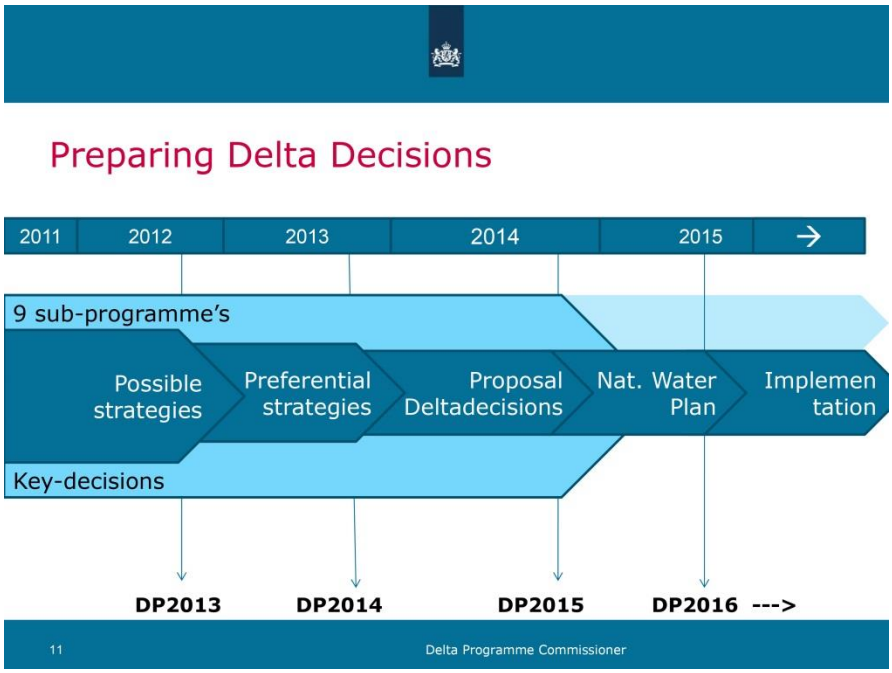

Fig. 3.1. Overview of the preparation process of the Delta Decisions (Kuijken, The Dutch Delta Approach Presentation to OECD, 2012)

In sustainable delta planning, of which the Dutch Delta Approach is an example, there are several general ways in which PSS have supported the planning- and decision-making process. Generally, they have been said to aid in 'problem diagnosis, data collection, mining and extraction, spatial and temporal analysis, data modelling, visualization and display, scenario-building and projection, plan formulation and evaluation, report preparation, enhanced participation and collaborative decision making' (Sudhira and Ramachandra, 2009, p178-179). In the Dutch Delta Programme, PSS tools have been used for instance for vulnerability diagnosis, climate-resilient design (through Climate Ateliers, cf. Goosen et al., 2014) and cost and damage assessments (by means of the Planning Kit, cf. Van Schijndel, 2005). However, there are several overarching characteristics of this approach to which PSS can make a valuable contribution. These characteristics, and particularly their consistent application throughout the planning and decision-making process, are to a greater or lesser extent unique to the Dutch Delta Approach. They consist of several basic principles and a number of planning approaches that together form a series of guiding principles within the Dutch Delta Approach (Delta Programme, 2011; Delta Programme Commissioner, 2012).

- Interconnectivity
  The basic principle of interconnectivity relates to an integral consideration of measures for both flood safety and availability of water. This implies that from the outset of the project, a multidisciplinary approach is required. In this, the Delta Commissioner plays an important role.
- Consistency
  Consistency is another basic principle within the overall Delta Programme – this relates for instance to consistent application of climate change and socio-economic scenarios used in the different sub-programmes within the Delta Programme. It ensures for example that the base data used within different parts of the programme correspond.
- Transparency
  Transparency, a third basic principle, is required within the planning- and decision-making process. This of course contributes to a higher democratic ideal but also has a very practical component, which is that transparency will help gain a wider support for the decisions that come out of the programme.
- Linking area-based approaches to national objectives
  According to the Dutch Delta Approach, a link between local agendas and large-scale national objectives is important. The national objectives for flood safety and water supply are considered in conjunction with local area ambitions. This interaction is enacted both at an administrative and an operational level, and existing consultation frameworks are retained where possible. (Delta Programme, 2011).
- Multi-level governance
  As mentioned previously, the Dutch Delta Approach combines national objectives with area-based implementation. This requires multi-level governance incorporating all levels of government – national, provincial and municipal, as well as the water boards. In addition, its integral focus (elaborated upon below) requires involvement of stakeholders in charge of tasks related not only to flood management and water supply, but also tasks and agendas from other policy fields.
- Linking short-term and long-term
  In order to address both urgent issues and ensure long-term sustainability, the Dutch Delta Approach applies the concept of ‘adaptive delta management’. In light of the uncertainties of long term developments, including climate change and socio-economic developments, this decision-making approach considers short-term measures that are not only suitable for addressing current issues but are also appropriate for the longer term, ‘increas[ing] adaptability (flexibility) and resistance to extreme events (robustness)’ (Delta Programme, 2011, p46).

- Joint knowledge development
  Within the Dutch Delta Approach, joint knowledge development and the incorporation of local knowledge is an important component of the decision-making. This collective development of a knowledge basis not only contributes to the quality of the outcomes of the planning and decision-making process, but also increases stakeholders' engagement with and support of these outcomes. Joint knowledge development is achieved for instance through joint fact-finding (Delta Programme, 2011).

3.2 Added value of PSS in Dutch Delta Approach

The premise of this paper is that PSS can contribute to the specific characteristics of the Dutch Delta Approach elaborated upon above. Table 3.1 provides an overview of the ways in which PSS can contribute to these characteristics, providing added value to the implementation of the Dutch Delta Approach. These potential contributions for PSS in the Dutch Delta approach have been observed in the Delta programme in the Netherlands.

Table 3.1 Overview of hypothesized added value of PSS to Dutch Delta Approach

Dutch Delta Approach principles	**Hypothesised added value of PSS**
Interconnectivity	Enabling an integrated consideration of multiple objectives
Consistency	Encouraging and allowing for consistency throughout the project, e.g. consistent use of base data
Transparency	Allowing for more openness of and contribution to the decision-making process, thereby increasing support for the decisions following from the planning process
Linking area-based approaches to national objectives	Combining of and switching between different scales, mapping ambitions on various scales
Multi-level governance	Bringing governmental representatives from different levels together in both problem analysis and strategy development
Linking short-term and long-term	Bringing a long-term outlook into the planning- and decision-making process through visualising future scenarios
Joint knowledge development	Enabling joint fact-finding, harvesting of local knowledge, verifying of data, collaborative strategy development, generally facilitating stakeholder engagement processes

With the Dutch Delta Approach now finding ground internationally, including in developing nations (e.g. in the Bangladesh Delta Plan 2100), it is relevant to evaluate the extent to which these added values can be achieved in developing countries, where the planning process and policy

context are inherently different from the western world. Conversely, if so, what conditions or (extrinsic) success factors need to be present in order to achieve those added values? In order to do that, the next section describes two case studies that will provide empirical data as to which requirements are particularly important in the developing context and which added values for the Dutch Delta Approach can be achieved.

4. Case study review

Bangladesh is a key example of a rapidly urbanizing delta region that is experiencing high vulnerability. Bangladesh is considered one of the most vulnerable countries in the world (Yu et al., 2010). Currently, approximately '21 percent of the country is subject to annual flooding and an additional 42 percent is at risk of floods with varied intensity' (Ahmed and Mirza, 2000, in World Bank Group, 2010, p47). In addition, it is vulnerable to other natural disasters such as cyclones and droughts (World Bank Group, 2010). At the same time it is experiencing high annual growth rates (BBS, 2011). Climate change is only going to increase the vulnerability. As a result of these conditions, the challenge for Bangladesh of increasing its resilience to the effects of climate change while at the same time accommodating this population increase and rapid urbanization is substantial.

The two cases reviewed in this paper focus on these challenges in different ways. The first one, the Climate Adaptation Atlas Bangladesh which was undertaken between 2012 and 2013, is a regional scale (pilot) project in which adaptation strategies have been developed in relation to the particular challenges of food security and flood risk under climate change. The second case study, the currently on-going Bangladesh Delta Plan 2100, is a country-wide programme that aims to provide an integrated strategy for sustainable development of this vulnerable nation.

4.1 Case Study 1. Climate Adaptation Atlas Bangladesh

4.1.1 Introduction

The first case described focuses on the Haor Region in the north east of Bangladesh. This region, with a surface area of approximately twelve thousand square kilometres and a population of close to 10 million

(BBS2011), is an extremely fertile area that is crucial to the food security for a large part of Bangladesh. With its characteristic depressions in the landscape known as *haors*, it provides both land for rice production in the dry season and surface water for fishery when the haors fill up in the monsoon season. At the same time, its location at the foot of steep hills in the surrounding Indian territory makes it vulnerable to flash floods. These flash floods threaten the rice harvest and are likely to worsen with the impacts of climate change. Population increase lays a claim on land for settlement growth, thus increasing the conflicts in land use further.

The 'Climate Adaptation Atlas Bangladesh' project that was executed between 2012 and 2013, aimed to explore the applicability of the Climate Adaptation Atlas as Planning Support System for developing climate adaptation strategies for this region. The Climate Adaptation Atlas is a participatory planning tool that discloses and visualises spatial information on both the physical and socio-economic system to a wider audience. This information includes maps and data on impacts and vulnerability of a certain area, particularly related to climate change such as increases in flood risk or droughts. This information is then collected in an atlas which is displayed on a touch table (a touch-sensitive digital platform) to allow for interaction by stakeholders. The tool enables them to identify key challenges in their areas of interest, and to develop appropriate strategies to reduce risk and increase resilience. It also allows for awareness-raising, agenda setting, joint fact finding, identification of knowledge gaps and capacity building. The CAA tool is used in interactive and multi-disciplinary workshops with scientists, policy and decision makers, spatial planners, and local stakeholders (Goosen et al., 2014).

For the 'Climate Adaptation Atlas Bangladesh', the PSS was applied for the development of an adaptation strategy for the flood-prone haor region described previously. In a first mission, preliminary analysis in combination with client consultations led to a narrowing down in focus to one specific but crucial problem in the area: (flash) flood impacts on food security, wetland conservation and flood safety, now and in the future. In this region, climate change is expected to influence rainfall patterns and to have an impact on the timing and frequency of flash floods. These flash floods in turn affect rice production in this area – particularly the production of boro rice, a high-yielding crop that plays an important role in food security of Bangladesh. A thorough understanding of the potential impacts of climate change on rice production in the area, as well as potential adaptation measures to reduce the vulnerability in the area, is therefore crucial. In addition, a consideration of expected socio-economic or demographic developments in the area is important, as the predicted considerable population growth increases the demand for new settlements and thereby the claim on

land by these settlements, yet also increases the demand for agricultural production. In the development of an appropriate adaptation strategy for the region, these processes need to be understood – the relations between the autonomous developments of climate change and demographic changes, the resulting changes in flood timing and patterns as well as land use claims and finally, the vulnerability and risk of the local population in which these result.

In order to achieve that, the Climate Adaptation Atlas Bangladesh project set out to conduct a joint problem analysis, to discuss and define appropriate adaptation measures and to develop an adaptation strategy based on these measures. This was done in a participatory workshop entitled "Integrated Management of Food, Wetland Habitat and Flood Safety under Climate Change" held at the local partner's office in Dhaka, in February 2013. A group of 10 selected participants from various institutes and different levels of government involved in regional planning were invited to participate.

4.1.2 Workshop set-up

The workshop started with an explanation of the purpose of the workshop and a brief discussion on the concept of vulnerability analysis. Next, a demonstration of the touch table was given by the local partner with an explanation of its use in the local language, and participants were asked to familiarize themselves with the tool (see fig. 4.1).

Fig. 4.1. Introduction of the tool and approach by local partner in workshop

Subsequently, the participants were asked to consider two series of vulnerability analyses: food security in relation to flash floods and flood safety of settlements in relation to monsoon floods. In the workshop, several base maps were combined with land use data, flood maps, and predicted potential effects of climate change on flash flood frequency. On the basis of this confrontation of multiple sets of information, participants were asked to develop two vulnerability maps (see figure 4.2).

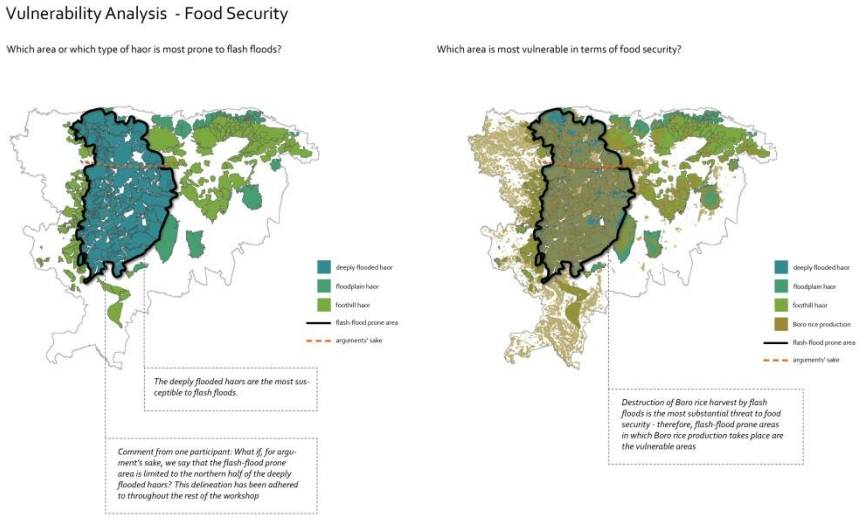

Fig 4.2. Outcomes of the workshop: vulnerability maps with regard to flash floods (left) and food security (right)

Subsequently, participants were asked to discuss possible adaptation measures to reduce this vulnerability. A set of measures (mainly physical interventions such as improved drainage, alternative crops and pole housing) had been compiled in advance of the workshop on basis of policy documents and existing master plans and participants were asked to discuss the appropriateness of these measures and add measures where necessary. Next, the participants allocated appropriate measures to the vulnerability maps produced previously in a first attempt towards an adaptation strategy for the region (see fig. 4.3).

Fig. 4.3 Workshop facilitation: development of adaptation strategies

4.1.3 Reflection on the use of PSS

The project has clearly demonstrated the potential of the participatory platform for adaptation planning. In an evaluation session following on from the workshop itself, the participants were asked after the added value of the PSS and particularly, whether they believed it stimulates participation and whether new knowledge had been acquired. A positive response was given by all participants.

The participants particularly mentioned the following benefits of the approach:

1. The climate atlas ***makes complex and dispersed knowledge accessible and harvests local knowledge***: The approach integrates and visualises complex climate information. The touch table enables users to easily compare and analyse maps from different disciplines. It also allows for easy switching between different scales, zooming in and out between local and regional level. The touch table invites the participants to share their local knowledge and check data collected previously by the facilitators. As the following quotes illustrate:

"Technical information is made accessible through visualization in the touch table"

"With the touch table we can connect micro-level with the macro-level; processes at the grassroot level can be confronted to processes at the national level"

"It is good to see that the huge amount of data (science knowledge) is translated into a small set of readable maps (political knowledge). With the touch table we can easily check the correctness of the maps"

2.The approach ***stimulates joint strategy development***: Participants worked together on developing suitable climate adaptation strategies. They analysed future land use scenarios by making overlays with the worst case flood maps and indicated vulnerable areas within the case study region. Or as the following quote reveals:

"We can talk about the strategy. All the stakeholders have different opinions; this is a way to discuss them. It is more than only showing then, that's the main beauty."

3.The approach ***increases acceptance of the workshop outcomes*** because participants contribute directly to the participatory planning process. This increases the stakeholder's acceptance of the outcomes of the decision-making process. As illustrated by the following quote:

"The tool is very […] helpful for planners in decision-making process in a participatory way"

4.1.4 Additional observations by the project team

In general, the PSS was considered to be a useful tool. Although participants were not familiar with the PSS itself, they had experience with computers and touch technology such as tablets, which allowed for intuitive use of the touch table. The introduction of the tool and brief demonstration by the local partner, in the local language, helped with familiarization and overall acceptance.

The cultural context of Bangladesh, which is rather hierarchical, makes active and equal participation challenging. Throughout the workshop, good facilitation was therefore required to ensure proper stakeholder interaction from all present. This included the introduction of the PSS by the local partner, but also culturally sensitive, pro-active facilitation that took into account and addressed existing group dynamics.

Data availability and accessibility was another barrier. The amount of data available was limited, and getting access to that data was challenging. This is related to the specific culture of Bangladesh, in which data is very valuable and therefore not shared easily.

Finally, the physical setting of the workshop proved to be a challenge. Although the room in which the workshop was held was suitable in terms of size and ability to block out daylight (which interfered with the hardware used), the power supply proved to be unreliable. A power cut and failing back-up generator caused a disruption in the workshop, necessitating the facilitators to improvise with the workshop schedule to switch to activities that were not PSS-based.

4.2 Case Study 2. Bangladesh Delta Plan 2100

4.2.1 Introduction

More recently, the same PSS was applied in the Bangladesh Delta Plan 2100 – a national-scale project that aims to develop an integral approach that addresses future challenges faced by Bangladesh through a strategic plan with a long-term horizon of 100 years while also providing short-term results to solve urgent problems. This project is a full-scale transplantation of the Dutch Delta Approach to Bangladesh, making use of the same methodology and guiding principles of the Dutch Delta Programme. Since the project is currently on-going, the observations below are related to the analysis phase of the overall project. Subsequently, strategy development will take place.

4.2.2 Workshop set-up

The approach for the analysis phase consisted of a series of base line studies on 20 different topics ranging from agriculture to major rivers to urbanisation in order to establish what information is available and what the current situation is. Objectives were the following:

- collecting main issues and expected future factors of influence for each baseline study theme
- verification with baseline study experts on the base data maps – basic geographic information – relevant to the various Baseline studies and primary climate change indicators
- verification with experts on hazard, vulnerability and risk maps for the current situation (flood, drought, erosion, salinization etc.)
- compilation of results in a so-called delta atlas

In a series of workshops, the following seven baseline clusters were addressed: water resources, water supply and sanitation, disaster risk reduction, spatial planning and land use, food security, environmental manage-

ment, economics and finance and governance. The following three assignments were dealt with for each of these clusters:

1. What are the main thematic issues for the BDP?
2. What influencing factors are expected to affect these issues?
3. What maps would be most essential to display the issues and influencing factors?

A PSS was applied to answer the 3rd assignment. In order to achieve this, a basic set of maps was prepared related to a baseline cluster; in an interactive session their quality was discussed. The following questions were raised specifically: Do they describe the issue well as identified under assignments 1 and 2? If not, what should be changed? If yes, what is the quality of the data? The data was queried, overlaid with other maps, and provided at different scales by zooming in and out. Often the source was requested by participants - this was a very important point. If the map was not of perfect quality, a note was made on how to improve it. If the map was of high quality it was marked green for use further in the process and in the delta-atlas.

4.2.3 Reflection on the use of PSS

In the analysis phase, Phoenix software was used that had been applied in Case Study 1 as well. Two small and one large touchscreens were available and all had the same structured set of data layers. Over two hundred maps were available. These had to be assessed by stakeholders to establish their reliability and current accuracy. Base data was often lacking in specific information on the source and temporal aspects (which measurements were visualised over which period). This led to discussion on legends as well. Some base maps were not available as gis-data and therefore had to be scanned in and assessed as image. Sometimes, visualisation of data layers led to discussion on other thematic issues not foreseen. On the basis of the workshop discussions, a list of over 75 additional required maps were identified. Several were assembled and produced afterwards and added to the database.

The complete set of maps was used in the baseline studies described previously. In this way, a consistent central knowledge base was set up, with everybody using the same data throughout the project. It further encouraged organizations that had data available to share this data with other parties within the project. Finally, the assignment encouraged participants

to make information visual: data had to be made available in maps displayed on the touch table, forcing them to translate the knowledge into maps and models (see fig. 4.4).

Fig. 4.4 Workshop set-up for Bangladesh Delta Plan 2100: Available maps and touch table.

4.2.4 Additional observations by the project team

During the analysis phase, it became apparent that the Bangladesh planning culture lacks a long-term horizon. Immediate problems and short-term solutions get most focus, while expected future developments or uncertainties are not taken into account. In addition, there is a lack of an interdisciplinary or integrated approach; plans are approached in a sectoral manner. This is partly due to poor collaboration between different institutions. Finally, there is a lack of data – although some data is available, it is rarely accessible or shared between stakeholders or institutions.

Based on preliminary findings within this case study, as well as previous experiences with PSS application, it is believed the PSS is able to address these challenges. It enables a long-term and interdisciplinary vision and encourages inter-departmental collaboration and sharing of data. Nevertheless, data scarcity remains a pressing issue.

5. Reflection on Case Studies

On the basis of empirical observations in both case studies, and reflection on the theoretical perspective of section 2, the following preliminary conclusions are drawn with respect to the added value of PSS in transplanting the Dutch Delta Approach (table 5.1).

Table 5.1. Added value of PSS in transplantation of Dutch Delta Approach

Dutch Delta Approach principles	Revealed added value of PSS	Observed in Case Study 1	Observed in Case Study 2
Interconnectivity	Enabling an integrated consideration of multiple objectives	Yes – both food security and flood safety were considered. Using the PSS forced both the project team and the participants to maintain an integrated perspective.	Not applicable here: so far, only the data verification part of the analysis phase has been conducted. Later phases (including joint problem analysis) will be taking place in an integrated manner.
Consistency	Encouraging consistent use of base data	Yes – the use of the PSS enabled careful consideration of base data and consistent use of this data throughout the project	Yes – the use of the PSS enabled careful consideration of base data and consistent use of this data throughout the project; in the baseline studies, experts were invited to verify the data and results were reported in a transparent manner – including any knowledge gaps
Transparency	Allowing for insight into the decision-making process	No – because of the 'pilot'-nature (short project duration, limited number of workshops) of the project this was not achieved to a substantial degree	Yes – in the baseline studies, experts were invited to verify the data and results were reported in a transparent manner – including any knowledge gaps
Area-based approach linked to national objectives	Combining of and switching between different scales, mapping ambitions on both scales	Yes – as specifically pointed out by one of the participants, this was a clear added value of the use of PSS	Yes, although in this phase, focus was on the quality of the data at different zoom levels
Multi-level governance	Bringing governmental representatives from different levels together in both problem analysis and strategy development	To some extent – workshop included governmental representatives of different levels, in combination with (scientific) experts.	Not yet; will be an important part of the rest of the project
Link short-term and long-term	Bringing a long-term outlook into the planning- and decision-making	Yes –the developed climate change scenarios and future land use modelling	Yes – climate change information was included in the analysis; for next

	process; visualising future scenarios	visualised on the PSS provided an important input for the development of the climate adaptation strategies	steps, future-oriented scenarios will form a main part of the process
Joint knowledge development	Enabling joint fact-finding and incorporation of local knowledge, joint strategy development, generally facilitating stakeholder engagement processes	Yes – the use of the PSS in the workshop facilitated stakeholder participation and input; its interactive nature encouraged stakeholder engagement	Yes – although the group of stakeholders consisted of experts at this stage; later a more varied group of stakeholders will be invited. Required data and knowledge gaps were identified through the workshops.

As mentioned previously, the setting in which the PSS is applied needs to comply with certain requirements in order to be able to achieve the added value. On the basis of literature review (Geertman, 2006), the following list of extrinsic factors influencing the adoption of PSS was composed. As described previously, observations from both case studies led to an extension of this list to include two more factors: facilitation and physical setting. In addition, because these factors remain at a somewhat abstract, conceptual level, a practical interpretation of the prerequisite condition for these factors has been provided. Although the factors as described by Geertman (2006) were not intended to be dichotomous, for the purpose of this paper the interpretations have been given a somewhat dichotomous character. Table 5.2 highlights the prerequisitie conditions as derived from both case studies.

Table 5.2. Prerequisite conditions for successful application of PSS

Extrinsic factors	**Interpretation of tangible prerequisite conditions**	**Observed in Case Study 1**	**Observed in Case Study 2**
Content of planning issue	Clear problem definition of planning issue at hand	Yes, on the basis of a preliminary analysis and discussion with key stakeholder	yes, this took place in assignments 1 and 2
	Planning issue suitable to PSS application in terms of analytical nature or modelling aspects	Yes, land use, climate change and flood risk were main topics of focus which have a strong quantitative-analytical and	Yes, the baseline studies included all kinds of geo-information to be discussed, although some subjects

		modelling component	inherently had less data available in geographical sense; (e.g. governance, economics etc.)
User characteristics	Minimum level of skills – map-reading abilities	Yes, participants had relatively high level of education	Yes, participants had relatively high level of education (mainly experts)
	Receptive to technological applications (cultural acceptance)	Yes, interested in technological advances, helped by introduction of PSS by local partner	Yes
	Some familiarity with use of technological tools	Yes, helped by introduction of PSS by local partner and active facilitation	Yes, most participants were familiar with technological tools
	User culture that allows for active participation	Limited – requires active facilitation	To some extent; since experts generally are more used to computers and models, they were more familiar with the setting. In addition, facilitation was undertaken in part by Bengali team members, which aided in the facilitation.
	Willingness to invest time	To some extent	To some extent; time was limited but that was more an organizational issue than unwillingness of the participants
Characteristics of planning and policy process	Timeframe of project allows for participatory component	Yes, although pilot nature of project limited the extent of stakeholder participation	Yes, many series are foreseen (this was just the first session)
	Orientation of planning process (socially, politically or scientifically oriented) is suitable for PSS application	Scientifically oriented, which lends itself well to PSS application	Scientifically oriented, which lends itself well to PSS application
Political context	Political context is encouraging or at least tolerant to use of PSS	Yes	Yes, much enthusiasm, although also questions

			regarding impact assessment.
	Political context requires transparency and public accountability of planning- & decision-making process	Not really	Not really.
Specific characteristics of geo-information, knowledge and instruments	Availability of data (existence of data)	Very limited	Limited, although on some subjects a lot; quality differs a lot
	Accessibility of data (willingness to share)	Very limited	Limited
	Reliability of data	Depends on source of data; generally limited	Depends on source of data; often references to the sources were missing which made participants question reliability of the data
	Acceptance of data amongst stakeholders	Limited; as observed by participant, the added value of PSS was in enabling them to check the maps	Yes, if quality is found good and source is known
Dominant planning style and policy model	Planning style contains participatory component	Limited	Limited
	Dominant policy model advocates/at least allows for public participation	Yes	Yes
Facilitation	Culturally sensitive approach to facilitation	Yes, extra attention was given to this issue	Yes, also through inclusion of local facilitators
	Facilitation addresses group dynamics	Yes	Yes
	Pro-active facilitation to address reluctance to actively participate	Yes	Yes
Physical setting	Stable and reliable electricity supply, back-up systems	No – power cuts and failing generator	Yes, but lots of electricity lines present
	Availability of internet	Limited reliability	Reliable and accessible
	Possibility to block out direct sunlight to prevent interference with hardware	Yes	Yes, but less important with type of hardware used

6. Conclusions and recommendations

The aim of this paper was to investigate whether a PSS helps to transplant the Dutch Delta Approach to a developing country. The paper looked both at the necessary conditions for this application and the extent to which intended outcomes were achieved. By and large, the two PSS applications studied were successful in transplanting the Dutch Delta approach to Bangladesh. Although the applications were not without problems, most of the intended added values of the PSS were achieved. Moreover, the study provided more insight the conditions for a successful application of a PSS in a developing country.

An important observation was that although higher-level conditions such as policy context and dominant planning styles were considerable success factors, in fact very practical conditions such as data accessibility and reliability, culturally sensitive facilitation and a suitable physical setting were in fact the *sine qua non* of a successful application of PSS.

Whereas these insights are arguably a very relevant addition to the debate, it should be noted that this paper has only scratched the surface of the issue of conditions for and added value of PSS in developing countries. The paper was only based on two case studies in one country. More research – particularly in other cultural contexts within the global south – would be required to refine our initial findings. This refinement would particularly lay in (1) corroborating the list of conditions and added values of a PSS application and (2) developing insight into the relationship between different kinds of conditions and different kinds of added values, something which this paper has not paid attention to.

As a final note, it is interesting to reflect on *how* such research should be organized. For this study, two of the authors were actively involved in the case studies and reflected on their own experiences. One author from a primarily academic background had more distance from the case studies and reflected from a more conceptual perspective on the findings. In our experience this way of working was fruitful, because it encouraged a continuous dialogue in which both findings and conceptual perspectives had to be clarified and/or refined. We believe such an approach holds promise for future research.

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