DeltAlliance

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Enabling Delta Life

'What makes managing land and water in deltas different?'

ALTERRA WAGENINGEN UR

Global Water Partnership

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Enabling Delta Life

‘What makes managing land and water in deltas different?’

Discussion paper

Table of contents

Table of contents

Introduction

Chapter 1

The Global Water Partnership (GWP) jointly with the Delta Alliance, supported by the Netherlands International Development Programme (DGIS), have the intention to jointly explore how to further the sustainable management of deltas. Many of the deltas worldwide host dense human populations and are important centres of economic activity, such as agricultural and industrial production, shipping and mining. Although comprising only some 5% of the land area, deltas have up to ten times higher than world average population densities. And this number is expected to increase rapidly, especially in the heavily populated mega-deltas in Asia.

Deltas are relatively young landforms shaped by the interplay of coastal and riverine processes. They are characterized by a mosaic of gradients between land and sea, fresh and saline waters, as well as exposed and sheltered environments. These patterns and dynamic processes are at the basis of the ecosystem services provided by deltas, such as land formation, coastal protection and food from fisheries.

Being 'hotspots' of human activity, deltas are also vulnerable to changes induced by a range of driving forces, both natural and anthropogenic. Under the uncertainty of the possible impacts of climate change, low lying deltas around the world face challenges to cope with subsidence, flood risk, storms and salinization. Due to on-going urbanization, demographic

growth and economic activities, which have to be combined with food production and ecosystem integrity, the demand for sustainable water allocation, water supply and sanitation and sound infrastructure is omnipresent. Competing demands from a variety of sectors and stakeholders require a transparent dialogue and an enabling governance environment for sound decision-making.

Assessments for investments are at the core of any delta management framework, whereas cost-benefit analyses addressing both short and long term perspectives are key to develop affordable and no-regret options to intervene as to sustain the well-being of people, their economic activities as well as their safe living environment. Although the above can be said of many water related areas, low lying deltas are most vulnerable to the threats mentioned above, which makes striving for comprehensive and integrated solutions even more urgent.

The complex and interrelated issues in deltas may need to be specifically addressed towards developing more resilient and sustainable deltas in the future. This discussion paper describes an integrated framework for delta assessment, the need for specific strategies for deltas, especially as it relates to integrated water resources management, and taking into account the increasing interest for the institutional, socio-economic, financial and awareness-raising aspects.

This is the final version of the discussion paper, which has been updated based on comments and suggestions received before, during and after the workshops at the GWP Consulting Partners Meeting and the Stockholm World Water Week in August 2012.

What makes deltas different?

Chapter 2

Ten reasons why deltas require special attention from integrated water management:

1. Most deltas are moderately to extremely vulnerable to **sediment deficit**. Upstream river developments (such as storage dams) often lead to a reduction of sediment inflow, whereas dikes and embankments often impede lateral sediment dispersion. Together with an on-going sea level rise 24 out of the 33 largest deltas are at serious risk (Syvitski et al., 2009)
2. The geological characteristics of delta soils make them prone to **subsidence**, exaggerated by anthropogenic extraction of ground water, which can lead to extreme subsidence on the short term.
3. Deltas are relatively young landscapes, featuring **highly dynamic geomorphological processes**, such as coastal erosion and accretion and river meandering and avulsion.
4. Delta **soft soils** pose specific challenges to civil infrastructure (such as roads, railways, bridges and tunnels).
5. Their position at the most downstream part of rivers make deltas particularly receptive to **water pollution**.
6. **Flood hazards** come from three different sources: fluvial, coastal and pluvial. A combination of high river discharges with heavy rainfall and extreme tide or storm surge may easily result in disastrous consequences.

7. Droughts in deltas do not only lead to a shortage of water, but also to an increase in **seawater intrusion**. Fresh groundwater reserves are being threatened with seepage of saline water.
8. Invariably, deltas are the **most densely populated** places on earth. Most of the world's megacities are situated in delta areas, and urbanisation rapidly increases. This fact leads to constraints of space and resources, resulting in a multitude of complex and interrelated development and management issues, ranging from spatial urban and land use planning and traffic control to flood protection, land reclamation, water supply and sanitation problems and preservation of nature reserves and ecosystem services.
9. Most deltas contain **deposits of fossil fuels** (oil, gas), of which their exploitation leads to soil subsidence and environmental challenges, such as risk of leakages and pollution.
10. Delta rivers and estuaries have the **highest economic value** of all ecosystems. Nutrient recycling and food production are the major functions that contribute to this high value. Typical delta wetlands (mangroves, salt marshes, estuaries) are among the most valuable as well as among the most threatened ecosystems.

Many of the issues above are somehow, and often strongly, interrelated. This calls for inclusive, integrated approaches towards delta development, management and governance under the uncertainty of climate change.

Framework for Delta Assessment

Chapter 3

A framework has been developed (figure 1 on next page) for describing deltas in a uniform format which enables a comparison of deltas with regard to sustainability and resilience (Bucx et al., 2010). This framework links the DPSIR approach (OECD, 1993) with a layer model for spatial development (McHarg, 1969, Meyer & Nijhuis, 2010, Marchand & Ruijgh, 2009). The framework also provides a linkage with governance issues and with the different actors and agencies involved in delta development and management.

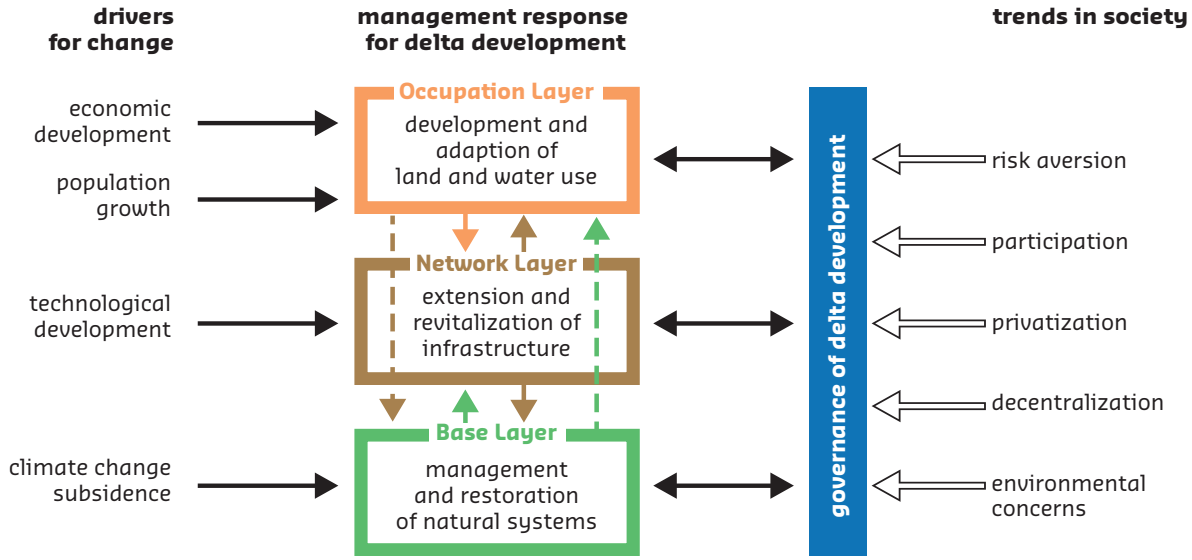


Figure 1
Framework for Delta Assessment

Drivers of change

Population growth, economic development, climate change and subsidence are the main drivers of change in deltas. These developments pose extensive demands on the available natural resources. But also technological development can be seen as a driver of change: it may provide opportunities for more cost-efficient and innovative infrastructure or exploitation of previously untapped natural resources. Box 1 provides a general description of the main drivers of change.

Box 1
Drivers of change

Population growth	the global population still grows with some 2% per year, although there are distinct regional differences. The migration of people towards coastal urban areas often yields in a greater than average growth of the population in delta areas. The number of people to be served and to be protected against natural hazards will increase.
Economic development	despite the current financial crisis, economic growth may be expected over longer periods of time, resulting in larger demands to be met, higher values to protect, more energy to be generated and more goods to be transported. This may also lead to upstream developments (dams etc.), which are also recognized as important drivers of change for deltas.
Climate change	there is general consensus that the rise of global temperature is inevitable, with its associated (local) impacts on sea-level rise and the hydrological cycle (larger and more frequent droughts and floods).
Subsidence	most deltas are subjected to the natural geological process of long-term subsidence. Additionally, extraction of groundwater and fossil fuels, may cause significant lowering of the delta surface on the short term. Other short-term processes leading to delta surface lowering at a more local scale are shallow compaction and oxidation of organic sediments, which may also result from human activities.
Technological development	innovations may open opportunities to enhance the functionality of infrastructure solutions, to extent the lifetime of infrastructure and/or to develop more cost efficient designs.

Decentralization	brings delta issues closer to the stakeholders involved. Due to lack of national coordination, there is, however, a sincere risk of uncontrolled and/or chaotic developments.
Privatization	Public-private partnerships are becoming the modus operandi for many infrastructural projects and services. Increased efficiency of tax payer's money is a key motive. The risk of privatization, however, is a focus on the short term as well as a neglect of the public interest.
Participation	Involvement of stakeholders and citizens is important to promote societal support of development projects as well as maintenance of infrastructure. Planning may benefit from the tacit knowledge of stakeholders.
Environmental concern	Worldwide concern about a changing climate and environmental degradation has raised the environmental awareness. Sustainability of development has become accepted as a basic policy concept for many deltas.
Risk aversion:	Acceptance of risk is decreasing in our modern societies. Hence considerable efforts are made to further reduce or control the risks of natural hazards.

Box 2
Trends in society

Trends in society

There is a number of societal trends that affect the organization and outcome of delta planning and development (Box 2). Of these trends decentralization and privatization may be viewed as autonomous developments. The challenge is to utilize the advantages of both trends, while minimizing their undeniable drawbacks. This calls for a selective enhancement of governance structures, reflecting the regional scale, an integrated and long-term perspective of more resilience and sustainable delta development.

Spatial layer model for deltas

In order to understand how the drivers lead to changes in the pressures and state of the delta, a multitude of relations between human activities, and physical and ecological delta conditions needs to be accounted for. To provide insight into this complex system, a simplified structure is applied in the form of a *Layer model*. This Layer model recognizes three physical planning layers (figure 2): the **Base layer** (water and soil), the **Network layer** (infrastructure) and the **Occupation layer** (zoning of land use functions), each with different but interrelated temporal dynamics and public-private involvement. The model indicates a physical hierarchy in the sense that the Base layer influences the other layers through both enabling and constraining factors. For instance, the soil type determines to a large extent the type of agriculture that can be performed in the Occupation layer.

Unfavourable conditions (constraints) posed by the Base layer can to a certain extent be mitigated through adaptations in the Network layer or Occupation layer. For example, farmers can use agrochemicals to improve soil conditions. And dykes can be constructed to protect low-lying land from flooding. But these adaptations to the original physical geography of an area require investments and need to be managed.

The essence of the Layer model is the difference in dynamics and vulnerability between the layers, which results in a logical order in planning for the various layers. The layers enable and/or constrain activities in another layer. Besides for analysing the physical interactions between the layers, the model is also useful in positioning the roles of different actors, such as government agencies, private entrepreneurs and stakeholders. The development and maintenance of infrastructure in the Network layer is traditionally the responsibility of the

occupation
speed of change
10 - 25 years

networks
speed of change
25 - 100 years

base layer
speed of change
50 - 500 years

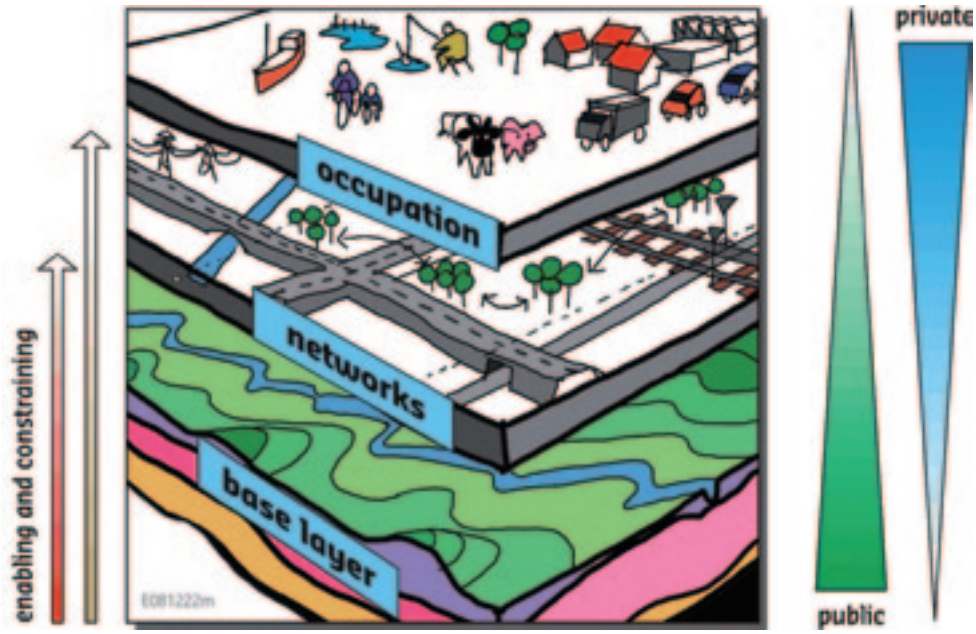


Figure 2
The spatial layer model

government. The government also has a main role in the protection and management of the Base layer. Moving towards the Occupation layer the role and influence of the government becomes more restricted and the influences of private parties and citizen's interests become more dominant.

The Layer model is largely compatible with other well-known approaches, such as the ecosystem functions approach (De Groot, 1992; De Groot, 1994; De Groot et al., 2002). The Base layer provides the enabling conditions for humans, which can be split into function categories, such as regulation, habitat, production, information and carrier functions. An important advantage of the Layer model is that it explicitly takes into account human alterations to the natural ecosystem. Indeed, many deltas are no longer in a pristine state and should be described as modified or highly modified ecosystems. The Layer model describes these modified ecosystems in terms of the Base layer and the Network layer.

Management responses for each layer

Using the Layer model, it becomes clear that there are three main response themes on which delta management could focus, i.e. the development and adaptation of land and water use (Occupation layer), the extension and revitalization of infrastructure (Network layer) and the management and restoration of natural systems (Base layer). Regarding the Base layer it should be noted that in deltas especially the sediment dynamics (balance) between sea, river and hinterland is important. Many deltas suffer from a sediment deficit, because sediments from the catchment are trapped in reservoirs upstream. Embankments along the delta distributaries prevent flooding and vertical accretion of the delta plain. The disturbance of natural delta sediment dynamics (i.e. lack of sediment) leads to land loss and increased flood vulnerability.

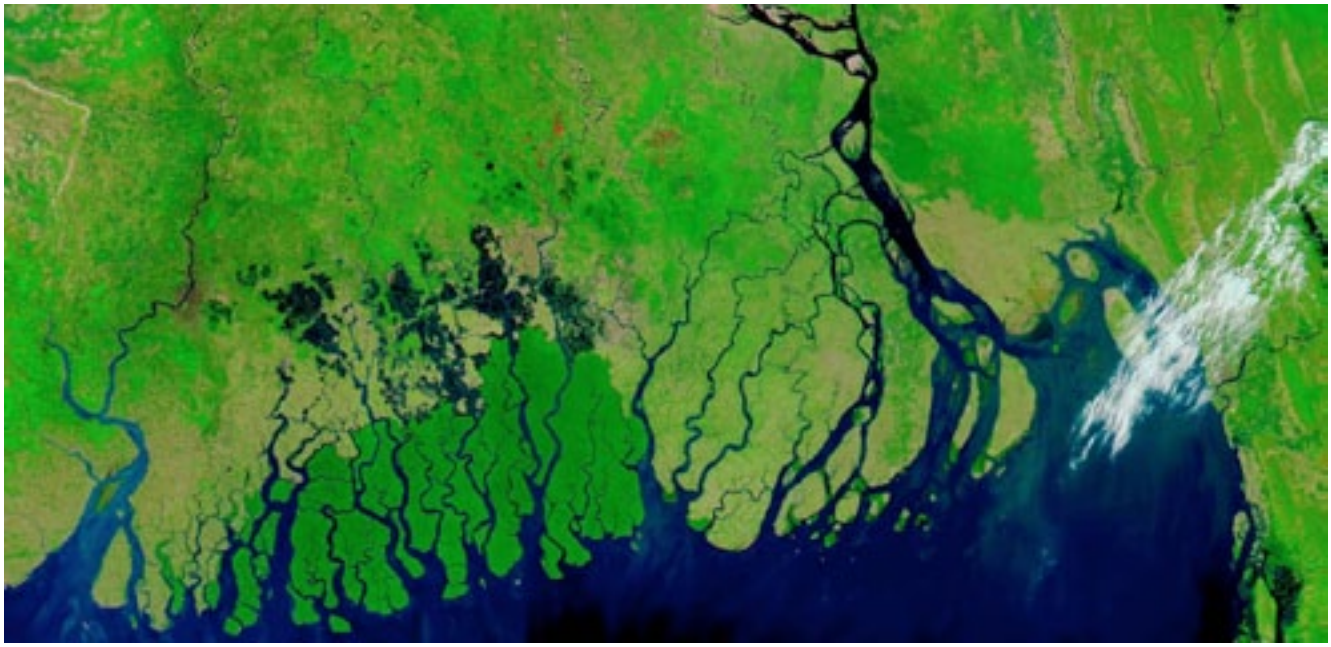
Governance characteristics for each layer

The governance required for sustainable delta development extends over all three layers and is characterized by a mix of government responsibility and private or non-governmental actor roles. The strong private role in the Occupation layer is most clearly symbolized in the land ownership, which is legitimised through property rights legislation and often embedded in deep values of ownership and values associated with entrepreneurship. Land ownership induces private investments (e.g. farms, houses) and can be traded on the free market. The government can enact its influence through zoning regulations and building codes and, under very stringent conditions, can expropriate land for a public cause of national or local importance (such road networks). Informal and formal arrangements exist for (participatory) planning processes and their legitimacy.

The role of private and public involvement in the Network layer often is the result of a transition in the fundamental viewpoint that it is the government's task to manage these networks. In the Netherlands, for instance, road and water networks are public but ownership of the utility sectors, such as railways, electricity and drinking water is being changed to public-private cooperation or private ownership. But that does not mean that there is no role left for the central government. Indeed, in order to safeguard public values in the liberalized utility sectors, authorities are installed as formal arrangements that oversee quality and guaranteed delivery of goods and services.

Although in the Base layer the role of the government is strongest, its management is often done in a rather fragmented way. Management responsibilities originate from a deep belief of stewardship to maintain the qualities of water, soils and subsoil natural resources. But the actual management instruments are mostly partially effective or inadequate to stop degradation and quality loss. These instruments are legitimized through national or international laws and obligations and enacted in the form of licences, concessions and covenants. We often encounter a multi-actor setting with government, non-government organisations and other stakeholders trying to agree on a sustainable development of the natural functions and resources.

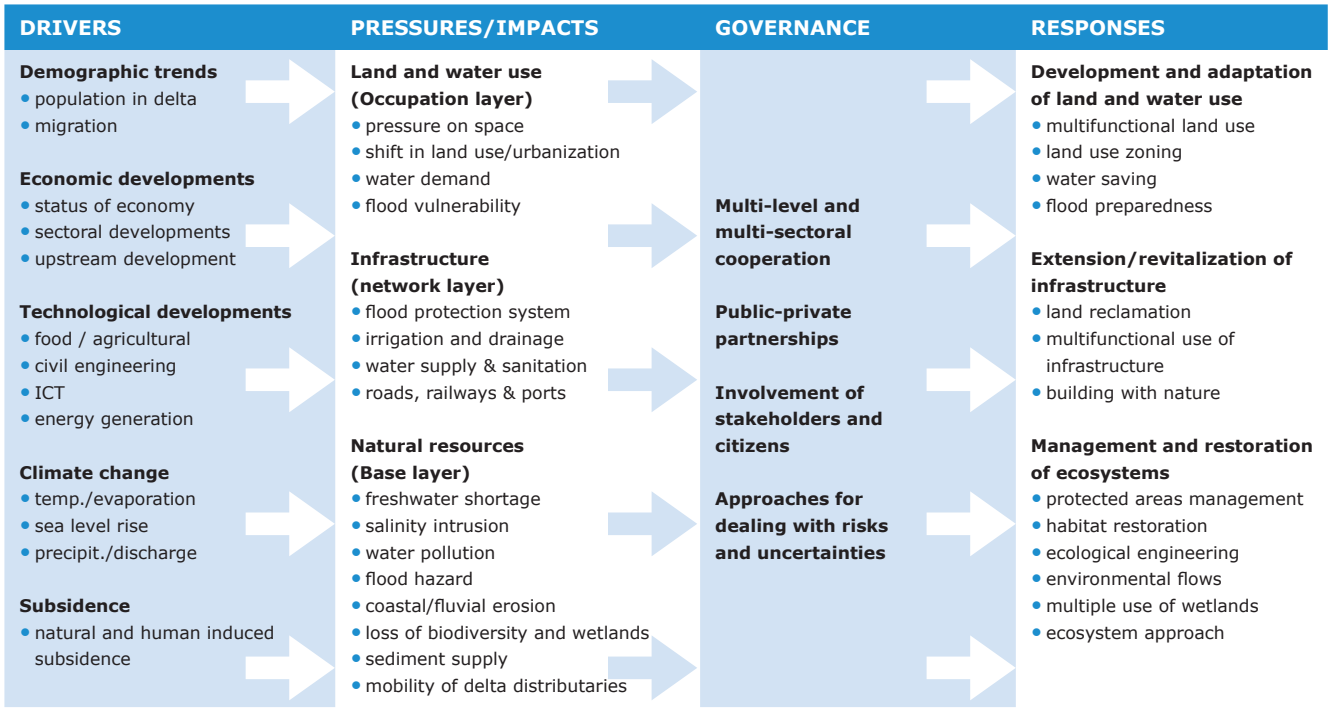
Ganges-Brahmaputra Delta, India and Bangladesh



As the governance is almost one of the most important driving forces in sustainable delta development it is not enough to only discuss roles of government and private sector in each of the layers. The three layer model can be combined with the institutional layer model of Williamson which thus gives a clear picture to link human-environment systems with different modes of decision-making (Marchand & Ruijgh-Van der Ploeg 2009). This helps to classify the different 'agencies' and 'domains' (Agarwal et al. 2002) and improve the multi-level and multi-sectoral cooperation and efficiency

Figure 3 summarizes main delta issues as a sequence of drivers, pressures, impacts, governance and responses, for each of the three layers.

Figure 3
Sequence of drivers, pressures, impacts, governance and responses in deltas (nb: this is a simplified representation as the vertical interactions between the layers are not included).



Analysis of case studies

Chapter 4

As a part of the collaborative initiative 'Enabling Delta Life' (Global Water Partnership, 2012) resource persons[1] involved in delta management were asked to develop a brief case-description on their delta[2]. These descriptions are analysed in this chapter.

Five questions related to delta governance were posed:

1. What are the 3 main issues in your delta?
2. What are the main measures to deal with these issues?
3. How did you organize/are you organizing the process in your delta for developing this?
4. What was the most difficult part in your process so far?
5. What suggestions do you have for a country that is just starting to think about their delta?

Answers to these questions were given by delta experts from 8 countries: Bangladesh, Benin, Cambodia, China, Egypt, Vietnam, Indonesia and Thailand. Based on the reactions from these resource persons a **very preliminary** analysis was carried out, using the Framework for Delta Assessment as a guidance. Of course, this analysis should be used cautiously because limited background information and time was available.

1 See Annex 2
2 See Annex 1

Table 1
Main issues mentioned
*in case descriptions**

Country	Bangladesh	Benin	Cambodia	China	Egypt	Vietnam	Indonesia	Thailand	total
Delta	Ganges-Brahmaputra	Oémé	Mekong	Pearl	Nile	Mekong	Deltas on Java	Chao Phraya	
Main issues									
Occupation Layer									
Inappropriate spatial management		●						●	2
High population density							●		1
Food security								●	1
Socioeconomic development			●						1
Network Layer									
Navigation networks			●						1
Problems with water supply and sanitation							●		1
Base Layer									
Flooding	●	●		●		●	●	●	6
Coastal erosion and SLR				●	●	●		●	4
Water shortage			●	●	●	●			4
Water pollution		●		●	●				3
Salt water intrusion					●	●			2
River erosion and sedimentation	●		●						2
Over-exploitation natural resources		●		●					2
Groundwater depletion					●				1
Upstream dependency						●			1
Drivers									
Climate change	●							●	2
Lack of knowledge		●							1

* *NB: the dots only indicate the most important issues mentioned in the case descriptions. Absence of a dot does not necessarily imply that an issue is not relevant.*

Main issues

Table 1 gives a summary of main water-related problems that have been identified. Note that here only the most important issues are presented. Of course many more issues are relevant in each delta than given in the table. We have not used a more subtle discrimination into the scale of importance, because the information in the case descriptions did not allow for this. The following observations can be made:

- The majority of the issues essentially deals with problems originating in the Base layer: apparently there is a substantial mismatch between the environmental conditions and resources and the demands from society. Not surprisingly, flooding, coastal erosion, water shortages and water pollution are most often mentioned here. Perhaps more surprising is that flooding is *not* mentioned explicitly for the Cambodian floodplain: living with the seasonal floods is practiced here. Other well-known delta problems are also identified, such as salt water intrusion, river erosion and groundwater depletion.

- Remarkably less attention is given to issues in the Network layer and Occupation layer. Benin and Thailand mention inappropriate spatial management and improper settlements in the occupation layer as a main issue. Cambodia sees socioeconomic development as a major delta issue (a direct link between livelihood, income and well-being is given) and Thailand mentions that food security is at risk for the new poor. Indonesia focuses on populated areas in the deltas on Java. But a distinction is made between three types of deltas in Indonesia: Developed deltas on Java, Developing deltas on Sumatra and Kalimantan and Undeveloped deltas on Kalimantan and Papua islands. Each of them have different problems.

Furthermore, it is remarkable that climate change is only mentioned twice. Current and short-term problems seem to dominate in many deltas.

Table 2
*Measures mentioned in case descriptions**

Country	Bangladesh	Benin	Cambodia	China	Egypt	Vietnam	Indonesia	Thailand
Delta	Ganges-Brahmaputra	Oémé	Mekong	Pearl	Nile	Mekong	Deltas on Java	Chao Phraya
Measures								
Occupation Layer								
Early warning system		●						
Zoning				●			●	
Wastewater reuse					●			
Changing cropping patterns						●		
Living with flood						●		
Network Layer								
Flood control measures				●				●
Water treatment					●			
Development of infrastructure in soft soils							●	
Residential areas free from flood						●		
Base Layer								
Fisheries program			●					
Environment program			●					
Sand mining regulation				●				
Shoreline and wetland management				●				
Non-conventional water resources					●			
Coastal protection forests						●		
General / across layers								
Comprehensive Delta Planning	●	●				●	●	●
Monitoring delta system dynamics and climate change	●							
Design and implementation sustainable management	●							
Climate change initiative programme			●					
Promote sanitation of delta	●							
Flood management			●					
Nationwide dialogue, seminars, public awareness					●			●
Practicing IWRM						●		
Social Engineering							●	

* *NB: the dots only indicate the most important measures mentioned in the case descriptions. Absence of a dot does not necessarily imply that a measure is not relevant.*

Measures

Mentioned measures are more equally distributed over the three layers than the issues (table 2). Clearly a balanced approach is visible for the Mekong Delta in Vietnam, consisting of a mixture of adaptation measures (in the Occupation layer), protection measures (in the Network layer) and measures for enhancing ecosystem services (in the Base layer) for flooding. The basic strategy is 'living with floods', but where needed residential areas are protected by dykes and cropping patterns are changed when salinity increases. Furthermore, coastal forests are protected to enhance their ecosystem services.

Also a large number of measures are mentioned, which, due to their general nature, cannot be easily classified as belonging to one layer: 'flood management', 'practicing IWRM', 'design and implementing sustainable management', etc.

Thailand identifies public awareness on the understanding of the changes in the deltas as the major measure (this issue will come back in the governance section). Several respondents stressed the need for comprehensive delta planning.

Nile Delta and river

Governance

Questions 3 and 4 relate to the organization of the process and problems encountered. This can be captured under the heading of governance. In the Framework for Delta Assessment indicators for governance are grouped under three headings:

1. Multi-level and multi-sectoral cooperation,
2. Involvement of stakeholders and citizens and
3. Approaches for dealing with risks and uncertainties.

Multi-level and multi-sectoral cooperation

When we look at the answers for the different deltas (table 3), we see that most countries explicitly mention some kind of delta planning:

- Vietnam: Revising Delta Master Plan;
- China: Pearl River Delta Comprehensive Regulation Planning;
- Bangladesh: Delta Development Plan;
- Thailand: Comprehensive plan of Town and Country Planning Act;
- Benin: Master Plan;
- Indonesia: Master Plan/Land and Water Resources Development Planning.

Indonesia mentions the important role of coordination among line agencies with a major coordinating role of the Planning Agencies during the planning stage.

Transboundary and river basin cooperation is explicitly mentioned by two countries (Benin and Cambodia).

*Table 3: Governance issues mentioned in case descriptions**

Country	Bangladesh	Benin	Cambodia	China	Egypt	Vietnam	Indonesia	Thailand
Delta	**Ganges-Brahmaputra**	**Oémé**	**Mekong**	**Pearl**	**Nile**	**Mekong**	**Deltas on Java**	**Chao Phraya**
Governance								
Multi-level and multi -sectoral cooperation								
Delta (Master) Plan development	●	●		●		●	●	●
Coordination among line agencies and planning agencies in lead role							●	
Transboundary / river basin cooperation		●	●	●	●			
Involvement of stakeholders and citizens								
Awareness campaigns					●			
Knowledge dissemination					●			
Creating consensus							●	
Capacity building local scale						●		
Partnerships								●
Approaches for dealing with risks and uncertainties								
Research		●		●		●		

* *NB: the dots only indicate the most important issues mentioned in the case descriptions. Absence of a dot does not necessarily imply that an issue is not relevant.*

Involvement of stakeholders and citizens

Involvement of stakeholders is mentioned by Egypt, Vietnam, Indonesia and Thailand. A closer look reveals that for the Nile delta the level of participation is mainly limited to informing and consulting. Vietnam mentions 'improving capacity for local organizations and communities', suggesting a deeper participatory involvement. Indonesia mentions consensus building as a building block in the organisation of the process. In Thailand, local stakeholders are actively involved in coastal erosion and coastal area development planning through the Thai Water Partnership. Also the enforcement of the Town and Country Planning Act is considered a major governance issue in Thailand. Interestingly, in Thailand the implementation of measures and initiatives at the local level seems to work well, but difficulties arise when these are upscaled to the policy level. Bangladesh mentions that broad stakeholder involvement is a difficult part in the implementation process.

Approaches dealing with risks and uncertainties

There is some mentioning of research towards a better understanding of delta processes and problems. Benin mentions 'lack of knowledge about the delta systems' as a main issue in the delta, and suggests 'to build up capacity towards monitoring the delta system dynamics and climate change'. Vietnam mentions 'Conducting deep research/studies to find appropriate solutions for specific areas', 'Studying and assessing impacts on delta of upstream development' and 'Establish scenarios for responding'. China mentions as a suggestion for other countries: 'From a holistic viewpoint, scientific research should be conducted to understand the natural evolution process of the whole delta'.

Suggestions for other deltas

The eight deltas presented here are of course but a fraction of the deltas of the world. Already during the Stockholm workshops in 2012 other deltas' representatives have shown interest to join the GWP-DA initiative: the Irrawaddy in Myanmar, the Zambezi in Mozambique, the Niger in Nigeria.

On the question 'what suggestions do you have for a country that is just starting to think about their delta?' all respondents came with very clear and often similar answers. These can be roughly grouped into four categories:

1. Know how your delta works,
2. Raise awareness,
3. Ensure stakeholder participation;
4. Build human capacity and learn from each other, and
5. Develop a delta plan.

1. Know how your delta works

Each delta has its own characteristics and it is important to understand how natural processes work, such as natural evolution, water and sediment movements, channel morphodynamics, etc. both in relation to history and under the present and future conditions. Monitoring (e.g. of water quality, coastal erosion and urban encroachment) will lead to on-time identification of (future) challenges, problems and potential solutions.

2. Raise awareness

Establishing an enabling environment, mentioned by the Benin contribution, is crucial for good management. This requires both the enhancement of political will among decision makers and of cooperation with all kinds of stakeholders (see next point).

3. Ensure stakeholder participation

There is almost unanimity with regard to the importance of ensuring meaningful and effective community and stakeholder participation in the process of the preparation of a delta plan. This is also relevant at the international level: river basin cooperation needs to be strengthened as well.

4. Build human capacity and knowledge sharing

Capacity building and human resources development was mentioned several times. Learning from other delta experiences was also mentioned: e.g. Cambodia would like to learn from Vietnam about salinity control, water management, rice cultivation, tourism, and livelihood improvement in the Mekong Delta.

5. Develop a delta plan

Each answer included reference to some sort of delta planning. Keywords that were used include: comprehensive planning, 'Delta Vision', Land and Water Resources Development Plan, holistic views and systematic working approach, no-regret measures, adaptive, economically feasible, restoring natural systems, resilience.

Synthesis of comments and suggestions from workshops

Chapter 5

In August 2012 two workshops were held in Stockholm jointly organised by GWP and Delta Alliance. At the GWP consulting partners meeting a workshop was held on *Managing the world's deltas: designing effective solutions in a climate of uncertainty* (26-08-2012). Later that week a Delta Session was held at the World Water Week titled *Managing the world's deltas: unique systems, unique challenges*. During these workshops presentations were held about the deltas mentioned in this discussion paper. The discussions enabled exchange of ideas and delivered useful suggestions and additions to the items elaborated in this paper. In this chapter some of the most salient remarks and suggestions are synthesized[2].

2 *Besides input during the discussions, written comments and suggestions were received from Mr. Aye Myint (Myanmar), Mr. Mhoammad Amron (GWP) , Sjeikh Javed Ahmed (AfDB), Marcel Marchand (Netherlands), Izeze Reuben (Nigeria), Fabien Hountondji (Benin), Watt Botkosal (Cambodia) and Godwin O. Usifoh (Nigeria).*

Delta challenges

During the presentations and discussions it was often reiterated that delta challenges include but are not limited to water problems (Mr. Slingerland, the Netherlands). Sediment management, subsidence, spatial planning, transportation systems etc. all interact with each other as well as with water. Also the urban – rural linkage is worth mentioning. For instance Cairo is the biggest water consumer in the region (Mr. Elrawady, Egypt). It was also often mentioned that deltas do not stand alone. They are heavily dependent on upstream river flows and are therefore sensitive to impacts due to climate change

and human activities (Mr. Vincente, Mozambique). Water availability in the dry season changes because of increased consumption upstream and increased flood levels could be experienced due to a reduction in floodplain storage (Mr. Botkosal, Cambodia).

To underline the importance of deltas for human societies, Mr. Elrawady from Egypt stated that 95% of the population lives in the Nile delta which occupies only 4% of the country. This is in contrast with Bangladesh of which almost the entire territory consists of a delta. Either way, both deltas are of paramount importance for the entire nation.

Bangladesh is an example where floods are of such order of magnitude that they will never be completely controlled. People have to live with floods, which pose less of a problem than river erosion, which each year leads to substantial losses of land (and accretion at other places) and creates social conflicts. To underline the resilience of the people, Mr. Haq told the audience that the Bangladeshi are nevertheless the 8th happiest people in the world.

Transboundary issues were mentioned several times: e.g. Cambodia shares part of the Mekong delta with Vietnam, moreover the Mekong river basin is shared by 6 countries, the Oume river flows through Nigeria and Benin (Mr. Houanye), Bangladesh shares many rivers with India.

Solutions

Suggestions and ideas for problem solving ranged from very practical and technical up to policy, planning and management guidance. For instance, from Egypt experiences in waste water reuse can be offered, Cambodia would like to learn from Vietnam about rice production and flood management and many countries could learn from living with risks. The presentation of Mr. Xiaokai Li (World Bank) introduced Green Water Defense (GWD), which keeps the right balance between the functions of the three spatial layers of the delta model. GWD approaches make full use of the ecosystem services and takes advantages of structural and non-structural measures based on cost-effectiveness.

Delta Master Plans are mentioned as a means to unite socioeconomic development and environmental protection (Mr. Tu, Vietnam), but should be financially sound as well (Mr. Yuhai, China).

Governance and international cooperation

Technical solutions and plans can only work in an enabling institutional environment. Governance of deltas is becoming most urgent. Typical problems include mismatching of planning domains with institutes. For instance Mr. Yuhai of China mentions that the Ministry of Water Resources only deals with freshwater, which only covers a part of delta management. Also the transboundary issues, mentioned earlier, poses an extra challenge for governance. Simply stated by Mr. Haq as 'A river cannot be managed by parts'.

Knowledge

Delta solutions, sustainable management and good governance also require sound knowledge on how deltas are functioning. This has been stressed by many during the workshops. But as Mr. Slingerland concluded, we cannot wait until we have all the knowledge: keep analyzing but start acting! He also was happy to conclude that the Assessment Model presented in the discussion paper is working and is a useful tool for integrated analysis of delta management.

The GWP-Delta Alliance initiative

Mrs. Ania Grobicki of GWP was impressed to hear the range of experiences and range of knowledge in the network and was very interested to draw this into the programme. Many participants were keen to support the GWP-Delta Alliance initiative and to start collaboration. Several asked how to get their delta joining the Alliance. Topics for such collaboration were mentioned. Mrs. Petra Hellegers (Netherlands) encouraged the GWP-Delta Alliance to go further on a show case on water allocation. Mr. Watt Botkosal sees an opportunity on transboundary issues. Mr. Elrawady saw the Green Water Defense initiative a good way how we can plan for the future. Mr. Jos van Alphen (Netherlands) sees the GWP-Delta Alliance initiative as an excellent platform to develop scenario thinking and the adaptation approach.

Conclusions

Chapter 6

Deltas provide opportunities for IWRM in practice

Deltas are the motor of economic development. Thanks to their location and physical properties they are often the most densely populated and economically most active parts of a country. Many of the world's megacities are located in deltas. Deltas provide food, fibres and fuel, enable transport and trade and harbour the most productive ecosystems worldwide. Current developments may jeopardise the historical symbiosis between man and deltas. Fast growth combined with climate change and sea level rise make deltas vulnerable. But the economic dynamics will provide also for a strong impetus to vulnerability reduction measures and policies. The stakes are high and better management will pay off.

The information provided by the delta representatives provides a 'snapshot' of the problems and approaches of their deltas. Since it was not intended as a comprehensive description, a full assessment of vulnerabilities and delta resilience is not possible. The assessment of ten deltas by the Delta Alliance (Bucx et al., 2010) showed a remarkable variation in delta conditions, although also some general trends and mechanisms were found:

- an imbalance between demand and supply with regard to land and water use;
- an inadequate or ageing infrastructure in the delta;
- disruption of the natural delta processes;
- inadequate governance to address problems and implement solutions.

The case studies presented in this discussion paper show issues, problems, measures and suggestions that are in line with these mechanisms.

Delta management faces an important dilemma: accommodating more people and more activities than the Base layer of a delta can support requires new or upgraded infrastructure, which on its turn could lead to a further reduction of the natural carrying capacity of the Base layer. Solutions for this dilemma include innovative technological breakthroughs, multifunctional land use and "building with nature" approach. More importantly, however, solutions should be looked into that take account of all three layers and their interactions. It is highly unlikely that unregulated autonomous development in the Occupation layer

can be accommodated solely through more and bigger infrastructure. In other words: delta governance should be focused on optimizing land occupation and activities of the population, on better managing the infrastructure and on the restoration of natural systems and processes.

Delta Assessments

- Using the Framework for Delta Assessments can effectively contribute to an increased insight in the strengths and weaknesses of existing delta management. It requires additional work however, to include institutional structures and governance issues.
- Sustainable solutions to delta problems can only be found when landuse, infrastructure and the natural environment and resources are taken into account in an integrated manner.
- Governance for deltas should start with identifying stakeholders in each of the three layers and with acknowledging that ownership and management responsibilities for each of them is fundamentally different.
- Climate change is an important driver of change, but on the short term is in most deltas subordinate to more urgent issues, such as population growth, rapid urban development and subsidence.

Towards a Delta Agenda

Our vision is that interdelta exchange of knowledge and expertise is essential for finding sustainable and innovative solutions for the delta problems worldwide. Because many deltas share the same problems, solutions developed in one delta may be applicable in other deltas, although we recognize that adaptations may be needed to account for delta-specific aspects. Globalization causes deltas to be more connected than ever before in history and urges a common search for integrated delta management strategies.

The aim is to work jointly towards a delta agenda 'Enabling delta life', providing guidance for implementation and joint pilots to enhance the knowledge base on issues of common interest.

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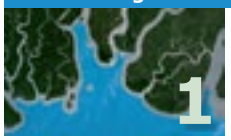
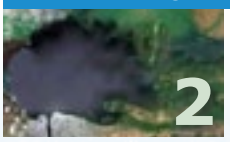
Annex 1
Case studies

Bangladesh



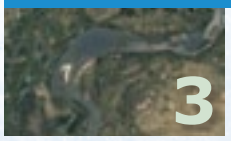
The Delta Development Plan 2012, the Ganga-Brahmaputra-Meghna Delta

Benin



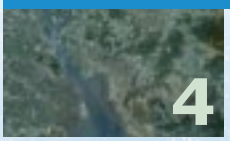
Towards designing a Master Plan, the Ouémé Delta

Cambodia



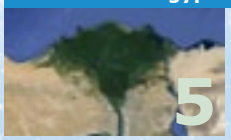
The Mekong delta

China



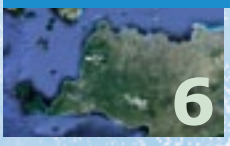
The Pearl River Delta comprehensive Regulation Planning, the Pearl River Delta

Egypt



The Alexandria 2030 Integrated Urban Water Management (IUWM) plan, the Nile Delta

Indonesia



Managing diverse delta systems

Thailand

The Town and Country Planning Act, the Chao Phraya Delta

Vietnam

The Delta Master Plan, the Mekong Delta

"Enabling Delta Life" is a collaborative initiative of the Global Water Partnership (GWP) and Delta Alliance, supported by the Netherlands International Development Programme (DGIS).

Selected GWP partners were asked to develop brief case descriptions focusing on deltas they are actively involved in. The presentations were to focus on five key questions related to delta management:

1. What are the 3 main delta issues in your delta?
2. What are the main measures to deal with these issues?
3. How did you organize / are you organizing the process in your delta for developing this?
4. What was the most difficult part in your process so far?
5. What suggestions do you have for a country that is just starting to think about their delta?

This document is a compilation of these presentations and was used as a background document for the two meetings:

1. **Global Water Partnership Consulting Partner Meeting, Workshop Two:** "Building climate resilience in the World's Deltas: Managing for effective water solutions". This will be a facilitated panel discussion on the 26th of August, 2012, 13:30-15:00 hrs.
2. **World Water Week, Seminar:** "Managing the World's Deltas: Unique Systems, Unique Challenges" on the 29th of August, 2012, 09:00-12:30 hrs.

This document may also provide inputs to further activities in the initiative, such as the framework for analysis and action. The framework will be finalised by the GWP Technical Committee and will inform the next GWP and Delta Alliance strategies and a joint GWP-Delta Alliance agenda.

Case Study 1

Dr. Khondaker Azharul Haq

Bangladesh

The Delta Development Plan 2012, the Ganga-Brahmaputra-Meghna Delta

Bangladesh is the biggest delta in the world formed by the three river systems of Ganges, Brahmaputra and Meghna. Approximate 80 percentage of Bangladesharea of 1.45.000 square kilometer is featured with 310 rivers and their floodplains, which support life, livelihoods, economy and ecology of the whole delta.

Main issues in the Delta

Floods

A comprehensive and integrated management of water resources is crucial for the riparian countries, especially Bangladesh, India and Nepal to reduce adverse impact of flood. Floods are very common in Bangladesh and depending on its intensity and duration may have severe adverse impact on lives and properties. Flood is considered as the most destructive natural disaster with its short and long term impact in every sphere of the economy including all types of infrastructure.

River Bank Erosion

River erosion renders hundreds of thousands of people homeless with partial or total loss of their agricultural lands and livelihoods. It is also one of the major problems of intra country migration where large number of families is faced to migrate to urban centers including the capital city of Dhaka where they live in slums under extreme poverty and life of indignity. During the last few decades the net erosion was over 200,000 ha. There are examples of families relocating them up to six times in their life due to river bank erosion.

Climate Change Impacts

Climate change is expected to have severe impact on the water resources availability and its governance. Bangladesh is already experiencing erratic rainfall both spacial and temporal, impacting crop calendar and agricultural production systems and productivity. Reduced surface water availability is also resulting in saline water intrusion further into the inland. It is also adversely impacting ecological balance of the country especially in the coastal areas. The Sundarbans, one of the largest mangroves in the world, home of the Bengal tigers and a UNESCO designated World Heritage site is also being threatened by significant reduction in surface water flow in the rivers.

Measures to deal with the issues

The government of Bangladesh developed a Delta Development Plan 2012 with assistance from the government of Netherlands. A Memorandum of Understanding (MoU) was signed between the two governments to implement the 1st phase of the plan by 2021.

Organization of the initiatives process

Bangladesh Water Partnership participated in the consultation process. A committee has been formed by the government of Bangladesh to operate independently using professional standards. The committee is responsible to the Ministry of Planning for strategic consultation and coordination with the other stakeholders including implementing agencies. The Bangladesh Delta plan is being positioned in such a way that under the guidance of the Ministry of Planning a long term strategic plan will be prepared and implemented.

Difficult parts in the process of the initiative

For the Delta plan an emergent planning approach has been proposed, where a planning track runs parallel with an implementation track. A holistic approach of the Delta Plan can only succeed by joint and coordinated action by agencies under the whole policy network. The difficult part of the process to develop the plan is the issue of a changing social, political and financial condition which is relevant for implementation of the plan. Another difficult part is the implementation process with broad stakeholder involvement.

Suggestions for countries that just have started to think about their deltas

Each Delta has its own characteristics, so formulation of a Delta plan can be initiated through understanding the process, issues and future challenges, ensuring meaningful and effective community and stakeholder's participation in the process of the preparation of the Delta Plan. Develop the "Delta Vision" to introduce "no regret" measure that is useful and regardless of the direction of the development. Integrate the Delta Plan in the national planning process.

Case Study 2

Benin

Prof. Abel Afouda
Dr. Fabien Hountondji
Mr. Armand Houanye

Towards designing a Master Plan, the Ouémé Delta

We expose views on management of the south eastern Benin delta. The Ouémé Delta is the most important of the two Benin delta. This delta is sustained by both two rivers (Ouémé and Sô), and includes a lake, a lagoon and a channel to the sea. The delta is classified as a Ramsar site. The Delta complex is facing challenges due to population pressure, unsustainable management and climate change.

Main issues in the Delta

Lack of knowledge about the delta system dynamics

It is important to point out that existing information about the Ouémé delta is scattered in time and space. It is therefore highly expected that a background study on the whole delta would generate upgraded overview knowledge about it and allow sketching out a better 'coalition-oriented' master plan for it.

Inappropriate space occupation and overexploitation

Inappropriate space occupation and overexploitation of the delta resources are big issues. Space occupation in the delta has caused great concerns related to the demographic and urbanization pressures. Fisheries and fish reproduction sites are multiplied on the water plans without appropriate regulation, ignoring navigation network. This situation generates conflicts among fishermen and between fishermen and other users of the delta, limiting its sustainable management.

Flooding, coastal erosion and pollution

Flooding and pollution are serious issues around the Ouémé delta. Sea level rise and the modification of water regimes due to climate change coupled with unsustainable management of the water complex resources have resulted in increasing flooding and coastal erosion in the delta. As consequences of both problems, populations' displacements, destruction of cultures, habitat destruction, and perturbations of socioeconomic activities/local knowledge management cause life to be constraining in the delta. Moreover, flooding together with serious sanitation problems due to unmatched demographic growth & urbanization associated with agrochemical use and oil spilt around the delta are responsible for environmental pollution of the delta and public health problems. The water complex is also threatened by proliferating weeds due to eutrophication wich is a consequence of pollution.

Measures to deal with the issues

Measures include:

- building up capacity towards monitoring the delta system dynamics and climate change,
- design and implementation of sustainable management of the delta system (build a master plan for the purpose),
- design of an early warning system and promotion of sanitation of the delta.

Organization of the initiatives process

To work towards establishing an enabling environment both at the national and at the river basin level for integrated management of the delta.

Difficult parts in the process of the initiative

- Lack of awareness of decision makers;
- Limited local capacities.

Suggestions for countries that just have started to think about their deltas

1. Identification of challenges and potential solutions for management of the delta
2. Enhancement of political will around decision makers
3. Establishing enabling environment and cooperation with existing delta projects

Case Study 3

Dr. Watt Botkosal

Cambodia

The Mekong delta

Main issues in the Delta

Climate change issues such as more flood and droughts can affect the ones most at risk in the delta, in Cambodia and in Vietnam.

Improve water management, cultivation technology and livelihood (including tourism)

Socio-economic development is needed, if people have a good livelihood and a good income they will live better. Socio-economic development is quite relevant to Cambodia and is important issue to make a change.

Sedimentation and erosion control

Upstream construction of dams in the mainstream part of the river may result in reduction in sediment transport and changed availability of irrigation water.

Minimum flow maintenance

If the flow goes below the minimum flow during the dry season of the Mekong River, from upstream to the Delta, then we need to maintain the flow.

Measures to deal with the issues

- 1995 Mekong Agreement: overall framework for cooperation and procedures
- Basin Development Plan Programme
- Flood Management and Mitigation Programme
- Navigation Programme: support water ways of two countries
- Fisheries Program
- Environment Programme
- Climate Change Initiative Programme

Organization of the initiatives process

- 1995 Mekong Agreement
- Mekong River Commission
- Cambodia National Mekong Committee
- MRC programmes/projects
- Bilateral Dialogue: Cambodia-Vietnam for Delta: MOU of CNMC and VNMC, MOU of MOWRAM and MONRE
- Joint Study and Development Project under MIWRMP

Difficult parts in the process of the initiative

- Mutual and joint interest such as navigation, flood management and joint water management.
- Minimum flow for Vietnam and Cambodia for navigation.
- Data and information is big challenges, but MRC has a lot of information that is now good base for development and management.
- Roles of CNMC and VNMC in coordination are important work but challenges to maintain cooperation.

Suggestions for countries that just have started to think about their deltas

Knowledge sharing with VN

- We would like to learn from VN about salinity control, water management, cultivation technology of rice in areas, tourism, improvement and livelihoods, and Mekong Delta: perhaps learning from VN development as they have many experiences about 20-30 years ago, even bad lessons, food control and management. This is to be supported by WB, MRC MIWRMP

Capacity building and human resources development in IWRM

- In Delta Planning and Management based on IWRM

Morphological management

- Regarding to sand mining, erosion, water way management and improvement for navigation and flood control and irrigation -shape or form of the river, depth, and no more sediment. Coastal erode will away. If high sea level so cause flood, wave high.

Case Study 4

Dr. Wang Yuhai

China

The Pearl River Delta comprehensive Regulation Planning, the Pearl River Delta

Main issues in the Delta

Increasing flood hazards

The delta region is characteristics of low-altitude flat plain with dense netted channels and tributaries. It is facing increasing risks of catastrophic flood hazards from riverine floods and/or marine storm surges, imposing serious threats to local human life and properties.

Deteriorating water quality and ecological environment

Over-discharged or poor-treated waste water and other pollutants have seriously deteriorated the water quality, causing lots of ecological environmental problems.

Over-exploitation of delta resources

The rapid socio-economic development has led to competitive and over utilization of delta resources including water resources, land & wetland, riverbed sand, shoreline, etc. This has led serious conflicts between development, protection and regulation and threatened the sustainable delta socio-economic development.

Measures to deal with the issues

1. Flood-guiding line management
2. Flood discharging harness
3. Water resources and water function zone management
4. Shoreline and wetlandmanagement
5. Sand- mining regulation

Organization of the initiatives process

Central government has issued"Pearl River Delta comprehensive Regulation Planning". Provincial and local authorities have strengthened the management of water resources, pollutant discharge, sandmining, wetland protection and take various engineering measures to stabilize and deepened the rive channels to ensure flood water to propagate into the sea smoothly and quickly, etc.

As the Pearl River delta has been one of the most developed and densely populated regions in China it has been a long history of development, protection and regulation in the delta. Chinese government has realized that law is the most effective way to regulate all socio-economic affairs in the country and strengthen the administrative power in regulating each sector. Meanwhile, the delta hydraulic and morphological evolving processes have, to a higher degree, been understood by research institutes and universities after many-year hard research efforts. These aspects have promoted "real solution" planning and regulation possible. Recently,

central government has ratified "Pearl River Estuarine comprehensive Regulation Planning" and "Pear River Basin Flood Protection Planning", provincial government has issued "Pearl River Delta Reform and Development Planning" (a master planning), different provincial bureaus has issued sectoral planning to materialize the master planning. In China these planning's at national, provincial levels are administrative laws, ministries and their subordinate agencies, and provincial, municipal, county governments have been granted mandates to manage water resources, flood control, pollutant discharge, sandmining, wetland protection, navigation, etc. a series of engineering projects have been taken to stabilize and deepened the rive channels to ensure flood water to propagate into the sea smoothly and quickly, etc.

Difficult parts in the process of the initiative

The most difficult part in the process towards a healthy, energetic delta life is lack of a true 'comprehensive' strategic planning that is scientifically sound, far-reaching and being implemented strictly. The difficulties might arise from the misunderstanding of the natural delta evolution processes, the competitive utilizations of delta resources including water, sand, shoreline, channel, etc. by various local, regional interests as well as weak awareness of sustainable regional development.

The most difficult part in the process towards a resilient, energetic delta development is the institutional coordination and cooperation. There are more often than not interest conflicts between central government and provincial government, provincial government with provincial government, local governments with each other, sectoral development priorities, etc. This might lead to prolonged quarrels when problem-solving action needs to be taken immediately. At the same time, the delta governance is prone to be rigid, so the institutional structure, relationship and mandate should be adaptive and evolving when new circumstances emerge.

Suggestions for countries that just have started to think about their deltas

1. From a holistic viewpoint, scientific researches should be conducted to understand the natural evolution process of the whole delta including water & sediment movement, channel morphdynamics, storm surge (typhoon) forecast and early warning system, etc.
2. With the help of the understanding of the delta process, comprehensive long-term planning encompassing water resources & water environment protection, flood-risk minimization, navigation, agriculture & fishery, recreation, etc. should be formulated and made a law.
3. As guided by the comprehensive planning, engineering projects aretaken to regulate water, sediment and pollutant movement in the delta. The harnessing engineering measures have to be scientifically-sound, adaptive, economically feasible and sustained.

Case Study 5

Eng. Mohamed ElRawady

Egypt

The Alexandria 2030 Integrated Urban Water Management (IUWM) plan, the Nile Delta

Main issues in the Delta

Competing and escalating demands

Aside from the competition between the Nile basins upstream and downstream, different sectors are competing over water, with the growing population and the evolving industry, the agricultural sector is facing a growing competition. The sector of the highest national consumption, in itself also has competing demands of its own, especially between upstream and downstream farmers.

Water Quality Degradation and Pollution

Caused by Inadequate treatment of municipal and industrial waste water.

Ground Water Depletion and Sea Water Intrusion

Caused by excess pumping of groundwater and excessive granting of well permissions.

Coastal Shore Erosion and Sea level rise

Measures to deal with the issues

- EWP was part of a nationwide dialogue on treated wastewater reuse as a measure for decreasing competition over conventional water resources.
- EWP facilitated the establishment of water treatment plants and low cost sanitation schemes in rural areas of the Nile Delta.
- EWP organized a seminar on the future of water in Egypt.
- EWP coordinated a focus study and organized workshops on industrial areas' water impacts in the delta.
- EWP was part of a future planning process for the coastal city of Alexandria that depends entirely on the Nile, developing what has been known as the Alexandria 2030 Integrated Urban Water Management (IUWM) plan. One of the main objectives of that plan is reducing the pressure on the Nile Delta by developing non-conventional water resources where possible.

Organization of the initiatives process

- Constantly in contact with decision makers and different stakeholders.
- Continuously facilitating technical Dialogue through workshops.
- Disseminating knowledge through publications.
- Organizing awareness campaigns and public events.
- Developing project concept notes and proposals.
- Giving awareness presentations.

Difficult parts in the process of the initiative

Lack of harmonization between different sectors, which is emphasized the most by mismatching Water, Agricultural, and Urban development policies.

Suggestions for countries that just have started to think about their deltas

Watch for trends of urban encroachment on Deltas, monitor pollution sources and water quality and identify all competing uses and get stakeholders consensus on ranking them by priority.

Case Study 6

Dr. Mochammad Amron

Indonesia

Managing diverse delta systems

Main issues in the Delta

- Developed Delta: Java Island: Brantas, Solo, Citarum
  - Populated Area (irrigated area, cities/ urban area)
  - Water Management (water supply, sanitation)
  - Flood Management
- Developing Delta: Sumatera and Kalimantan islands
  - Water management and tidal area
  - Sustainable development plan
  - Conservation
- Undevelop Delta: Kalimantan and Papua Islands
  - Conservation and preservation
  - Sustainable development plan
  - Resettlement

Measures to deal with the issues

- Master Plan/Land and Water Resources Development Planning
- Zoning (Macro, Micro and Meso Zoning)
- Development of infrastructures in soft soils
- Social Engineering

Organization of the initiatives process

- Coordination's among Lines Agencies
- Planning Agencies as a Lead Agency during Planning stage
- Role and regulations
- Meeting consensus

Difficult parts in the process of the initiative

- Appropriate development plan
- Staging of development
- Political support

Suggestions for countries that just have started to think about their deltas

- Global warming: Attention to CO_2 emission reduction
- Stages of Development:
  - Land and Water Resources Development Plan
  - Appropriate development plan
- Delta management require significant cost
  - Delta Development require careful plan
  - Stages of development are required
  - Environmental consideration and social aspects
    - Biodiversity protection
    - global warming
    - degraded land
    - resettlement issues

Case Study 7

Ms. Panpilai Sukhonthasindhu

Thailand

The Town and Country Planning Act, the Chao Phraya Delta

Main issues in the Delta

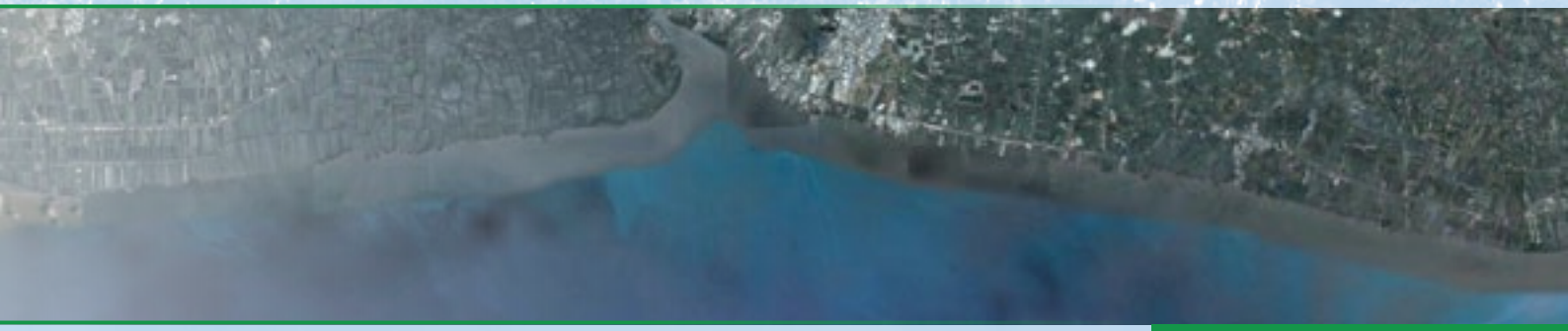
- Improper settlement in Young Delta: lacking long term land use planning, ineffective urban planning and coastal area development plan
- Flood risks and coastal erosion problems
- Resilience and adaptation to environmental changes (climate condition and extreme weather): Food security has been at risk for the new poor. There is tendency for the local producers to adapt the cropping patterns.

Measures to deal with the issues

- Public awareness on the understanding of the change process in the Delta is the major measure. Most of the works are undertaken by academics, civic groups and user groups, but it is not yet covered the whole picture of the delta and the change process.
- The structured measures: constructions of dike, flood ways, water diversion scheme, have been the effort of the line agencies, while local initiatives and economic measures are not integrated.
- The legal aspect as the enforcement of the comprehensive plan of Town and Country Planning has been put forth by the Senate Committee on Natural Resources and Environment.

Organization of the initiatives process

Thai Water Partnership works in coordination withlocal stake-holders concerns with coastal erosion and coastal area development planning. Examples of work cover the enforcement of the Town and Country Planning Act in downstream Mae Klong, and Thachin river basins, water allocation in Prachin-Bang Pakong river basin.



Difficult parts in the process of the initiative

So far, the implementations at local level have been the problems solving at the basin level, then it is very difficult to synthesize and upscale issues to the policy brief proposed to line agencies and public sectors. Facilitating the common understandings of diverse-stakeholdersis also challenging.

Suggestions for countries that just have started to think about their deltas

- Develop the holistic views and systematic working approach to make the understanding of the complete picture of your delta. It should not be the sectorial work of different line agencies.
- Prioritize key issues affected the changes in the delta: impact of Climate Change, land use change, and plans of coastal area utilization, for examples. Have the monitoring system in place, with the accurate and update information and data.
- Public awareness raising: on the ecosystem of the mangrove forest, coastal areas, the expansion of urban settlements, for examples. These should be done through the easy accessible channels. Advocate to the young generation through the educational system.

Case Study 8

Dr. Tu Dao Trong

Vietnam

The Delta Master Plan, the Mekong Delta

The Mekong River has a catchment area of 795,000 square km and a water volume of 475 BCM. The Mekong delta has a catchment area of 40,000 square km. The Mekong river basin incorporates land and people within six riparian countries namely China, Myanmar, Thailand, Laos, Cambodia and Vietnam.

Main issues in the Delta

Dependent on upstream water/cross-boundary issues

- Heavy dependent on water from upstream countries (95%)
- Too much water in flood season and shortage water in dry season.

Salt water intrusion

Sea level rise

Measures to deal with the issues

- Living with flood
- Establishment of resident areas free from flood
- Changing the crop pattern fitting to specific area- aquaculture development
- Development of coastal protection forests to mitigate damage of sea level rise
- Practicing IWRM

Organization of the initiatives process

- Revising Delta Master Plan
- Conducting deep researches/studies to find appropriate solutions for specific areas
- Improving capacity for local organization and communities
- Learning experiences from other Deltas in Region and in the world
- Studying and assessing impacts to Delta of upstream development– Establishing the scenarios for responding

Difficult parts in the process of the initiative

- Capital and human resources shortage
- Gaps of understandings on Delta, development for short term but not for long term, outstanding's in policy and Local benefits.

Suggestions for countries that just have started to think about their deltas

- A Comprehensive and scientific plan for Delta development
- Human resources building
- Participation of communities in decision making process
- Strengthening comprehensive basin cooperation
- Build resilience through restoring natural systems (the Delta used to be an open, highly adaptive systems but large scale infrastructures have turned the delta into a largely human regulated system with low resilience to changes including climate change)
- The Delta Master Plan is a multi - discipline plan for social-economic development and Environmental protection for the Delta. Therefore it needs allot of efforts from all stakeholders including government (at central and local levels), civil society, communities etc. The solutions should be combined with advanced technologies, local knowledge and experiences (e.g. living with flood).

Annex 2

List of resource persons and Case Studies

Name	Case Study	
Dr. Khondaker Azharul Haq	Case Study 1	**Bangladesh:** The Delta Development Plan 2012, the Ganga-Brahmaputra-Meghna Delta
Prof. Abel Afouda, Dr. Fabien Hountondji, Mr. Armand Houanye	Case Study 2	**Benin:** Towards designing a Master Plan, the Ouémé Delta
Dr. Watt Botkosal	Case Study 3	**Cambodia:** The Mekong delta
Dr. Wang Yuhai	Case Study 4	**China:** The Pearl River Delta comprehensive Regulation Planning, the Pearl River Delta
Eng. Mohamed ElRawady	Case Study 5	**Egypt:** The Alexandria 2030 Integrated Urban Water Management (IUWM) plan, the Nile Delta
Dr. Mochammad Amron	Case Study 6	**Indonesia:** Managing diverse delta systems
Ms. Panpilai Sukhonthasindhu	Case Study 7	**Thailand:** The Town and Country Planning Act, the Chao Phraya Delta
Dr. Tu Dao Trong	Case Study 8	**Vietnam:** The Delta Master Plan, the Mekong Delta