

EXECUTIVE SUMMARY

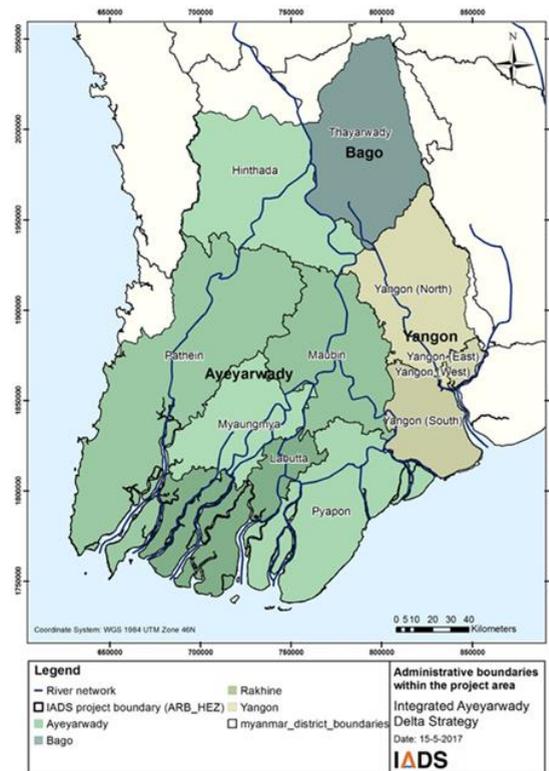
Background and Motivation

The disaster caused by cyclone Nargis in 2008, has been etched into the collective consciousness of the people of Myanmar like no other recent disaster. Tragically, it demonstrated the vulnerability of the Ayeyarwady Delta to extreme weather conditions which are generally expected to occur more frequently in the future due to climate change. Peak flows and river discharges are expected to increase in the wet season causing more frequent flooding, while they may decrease in the dry season leading to serious fresh water shortages. The sea level will continue to rise, and saltwater intrusion will further increase, subjecting large areas of the coastal delta to a brackish environment. At the same time, socio-economic development in the Ayeyarwady Delta is increasing the pressure on the Delta's land and water resources.

The government of Myanmar acknowledges that integrated water management is one of the building blocks for sustainable development and achieving peace and prosperity. The Ayeyarwady River is the 'life-vein' of the country. With its delta, the river and its catchment are unique in the sense that large areas are relatively unspoiled. At the same time development is speeding up and structuring choices will increasingly have to be made. How to balance socio-economic development and sustainable use of natural resources, while at the same time guaranteeing sufficient safety from water related risks, is a key challenge for the government and people of Myanmar.

Myanmar and the Netherlands have a long-standing relationship in working towards Integrated Water Resources Management (IWRM) in Myanmar. Experts and officials from both countries have been working together to develop an integrated strategy for Ayeyarwady Delta. Involving as much as possible representatives of all sectors and government layers, because long-term decision-making requires such collaboration, the combined Myanmar and Dutch team has been applying a systems approach to explore the most beneficial measures. Such a systems-approach is needed to promote that the physical conditions of the Delta and its human exploitation and management become interlinked.

A consortium led by Arcadis and comprising Sweco, Deltares, HKV, Wageningen University and Research Centre, Delft University of Technology, Ink Strategy, Haarlem Hydraulics (all from the Netherlands) and NEPS and IUCN (from Myanmar), worked from December 2016 – November 2017 on the first phase the Integrated Ayeyarwady Delta Strategy (IADS) project. This first phase of IADS has brought together numerous stakeholders including concerned ministries at national and state level, as well as representatives of NGOs working in the Delta.



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The output of this process is a vision and goals for the Delta, a list of promising measures and suggestions regarding their temporal implementation that together outline a tentative strategy towards a safe, prosperous and sustainable future for the Delta. It does not provide a list of specific investment opportunities; the Delta planning process is still at an early stage of development. The development of a detailed delta plan requires more data, dialogue, and time.

Delta Strategy Development Process

A comprehensive, collaborative process consisting of five main steps was followed:

1. Inception – this sets the boundary conditions for the analysis where the vision and goals are developed;
2. Situation analysis – this describes the Delta system (i.e. the natural resources, the socio-economic conditions and the institutional system) as well as present and future challenges and opportunities;
3. Strategy building – this step develops alternative strategies for decision making;
4. Action planning – this includes the preparation of Detailed Project Reports (DPR's), including Social and Environmental Impact Assessments and investment planning; and

5. Implementation – actual implementation of measures, monitoring and evaluation.

The first phase of the IADS project provides the results of the above first three steps. The kind of long-term planning that underpins the Delta strategy takes time and cannot be achieved without the full ownership of the government being responsible for implementation of its first steps. Therefore, the approach focused on working together, for example with working groups, working sessions with stakeholders, and the use of innovative communication methods (i.e. visualisations). Capacity building, based on a ‘learning-by-doing’ principle, has been another key element of the working process and is an essential additional output.

Vision and Objectives

This delta vision describes ‘future perspectives’ on a time horizon up to 50 to 100 years, including goals, values and principles. It is an important step in the development of a delta strategy, because it presents the ‘final’ situation for the Delta that all measures in the strategy aim for. Starting with this future perspective, it is possible to formulate what needs to be done in the short-term (until 2025), mid-term (2025- 2050), and for the long-term (after 2050). In view of the inherent uncertainty of future developments, it is important to ensure that chosen pathways do not create lock-in situations or unwanted interdependencies, so that future measures can be adjusted in such a way that under emerging future (yet unknown) conditions, all interventions still lead to the same desired long-term situation. This is an adaptive way of integrated delta management.

For the Ayeyarwady Delta, the chosen long-term perspective envisions a safe, prosperous and sustainable delta with a vibrant diversified economy and ecology that are resilient to salinization, floods and water shortage.

To be able to develop an action plan, it is important to translate this vision into clear objectives with measurable performance indicators. The indicators allow an assessment of the current and future performance of the Delta and its sectors and the potential performance of development and adaptation strategies. They can also be used to monitor progress once implementation of the strategy has started, albeit that such indicators first need to be chosen, developed and assessed. Because of the importance of the Delta subsurface and water systems, the IADS focuses on the water system, leading to the following five main objectives:

- Objective 1: Ensure safety from floods (based on introduction of a flood risk management approach). This means developing a system of flood standards in relation to acceptable consequences of any such flood.
- Objective 2: Develop climate smart agriculture, fisheries and livestock. This means increased resilience (diversification of products to make production less vulnerable and less yield losses) and increased added value (to add economic prosperity to food security).
- Objective 3: Improved water supply and sanitation. This means providing safe and sufficient drinking water and sanitation to a higher percentage of inhabitants of the Ayeyarwady Delta.
- Objective 4: Conserve and restore ecosystems and promote their sustainable use. This means reduction of pollution and pro-actively protecting and expanding eco-systems and their valuable services, for example, to flood protection and agricultural production.
- Objective 5 Develop effective institutions and equitable governance for delta management and planning.

These objectives provide the potential to set measurable targets, such as for example “the probability of a riverine flood is less than once per 100 years”, or “50 percent of the inhabitants in the Delta region have access to safe, piped drinking water in 2040”. It is noted, however, that adequate data and approved policies are not yet available to set such targets. The governance of the Ayeyarwady Delta’s development is still at its very early stages, which is why the chosen objectives remain at a rather generalized level.

Reference Situation

Based on: (1) the present situation, presented in the IADS Delta Atlas, (2) identified trends and (3) identified planned changes and interventions, it is possible to picture a possible development for the Delta, albeit, only in general terms due to the lack of sufficient quantitative data. In the IADS, this future situation is called the Reference Situation, which is a worst case that may be realised if no delta-wide holistic management and development is put in place. It demonstrates the necessity and urgent need for an IADS. The most important trends, threats and developments for the Ayeyarwady Delta are summarized in the table below:

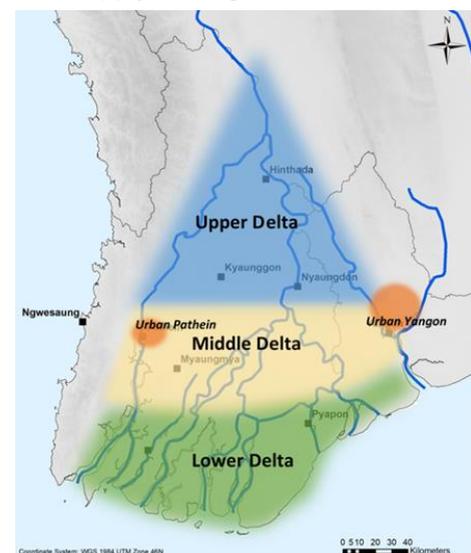
Climate change	<ul style="list-style-type: none"> • Increasingly intense rainfall events; threat to water quality and increased peak discharges in rivers. • Sea level rise: threatening the coastal zone, increasing coastal flooding risk and salinity intrusion.
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People	<ul style="list-style-type: none"> • More and longer dry spells; threatening water quality, water availability (drinking water and irrigation), and navigability of rivers.
	<ul style="list-style-type: none"> • Increasing temperatures; heat stress, threat to health and water availability by increasing evaporation, water demand and disease pressures.
	<ul style="list-style-type: none"> • Urbanization; Loss of fertile land, building in flood prone areas and congestion. It can potentially become urban sprawl, which expands the threats to health and environment. This is often accompanied by an increase in impermeable (urban) surfaces that result in higher peak discharges in urban areas and rivers during rainfall events.
Economy	<ul style="list-style-type: none"> • Population increase; increasing energy, food and water demands; these might result in health issues, drinking water shortages and potential famine.
	<ul style="list-style-type: none"> • Increasing need for sanitation and better water quality; reduced sanitation and drinking water access results in more diseases and other health issues.
	<ul style="list-style-type: none"> • Increasing transport demand; congestion. Poorly connected cities, villages and towns through proper roads and water ways result in non-development of the economy, slow evacuation possibilities during floods and increased urbanization due to rural isolation.
Institutional	<ul style="list-style-type: none"> • Industrialization; the increase in pollution and encroachment of agricultural land results in lower food productivity and environmental issues. • Fragmented spatial planning and land speculation.
	<ul style="list-style-type: none"> • Decision-making process; fragmented responsibilities and tasks between ministries and departments. This hinders coordinated decision-making and integrated water resources/river basin management. • Decentralization; more local control, which is positive when the local authority is capable of coping with their issues. It can also result in negative developments when the local authority cannot implement the required developments. • Financing options: increased opportunities for international financing, specifically at Union level. • Social development: more attention for protection of people against natural disasters, social support from various NGOs, public portion in decision making regarding development projects, gender equality. • Legislation: Water Framework Directive becomes active; more legislation is being developed.
	<ul style="list-style-type: none"> • Decision-making process; fragmented responsibilities and tasks between ministries and departments. This hinders coordinated decision-making and integrated water resources/river basin management. • Decentralization; more local control, which is positive when the local authority is capable of coping with their issues. It can also result in negative developments when the local authority cannot implement the required developments. • Financing options: increased opportunities for international financing, specifically at Union level. • Social development: more attention for protection of people against natural disasters, social support from various NGOs, public portion in decision making regarding development projects, gender equality. • Legislation: Water Framework Directive becomes active; more legislation is being developed.

In a worst-case scenario, government planned interventions and policies will not be able to keep up with the deteriorating situation, leading to increases in overcrowded, unhealthy and flood-vulnerable urban agglomerates, poor rural subsistence farming towns and uninhabitable areas with regular rapid floods or semi-permanent flooding. Urban areas may increasingly lack proper water supply, sewage treatment and economic opportunities especially for poorer people. Apart from the poor hygienic conditions in the cities, industrial pollution may also create health issues and the degradation of the natural environment. Insufficient flood defence may cost hundreds of lives and vast and growing economic risks and damages every year. The mangrove forests may disappear completely, because they are used for firewood, cut for aquaculture farming, sold for building materials, or environmentally degraded. This contributes to an increase in coastal erosion.

For a more detailed description of the Reference Situation, the Delta is separated into four zones.

The Upper delta is characterized by dynamic rivers with highly variable discharges. This zone is also prone to rapid increases in water levels and bank erosion due to the highly variable river discharges. Bank erosion causes sedimentation in the riverbed, building up local sand bars that may lead to increased local flood probability and reduced navigability. If the logging of forests in the



upstream areas of the Ayeyarwady Basin continues, surface runoff and sediment loads increase. This results in increased peak discharges with more destructive power than the increased rainfall intensity alone would account for. The current infrastructure may fail more often in the future due to increased peak discharges. The returning costs of repairing and rebuilding the damaged embankments, roads and electricity grids become difficult to manage. Parts of the land are not attractive for (international) investors because they are flooded too often.

The middle delta is characterized by less dynamic rivers and less rapid changes in water levels than the upper delta. In this mainly agricultural zone, salinity intrusion is of major concern. The uncertainty in the changing rainfall patterns and salinity intrusion threaten the investments in agriculture and aquaculture due to an increasing risk of yield loss through salinization, flooding or drought. Another important factor in the middle delta is drinking water supply threatened by changing seasonal rainfall patterns and salinity intrusion and groundwater salinization. If the current low pace of drinking water investments continues, many more people in the future will lack access to good quality fresh water.

The lower delta is most vulnerable to climate change because of its exposure to sea level rise, potentially more severe cyclones and changing rainfall patterns that occur on top of riverine flooding and land subsidence. If these threats remain unaddressed, the loss of land to the sea by vanishing mangrove cover and subsequent coastal erosion, sea level rise and land subsidence, is accelerated by increasing storm occurrences. The existing poverty in the lower delta becomes worse because people lose their means of growing and collecting food. Their lands are lost to the sea and fisheries becomes less of an option as a result of increased pollution and overfishing due to lack of regulations. At the same time, fresh water availability is changing due to longer dry spells and higher peak discharges. This makes the environment even harsher and the struggle to survive more difficult. Due to the year-round saline conditions in the lower delta, rain-fed rice paddy can only be grown during the monsoon season and not in the dry season. The lower delta gradually loses all productive and economic benefits.

The urban areas, mainly Yangon and Patheingyi and to a lesser extent Hinthada, continue to rapidly expand uncontrolled. Infrastructure, such as water supply, drainage, sewerage systems and flood protection, is not keeping up with the rapid changes. Moreover, with the developments described above due to the continuing threats in the rural areas, the urbanization rates further increase. Migrating people form large urban agglomerates without proper infrastructure. The slums grow, and the city centers become congested. Many people live without drinking water supply, without proper sanitation or sewage systems and due to the large influx of people, jobs are increasingly difficult to get. The quick expansion further disables proper flood protection for most parts of the cities. Floods occur several times a year, hampering the socio-economic development. The high rate of urbanization might overburden the infrastructure.

The Reference Situation provides a bleak outlook and may become reality on a scale that depends on actual climate change as well as the global economic development, global political situation, and the ability of the government of Myanmar to implement projected policies.

Assessment of possible measures for development and adaptation

More than 90 possible measures (both structural and non-structural) have been assessed together with stakeholders in Myanmar. All these measures were viewed as beneficial and desirable to counteract the problems experienced in the Delta but are mostly only ideas or concepts; there is not a list of project proposals (DPR's) that are based on feasibility studies, cost-benefit analysis or the like.

Substantiated choices however need to be made to come to a preferred set of solutions. Therefore, a tool, developed by the project and called the IADS Toolbox, has subsequently been used to rank and structure the measures in a comprehensive way based on a multi-criteria analysis. The criteria are carefully chosen to cover all aspects of integrated and Adaptive Delta Management (ADM). The assessment of the conceptual measures was done by experts, which was also verified with stakeholders in Myanmar.

Two sets of criteria were used in the assessment. The first set relates to the chosen delta objectives. If a measure potentially contributes significantly to more than one of the objectives, then it gets a higher 'score' than other measures. The development and use of an early flood warning system, for example, gets a high score on almost all objectives, so it ranks high. Another general measure that receives a high score on 'contribution to objectives' is 'mangrove restoration'. If these high-scoring measures are ultimately selected based on their positive contribution to meeting the objectives, detailed studies are required to be able to judge if such a measure is indeed beneficial for the long-term development of the Delta. The second set of criteria that is used in the IADS Toolbox are 'implementation criteria', including tentative cost ranges, social and environmental acceptability, technical and institutional aspects and adaptive capacity. From the scoring on these criteria quick-wins can be identified.

From measures to strategy

Strategies comprise coherent packages (sets) of measures with different extent at different locations to meet a set of predefined objectives. For example, a typical integrated flood risk management strategy for a delta consists of a larger set of ‘Room for the River’ type of measures (i.e. providing more space for the river discharge), protection measures, flood proofing and emergency response measures, which all complement each other. Not all measures can be implemented at once: available budgets are spread over time, some measures need more preparation than others, and due to uncertainty about future developments, it can be unclear to what extent the measures are required. Therefore, in addition a strategy consists of sequences of measures implemented over time, also termed pathways. In these pathways one can distinguish short-term actions and long-term options. This requires the inclusion of long-term options in the strategy, combined with an assessment on how the short-term actions can be followed-up efficiently.

To arrive at a robust IADS, measures that were assessed to contribute best to the Delta objectives, were first organized according to two guiding principles into alternative strategies: one grey (‘fighting the forces of nature’) and one green (‘building with nature’) strategy. This was done to show the wide range of available choices and to create awareness of the pros and cons of the two choices. In the end, practical choices were made together with Myanmar’s stakeholders to form a mixed strategy derived from both strategies, by explicitly taking into account similar criteria that were used for the assessment of single measures: contribution to the objectives, costs, trade-offs and adaptive value. The stakeholders were also explicitly asked to consider in the mixed strategy both the current and future climate and socio-economic conditions, and to choose measures for the short- and mid-term, and optional measures for the long-term.

Five Strategic Development Directions

The above consultation with the Myanmar’s stakeholders and experts resulted into five “Strategic Development Directions”, which can be considered in the mixed, most-promising strategy for the Delta:

1. Integrated river and delta wide flood risk management;
2. Resilient rural economies;
3. Resilient cities;
4. Robust Energy and transport networks; and
5. Risk informed spatial planning system.

Measures in each of these five strategic directions will be required to achieve the Delta objectives.

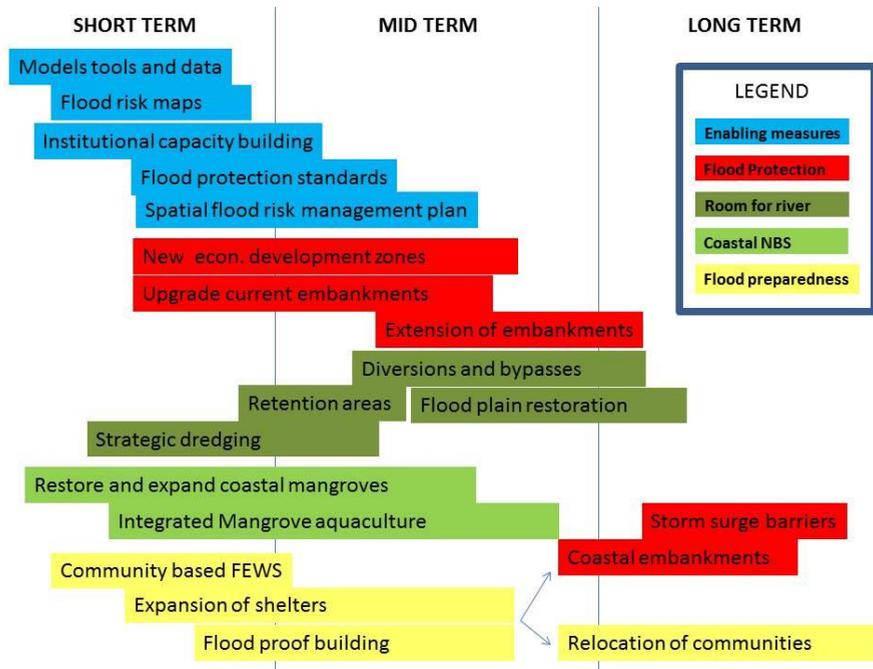
SDD 1. Pathway to a more robust flood risk management system

This strategic direction aims to better manage the flood risks in the Delta. Its focus is on a systematic risk-based and proactive delta wide approach. Instead of restoring or replacing dikes after each flood or river bank erosion event, investments and improvements in flood risk management and prioritization of flood risk measures, can be planned and designed. Prioritization will be based on information of both current and potential future risks and implemented according to acceptable yet-to-be established standards (such as once per 100 years flood probability in certain build areas, or once per 20 years in some rural areas).

Because it is currently lacking, the first step would be to build the knowledge and capacity for a regulatory framework including a differentiated clear set of protection standards, as the necessary foundation for further decision making on investments in flood risk management of the Delta. This includes the preparation of flood risk maps. Approximately 2000 km of embankments in the Ayeyarwady Region is already being monitored yearly and 200 km per year is being restored and upgraded. In order to know if continuing this effort has a high priority, it is important to calculate the associated costs, spatial impact, cost-benefit ratios and identification of alternative solutions. In pilot projects, existing procedures can be adopted towards dike building procedures that blend the use of local material and geotechnical information with international building standards.

The figure below shows the timing and logical order of flood risk management measures based on interdependencies between enabling and physical measures, the potential regret of the measure, and assumptions on the cost-effectiveness of the measures. The different colours correspond to different types of measures as explained in the main report. Depending on how economy and population will be developing in the coastal zones there will be a moment in the future when risks due to sea level rise become such that one has to choose between investing in expensive flood infrastructural protection measures or relocation of communities and economic activities. This choice, indicated in the figure with the arrows, can be different at different location. For the greater Yangon area these investments may pay off whereas in other parts of the

Delta a relocation strategy might be the only option. To be able to make this choice in the future time, it is important to continue collecting data and analysing the developments in the Delta as a whole.



The restoration of coastal mangroves is also a measure that can be intensified in the short term, as well as the improvement of emergency preparedness and response measures. These measures all have potentially little negative impact on other decisions.

Because an integrated spatial development plan for the whole delta does not exist, it is not possible to decide now on structural measures related to both Room-for-the-River and enhancement of the flood protection system. Evident obstruction of the flood plain by illegal activities can be addressed, but for that to occur, proper legislation and effective law enforcement must first be implemented. Furthermore, improvements of existing flood protection and retention areas that currently do not function in the way they were designed, for example in the Monyo and Bago area, can be studied in the short term. Based on these studies, decisions can then be made as to whether they be included in an investment programme.

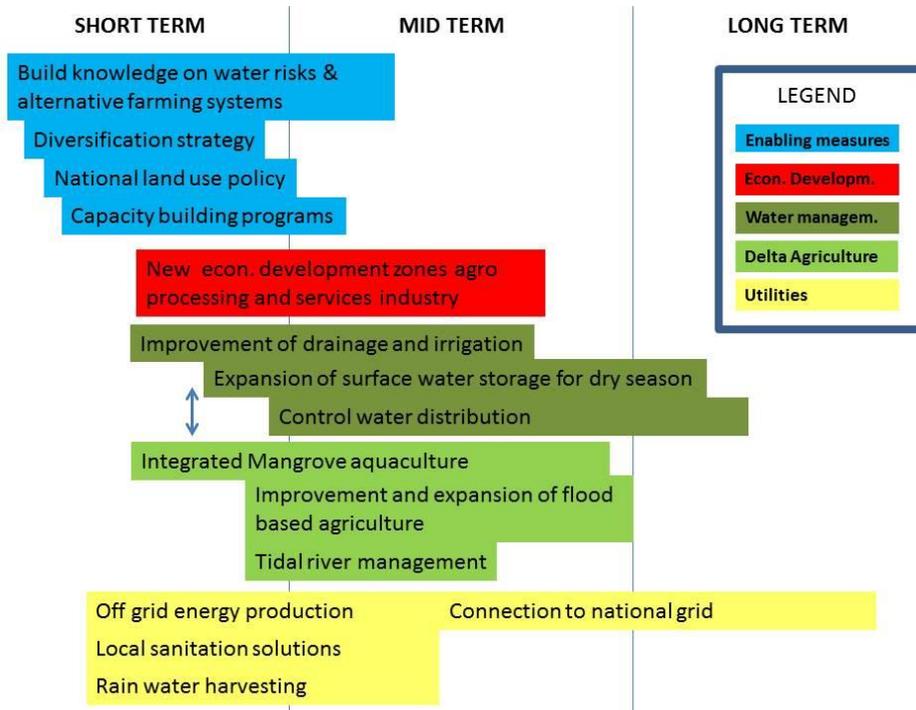
SDD 2. Pathway to more diversified rural economies

The regional industrial zones located in the Ayeyarwady Region (i.e. Hinthada, Myaungmya, and Patheingyi) and the four in Yangon, are expected to boost further industrialization and economic growth. However, apart from developing industries in regional dedicated zones, the IADS consultations reveal that the rural economies in general need further diversification. A strong agricultural economy based on smallholder farmers’ development depends both on the growth of the rural farm and non-farm economy. This can be accelerated through several public investments, particularly in rural roads, electrification, telecommunication, and market infrastructure (e.g. market places, warehouses, collection centres, packing houses).

The strengthening and reform of the agricultural sector as the most important economic sector in rural areas, has high priority in Myanmar. As water management and agriculture / aquaculture are strongly interlinked, it is important to include a strong water focus in any agricultural diversification and agribusiness value chain propositions. The issues that at least need to be addressed in light of sustainable development and climate change are: increasing flood risks caused by the expansion of polders, the risk of subsidence, the sustainability of meeting water demand (in terms of volume of water and in terms of water quality) now and in the future, but also the contribution of flood-based farming systems to flood, sediment and water quality management.

From the IADS toolbox, some measures can be implemented independently from others in the short term (quick win). They also have low impact up- or downstream of the Ayeyarwady river. Off-grid energy production, rainwater harvesting, and local sanitation solutions are examples of such measures. However, these measures require further studies before a decision can be made to implement them. It is advisable to

continue the stakeholder process to discuss the priorities for, and results of, the proposed studies and the strategic choices related to them.



There is a clear interdependency between the groups of measures shown in the figure. The potential increase of fresh water shortages for example can be combatted by better polder water management, increase of water storage and by better control of low water discharges, or by adapting land use and farming practice to the changing conditions. This choice, indicated in the figure with the double arrow, can be different at different locations within the Delta depending on the costs and benefits of such choices.

SDD 3. Pathway to resilient cities

Safety against flooding is also one of the major challenges for cities. Considering the rapid economic growth in urban areas, there is a need for (risk informed) flood protection standards, which currently do not exist. The flood protection infrastructure around cities can then be upgraded accordingly.

Upgrading old infrastructure (drainage, sewage systems, roads) and utilities (drinking water supply) are a general challenge for cities in the Delta, as much of the existing infrastructure dates back many decades. Existing industries are often outdated and located too close to housing areas and therefore need to be relocated. Which ones exactly and how far, requires further studies.



The combination of spatial planning to accommodate the growth of the city together with the upgrade of networks in the city is important. To provide safe and sufficient water for everyone in Yangon and the urban delta, there is a need for more related infrastructure (e.g. piped water systems, surface water storage). These developments can be combined with measures to cope with the increasing demand for sanitation, water quality improvement (e.g. sewage treatment, improving the sanitation system) and healthcare. However, detailed information on how and what is not yet available. Data collection, feasibility studies and stakeholder consultations are first needed before concrete steps can be made towards actual project realisation.

As the city of Yangon is undergoing a phase of fast development now, there are many investment opportunities that can be seized upon in the short term to start the transition to a more resilient city. As the challenges are enormous, the transition will take decades and should therefore be developed as a long-term programme. The figure above summarizes the different measures that emerged from the IADS process for this strategic direction.

SDD 4. Robust Energy and transport networks

One of the main barriers for further development of the rural economy and urban delta cities is the lack of reliable power supply and transportation via road, water and rail. Rail, roads and bridges need to be extended to connect the economic centres in the Delta. Harbours need to be more accessible for larger ships. Many plans to do so are underway, but it is not clear how much they may contribute to the Delta objectives and how these initiatives impact neighbouring areas.

From the perspective of controlled delta management, it is important that the developers of these investment plans consider two aspects: 1) is the infrastructure exposed to the risk of flooding and 2) does it enhance water-related risks (floods, droughts, pollution) upstream or downstream in the flood plain? A 'climate risk assessment' or 'stress test procedure' would be a good first step. For the implementation of such a procedure good practices can be used from the Netherlands ('*watertoets*'), and internationally from the World Bank (CCRA, WB decision tree). Implementation can be connected to already existing procedures of Environmental Impact Assessment. A key part of such new procedures will be the use of adequate field data and quantitative simulation tools, which will first need to be developed.

To make the Delta more accessible to shipping requires smart dredging solutions, which is one of the measures from the IADS toolbox with a high score on objectives and implementation criteria. An infrastructure and transport masterplan for the Delta, with a solid scientific underpinning, will help to make robust choices ahead of the increasing investments in infrastructure.

Especially for power supply, rural areas cannot rely on the national grid. For some areas, local decentralized solutions using renewable sources (wind, solar but also biomass from for example rice straw) can be a good solution. Local grids for the more populated parts will have to be set up as well, for which dedicated studies are required first.

SDD 5. Risk informed spatial planning system

The overarching challenge for the short term is in setting up a risk-informed spatial planning system. It is of utmost importance to share data between the various ministries in this regard and to design a national data knowledge portal. The Delta Atlas is an important first step, which needs follow up. Alignment can be sought with the AIRBM program in this regard, and with similar initiatives in the Netherlands (national delta program, existing tools like 'water and climate adaptation stress test'). Appropriate organizations with planning competence and executing and enforcing capacity, such as organisations for land use and land ownership registration, can be strengthened with the latest tools to access data and information.

Myanmar formed an Ayeyarwady Delta Working Committee in November 2016, appointed by the National Water Resources Commission (NWRC). This committee can be made responsible for developing plans to respond to urgent emerging issues in the Delta. Cyclic evaluation (for example every 10 years) and reassessment of plans are needed, and their progress needs to be monitored using a yet-to-be-developed system of performance indicators and targets (what and how much to achieve when). Further, appropriate legal and regulatory frameworks need to be developed, implemented and enforced. For example, for risk zoning and flood protection standards, and on land rights. A proper system of permitting and land buyout schemes is also necessary to be able to implement spatial plans.

In general, for the Delta as a whole, most measures shown will be needed to overcome the challenges of the Delta. However, at a particular location, for measures that serve similar objectives, it is often a choice between one or the other. Consequently, the choice for a specific measure will influence effectiveness,

feasibility and urgency of alternatives. For example, choices for Room for the River type of measures will not exclude the necessity for dike reinforcements but will lower the urgency for higher dikes.

Results of IADS first phase

The first phase of IADS resulted in a description of the current state of the Delta, possible types of interventions and, above all, commitment from all involved stakeholders in Myanmar. The necessity for integrated delta management is recognized by all, and the question is how and where to start. There is an urgent need to steer delta development in a direction that is aligned with the vision and objectives, and this urgency rises with the number of new projects and development initiatives. Examples are the billion-plus USD investments expected in the upgrade of the water transport corridor to China, the development of new masterplans for urban and port extensions, legal and illegal construction of embankments for fish ponds or economic zones, polder development for rice production in the lower delta, small scale livelihood improvement projects, expected increase in aquaculture production, large scale interventions in the upstream Ayeyarwady river basin; just for example. There are numerous such water-related initiatives and projects, from small to large scale, from conceptual ideas to finance-guaranteed projects, all with small, large or simply unknown impacts on the whole delta system.

There is no (centralized) coordination over all these active and planned initiatives and projects. Myanmar lacks instruments and means to do so, such as legal, financial, institutional, governance, or technical instruments. Adequate data, centrally stored and digitally accessible, on which any holistic assessment can be based, is also lacking.

Without proper planning and coordination, the Delta risks developing in an unsustainable direction as described in the Reference Situation, with no benefits to the people in the long run. Lessons from other deltas (and coasts and rivers in a broader sense) teach us that lack of coordination can lead to problems that need costly restoration and re-development afterwards. For example, if sand is being mined from a stretch of the river to improve local navigability, then this may lead to bank erosion and undermining of bridge pillars further downstream. Or, if fresh water rice fields are being developed in the lower delta, how long would that investment last, considering progressive salt water intrusion. Or, what would be the increase in flood frequency in downstream areas if embankments, such as the horseshoe dike in the upper delta, are being extended.

The strategy building as part of the first phase of the IADS project, resulted in five Strategic Development Directions with possible pathways to follow over the short-, mid- and long-term. However, based on the first steps, which lacked the possibility for more elaborated studies, it is not possible to select short-term (pilot) investment projects that contribute most cost-effectively to the IADS objectives. The main reason for this is a lack of data, detailed project proposals, and a lack of (enforced) legislation and policy decisions. This phase of IADS therefore cannot produce a directly implementable Investment Programme, nor a delta plan with clearly prioritized actions. The development of a delta plan generally takes many years. Even in areas with much more data, studies and institutions than in Myanmar, such as Vietnam, Bangladesh and even the Netherlands itself, this took many decades. Given the fast pace with which investors and development organizations have already entered the country and the Delta, there is however an urgency to start collecting all data, start doing the project feasibility studies and start developing and getting the appropriate legislation, finance and governance in place.

In order to make steps in each of the five strategic development directions, the following is needed most:

- A flood risk management plan;
- Better (quantitative) understanding of the decisions to be made in the development of the rural and delta urban areas, under different socio-economic scenarios; and
- A risk-based spatial plan for the delta in which these are worked out including opportunities for synergy and in full consideration of the vulnerability of the whole delta system.

Therefore, the following steps are proposed to be taken in the next three to five years given the need to develop the Delta as one natural, socio-economic and governance system. These steps address the question what is required to: (1) avoid regrettable interventions in the short term, and (2) to be able to develop a delta plan that has the level of detail that it can be incorporated in Myanmar's future 5-year programmes? Based on the results from IADS phase A, the following steps are suggested:

1. Data and models to support informed delta decision-making

The key suggested next step is to start collecting data and expand the numerical simulation models for the hydro-morphological system of the Delta while linking it to a process of decision making (as explained in Annex B). The meta-model concept (Annex B), would be a good way to approach this. It allows for a clear

role for the decision makers in the formulation of the research questions, in order to ensure that only relevant information is being collected and delivered. Such knowledge is needed before fact-based decisions can be made on (new) projects such as fresh water intake stations, aquaculture facilities, new rice production fields, the impact of dredging or any other river works, the assessment of flood frequencies and climate change impacts, etc. If, for example, investment choices need to be made in five years from now on new fresh water agriculture (e.g. Paddy 3), then one will need to know the status of progressive salinization. In order to have the information available by the time these decisions need to be made (years from now), it is advisable to start obtaining the data immediately and modelling the physics. Alignment with other ongoing or planned initiatives is needed to get the best outcomes.

2. Develop an instrument for impact assessment.

To avoid unwanted negative effects of physical interventions, a first step would be that investors/developers who want to intervene in the hydro-morphological system of the Delta require a No Objection Certificate (NOC) before they are allowed to start the work. To obtain such a NOC, the developer will need to perform a 'water-', or 'climate stress test', in which the consequences of the proposed intervention on the hydro-morphological system are assessed. The suggested next step for IADS is to develop an evaluation procedure including the development of the necessary assessment tools (such as hydraulic modelling – with step 1) for NOC submittals. Such a procedure, after piloting in a few already planned large projects, could be tied to (strategic) environmental impact assessments at a later stage.

3. Set flood safety levels.

For (international) investors, it is important to know the level of flood probability and that flood probabilities are adequately controlled and managed. The suggested first step is to assess the flood probability and flood risks (requiring flood risk mapping, flood inundation modelling – also see under 1, flood impact assessment) in the Delta. Only after flood risk maps have been produced, quantitative and fact-based information becomes available for the most flood-vulnerable areas. This is a prerequisite for risk-informed decision-making. After quantitative data has become available, as a follow-up step, public consultation can be considered on acceptable and realistic flood probabilities and flood risks. Once safety standards are set, based on the results of the flood risk assessment studies and public sessions, measures can be designed to achieve the desired safety levels. It is noted that this is entirely dedicated to the first layer of flood risk management: prevention. For less developed areas, such as the coastal zone and large parts of the rural areas, other types of flood risk management measures need to be considered, dealing with protection and emergency preparedness.

4. Reducing flood risks at a delta scale

When the water in the river rises to a critical height, water is being diverted to the Bago region, where it causes serious damage. This is akin to "sharing the burden" with neighbours, because without such diversion, the flood would be worse in the Ayeyarwady Region. A suggested next step for IADS is to work on maintaining this 'solidarity'. For that it is important to assess the (potential) damage caused by these regular floods so that an informed decision can be made on adjusting the water-distribution or flood risk management system. This requires inundation modelling, potential damage assessment and stakeholder consultations, linked to a policy (decision-making) process.

5. Develop solutions for integrated delta management

To support the coordinated management of the whole Delta, cooperative solutions at all levels - local, cross-regional and national - need to be considered. The suggested next step for IADS is to set up a pilot project in which cooperative models that have proven their success in other deltas can be tested and made 'Myanmar-proof'. The area around Nyaungdon comprises all elements of the Delta on a relatively small spatial scale, such as agriculture, urban area, flood risks, and dynamic river bifurcation. A pilot can be developed to set up a Myanmar-specific 'Water Governance Board' for this part of the Delta. Such a Board helps to set objectives (such as safety levels), carries out projects to achieve agreed objectives, balances conflicting interests of inhabitants via informed dialogues, and operates and maintains the local water system such as dikes, canals and sluices. Specific legislation needs to be developed, implemented and enforced.

6. Alignment with existing plans and strategies

Alignment of IADs next steps with existing programmes and initiatives for (parts of) the Delta has two main benefits: (i) it provides an opportunity to re-evaluate planned actions by others, so that unwanted developments can be changed, and (ii) it may provide an opportunity to share funding to achieve the maximum outcomes for the Myanmar society at large. A suggested next step in IADS therefore, is to make a more thorough and quantitative assessment of the plans and strategies, including implementation status,

government responsibilities, and a gap analysis on what is required to make sure that alignment of policies and strategies takes place in the development of a delta plan and its implementation.

7. Increase emergency preparedness

The trauma of Nargis (2008) has been etched into the collective consciousness of Myanmar's people. To minimize the loss of lives during a next extreme event, evacuation protocols, early warning systems, and local shelters are good short-term solutions, and these have already been implemented after Nargis. It is however not known if the current level of disaster response is adequate and acceptable. A suggested next step for IADS is to undertake extreme event modelling to get a better hold on the current situation and to assist in preparing for possible future extreme events. This includes statistical analysis of such extreme events and strong interaction with local communities who are at risk. Also, an evaluation of the existing cyclone risk reduction facilities (cyclone shelters) and management may be beneficial, as this will support concrete actions (physical interventions) that can be implemented on short notice. Last but not least, it is important to train the communities on how to take action during an extreme event (undertake field exercise).

IADS Phase B

The above proposed follow-up activities for IADS can be categorised into (i) technical actions and (ii) people-oriented actions, as follows:

1. Technical actions that aim to support decision-making processes for the whole delta (Decision Support Systems - DSS):
 - Data management;
 - Numerical modelling;
 - Flood risk mapping; and
 - Meta-model to support decision-making processes.
2. People-oriented actions that aim to support inhabitants of the Delta:
 - Better understand the added value of IADS to existing plans and strategies;
 - Explain IADS and how it can positively influence their lives;
 - Community-based training on living with water and cooperation;
 - Gap analysis to determine the niche role for IADS compared to the existing plans and strategies;
 - Training people in the coastal zone on how to act during a cyclone event; and
 - Investigate the options to de-traumatize the victims of Nargis.

The next phase of IADS will likely commence in March 2018 and takes approximately one year. During the IADS phase A final workshop (Annex D6) the participants concluded that all the above eight activities are of equal importance, with only the concrete action towards training and de-traumatizing the inhabitants of the coastal zone as a priority. Given the constraints in time, budget and basic decision-making information in general, the team proposes that phase B of IADS deals with scoping of the above eight concrete actions. The aim of these separate scoping studies is to deliver a workplan, an inventory of lead department (with an assessment of their current capacity (including gaps) to implement the studies/works) and an assessment of concrete donors for who the different actions may well fit in their current plans and strategies. By doing so, Myanmar officials will be trained in how to get projects scoped, planned, financed and implemented.

The work plans for each of the eight activities need to be jointly developed by the IADS project team (including the local working group members) and the Ayeyarwady Delta Working Committee, so that all activities are aligned with Myanmar's priorities. Furthermore, the work plans need to be aligned with the work done under the AIRBM project. After all, the Delta is part of the river basin, so interventions upstream will impact the Delta and vice-versa.