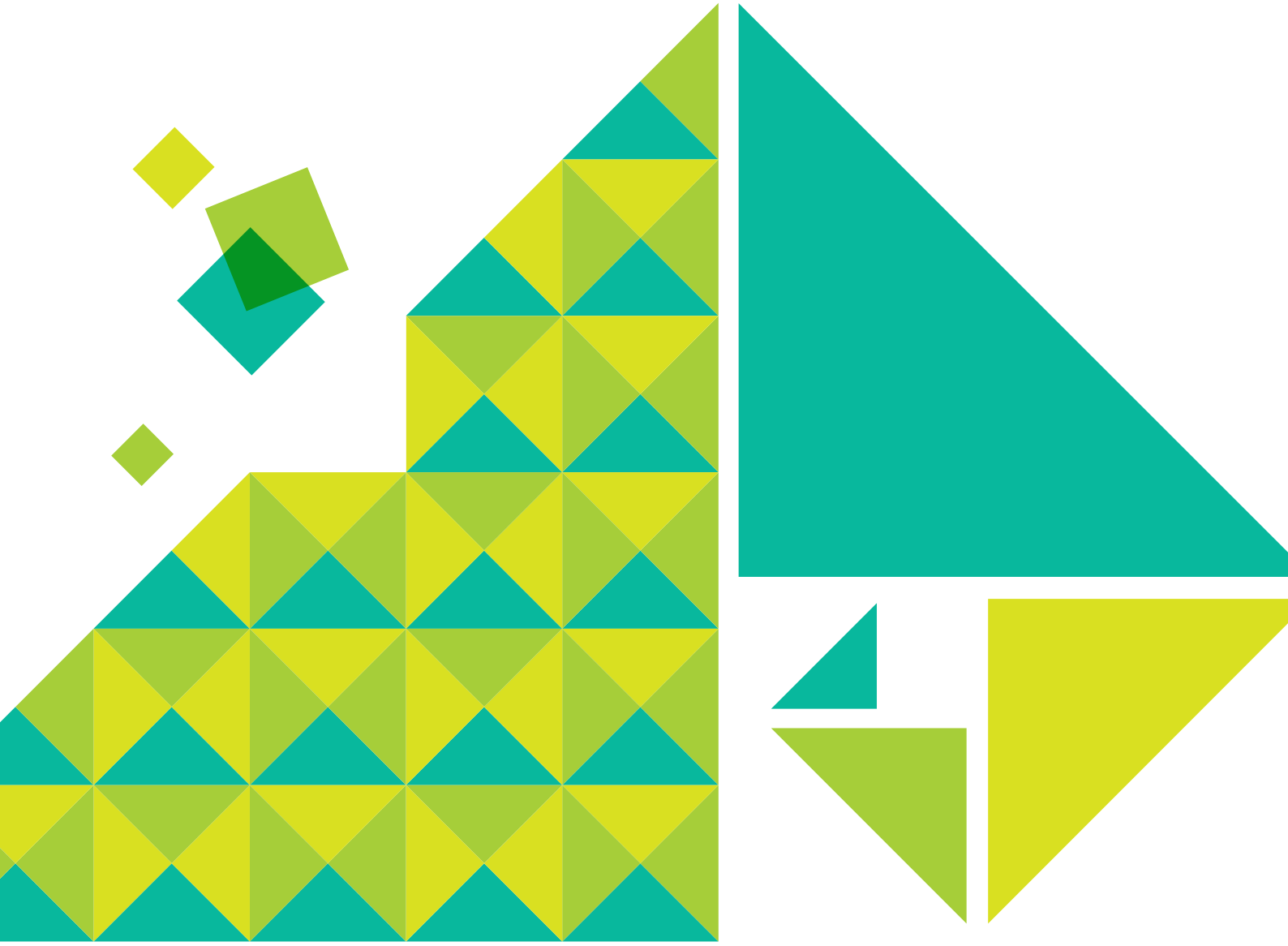
Unleashing Green Growth in the Mekong Delta

A Multi-stakeholder Approach to Identify Key Policy Options



Global Green Growth Institute

VNMC

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Foreword

The Mekong Delta Region in Viet Nam has long been regarded as a symbol of prosperity and one of the most productive areas on the planet. This largely owes to the innately favourable environmental conditions with fertile soils that provide basis for crop production, which soon develop into one of the core pillars of economic growth of the country.

Over the recent years, the region has also been recognized as being especially vulnerable to the impacts of climate change. Sea level rise and extreme and unexpected climate events are not only threatening the Delta which serves as the foundation for economic progress but also causing disasters to jeopardize human lives. This is further compromised by urban developments at the cost of environmental degradation which in turn can lead to serious consequences.

Water lies behind all what characterizes the Mekong Delta. Periodic floods nourish and enrich the soils used for farming and aquaculture which are both highly reliant on water. Simultaneously, water is also a medium that is directly influenced by natural and artificial developments to exert negative influence on everyday aspects of life.

The Viet Nam National Mekong Committee (VNMC) was established in 1978 as a governmental inter-sector agency to represent Viet Nam in views of sustainably developing, utilizing and protecting water and related resources in the Mekong River Basin including Mekong Delta. Green growth is still a new, fast spreading concept in Viet Nam even though a National Green Growth Strategy was approved 2012 as an effort to drive economic growth in a sustainable manner.

In light of a series of recent developments in the Mekong Delta in Viet Nam, it has come to the VNMC's attention the idea of green growth, and its application in the water sector for the Delta as one solution. Reflecting a shared understanding that improved water resource management was considered as the key to sustainable development, the VNMC has cooperated with the Global Green Growth Institute to produce this Scoping Report on *Unleashing Green Growth in the Mekong Delta: A Multi-stakeholder Approach to Identify Key Policy Options.*

Experts from Viet Nam together with global pundits have incorporated invaluable views and discussed on the possible options that were identified in this study. This Report provides

a wealth of information to capture the link between water and economic growth in the Mekong Delta context and identifies the policy options which would support green growth in the Delta, from a conceptual viewpoint. It also provides an assessment tool which can prioritize green growth options and facilitate preparatory works for green growth policies in the Mekong Delta. We do hope these efforts will contribute to chart our way to set a green growth pathway in the Mekong Delta in very near future.

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Director General

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Executive Summary

- The Mekong Delta encompasses 39,000 km^2 of the southern part of Viet Nam and it is home to approximately 17 million people, or 20% of the Vietnamese population. The Delta is one of the most productive areas in the world, accounting for 50% of rice production, 65% of aquaculture production and 70% of fruits of Viet Nam.

- The sustainability and prosperity of the Delta, however, are being undermined due to natural and man-made challenges which range from climate change, rising sea levels, flood and salinity intrusion to third rice crop cultivation, rapid urbanization and large-scale infrastructure. A smart, comprehensive solution is needed to counter and mitigate the negative impact of this series of events.

- GGGI's water and green growth project aims to develop and apply a systemic approach to water resources management to support a transition to sustainable development. The use of this approach would allow the full integration of the water sector, its products and services in the development planning process.

- GGGI's involvement in the Mekong Delta has evolved from a regional approach, engaging riparian governments along the Mekong River, to a country-specific focus on the Mekong Delta. This process was driven by strong interest expressed by the officials from the Viet Nam National Mekong Committee (VNMC) in applying the concept of green growth in water sector at the national level.

- The identification of the water and green growth opportunities for the Delta is based on a 'Four-Step Approach' consisting of the following four activities: **(a) stocktaking; (b) development of the ranking methodology; (c) assessment; and (d) analysis.**

    - *Stocktaking:* A total of 20 opportunities were identified and grouped in three categories, according to their main expected contribution: **(i) mitigation of the impacts of socioeconomic development on the water sector, (ii) removal of the constraints that the water sector imposes on socioeconomic development, and (iii) improvement of water governance.** The identification of the opportunities was based on the assessment of context of the Mekong Delta, its strengths and weaknesses. The analysis also considered the projects and policies already implemented over the years, and those being planned and evaluated.

- *Ranking Methodology:* The Water and Green Growth (W-GG) Assessment Tool was created to support the assessment of the opportunities identified, and was customized to the unique context of the Mekong Delta with VNMC being an instrumental partner to make this process relevant and useful. Specifically, the tool allows to assess intervention options against the following outcomes: **(i) contribution to the economy; (ii) reduced vulnerability to external changes (e.g. climate change impacts); (iii) reduced environmental pressures; and (iv) improvement in the state of the environment.**

- *Assessment:* In order to test and validate the tool in the first phase of the project, a preliminary qualitative assessment of four W-GG interventions was carried out with national experts, primarily in order to illustrate the analytical process required to compare alternative options. These are: (1) improvement of eco-efficiency of water-related infrastructure, (2) improvement of the urbanization process, (3) flood management for agriculture production, and (4) improvement of coastal area management. This exercise also requires the convening of several stakeholders with varied sectoral expertise and interests, to ensure that the unique local context are taken into account and all the key dimensions of green growth are captured.

- *Analysis:* The results of the exercise indicate that the four interventions had a similar overall performance. On the other hand, similarities and differences of the various options can be identified. For example, all the options would lead to a large increase in water expenditure, due to the fact that capital investments in infrastructural improvements are expected under each intervention. At the same time, a more detailed analysis shows that Option 1 is particularly indicated for reducing vulnerability to external changes; Option 2 shows a moderate and more balanced improvement across the board; Option 3 indicates good results for the contribution to the economy; and Option 4 seems to be most appropriate to reduce environmental pressure.

- The work carried out during this project has shown considerable potential in supporting the identification and selection of intervention options that would support green growth. This would be achieved by the incorporation of water in the development plans of the Mekong Delta, to highlight its several roles in supporting the sustainable socioeconomic development of the region. In particular, the opportunities identified and the analytical tool developed by GGGI represent a first step in the operationalization of the process,

which could be linked to an extended version of CBA in collaboration with VNMC and relevant ministries.

- Finally, the same participatory and multi-stakeholder process could be replicated at the Mekong Delta regional level (including Cambodia) and whole basin level, reaching to support upstream planning and create synergies with downstream sustainability. **This process will have to be supported by a clear set of vision based on common understanding of water and green growth, and a master plan that can foster green growth implementation in the region.**

1. Introduction

1.1. Project Background and Objective

Since the establishment of the Mekong Cooperation in 1957, the Mekong Delta has always been recognized as a core part for an integrated development of the Mekong River Basin (MRC 2011). Throughout the nearly six decades of cooperation, many tools have been researched and developed to enable detailed planning to examine the possibilities of optimum management of water resources and development of the rich resources of the Mekong Delta, taking into account benefits and impacts of upstream development. In particular, as the countries in the Mekong River Basin and the Greater Mekong Subregion recorded impressive economic development results during the past two decades, water resources utilization has become more intensive, and the prospects of cooperation for mutual benefits more risky. These challenges highlight the need to develop a regional neutral platform for the integration of the green growth approach into water resources management strategies of the Mekong River Basin and the Greater Mekong Subregion.

GGGI's water and green growth project has evolved from a regional approach engaging riparian governments along the Mekong River, specifically with Cambodia, Lao PDR, and Viet Nam, to a country-specific focus on the Mekong Delta located in Viet Nam. This change in geographical scope of the study fully reflects the strong interest expressed by the officials from the Viet Nam National Mekong Committee (VNMC) in applying the concept of green growth in water resources management at the national level. Based on the findings from this country-level study, potentials to modify and replicate the approach used throughout the project in other riparian governments will be examined, thereby instigating a bottom-up approach towards building a green growth vision in the Greater Mekong Subregion.

Building on the strong political buy-in of Viet Nam, a series of narrowing-down exercises were carried out to select a specific target region based on a number of different criteria. Data availability and access was one of the most crucial determinants that were considered in order to design and test methodology and tools. Areas with relatively better data quality and easier data access were preferred to areas with insufficient data, considering the great importance of data availability for the success of the project. Internal capacity and resources were also assessed in order to set out realistic work scope and targets for the study area. The target area also had to exemplify a strong connection to water and

economic development to develop a clear rationale for water and green growth concept that could be used when delivering to decision makers. Based on the outcomes of the exercises, the Mekong Delta in Viet Nam was selected as the focus area of the project, especially considering the great significance of this region for Viet Nam's economic growth.

The main goal of the analytical part of the project is to develop and apply a systemic approach to water resources management. Given this purpose, the main tasks performed at this stage to develop and apply the systemic approach include:

1. Analyse the contribution of the water sector to economic development across sectors and actors, as well as its economic value (as an independent sector).

2. Estimate the vulnerability of the economy to changes in the water sector (demand and supply, as well as extreme events).

3. Provide key information illustrating why the improvements in the water management have a high potential impact on economic growth and development objectives in Viet Nam and the Mekong Delta region.

4. Identify approaches to promoting water green growth in the Mekong Delta.

5. Initiate a prioritization process to establish a specific framework for water and green growth in the Mekong Delta.

6. Identify a strategy for integrating green growth strategies in national policies and possible replication into other regions of the Mekong River Basin.

This paper, as an output of a 9-month scoping project by GGGI in cooperation with VNMC, presents the results of each task and concludes with key recommendations for the Mekong Delta. The study took a conceptual approach focused on stock-taking socio-economic context of the Mekong Delta, identifying the possible water and green growth opportunities and establishing a customized tool which can produce a Multi Criteria Analysis to assess and prioritize the identified list of opportunities in the Mekong Delta. Due to its short duration, this scoping project was able to apply the tool only for a preliminary qualitative assessment of selected interventions and a single quantitative assessment for demonstration purposes.

On the other hand, there are two major constraints of this study: 1) stronger interaction with local stakeholders and buy-in and 2) data availability of quality. A more thorough validation process would be required to further tailor the tool to the needs of VNMC and other relevant stakeholders in Viet Nam. Training should be conducted (on green growth and on the use of the tool), and joint efforts should be implemented for testing the tool with VNMC and interested ministries. Aside from the understanding and use of the tool, data availability and data quality are anticipated to be potential constraints. Initial data collection efforts highlighted the availability of macroeconomic information (e.g. on population and economic activity) and the lack of environmental data (e.g. on water consumption by use and on water pollution). Project-specific information was also lacking, which is a key requirement for a comprehensive cost-benefit analysis. Nevertheless, the creation of the tool is a first step towards the promotion of more systemic, cross-sectoral analyses that would effectively support the preparation of integrated strategies to reach sustainable development.

1.2. Conceptual Approach: Water and Green Growth

According to the Organisation for Economic Co-operation and Development (OECD), “green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities” (OECD 2011). The green growth approach to sustainable development necessarily involves decoupling economic growth from environmental impact, ecosystem degradation and resource depletion.

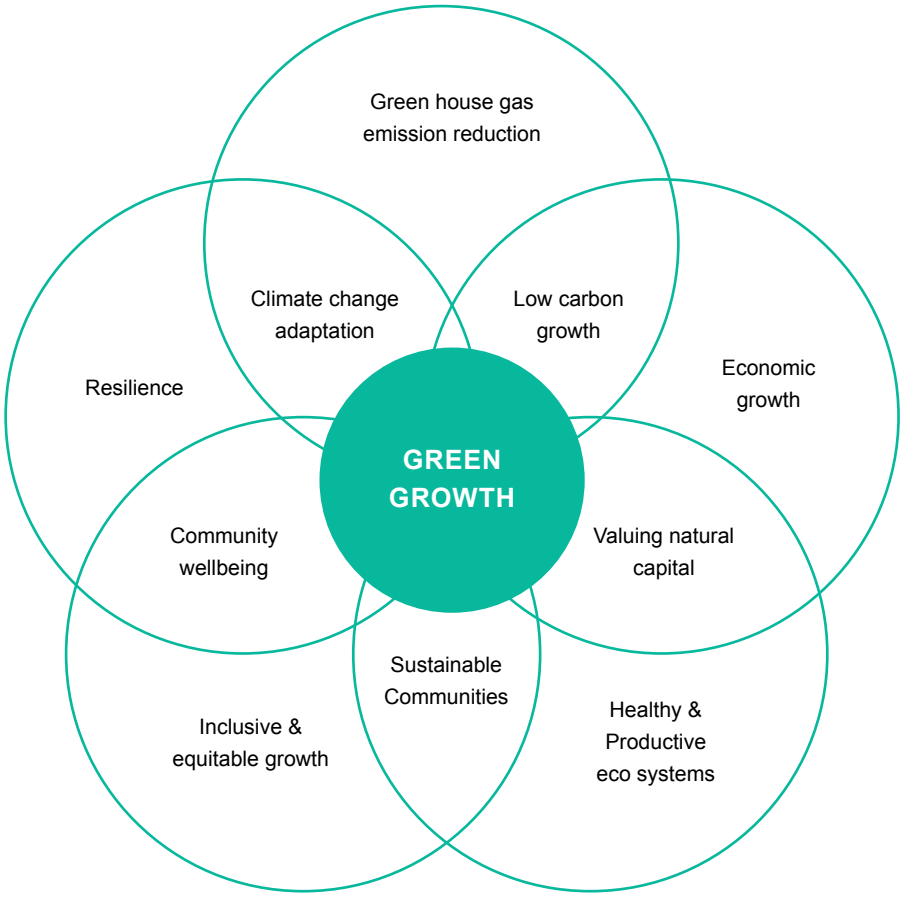
However, it is crucial to understand that achieving green growth in Viet Nam will take time and green growth planning cannot be done overnight. There are multiple challenges in building an effective framework for green growth planning and assessment, including identifying green growth priorities, choosing appropriate data sources, selecting key performance indicators, and adopting the most suitable economic modelling tools. Therefore, it is necessary to develop a conceptual framework and methodology to determine the most appropriate steps for green growth planning.

GGGI, as a new international organization solely dedicated to green growth, used its green growth planning approach to initiate a discussion with key stakeholders on what is an appropriate framework for customizing the green growth definition to the Viet Nam and

Mekong Delta context and priorities. As part of this process, it is essential to understand the interdependencies between national and regional economic competitiveness drivers and their implications for social development and environmental impact.

Figure 1 sets out the five dimensions of green growth defined with stakeholders during the first workshop on the Green Growth Framework at the Green Growth Knowledge Platform (GGKP, June 3, 2013). This conceptual diagram is used as a starting point to support dialogue with national stakeholders on planning and designing the future development of Viet Nam.

Figure 1. The five dimensions of Green Growth.



More specifically, the five dimensions of green growth are:

- **Sustained economic growth,** which is important for social development and prosperity and must be considered in conjunction with other environmental and social factors, and business activities. Rapidly growing and/or less resource efficient countries with a focus on resource extraction have a more urgent need to adopt green growth policies, diversify economic sectors and ensure these sectors build local economies.

- **Healthy and productive ecosystems.** Ecosystem services and biodiversity provide valuable contributions to economic growth and human welfare, but are often ignored in the decision making process as they are not seen as inputs of production. Green growth seeks to address these market failures. In particular, countries where biodiversity is rich and where population is largely dependent on ecosystem services are likely to have more urgent need for assistance.

- **Inclusive and equitable growth** is a central objective of green growth, and is highly correlated with economic growth and environmental quality. Countries with higher levels of poverty and inequality are likely to benefit more from green growth interventions.

- **Resilience** refers to economic, social and environmental resilience and is about the system's ability to withstand external shock (e.g. adapting to the physical impacts of a changing climate, diversification of economic sectors, food security). Countries that are more exposed to the physical and resource impacts of climate change, as well as countries that generate most of their GDP from extractive and resource intensive sectors are likely to benefit more from green growth interventions.

- **Greenhouse gas emissions** need to be limited to contribute to global and national efforts to mitigate climate change and minimize future adverse impacts. Countries with higher greenhouse gas emissions intensity have more urgent need for assistance and greater opportunities for cost-effective emissions reduction.

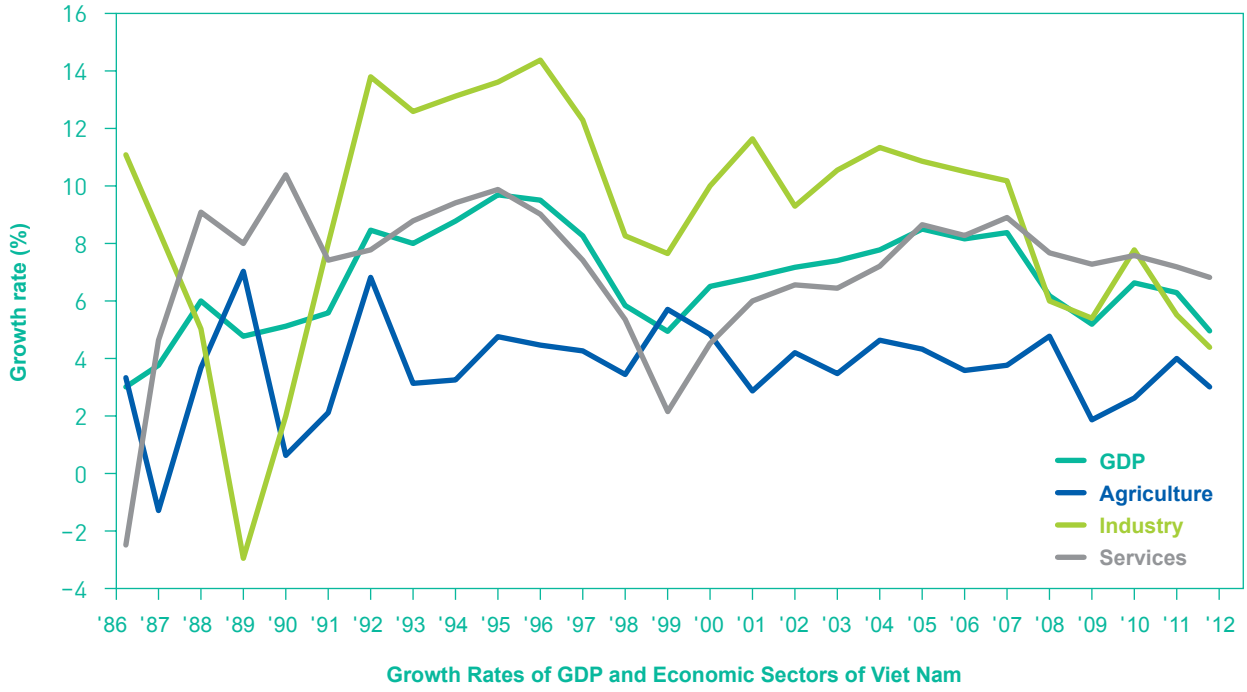
This study uses the green growth approach described above to facilitate the identification of key opportunities for integrated water resources management in the Mekong Delta region of Viet Nam.

2. The Mekong Delta

2.1. The Context

As shown by Figure 2, the economy of Viet Nam has been growing at a high rate during the past three decades (Thai 2013). The stability of the Vietnamese economy during this period is owed, among others, to the strong performance of its agriculture sector, which has been growing consistently at about 4% and turned Viet Nam from a rice-importing country to one of the largest rice-exporting countries in the world.

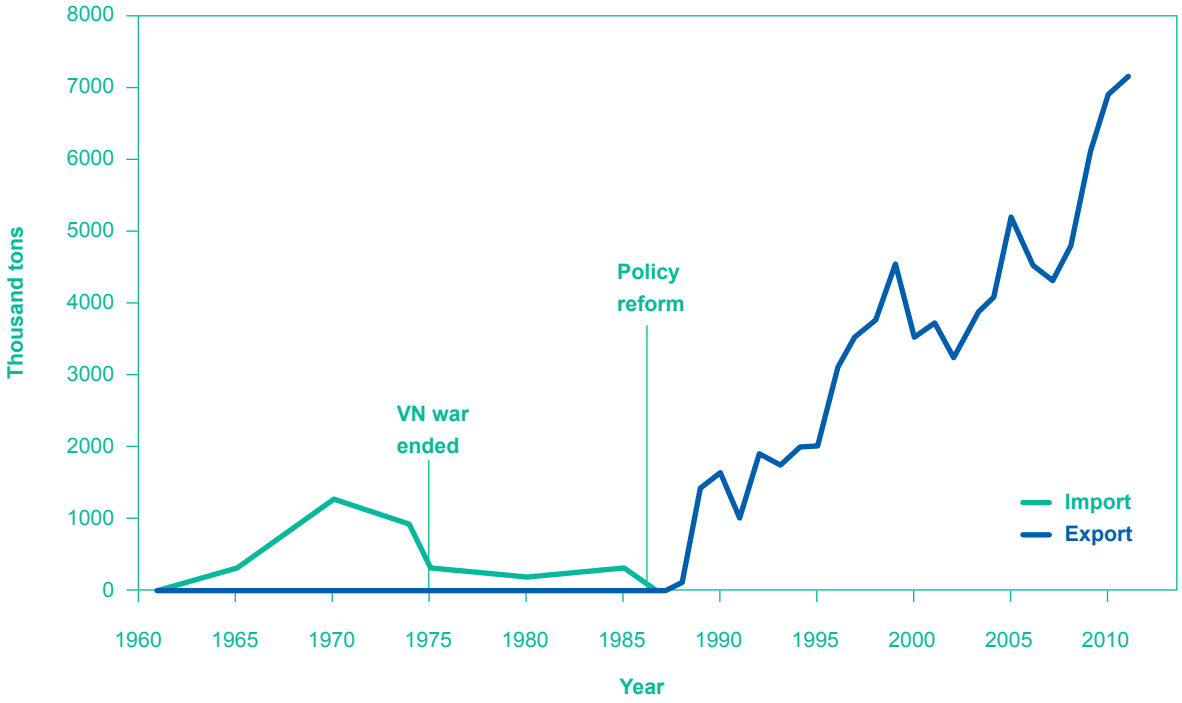
Figure 2. Growth Rates of GDP and Economic Sectors of Viet Nam (Thai, 2013).



Source: Nguyen Quang Thai and General Department of Statistics of Viet Nam

The Vietnamese part of the Mekong Delta, which is the focus area of this project, plays a significant role in the socioeconomic development process of Viet Nam. This region, which forms a triangle of 3.9 million hectares and is home to 17 million people (about 20% of the Vietnamese population), is one of the most fertile and productive deltas in the world, accounting for 50% of rice production, 65% of aquaculture production and 70% of fruits of the country. It also accounted for 95% of rice export and 60% of fish export of Viet Nam during the past decade (Hien 2013).

Figure 3. **Rice imports and exports in Viet Nam, 1960-2010.**



Source: FAOSTAT, General Statistics Office

During the past few decades, the sectoral structure of the national economy changed sharply with an important reduction of the agriculture's share. However, in the Mekong Delta, this share is 40% of GDP in comparison with 20% of the country's GDP for the national agricultural sector. This implies that the economy of the Mekong Delta is still very much water-based. As the country is moving from an agriculture-based economy to a more diversified economy, efforts are being made to diversify the economic production of the Mekong Delta as well. According to a report of the Ministry of Planning and Investment of Viet Nam (MPI, 2011), this effort towards industrialization and modernization has been stronger since 2006 to enable the industry sector to reach 26% and services sector 35% of economic landscape in the Mekong Delta in 2010. This diversification effort enabled the Mekong Delta to record economic growth of 13% during the period 2006-2010 while the growth rate of the country was at about 7% during the same period. The above economic indicators point to the importance of the Mekong Delta in ensuring not only economic stability (mainly through agricultural production), but also the high economic growth rate of the entire country.

As a result of economic and demographic growth trends, land use in the Mekong Delta has changed with a reduction in forestland and an increase in agricultural land, residential land and specially used land (for purposes others than agriculture, homestead or forestry). During the period from 2008 to 2012, the largest increase was the expansion of agricultural land (about 40,000 ha), followed by an expansion of specially used land (some 23,000 ha) and residential area (12,000 ha). The loss of forestland during the period was about 32,000 ha (see Table 1).

Table 1. Changes in land use in the Mekong Delta.

Year	Total area	Agricultural production land		Forestry land		Specially used land		Homestead land	
	(1,000 ha)	(1,000 ha)	%	(1,000 ha)	%	(1,000 ha)	%	(1,000 ha)	%
2008	4,060.20	2,560.60	63.07	336.8	8.30	234.1	5.77	110	2.71
2009	4,051.90	2,550.70	62.95	331.4	8.18	241.2	5.95	111.6	2.75
2011	4,054.80	2,616.50	64.53	310.8	7.66	255.4	6.30	122.2	3.01
2012	4,055.40	2,600.30	64.12	304.7	7.51	257.3	6.34	122.4	3.02
Changes		39.70		-32.10		23.20		12.40	

Source: GSOVN (Land use by provinces, 2008, 2009, 2011 and 2012).

Despite the small rate of increase in agricultural land, rice production in the Mekong Delta has almost doubled during the past two decades from about 12.8 million tons in 1995 to 24.3 million ton in 2012. This increase can be attributed mainly to the improvement in productivity of rice cultivation. The average annual increase in paddy yield during this period was about 2.2% and the highest growth rate during the period from 2005 to date was estimated at 3.2%. It is important to note that the rapid increase in paddy yield is mainly attributable to the intensification of agricultural production, especially through increased use of chemical fertilizers and insecticides, which often leads to groundwater pollution.

The average economic growth rate of the Delta during the period from 2005 to 2011 was 11.7%, with agriculture growing at 5.2%, industry at 16.7%, and services at 15.6%. The high growth in the services sector is due to rapid urbanization, which experienced an annual growth rate of about 3.3% over the period from 2005 to 2012. During this period, Can Tho City was growing at an annual rate of about 5%, while the two provinces Hau Giang (covering the Can Tho City) and Soc Trang (neighbouring Can Tho City) were growing at an annual rate of 8.1% and 9.4% respectively (GoV 2012b). In these provinces, urbanization represents a challenge to water resources management.

Table 2. **Urban population in the Mekong Delta (in thousand people) and growth rate (GoV 2012b).**

	2005	%(2005-09)	2009	% (2009-10)	2010	% (2010-11)	2011	% (2011-12)	2012	% (2005-12)
Delta	**3443.1**	**14.5**	**3942.8**	**3.2**	**4067**	**3.4**	**4204.3**	**3.0**	**4329.1**	**25.7**
Long An	236.6	6.2	251.3	1.3	254.6	1.4	258.1	1.4	261.8	10.7
Tiền Giang	222.3	3.0	229	7.7	246.6	7.6	265.4	-6.0	249.5	12.2
Bến Tre	118.6	6.0	125.7	0.2	125.9	0.2	126.1	0.2	126.3	6.5
Trà Vinh	141.2	8.9	153.7	0.8	154.9	2.5	158.7	3.8	164.8	16.7
Vĩnh Long	152.3	3.0	156.9	0.7	158	0.8	159.3	1.0	160.9	5.6
Đồng Tháp	262.6	12.7	296	0.2	296.5	0.2	297.1	0.2	297.7	13.4
An Giang	538.9	13.1	609.7	5.0	640.3	0.4	643.1	0.4	645.9	19.9
Kiên Giang	401.9	13.0	454	1.3	460.1	1.2	465.5	1.2	471.2	17.2
Cần Thơ	573.8	36.5	783.2	0.6	787.9	0.9	795.1	1.3	805.2	40.3
Hậu Giang	117.2	27.7	149.7	8.0	161.7	12.3	181.6	11.7	202.8	73.0
Sóc Trăng	236.7	5.9	250.6	16.3	291.4	23.3	359.2	23.2	442.5	87.0
Bạc Liêu	207.8	8.6	225.6	1.5	229	2.3	234.2	1.7	238.1	14.6
Cà Mau	233.2	10.4	257.4	1.1	260.1	0.3	260.9	0.6	262.4	12.5

Although the industry sector has been growing at a high rate, the Mekong Delta is not heavily industrialized. The industry and construction sector is the smallest contributor to the Delta's GDP, accounting for about 25%, as shown in Table 3. Almost half of the Delta's industrial production is concentrated in Can Tho, Long An Province and Ca Mau Province. In particular, Can Tho City is the economic centre of the region and more industrialized than the other provinces. Long An has been the only province of the region to attract part of the manufacturing booming around Ho Chi Minh City and is seen by other provinces as an example of successful FDI attraction. Ca Mau Province is home to a large industrial zone including power plants and a fertilizer factory. Overall, however, the industrial contribution to GDP is reduced, and FDI in the industrial sector is particularly small, accounting for only 18% of the value of industrial production, compared with 40% at the national level.

Table 3. GDP structure in the Mekong Delta Region.

GDP in Mekong	2005	2006	2007	2008	2009	2010	2011
Current prices (billion VND)	122847.2	143,302.9	178,969.8	238967.2	274516.5	327781.4	437331.5
Agriculture	56255.0	61496.2	74922.5	105984.2	111494.7	130243.6	177337.9
Industry	26962.4	32750.1	42377.9	53357.6	66780.1	84253.1	107534.7
Service	39629.8	49056.6	61669.4	79625.4	96241.7	113284.6	152459.0
1994's price (Billion VND)	78614.4	87795.2	99137.9	111730.4	122496.2	136860.0	153059.8
Agriculture	35859.4	37541.3	40158.1	43713.1	44425.1	46265.8	48692.7
Industry	17596.7	20908.4	24864.2	28638.4	33064.9	38555.4	44455.4
Service	25158.3	29345.5	34115.6	39378.9	45006.3	52038.7	59911.6
Structure of GDP (%)							
Agriculture	45.8	42.9	41.9	44.4	40.6	39.7	40.5
Industry	21.9	22.9	23.7	22.3	24.3	25.7	24.6
Service	32.3	34.2	34.5	33.3	35.1	34.6	34.9

Source: Review of statistical data from 12 Provinces and Can Tho City (Ti, et al. 2014).

Water constitutes a central aspect of life in the Mekong Delta, as the extensive network of canals influences all economic activities and determines social dynamics. Consequently, the socioeconomic development of this region is strongly linked to the sustainable and effective management of water resources. This is confirmed by the National Green Growth Strategy of Viet Nam, which prioritizes water resources management as a key sector for the achievement of stated goals (GoV 2012d). In this regard, the national water strategy originates from the identification and review of worrying environmental trends at the national level, including:

- Economic growth is increasingly fuelled by the use of natural resources, leading to environmental losses that have impacted 70% of the population relying mainly on natural resources for their livelihood.
- The increase of population, fast urbanization and infrastructure building, and the enlargement of agriculture have deteriorated ecosystems and caused biodiversity loss.
- Urban and industrial pollution have negatively impacted adjacent water sources and contributed to the spreading of health diseases.

The Mekong Delta region is heavily impacted by these trends. In fact, according to the Ministry of Natural Resources and Environment (MONRE), during the past decade (2000-

2010), some 27,000 ha have been lost every year due to urbanization, insecure land tenure, land degradation due to inappropriate and excessive use of chemical inputs, poor logging practices, drought, salinity, acidification, soil erosion etc. (VNMC 2013).

Rapid demographic growth has led to the development of economic plans at an unprecedented scale, including the construction of roads, hydropower plants, ports, and irrigation and water supply infrastructure for satisfying the needs of an expanding population. However, if not planned in a sustainable way, these infrastructural projects are likely to produce negative impacts on water resources and biodiversity as a result of changes in the channel network and its ecosystems. In addition, climate change is already threatening the socioeconomic development of the region: increases in temperatures, sea level rise and extreme weather events such as floods and storms are challenging key economic activities and reducing freshwater availability, with negative consequences for the overall well-being of the population.

The main challenges and risks related to water resources management in the Mekong Delta can be summarized as follows:

- Impacts of climate change: Sea level rise is a critical challenge for the Mekong Delta. Projections indicate that the combined effect of sea level rise and changing flooding patterns could result in a direct net loss of arable land in the Delta (GoV 2012c), with an estimated sea level rise of 30 cm by 2050 and of about 75 cm by the end of the 21st century. To put this projection in context, it was estimated that sea level rise of about 20-40 cm would affect all three rice cropping seasons, greatly limiting rice harvest. Salinity intrusion in Mekong Delta is also increasing year after year. Sea level rise and the impacts of high tide and low discharge in the dry season contribute to deeper salinity intrusion. In 2005, deep intrusion, high salinity and long-lasting salinization occurred frequently in Mekong Delta province, with salt intrusion reaching up to 140km into the Delta and the total economic loss amounting to VND16 billion (GoV 2013). Only innovative implementation of adaptation measures by the whole society, including local people and the government, could ensure sustainable development and stable living conditions under projected climate change impacts.

- Over exploitation of water and related resources: Fast urbanization and industrialization together with high population pressure and commercial aquaculture have highly increased water demand. After decades of sector fragmented development, integrated

river basin planning is needed, including coastal planning in the Mekong Delta. Failure in this endeavour would imply further degradation of the country's natural resources and environment.

- Trans-boundary complexity: The annual catch in the lower Mekong alone is estimated at 1.6 to 1.8 million tons. It has a retail value of USD 1.4 billion and provides food security for 60 million people. Change in flows affect fresh water availability and the hydrological regime. Also, trans-boundary environmental risks such as oil spill, pollution discharge, navigation obstacle event are likely to reduce river water quality, with negative consequences for fishery resources and nutritious alluvium sediment.

- Water sector governance: There are strong needs for a change in investment policy in the water sector to properly channel and manage necessary funds for improving water-related infrastructure and services in Viet Nam. Laws and regulations that are already in place (e.g. Law on Environmental Protection and Law on Water Resources) need to be better enforced. MONRE has reported in 2013 that Viet Nam still has 180 processing and industrial zones, 12,259 healthcare facilities, and 72,012 enterprises that discharge considerable quantities of untreated wastewater into rivers despite such actions are clearly prohibited under Article 9 of Law on Water Resources (GoV 2012a).

- Low development of human resources and job opportunities: Although the education and vocational training systems have been developing at a quicker pace, there is a lack of job opportunities. Rural human resources represent a critical opportunity to boost the development of the Mekong Delta. The transfer and application of relevant knowledge, practices and technologies in relation to the use of natural resources at the local level is important to increase local capacity. Also, it is valuable to look into possible private sector interventions for encouraging local small and medium-sized enterprises (SMEs) that could potentially contribute to social sector development.

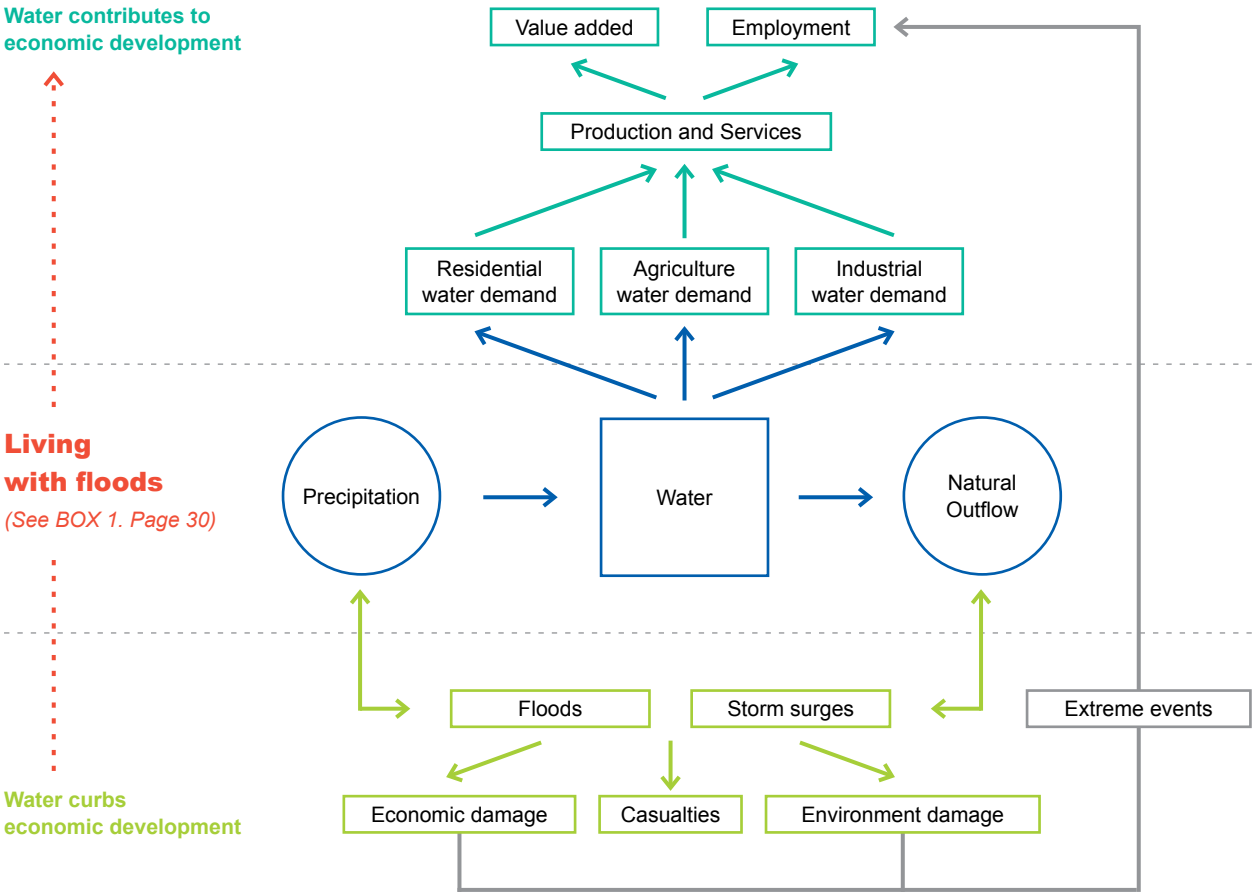
In the face of these severe challenges and their high costs for the development of the Mekong Delta, national authorities have initiated to explore ways to promote a sustainable approach to water management, namely one that can boost development and reduce poverty, at the same time preserving the environment and its essential services.

2.2. The Role of Water in Socioeconomic Development

Starting from current efforts and commitments, the development of an integrated, systemic approach to water sector should be prioritized as an essential step for the transition towards green growth in Viet Nam Mekong Delta. Integrated water resources management represents an approach that maximizes the long-term profitability of key economic sectors, at the same time ensuring sustained water availability, and minimizing the damages caused by extreme weather events such as floods and storms.

The adoption of an integrated approach to water resources management requires a comprehensive analysis and understanding of the systemic relationships between water resources and key elements of the socioeconomic reality in the Mekong Delta region. Figure 4 provides a schematic representation of the main contributions and challenges posed by water to economic growth and social well-being in the region, which are described in more detail in the following sections.

Figure 4. Water contribution and constraint to socioeconomic development in the Mekong Delta region.



In the central part of the diagram, a simplified version of the stock and flow structure of water resources is provided: the stock of available water is influenced by precipitation trends (inflow) and natural outflow.

In the upper part of the diagram, the positive contribution of water to socioeconomic development is represented. In particular, water resources are used to fulfil the needs of key productive sectors, i.e. agriculture and industry, as well as to satisfy the demand of the population, including for drinking, cooking, sanitation, etc. As a result, the production of goods and services is strictly linked to the availability of sufficient water resources in each of the key sectors identified. In turn, production trends have a direct influence on employment and income generation opportunities for the local population, as well as on overall regional economic growth.

In the bottom part of the diagram, the potential negative impact of water related events, such as storms and floods of strengths beyond average, are presented. More precisely, intense precipitation and can lead to floods and storm surges, especially in the absence of adequate infrastructure and water management strategies. These extreme events can cause significant damages to the economy (e.g. crop losses, destruction of key infrastructure), society (e.g. deaths, injuries, loss of houses etc.), and the environment (e.g. freshwater salinization), eventually affecting overall socioeconomic growth.

2.2.1. Water contribution to socioeconomic development

The economic transformation of the Mekong Delta has changed water resources planning and development approaches over the past four decades. Three main economic development periods can be distinguished in the region: (i) the economic subsistence period (1975-1990); (ii) the agricultural intensification period (1990-2000); and (iii) the agricultural diversification period (2000 to date). During all these periods, the consistent and stable economic growth of the Mekong Delta has contributed to ensuring the economic stability of Viet Nam.

In 2010, export turnover in the region was USD 6.8 billion (accounting for 90% export volume of the nation), of which 51% from fisheries, and 46% from agricultural products (mainly rice). The industrial value of the Delta reached VND 156,000 billion in 2010 (SIWRP 2011). The contribution of economic sectors to the regional economy has changed in the last two decades as a result of expansion of the industrial and service sectors. In 2010,

the primary sector contributed 39% of regional GDP, the secondary sector 26%, and the tertiary sector 35% (Bao 2012).

The provincial competitiveness index (PCI) – which has been in place since 2005 as a tool for measuring and assessing the standards of economic governance in 64 provinces of Viet Nam from the private sector perspective, in recent years showed that the Mekong Delta has great economic development potential (VCCI 2014). Nonetheless, policy makers have recognized that the increasing disparity in the socioeconomic conditions of the local population represents a key challenge to be urgently addressed. In particular, the sustainable use of water resources is seen as a means to achieve sustainable and inclusive socioeconomic development in the Mekong Delta. Indeed, water is a key driver of growth in the region, extensively contributing to all the economic activities that provide livelihoods to the population.

Firstly, water is key to the agricultural sector, which represents the main source of income for the population of the Delta. The region contributes over 50% of national food production, and produced over 18 million tons of rice every year on average since 2005, of which 4.5 to 6.0 million tons were exported every year. In the last two decades, rice production in the Mekong Delta has increased by approximately 2.5 million tons every 5 years, corresponding to an average annual increase of more than 500,000 tons. In addition to rice, the Mekong Delta contributes about 70% of fruit production, over 40% of fish products from aquaculture and over 74.6% of the total fishery production in the country. The region produced an agriculture value added of VND 23,430 billion in 2011, corresponding to about 41% of regional GDP, compared to a 21% contribution provided by agriculture to national GDP (see Table 4). As a result, agricultural production in the Mekong region constitutes a crucial sector for national food security, employment generation and economic growth. Moreover, the sector represents an important source of revenue for the national government: in 2012, total annual tax revenues from agriculture amounted to about VND 14,064 billion. At the same time, however, the intensification of agriculture in recent years is putting a strain on water resources, leading to groundwater depletion due to an increasing use of groundwater resources for irrigation purposes, especially in areas, such as the coast, where saltwater intrusion and floods are limiting the availability of usable water (GoV 2013). In this sense, the expected increase in population and GDP is likely to put pressure on available surface and ground water resources in the coming years, especially in those areas that are already under moderate or high water stress.

Secondly, water brings considerable value added and income opportunities in fisheries and aquaculture. The Mekong Delta is considered the world's largest single freshwater fishery, thereby representing an impressive economic potential and biological treasure. In 2011, fisheries GDP in the region amounted to about VND 5,391 billion (about 0.2% of national GDP) and aquaculture produced value added for VND 10,647 billion in the same year (almost 0.4% of national GDP) (see Table 4). The aquaculture sector has experienced a significant growth in the last years, in particular due to the expansion of catfish production. In 2010, total aquaculture production reached 2 million tons, of which fresh water aquaculture production was 1.48 million tons and saline/brackish production was 0.49 million tons. Despite the abundance of fishery resources, however, unsustainable water management and climate change impacts are already threatening sectoral productivity and production (GoV 2013). In particular, increased salinity levels as a result of sea level rise, as well as downstream pollution from chemical fertilizers and industrial wastes generate disruptions in fish biological cycles, and consequent fish stock losses (GoV 2013). Also, unsustainable practices, such as salinity control in shrimp farming along the coast, are driving the depletion of phreatic ancient deep groundwater resources (GoV 2013).

Thirdly, a key water related economic sector is the provision of water supply services, which generates value added and employment for the local population in the Mekong Delta. In particular, the GDP derived from water distribution services amounted to VND 1,590 billion in 2012, compared to VND 1,216 billion in 2011 (see Table 4).

Finally, the extended channel network of the Mekong Delta is a vital gateway for people and goods. According to the Mekong River Commission, 73% of cargo tonnage and 27% of passengers in Viet Nam travel by water (MRC). Water transport is thus an essential driver of economic competitiveness for Viet Nam and its neighbouring countries, and it generated a total value added of about VND 3,360 billion in 2012 (see Table 4). On the other hand, a number of issues are challenging the navigability of rivers, including the construction of dams and other infrastructure, as well as sedimentation due to deforestation. An integrated development planning approach is essential to address these trade-offs and maximizing the economic advantages deriving from river commercial and passenger transport.

Table 4. Water contribution to the economy of the Mekong Delta region.

Indicator	Unit	2003	2008	2010	2011	2012
GDP from water distribution services	million VND/Year		632,553	1,005,423	1,215,743	1,589,850
Agricultural GDP	million VND/Year	19,991,314	21,805,480	22,497,206	23,430,036	
Fisheries GDP	million VND/Year	3,389,598	4,764,497	5,219,129	5,391,913	
Aquaculture GDP	million VND/Year	5,126,959	9,330,883	10,043,817	10,647,324	
Water transport GDP	million VND/Year		2,561,150	2,792,327	2,988,137	3,360,641

Table by author (Hien); data source: (Provincial Statistical Offices 2013).

Water also represents a vital resource for satisfying the basic needs of the local population, including drinking, cooking, sanitation etc. The abundance of surface water resources in the region provided access to potable water to 82.1% of the local population in 2010. However, this figure is well below national access to improved water sources, which amounts to 95.6%. Such discrepancy might be determined, among other things, by the lack of water supply infrastructure, as well as the high level of downstream pollution, which reduces the availability of potable water. Water abundance is also key to ensure access to basic sanitation in the region. However, the gap between rural and urban areas is still considerable: in 2011, 78.71% of rural population in the Delta had access to sanitation, compared to 94.53% in urban areas (see Table 5). Despite the gap, the Delta itself contributes to making substantial progress towards environmental sustainability in line with Millennium Development Goal (MDG) 7: in 2011, the country had 71.4% of rural households with access to sanitation, up from 32.5% in 2000 (UN Viet Nam 2012)

Table 5. Access to water and sanitation in the Mekong Delta region.

Indicator	Unit	2003	2008	2010	2011	2012
Total access to potable water	%	63	80.80	82.10		
Urban access to sanitation	%		92.83	93.75	94.53	96.13
Rural access to sanitation	%		73.25	73.99	78.71	83.63

Table by author (Hien); data source: (GSO 2012) & (Provincial Statistical Offices 2013).

The role of water in socioeconomic development is also linked to the creation of employment opportunities. In fact, the majority of people derive their livelihoods from activities that are strictly related to water resources, such as fisheries, agriculture, and water distribution services. As shown in Table 6, about 5.6 million people were employed in agriculture in 2012, obtaining an annual average income of about VND 23 million. Although a slight increase in agricultural employment has been registered between 2011 and 2012, the occupation in

this sector has declined when compared to 2008. These figures confirm that the sector is facing increasing challenges – e.g. flooding, downstream water pollution – that have repercussions on productivity, eventually impacting social well-being. On the other hand, employment in the water distribution sector has been increasing over the last years, going from about 10,000 people in 2008 to 11,746 in 2012. This trend is attributable to the increase in water demand, mainly driven by demographic expansion, as well as rapid urbanization and industrialization processes. Despite the absolute number of people employed in water distribution services is much lower than total agricultural workers, the average annual income is almost three times higher. In particular, water distribution workers earned about VND 69.6 million per capita in 2012.

Table 6. Water contribution to employment and income generation in the Mekong Delta region.

Indicator	Unit	2008	2010	2011	2012
Water distribution employment	People	9,999	10,647	11,243	11,746
Water distribution average income	VND/Year per capita	36,274,213	49,081,944	53,368,098	69,615,374
Agricultural employment	People	5,594,771	5,620,226	5,555,378	5,577,344
Agricultural income	VND/Year per capita	21,988,846	16,844,479	20,131,508	23,067,765

Table by author (Hien); data source: (Provincial Statistical Offices 2013).

A final aspect to be considered is the strong cultural significance of water for riverside communities. In particular, several traditions and practices are strictly dependent on the availability and quality of water resources. In the Upper Delta, for example, the few remaining areas devoted to traditional floating rice production constitute a precious cultural crop-genetic heritage site that should be protected and preserved (GoV 2013).

2.2.2. Water constraints to socioeconomic development

On top of contributing to economic development, water in the Mekong Delta can also represent a constraint to economic growth and the improvement of well-being. In particular, water related disasters exacerbated by climate change are challenging the economic and social well-being of the region. Over the last 10 years, the Mekong Delta has experienced a number of extreme events, including: three large floods in 2000, 2001 and 2002; eight continuous years with small floods (especially in 2008 and 2010); eight continuous years with dry water runoff under average value, causing severe drought and saltwater intrusion (especially in 2004, 2008 and 2010); two typhoons in 1997 (Linda) and 2006 (Durian); widespread river bank and coastal erosion (on the Mekong river in 2001, 2002, 2004,

2005; on the Bassac River in 2009, 2010; and in coastal areas of Ca Mau in 2012 and 2013); and forest fires in 2002 in the U Minh Thuong National Park.

In particular, the impact of floods and storms, increasingly exacerbated by climate change, generates considerable losses in terms of human lives, infrastructure, and economic activity. As shown in Table 7, the extreme weather events in 2011 have resulted in damages to houses up to VND 327 billion, and infrastructure losses by VND 5,304 billion. Moreover, floods and storms affected 0.7% of agricultural land, with crop losses amounting to about VND 1,020 billion. Although the total cost of damages from water related disasters amounted to about VND 6,650 billion in 2011, only VND 322 billion were allocated from public budget for reparation and compensation. Noteworthy, costs of damages in 2011 were more than four times higher than value added from water distribution services, and amounted to 0.2% of national GDP.

In addition to economic losses, water related disasters such as floods and storms represent a constant threat for the life of the population in the Mekong Delta region. In 2011, for example, 85 people died during such extreme weather events, and 138 people died in 2008 for the same reasons.

Table 7. Damages from water related events and government expenditure for reparation, in comparison with water GDP.

Indicator	Unit	2008	2010	2011
Damages to houses due to extreme weather events	million VND/Year			326,885
Damages to infrastructure due to extreme weather events	milion VND/Year	116,400	169,284	5,304,340
Value of crop losses due to extreme weather events	million VND/Year			1,019,436
Total expenditure for water related disaster relief	milionVND/Year			321,924
GDP from water distribution services	milionVND/Year	632,553	1,005,423	1,215,743

Table by authors (Ti and Hien); data source: Compiled from Viet Nam Disaster Management Centre (DMC).

Another challenge for the sustainability of the local economy is the increase in residential and industrial water demand experienced over the last decade. In particular, industrial water demand experienced the most significant increase, going from 198 million cubic meters in 2003 to 368 million in 2012, corresponding to an 86% increase (see Table 8). Similarly, population growth and urbanization trends have led to an increase in water demand for residential use, which went from 440 million metric cubes in 2003 to 453 million cubic meters in 2012. Such an increase is attributable to a 3% demographic growth

between 2003 and 2012, as well as an expansion of the urban area by 78.2% over the same period. On the other hand, agriculture water demand has decreased by more than 22% between 2003 and 2012, but has remained about constant since 2008 (see Table 8).

While production and demographic trends have put pressure on water resources over the last decade, annual water inflows and water stock levels have progressively declined, as shown in Table 8. In particular, fluctuating precipitation patterns, including from climate change effects, influenced annual surface water inflow. Also, increasing use of groundwater resources for satisfying population and production needs have led to a reduction in the groundwater stock, from 8.29 billion cubic meters in 2003 to 8.22 billion cubic meters in 2012. Although this corresponds to a limited decline, the projected increase in water demand due to population growth and economic development in the region might accelerate the depletion of the stock, unless effective policies are implemented for the sustainable management of water resources.

Table 8. Water demand, stocks and flows in the Mekong Delta.

Indicator	Unit	2003	2008	2010	2011	2012	% Change 2003-2012
Water demand							
Total water demand	000 m3/year	16,311,375	12,793,000	12,994,315	13,119,688	13,072,806	-19.85%
	% Change		-21.57%	1.57%	0.96%	-0.36%	
Residential water demand	000 m3/year	439,767	461,000	449,985	451,514	453,067	3.02%
	% Change		4.83%	-2.39%	0.34%	0.34%	
Industrial water demand	000 m3/year	197,895	340,000	365,369	366,611	367,871	85.89%
	% Change		71.81%	7.46%	0.34%	0.34%	
Agricultural water demand	000 m3/year	15,723,229	11,992,000	12,178,961	12,301,563	12,251,867	-22.08%
	% Change		-23.73%	1.56%	1.01%	-0.40%	
Water stocks and flows							
Precipitation	mm/year		2,679	2,244	2,446	2,154	-19.60%
	% Change			-16.24%	9.00%	-11.94%	
Surface water inflow	000 m3/year	345,367,670	423,581,457	321,316,876	461,106,000	379,850,818	10%
	% Change		22.65%	-24.11%	43.5%	-17.6%	
Surface water outflow	000 m3/year	311,787,912	389,609,385	296,399,723	446,815,382	312,300,011	0.16%
	% Change		24.96%	-23.92%	50.75%	-30.11%	
Groundwater stock	000 m3	8,289,029	8,283,711	8,270,417	8,243,829	8,217,241	-0.87%
	% Change		-0.06%	-0.16%	-0.32%	-0.32%	
Groundwater inflow	000 m3/year	445,319	445,034	444,319	442,891	441,464	-0.87%
	% Change		-0.06%	-0.16%	-0.32%	-0.32%	
Groundwater outflow	000 m3/year	199,402	199,274	198,955	198,315	197,675	-0.87%
	% Change		-0.06%	-0.16%	-0.32%	-0.32%	

Table by author (Hien); data source: Estimations, records and unpublished studies by Southern Institute for Water Resources Planning (SIWRP) & Calculations based on National Centre for Hydro-meteorological Forecasting (NCHMF).

The government of Viet Nam has already implemented a number of measures to respond to the challenges posed by water resources to socioeconomic development in the Mekong Delta region which can potentially be studied within the context of water and green growth. These include, among others:

(i) Irrigation and drainage

In the Mekong delta, currently there are over 14,000 km of main/primary canals, 27,000 km of secondary canals, about 50,000 km of tertiary/on-farm canals and 80 culverts over 5-meter wide (the biggest sluices are the 100-meter wide Lang The and the 84-meter wide Ba Lai), over 900 culverts between 2 and 4-meter wide and tens of thousands of

small culverts, small bladders, over 1,000 large and medium-sized pump stations, and thousands of small pumps for irrigation (Ti, et al. 2014).

(ii) Flood control

To control floods, dikes and embankments have been built at a total length of about 13,000 km, of which 7,000 km are early flood embankments for summer-autumn rice protection (Ti, et al. 2014). There are also over 200 km of dykes to store water for fire prevention for the National Park and mangrove forest. The concept "to live with floods" along with the existing system of dikes is being challenged with the expansion of the "third rice crop" in the deep-flooded part of the Delta.

Box 1. How to "live with flood" in the Mekong Delta

Flood has been an integral part of life for the people and the ecosystem in the Mekong Delta due to its geographical location and features. But while annual floods have the potential to cause damage to unprepared communities, spoil crops and threaten food security, they also bring great benefits to the region (MRC n.d.). In fact, farmers in the Delta traditionally relied on flood pulse as flood plays a vital role in agriculture. Floodwaters are used for irrigation and to create flood-deposited sediments which help soils stay fertile in the floodplains. Floods help dissolve stagnant and polluted waters from the area, recharge groundwater tables, and maintain river morphology. Freshwater fisheries in the Mekong are also the result of the routine flood. Thus the local authorities strive to build resilience by taking structural and non-structural adaptation measures in response to floods. Structural efforts have largely been centred around on building dikes to ensure safety, whereas non-structural measures emphasize on being prepared whilst taking advantage of the flood seasons for fishing, raising crops and aquaculture, etc. This idea to 'live with flood' is in line with green growth and sustainable development as it aims to utilize the given setting and achieve growth without directly compromising the environment. However, it will need to strike a balance between sustainable flood adaptation efforts in order to counter severe, frequent and unpredictable floods resulting from climate change and man-made developments.

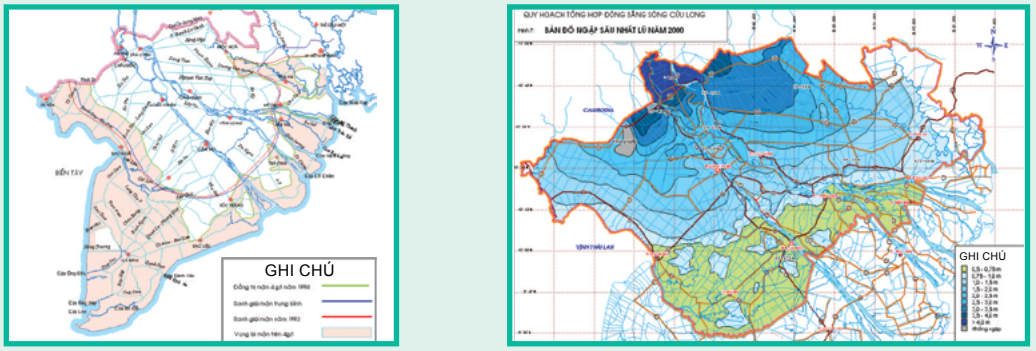
Box 2. The costs and benefits of producing "third rice crop"

'Third rice crop' refers to cultivating three crops (winter-spring, summer-autumn and autumn-winter) of rice per year on the same acreage. So while the size of land used to grow rice in the Delta remained somewhat consistent at 1.8 million hectares, rice production rose from 4.5 million tons in 1976 to 21 million tons in 2008 (IUCN 2011). This has led Viet Nam to become one of the world's largest rice exporter and contribute significantly to the country's economic development. However, cultivating third crop of rice entails environmental and social consequences. This intensive farming schedule requires investments in sluice gates, dikes, and other huge-scale water resources management infrastructure required to control flood and irrigation. This, in turn, sets off a series of events by disrupting the natural flood pulse to restrict the transfer of nutrients to improve soil conditions. This then triggers extensive use of fertilizers and other agricultural chemicals by farmers to compensate soil for the loss of nutrients, thereby polluting canals and acidifying water and soil that is held partially accountable for decline in fish populations and a general loss of biodiversity. In addition, there is another chain of events directly affecting human lives. Chemicals used for farming have negative health impacts and increase flood risks; High dikes to ensure third rice crop harvesting also allows deposition of sediment on river bed to rise quicker compared to the floodplain, thus increasing flood risk. In other words, infrastructures built for the sake of protecting human activities will end up taking human lives. The most vulnerable group from third rice crop are the poor and landless who heavily rely on natural setting to sustain economic activities. Despite such grave social and environmental consequences that can ultimately lead to negative economic impacts, third rice crops are still being pursued for immediate, tangible gains from rice exports and construction projects.

(iii) Salinity intrusion and tide control

Coastal Delta has built 450 km of sea dykes, 1,290 km of river dykes and about 7,000 km of embankments along the inland canals to prevent saltwater, high tide and coastal waves (Renaud and Kuenzer 2012). Along with this system of sea and river dikes, many water control structures have been built, several of which are large structures such as the Ba Lai Barrage.

Figure 5. Salinity intrusion and flood maps for the Mekong delta (Ti, et al. 2014).



(iv) Domestic water supply

Most people in the region have access to safe water. However, in the midst of challenges from increasing pollution and intensive agricultural production, this important achievement needs to be sustained within the context of integrated water resources management.

Box 3. Climate change trends and projections in the Mekong Delta Region

Climate change plays a central role in determining both the availability of water resources and the occurrence of extreme water related events. For this reason, a review of climate change trends and projections for the Mekong Delta region is necessary to fully understand the scale of current and future challenges, and identify key opportunities for adaptation and climate resilient growth.

Viet Nam is already heavily affected by climate change impacts. During the last 50 years, average annual temperatures have risen from 0.5 to 0.7°C, and sea level rise has reached about 20 cm (DELTARES 2011). Over the past years, extreme weather events have caused human and economic losses in many regions of the country, and particularly in the Mekong Delta. According to government estimates, between 2001 and 2010 natural disasters exacerbated by climate change have resulted in 9,500 deaths, and caused the loss of 1.5% of annual GDP (GoV 2011a).

The Mekong Delta ranks amongst the top 5 most vulnerable deltas to climate change (Cruz, et al. 2007). The average temperature in the region increased by 0.6°C between 1970 and 2007, and average annual rainfall increased by 94mm over the same period (GoV 2013). The amount of rainfall is unevenly distributed between the western (2000-2400 mm) and eastern regions (1600-1800 mm), and almost 90% of rainfall is concentrated in the wet season (DELTARES 2011). Heavy rains in the wet season cause the Mekong River to flood large areas of the region every year, especially in the northern part of the delta. In particular, regular annual floods can reach an area comprised between 1.2 and 1.9 million hectares, with a depth from 0.5 to 4 meters, for a period of time comprised between 3 and 6 months (DELTARES 2011).

According to projections of the Viet Nam National Institute of Meteorology, Hydrology and Environment (IMHEN), rainfall is expected to decrease in the dry season and to increase in the wet season. Rainfall in the wet season is projected to increase by 10% by 2100 under moderate climate change scenario, and by up to 30% under high climate change scenario. In the dry season, rainfall could decrease by 15% by 2100 under moderate climate change, and up to 40% under high climate change (GoV 2013). As a result of rainfall pattern modifications, annual precipitation might increase by 0.2 mm by 2030, and total annual runoff from the basin is likely to increase by 21% (Eastham, et al. 2008). Moreover, average temperatures in the country are expected to increase by 2-3°C by the end of the century, and sea level might rise up to 1 meter compared to the 1980-1999 period (GoV 2011a). Higher temperature and increased rainfall in the wet season are likely to increase the flood risk, especially in the riparian zone, where the local population practices agriculture extensively (Eastham, et al. 2008).

At the national level, climate change impacts are projected to affect about 10-12% of the population and cause the loss of 10% of GDP, thereby undermining the path towards sustainable development (GoV 2011a). In the Mekong Delta region such effects will be exacerbated by the vulnerable conditions of the population and the high exposure to extreme weather events. Sea level rise, fluctuating rainfall patterns and higher temperatures are expected to modify water inflows and outflows dynamics, eventually impacting the social and economic life of the region. In particular, the government estimates that about 40% of the Mekong Delta area would be inundated if sea level rises by 1 meter (GoV 2011a), affecting 35% of the population (GoV 2012c). The flat areas of the delta will be particularly affected, resulting in permanent and more frequently inundated coastal plains (GoV 2013).

Climate change is projected to seriously affect the productive sectors of the Mekong Delta region. Rice production, for example, will suffer from excessive flooding in the tidally inundated areas, and prolonged floods in the central part of the delta, with negative consequences for all three cropping seasons (GoV 2013). Irregular rainfall patterns, such as the expected increase in dry spell events during the early season, are likely to reduce crop yields, and to increase production costs for local farmers, as they would be obliged to compensate reduced rainfall with other water sources (e.g. pump water from groundwater

reservoirs). In addition to agriculture, the productivity of fisheries, a key source of livelihoods for the local population, might also be affected by the changing hydrology of the delta (Eastham, et al. 2008). In general, the combined effect of late monsoon rains, sea level rise, and changing upstream flows will exacerbate the phenomenon of saltwater intrusion, with dramatic consequences for inland cultivations, and freshwater aquaculture (DELTARES 2011).

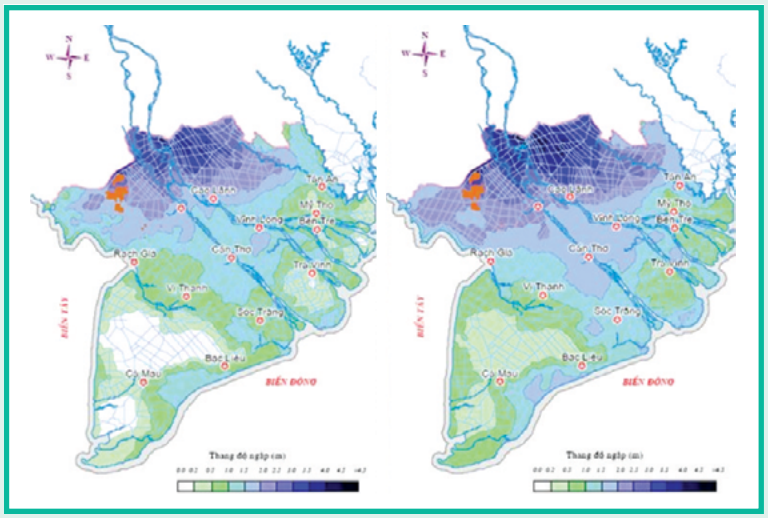
Together with economic effects, climate change will heavily affect the well-being of the local population. In particular, sea level rise and the increase in freshwater salinity will reduce the availability of freshwater for drinking, cooking and sanitation in many areas of the delta (World Bank 2012). Moreover, the reduction in crop yields, fish catch, and aquaculture production resulting from increased floods, higher temperatures and irregular precipitation will have a negative impact on the livelihood systems on which the population heavily relies on. Finally, the projected exacerbation of extreme weather events, such as floods and storms, is likely to cause destruction of property and loss of life, thereby hampering the achievement of key development objectives.

Climate change projections for the Mekong Delta region, under moderate and high scenarios.

	Moderate scenarios		High Scenarios	
Increase wet season flow	No change	10%	0-10%	20-50%
Increase wet season rainfall	0-5%	5-10%	10-20%	10-30%
Dry season flow	+/- 5%	5% higher or 15% lower	10-30% lower	30-60% lower
Decrease dry season rainfall	0-10%	5-15%	10-20%	20-40%
Increase salinity intrusion	Slight	Moderate	Moderate	Dramatic
Sea level rise	20-30 cm	57-73 cm	40-60 cm	78-95 cm

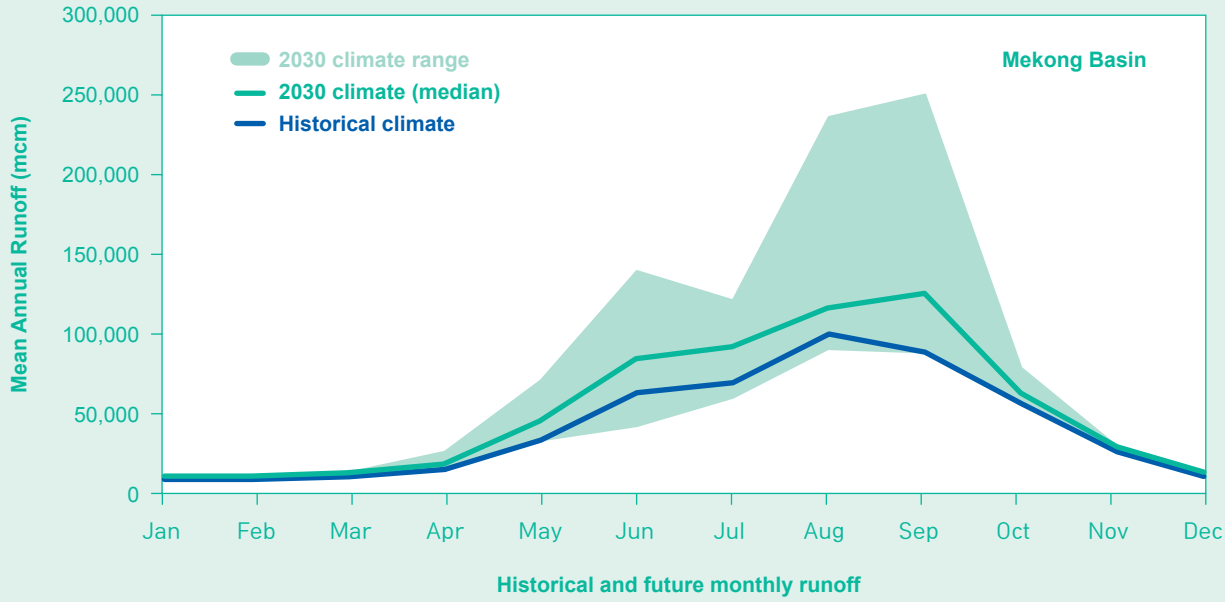
Source: (GoV 2013)

Flooding extent in the Mekong Delta in 2012 (left) and 2050 (right) with a sea level rise of 30cm.



Source: (GoV 2012c)

Historical and future monthly runoff.



Source: (Eastham, et al. 2008)

2.2.3. Water governance

In the Mekong Delta, the rapid economic transformation and diversification have resulted in a high degree of complexity in water governance and brought about some challenges, which has to be carefully addressed for successful introduction of the water and green growth approach. In response, international organizations, governments, and local authorities have conducted studies and approved legal instruments that were viewed as vital in addressing a complex web of water-related challenges the region faced due to rapid economic development and subsequent environmental damage.

International legal and policy framework

At the international/basin level, the 2011 IWRM-based Basin Development Strategy was approved by the Mekong River Commission (MRC) Council with aim to promote regional cooperation for the sustainable development of water resources, including through the adaptation to climate change and the protection of ecosystems and livelihoods. In particular, the Strategy identifies the following opportunities:

- Potential for further hydropower development in the Mekong river and tributaries, particularly in Lao PDR and Cambodia, provided that uncertainties and risks are fully addressed, and requiring further harmonization of social and environmental standards to ensure sustainability;

- Potential to expand and intensify irrigated land and agricultural production to increase food security, including water use from the Mekong mainstream, and to combat Delta saline intrusion;

- Potential for other priority water-related developments (e.g. fisheries, navigation, flood and drought management, tourism, and environment and ecosystem management), as well as those beyond the water sector (e.g. other power generation options).

National legal and policy framework

At the national level, before 1998, water policies were mainly focused on water resources development to enhance irrigation and drainage, hydropower generation and domestic water supply. However, all the objectives could not be met due to unbalanced investments and lack of complementarity in policy formulation.

The key milestone at the legal level was the issuance of the 1998 Law on Water Resources (LWR), which established, after a decade of drafting and public deliberation, the functions of water resources management and represented the first unified national framework for the water sector in Viet Nam. Also, the 1998 LWR and the 2006 National Water Resources Strategy included provisions on financing needs for effective water resources management.

Irrigation fees were removed in 2007 after a half century long application. This provision reduced the general effort in improving efficiency and maintenance of infrastructure, driving the government to initiate and approve a process in which local water user groups would be responsible for the development of local on-farm irrigation systems and the collection of irrigation fees. Further, the “polluters pay” principle for wastewater discharge was applied only marginally in recent years in some large cities. Municipal authorities are allowed to pose an environmental levy at 10-15% on top of water supply fees, a part of which are used for wastewater discharge.

In 2012, the new Law on Water Resources (LWR) provided some principles on financing water resources management activities, but none about financing water use and service delivery; these are covered sectoral legal systems. The 2012 LWR includes various provisions for more effective water resources management within the river basin, and clearly stipulates the rights and duties of water exploitation and use. In particular, specific procedures are established for granting, renewing, adjusting, suspending and revoking water licenses. Such licensing of water rights is applied to new water exploitation projects, including small hydropower, groundwater supply and wastewater discharge projects. Also, river basin management functions, which were defined by a special decree in 2008, are fully integrated into the 2012 LWR. However, detailed institutional arrangements to support the establishment of river basin organization under the 2012 law need to be set up.

Regional legal and policy framework

At the regional level, the management of water resources has always been the main focus of development plans, especially since the establishment of the Viet Nam Mekong Committee (VNMC) in 1957. Over the last two decades, in particular, a number of Master Plans for the Mekong Delta have been implemented in order to improve the socioeconomic development of the region. Most of these plans gave central priority to the management of water resources and water related disasters as a precondition to achieve development goals. Hereafter, the most relevant Plans for the purpose of this study are reviewed.

The Mekong Delta Master Plan of 1993 introduced the concept of integrated development and protection of water and related resources (land, forest and fishery). Since then, aquaculture and diversified agriculture have developed rapidly throughout the Delta. The Plan identified various water-related projects, including inland transportation system, as priority projects for investment. Although efforts were made to ensure that the Master Plan would represent an integrated water resources development plan for socioeconomic development, the Delta Master Plan of 1993 fell short of providing linkage to macro-economic policy making at the top level.

The Mekong Delta Master Plan of 1998 included the following socioeconomic objectives: agricultural sector growth rate of 5% in 2000-2010 period; GDP growth rate of 4% per year in order to more than triple GDP by 2010. The 1998 Master Plan also addressed the impacts of the regional financial crisis of 1997/1998, for which special attention was paid to the improvement of social and economic conditions. In that context, the Government

required local authorities to set up detailed plans for the period 2001-2005, focusing on social stability through irrigation development.

The Plan 2001-2005 was signed by Prime Minister Phan Van Khai on 11 June 2001 (No. 173/2001/QD-TTg). The plan focused on irrigation projects and flood control so as to improve the resilience of flood affected areas (nearly 1 million hectares). The Plan also addressed the issue of salinity intrusion, affecting more than 550,000 ha.

The Master Plan of 2006 included three main water resources development scenarios, for the short, medium and long term. These scenarios prioritized agriculture development and flood control, with targets for the provision of clean water supply reaching 85% and 100% for rural and urban areas, respectively.

The Master Plan of 2012 focused on the development of large-scale production of rice and aquatic products. It also included key water resources management objectives for 2050, such as the need to address salinity intrusion and sea level rise, storage of fresh water and effective water distribution to support economic growth. These interventions would help ensure (1) the safety of over 30 million people, two-thirds of which are living in flooded areas severely affected by climate change and upstream development, and the remainder living in coastal area severely affected by both climate change and sea level rise; and (2) social development with food security and access to clean and potable water.

The Mekong Delta Plan of 2013 was prepared in close partnership with the Dutch government, and it aims to provide a long-term vision and recommendations for the sustainable and safe development of the Mekong Delta. Four socioeconomic scenarios were identified: two unsustainable scenarios (industrial corridor and intensive food production) and two sustainable scenarios (agro-business and dual node industrialization). The unsustainable scenarios ignore the state of the environment, while the sustainable scenarios prioritize considerations of land use and water management. In particular, the ‘agro-business industrialization’ scenario makes optimal use of land and water resources, without negatively impacting the environment. As a result, this scenario has been adopted as the basis for the long-term vision for the Mekong Delta in Viet Nam.

Measurable policy impacts

Thanks to the numerous planning exercises, significant investments have been made over the last decades, resulting in the creation of a complex system of hydraulic works built to satisfy the requirements of socioeconomic development in the Mekong Delta.

In terms of irrigation, approximately 1.4 million ha (over 90 % of acreage of the winter-spring and summer-autumn crop) have been irrigated by a system of canals.

Regarding flood control, in the 1990s the people living in flooded areas have built embankments to control early floods (in August) and ensure summer-autumn crop production. The development of the system of embankments for controlling early floods is still spontaneous, and not rigorously planned. However, public investments in the flood control system (including dykes to protect concentrated residential areas) combined with spontaneous adaptive initiatives, have led to significant improvements, helping to stabilize agricultural production in the flooded areas.

The current drainage system can only serve about 80 % of the cultivated land, mainly due to the great extension of low-lying and flood affected areas. Consequently, in the years of heavy rain, late flood withdrawal still causes difficulties for production.

Vast areas of alum (aluminium sulphate) soil in Dong Thap Muoi, and Long Xuyen quadrangle and the Ca Mau peninsula have been converted into stable rice production areas (2 to 3 crops). However, in some cases the development of canals and sluices in alum areas has caused negative impacts on water quality.

Encouraging improvements have been made with water and road transport in flooded areas thanks to dredging, canal upgrading, constructing embankments as rural roads and inter-district roads, and improving the layout of residential areas.

Sea dykes and river estuary dykes, all part of an advanced dyke system, have gradually been built to prevent salt intrusion by controlling spring tides, high waves and water rise due to typhoons. Many dikes have been effective in promoting better salinity control and prevention of natural disasters, such as the sea dikes of Tien Giang, Tra Vinh, Soc Trang, Bac Lieu, and Kien Giang.

Concerning coastal erosion and sedimentation of rivers and canals, dredging operations have been carried out in estuaries and canals to protect residential areas and ensure water supply and drainage along the coast.

Finally, regarding forestry fire prevention, thanks to the system of dykes, regulators and pump stations, the National Parks of U Minh Thuong, Tram Chim, U Minh Ha, and the natural reserve areas of Xeo Quyt, Lung Ngoc Hoang and Tra Su have been well protected over the recent years.

Institutional framework

The National Water Resources Council (NWRC), established in 2000 and presided by a Deputy Prime Minister, is the coordinating institution for water issues in Viet Nam.

A major milestone in the evolution of the institutional framework for water resources management in Viet Nam was the establishment of the Ministry of Natural Resources and Environment (MONRE) in 2002. Since then, water resources management functions were entrusted to MONRE and treated as separate from all decisions pertaining water resources exploitation. Thus, MONRE has emerged as a neutral organization to deal with multiple requests from water users and polluters, which is in line with the principles of the integrated water resources management (IWRM) approach. However, the current organizational arrangements still present several overlaps between Ministries (see Table 9).

Table 9. Ministerial responsibilities with respect to the water sector.

Ministry	Responsibilities related to water
Ministry of Natural Resources and Environment - MONRE	Water resources and river basin planning and management; Water resources policies, strategies, legislation; Hydro-meteorology; groundwater; forecasting, climate change; Monitoring of water quantity, quality, pollution Water environment; wetland, water ecosystem; Water permit and license transfer Offices of the National Water Resources Council and river basin organizations; International river affairs including Mekong cooperation, Office of the VNMC. Conflict resolution
Ministry of Agriculture and Rural Development - MARD	Water development and service for irrigation and drainage in agriculture, aquaculture, fishery, forestry and salt works; industry (wherever water could be shared from irrigation system) Rural water supply and sanitation; Flood control and management.
Ministry of Industry and Trade - MIT	Hydropower; Treatment of industry polluted wastewater, including rural industry
Ministry of Construction - MOC	Urban and industry water supply and sanitation; Urban sewerage and pollution treatment
Ministry of Transport - MOT	Inland navigation
Ministry of Health - MOH	Water drinking and sanitation standards.
Ministry of Science & Technology - MOST	Water quality and environment standards

Ministry	Responsibilities related to water
Ministry of Planning and Investment - MPI	Water plan in national economy; Water related project investment plan (budget allocation, ODA, loan) Green growth / green economy
Ministry of Finance - MOF	Water and environment financing: budget and loan administration, Water resources tax, Water and environment management fees

The management of water resources is operationalized at two levels: (1) national, Department of Water Resources Management of MONRE; and (2) provincial, Water Resources Management Section of the Provincial Department of Natural Resources and Environment (DONRE). The main tasks of provinces consist of licensing water rights and monitoring water use. In many provinces, the water resources section is very thinly staffed. In parallel with MONRE, other ministries are responsible for coordinating water management. These include the Ministry of Construction (MOC) (for urban water supply and sewerage), the Ministry of Industry and Trade (MIT) (for water issues related to energy) and Ministry of Transport (MOT) (for those related to waterborne transport). At the grassroots level, water user groups are being established for the management of on-farm irrigation, rural water supply and sanitation, and flood mitigation.

Hydraulic works and operations belong to MARD, with line agency the Directorate of Water Resources. In provinces, hydraulic works management belongs to the Provincial Department of Agriculture and Rural Development (DARD) at level of sub-department, i.e. the Provincial Sub-Department of Hydraulic Works, the Provincial Sub-Department of Flood control and the Provincial Centre for Rural Water Supply and Sanitation (PCERWASS). Hydraulic works systems of each province are maintained and operated by a state-owned Hydraulic Works Operation Company, who is responsible for maintenance and operation of head works, primary and secondary canals and sluices. The management system is designed for provincial level, while most of irrigation systems are inter-provincial by nature.

MARD has created, in addition to the Provincial Sub-Department of Hydraulic Works and the Provincial Hydraulic Works Operation Company, three large water control zones and three Management Boards of Inter-provincial Hydraulic Works Systems, namely Plain of Reeds, Long Xuyen Quadrangle and Ca Mau Peninsular. This was in an attempt to deal with inter-provincial matters effectively at a basin level.

Considering the basin level, the 1998 LWR had, for the first time, stipulated that water resources development must ensure the integrity of river basins and comply with the principles of river basin planning. On the basis of the 1998 LWR, MARD established the Management Boards for River Basin Planning (RBPMB) for three large basins, including the Mekong Delta. The 2012 LWR provided the RBPMB with the functions of devising and implementing water resources plans; coordinating the regulation and allocation of water resources; monitoring the exploitation, use and protection of water resources, and the prevention, control and mitigation of water disasters. However, a detailed institutional model of a river basin organization is still missing.

The absence of a proper delta-wise river basin organization has been recognized by many experts as a major constraint. Although almost all development actions in the Delta are influenced by the river regime, the delta is still without an inter-provincial mechanism that could deal with various technical-managerial aspects, and play a central role in the prevention of conflicts among upstream and downstream water users.

In parallel with improvement of water resources management, the Ministry of Planning and Investment (MPI) created an independent Southern Economic Studies Centre for planning, coordinating, monitoring and evaluating developments, as recommended by the 1993 Mekong Delta Master Plan. In 2003, the Centre was merged into the MPI Development Strategy Institute. The Centre monitors regional development, updates socioeconomic information system and participates to central institute studies for the formulation of socioeconomic strategies for inter-provincial regions.

3. Methodology and Results

The methodology used to carry out the project is summarized in a four-step approach, as outlined in the next section. Local experts extensively supported the project, to gain a deeper understanding of the local context (social, economic, environmental, cultural as well as political).

3.1. Four-Step Approach

A 4-step approach was adopted to carry out the scoping activities. This is done with the aim to identify, quantify and understand the role of water in the Mekong Delta, and then select and analyse intervention options that would promote green growth. By incorporating a green growth approach into water resources management for the sustainable socioeconomic development of the Mekong Delta, systemic (cross-sectoral) planning would be promoted as well as broad stakeholder consultation. The 4-step approach consists of the following four activities:

- **Stocktaking:** review of the setting, data and existing policies in the Mekong Delta to recognize that improvements in water management have a high potential impact on economic growth and other development objectives. The goal is to identify opportunities for intervention that can reduce risks of climate change while promoting sustainable economic growth.

- **Development of the ranking methodology:** elaboration of the data needs and preparation of a prioritization methodology that takes into account the key dimensions of green growth in the context of the Mekong Delta. Among other indicators, the economic dimension included in the prioritization exercise accounts for an assessment of (1) the investments required, (2) policy induced avoided costs and (3) added benefits across social, economic and environmental dimensions. These indicators are considered in the tool developed to assess intervention options for green growth, as presented in section 3.3 of the report, and could be assessed in more detail in a follow up phase of the project (e.g. during the preparation of a quantitative cost benefit analysis for selected intervention options).

- **Assessment:** analysis on selected opportunities with both data and qualitative knowledge, through a Multi Criteria Analysis (MCA), to assess the expected impacts of implementation and their contribution to green growth. The key dimensions of the

Sustainable Development Plan of Viet Nam were used to drive the assessment, to guarantee coherence with national priorities:

- *To ensure macro-economic stability; firmly maintain food, energy and financial securities; gradual approach to green growth, low-carbon development; economic and effective use of resources.*
- *To mitigate negative impacts of economic activities; reasonably exploit and effectively use natural resources, especially non-renewable ones; prevent and restore polluted and degraded environments; protect and reforest; conserve bio-diversity; reduce harmful effects of natural disasters, actively and effectively respond to climate change, especially sea level rise.*

- **Analysis:** selection of the intervention options that would (individually and collectively, in bundles) lead to the highest impact on green growth, promoting a balanced and sustainable development of the Mekong Delta. The use of MCA, a decision-making process that allows the assessment of different options against a variety of criteria, allowed to identify the respective strengths and weaknesses of the options analysed. It is further envisaged that the continued engagement of national experts and the VNMC in the use of the methodology developed (creating synergies for the use of both qualitative and quantitative approaches) would be conducive to the development of an analysis tailored to the needs of decision makers.

In order to implement the 4-step approach the following information was collected and integrated in this study: (a) existing government's policies in the development of the Mekong Delta and the recently adopted National Green Growth Strategy and progress in its implementation; (b) experiences in the planning and development of the Mekong Delta, especially those related to the formulation of Mekong Delta Master Plans and water resources management strategies; (c) emerging directions in the socioeconomic development of the country and the Mekong Delta, including opportunities for collaboration with the Mekong upstream countries; and, (d) latest achievements and development in the planning and implementation of green growth strategies.

Box 4. The Viet Nam Green Growth Strategy

Adopted by the Prime Minister of Socialist Republic of Viet Nam; No. 1393/QĐ-TTg

- It is composed of three parts: 1) Viewpoints and objectives of the strategy, 2) Strategic Tasks, and 3) Solutions.
- Relevant descriptions to this project are the following:

1) Solution no. 7

"Economic and efficient utilization of natural resources"

- Establish and complete the legal framework and policies to enforce and effectively implement the Law on water resources, Law on land, Law on mineral resources, Law on environmental protection and related regulations; to strengthen the use of economic and administrative instruments based on the "polluters pays" principle.
- Establish effective administrative organizations, complete the management system for natural resources and environment protection at the central and local levels.
- Promote, develop and apply widely technologies and practices to use natural resources efficiently.

2) Solution no. 8

"Promote fast development of green economic sectors to create jobs, increase income and enrich natural capital"

- Development of green economic sectors
- Promote recycling and reusing waste within the country
- Promoting environmental goods and services
- Restoration and development of "natural capital"

3) Solution no. 9

"Development of key sustainable infrastructure including: transportation, energy, irrigation and urban works"

- Transport infrastructure
- Energy infrastructure
- Irrigation and water infrastructure

Taking green growth approach to the Mekong Delta could contribute to the implementation of the Green Growth Action Plan (GGAP), which was approved by the Prime Minister on 20 March 2014. The GGAP covers 66 activities in total in the following four main themes: (i) institutional building and local-level green growth plan, (ii) reduction of greenhouse gas emission and promotion of clean and recycled energies, (iii) green production, and (iv) green lifestyle and sustainable consumption (Prime Minister, 2014). While the interaction between the Mekong Delta development process and the National GG Strategy is expected to be led by the respective local authorities in their efforts to integrate the GG Strategy into the development process, specific water-related components are also expected from the implementation of the 16 priority activities of the 66 GGAP activities as follows: Activity 26 (making use of the tidal energy), Activity 29 (which would involve review of integrated development plans of key economic areas of the Delta), Activity 32 (which could cover water-borne transport), and particularly Activity 31 that would be coordinated by the Ministry of Agriculture and Rural Development (which would involve review of sectoral masterplans on natural resources management and green growth policies for GG in agriculture, forestry and aquaculture) (Ti, et al. 2014).

3.2. Identification of Opportunities

The information collected and analysed throughout the project was used to identify 20 opportunities for intervention that would enable and stimulate green growth in Mekong Delta from a conceptual context. These opportunities are grouped in three categories, according to their main expected contribution: (a) mitigating the adverse impacts of socioeconomic development on water, (b) curbing water constraints to socioeconomic development, and (c) improving water governance. As such, these opportunities can be seen as direct contributors to green growth in the Mekong Delta (see Section 2.2) in that they would enable sustainable development by simultaneously increasing water productivity and curtail environmental degradation. The following sections present in more detail the opportunities identified. However, the scanned opportunities are general (conceptual) overview based on the insights provided by the local experts and government stakeholders, which needs to be strengthened to be embedded into policies and/or formulated into real projects. Based on these findings, specific intervention opportunities can be outlined in collaboration with a wide range of stakeholders from Viet Nam.

3.2.1. Mitigating the adverse impacts of socioeconomic development on water

The economic growth and changes in lifestyle, coupled with population growth and low water prices, have led to a marked increase in water consumption in the Mekong Delta. This in turn has led to the rapid deterioration of the environment, including water resources. Moreover, while economic development of most of the provinces in the Mekong Delta has mainly been agriculture-based, recent economic diversification efforts have led to the adoption of different perspectives on socioeconomic development.

In particular, the rapid improvement in socioeconomic conditions and growth of the Mekong Delta during the past three decades can be attributed largely to the expansion of urban areas. While most people in urban settings have access to water, a smaller percentage of rural population can have access safe water supply. This is also due to the rapidly increasing pollution from urban waste and intensive agricultural production. In this context, various opportunities for the promotion of water and green growth can be identified, including:

1. *Promotion of urban wastewater treatment.* Most of the residents in urban areas of the Mekong Delta dispose domestic wastewater directly into canals and creeks. For example, many canals in the inner city of Ca Mau have turned into black water canals due to more than 6,000 houses along the rivers discharging wastewater directly into water bodies without treatment (Ti, et al. 2014). Local industrial wastewater also contaminates the rivers following through the Delta – areas with industrial parks and clusters exhibit BOD5 levels 7 to 12 times higher compared to the environmental standard (Ti, et al. 2014). Such trend of industrialization in the Mekong Delta in recent years have polluted surface water sources of the Delta. This can be related to water security issues as the total amount of clean water available for use declines, while the demand continues to increase. This highlights the need to introduce urban wastewater treatment in the Delta to ensure sustainable development. For this, not only an investment program is necessary, but also a strategic program along the concept of wastewater revolution in the region.

2. *Rehabilitation of urban rivers for socioeconomic development.* Urban rivers contribute significantly to socioeconomic development. These rivers serve as the main source of water to sustain life and create favourable setting to accommodate activities associated with community well-being. Rehabilitating the urban river channels involves attracting investment and setting development projects to restore urban canal system and improve water management in an efficient manner, so as to meet the growing water needs for development and protect the environment.

3. *Establishment of a program on flood management for better urbanisation process in the Mekong Delta.* Rapid population growth rate at a 3 to 5 % per year has resulted in active land reclamation and introduced large-scale traffic networks that in turn allowed greater economic growth. Nonetheless, these developments make it difficult to manage flood flow, and cause from time to time severe flooding in neighbouring zones to disturb aquaculture and destroy livelihoods. Review of water-sensitive urban design in other countries can help Viet Nam draw lessons to be integrated into its flood management program. The program should also link findings at local level with the current large-scaled flood studies so that impact at social level can be better taken into account and be monitored.

4. *Development of priority programs for coping with plausible upstream development scenarios.* Given the geographical characteristics of the Mekong basin, upstream activities are likely to have considerable impacts on the Delta. An assessment of intervention options – including the construction of large hydropower-dams, to ensure resilience and reduce the vulnerability of economic activities would contribute to green growth.

5. *Development of a strategy and action plan for coping with the projected impacts of climate change and sea level rise.* As aforementioned, the combined effect of sea level rise and changing flooding patterns is projected to result in a direct net loss of arable land in the Delta (GoV 2012c), with an estimated sea level rise of 30 cm by 2050 and of about 75 cm by the end of the 21st century. Salinity intrusion is also one of the consequences of sea level rise that can lead to economic and biodiversity losses. In 2005, salt intrusion reaching up to 140km in the Delta result in total economic loss of one area to mount to 16 billion VND (GoV 2013). While such longer term climatic changes are being forecasted and analysed frequently, annual climate change impacts are often unpredictable. For this reason, and to ensure resilience, a strategy and action plan should be developed to reduce risks, mitigate the potential impacts of upcoming events and adapt to climatic changes.

3.2.2. Curbing water constraints to socioeconomic development

During the past four decades, large investments were made to improve water resources management. It was estimated that since 2006 over US$ 650 million have been invested in some 65 construction projects[1]. A key priority is to re-examine the design of water infrastructure systemically, in order to improve its eco-efficiency and meet new water demand, especially for inland and coastal aquaculture.

The current system of flood control includes dikes and embankments with a total length of about 13,000 km. In fact, floods have always been a part of the Mekong Delta given its geographical conditions. Since the 1980s, efforts have been made at both national and local levels to not only minimize but also adapt to this natural disaster via utilizing the influx of water during the flood seasons. However, the growing pressure to increase rice production in the Delta is behind the ongoing construction of dikes and irrigation

1. An extensive system of irrigation and drainage of over 14,000 km main/primary canals, 27,000 km secondary canals, about 50,000 tertiary/on-farm canals and 80 sluices over 5 m wide (the biggest sluices with the Lang The 100 m wide and Ba Lai 84 m wide), over 900 culverts 2-4 m wide and tens of thousands of small culverts, and over 1,000 large and medium-sized pump stations, thousands of small to actively pump for irrigation.

infrastructures that can ultimately damage the region's ecological system. In addition, economic growth has led to the rapid development of transport systems, with negative impacts on flood management and the socioeconomic conditions of the population living in flood plains. Efforts are being made to examine this emerging issue in the context of water and green growth.

In light of these considerations, opportunities to improve the contribution of the water sector to economic growth include:

6. *Improvement of water productivity.* It is important to increase the effectiveness of water use, and to reduce the pressure that socioeconomic development is putting on water resources. This includes several potential interventions, such as reducing water losses (leakages) as well as improving the efficiency of use (from end users).

7. *Optimisation of the water distribution infrastructure to increase its eco-efficiency in the Mekong Delta.* Most of water-related infrastructures present in the Delta were built to allow intensive irrigation and drainage for strong agricultural production. Sustainable environment and eco-efficiency were a low priority at that time. Thus, examining the existing infrastructures from a green growth perspective and provide valuable lessons for water-related infrastructure developments in the future. This is also essential to meet new water demands, especially for inland and coastal aquaculture, and requires the introduction of a new set of criteria for future water infrastructure development.

8. *Creation of a program for the sustainable utilization of transport infrastructure (road and river).* In order to accelerate socio-economic development of the Delta, efforts have recently been made to improve the system of the national highways and as well as the provincial road network, which is underdeveloped, especially in large areas of the Delta that are not served by roads and reliant on the waterways and motorcycle tracks. These efforts should be scaled up and aligned with flood management practices and plans to create synergies.

9. *Development of a flood management program in support of the rapid expansion of agricultural production.* Assessing the impact of producing third rice crop in the Mekong Delta in link with flood management is required. This includes conducting a pilot study to test the adverse impacts of expansion of protected areas for agricultural production in areas near or deeply flooded zones such as An Giang Province.

10. *Preparation of a comprehensive review of experiences in the Mekong Delta,* with emphasis on wetland management to identify strategies and policies, including required investments, to effectively support green growth. The wetlands of the Mekong Delta were once extensive and varied. Today, much of the Delta has lost its natural habitats, although remnants of the once extensive peat swamp forests, freshwater forests and flooded grasslands are represented in these wetlands.

11. *Country case study on the emerging adverse impacts of the diking and damming of channels in estuarine areas.* The dam system has contributed significantly to the reserves of freshwater, saltwater prevention, flood prevention for hundreds of thousands of hectares of agriculture land mainly in the coastal areas such as Go Cong, South Mang Thit, Quan Lo-Phung Hiep, North Ca Mau and Long Xuyen quadrangle. However, the construction of dam/gates also created side effects (e.g. water pollution and river bank erosion). Experiences of the Netherlands and Republic of Korea should be examined.

12. *Improvement of water resources planning and management for the coastal areas of the Mekong Delta,* to support the expansion of cultivated areas and aquaculture by managing salinity intrusion more effectively. Negative impacts of climate change, upstream discharge and sea level rise are identified as the key drivers behind a series of coastal erosions over the past decade.

3.2.3. Improving water governance

While the legal and institutional framework for water resources management has improved extensively at the national level, the Mekong Delta has begun to embark on changes that would enable a more active participation of a diverse group of stakeholders. The adoption of green growth principles would further leverage and enhance this process, but improving risk management at various levels of development. The opportunities identified in the context of water governance include:

13. *Promotion of water and green growth leadership* in the Mekong Delta, possibly through the development of a "shared" water and green growth vision, to ensure continuity and consistency of policies and investments.

14. *Promotion of water and green growth at community level* to improve both the prevention of water-related conflict and the effectiveness of resolution processes. Conflicts relate to issues including the use of irrigation water, wastewater discharge, water pollution, and public sanitation. Water user groups operate at the community level in the Delta to represent the farmers and mediate and resolve conflicts amongst themselves as well as between water agencies and the private sector. Raising awareness and improving the understanding of green growth at the local level will enable these groups to build a strong rationale to use in negotiations while simultaneously promoting sustainable water use.

15. *Improvement of institutional processes* (e.g. funding allocation and decentralization mechanisms) to avoid inconsistencies and inefficiencies in provincial development planning processes (e.g. inter-provincial hydraulic works system).

16. *Update of the Mekong Delta Water Master Plan and of the Socioeconomic Master Plan,* fully integrating the concepts and assessment framework of green growth. This will be in line with the National Green Growth Action Plan that has been approved by the Prime Minister in March 2014.

17. *Development of programs for capacity building and awareness raising on water and green growth,* with the aim to stimulate behavioural change and private sector buy-in for investments. The contents for the capacity building program can stem from the four main themes of Green Growth Action Plan (GGAP): (i) institutional building and local-level green growth plan; (ii) reduction of greenhouse gas emission

and promoting of clean and recycled energies; (iii) green production; and (iv) green lifestyle and sustainable consumption.

18. *Identification of suitable pilot projects* to demonstrate the potential impacts of concrete projects on embedding green growth in Mekong Delta. One possible approach is to develop a provincial-level project that can provide a clear illustration of the impact of green growth options, thereby driving momentum towards green growth in the region.

19. *Identification of policies and interventions, besides the water sector, that could leverage the implementation of the opportunities identified in this study.* Water serves as a source of life and thus can be linked to various sectors including agriculture, energy, health, poverty, and tourism. The aim is to make use of synergies, and employ a systemic approach to fully integrate water planning in the economic structure of the Mekong Delta.

20. *Establishment of a proper Mekong Delta basin organization,* to provide a unified framework that would help overcoming the current fragmented and at time overlapping undertakings and ensure sustainable water resources management in the Mekong Delta.

Table 10. Summary of scanned opportunities for water and green growth in the Mekong Delta.

Identified challenges		Opportunities		
Cause	Affect	To mitigate the adverse impacts of socioeconomic development on water	To curb water constraints to socioeconomic development	To improve water governance
Rapid and unplanned urbanization process entailing poor water resources management.	Disturbing the water ecosystem. Not enough water for sustained economic growth (including agricultural production), thus creating significant impact on the lives and sectors that are heavily dependent of water	1) Promotion of urban wastewater treatment. 2) Rehabilitation of urban rivers for socioeconomic development. 3) Establishment of a program on flood management for better urbanisation process in the Mekon Delta.	1) Improvement of water productivity. 2) Preparation of a comprehensive review of experiences in the Mekong Delta, with Emphasis on wetland management. 3) Development of a flood management program in support of the rapid expansion of agricultural production. 4) Improvement of water resources planning and management for the coastal areas of the Mekong Delta.	
Water infrastructure incapable to meet the continued upstream developments.	Growing water demands leading to potential water conflicts at different levels (including transboundary conflict). Rising sea levels and salinity.	1) Development of priority programs for coping with plausible upstream development scenarios. 2) Development of a strategy and action plan for coping with the projected impacts of climate change and sea level rise.	1) Optimisation of the water distribution infrastructure of increase its eco-efficiency in the Mekong Delta. 2) Creation of a program for the sustainable utilzation of transport infrastructure (road and river). 3) Country case study on the emerging adverse impacts of the diking and damming of channels in estuarine areas.	
Lack advocacy/ continuty of green growth policies.	Poor legal and institutional framework for water resources management. Slow improvement towards sustainable water management in the Delta.			1) Promotion of water and green growth leadership. 2) Promotion of water and green growth at community level. 3) Improvement of institutional processes. 4) Update of the Mekong Delta Water Master Plan and of the Socioeconomic Master Plan. 5) Development of programs for capacity building and awareness raising on water and green growth. 6) Identification of policies and interventions, beside the water sector, that could leverage the implementation of the opportunities identified in this study. 7) Identification of suitable pilot projects to demonstrate the potential impacts of concrete projects on embedding green growth in Mekong Delta. 8) Establishment of a proper Mekong Delta basin organisation.

3.3. Green Growth Assessment

Prioritization is a crucial step for policy makers in identifying the option that deserves both tangible and intangible resources to be implemented from a long list of different options with varying degree of positive and negative impacts depending on the time frame. Time constraints, limited amount of resources, as well as the opinions from stakeholders with conflicting interests complicate priority setting. The Green Growth Best Practice Assessment Study (GGBP) on prioritization of green growth options has revealed that pragmatic reasons including data availability, technical expertise, and timing are determinants used in selecting a tool for prioritization (GGBP 2014). The study emphasizes quality and availability of data as the key factors shaping the quality of the analysis outputs. Since no situation is exactly alike, there is no single tool that can work the best in all countries alike – so analysts should make a careful decision in selecting the prioritization method tailored to the circumstances of the target area which in return will decide on the scope of issues that can be considered. In the case of the Mekong Delta, the prioritization criteria originate directly from the role that water plays in the socioeconomic development of the region. In fact, prioritization criteria include the cost of the option compared to the business-as-usual option as well its social, economic, and environmental impacts. Further, to complement a cross sectoral analysis of cost-effectiveness, the state of the environment is also considered (effectively assessing both stocks and flows), to take into account medium to long term effects.

The main criteria considered to create the assessment methodology include (GGBP 2014):

- Customize the prioritization tool and method to address key economic, environmental, and social drivers in a robust manner and appropriate for the local context, without letting the tool drive the analytic direction.
- Combine top-down and bottom-up approaches to improve robustness of results and address limitations of individual tools and methods. Consider options across broad range of sectors (including agriculture, energy, forestry, transport, water) and economy-wide options (e.g. poverty reduction, natural asset protection and resource efficiency, green jobs, etc.).
- Apply an iterative process to analyse options, identify priorities and combine them into pathways for near and long-term green growth transformation.

- Use pathways (or scenarios) to identify the scale and pace of change required in different sectors and highlight the choices and actions that need to be made over time, along with uncertainties.

3.3.1. Analytical tool: An overview

An integrated approach to water and green growth implies the recognition of the multiple risks and opportunities that are linked to water resources, and requires a careful assessment of the potential impacts of water on the economy, society and environment. Depending on the strategic approach adopted for the management of water resources in the Mekong Delta, different impacts can be expected. These include three main categories:

- **Water contributes to socioeconomic development.** Water resources constitute a fundamental prerequisite for long-term socioeconomic development. Indeed, water is a key driver of growth in the Mekong Delta region, extensively contributing to all the economic activities that provide livelihoods to the population.

- **Water can curb the economy and negatively affect well-being.** Water in the Mekong Delta can represent a constraint to economic growth and the improvement of well-being. In particular, the impact of floods and storms, increasingly exacerbated by climate change, can lead to considerable losses in terms of human lives, infrastructure, and economic activity.

- **Sustainable water resources management enables green growth.** The sustainable management of water stocks and flows facilitates the transition towards an inclusive and sustained economic growth path. The preservation of water ecosystems and - more in general - the improvement in the state of the environment of the Mekong Delta region would contribute to the achievement of key sustainable development goals.

Based on the approach described above, a number of risks and opportunities for water resources management have been identified by stakeholders in the Mekong Delta region. In particular, a series of water and green growth opportunities have been selected under the three main categories of: (1) opportunities to mitigate impacts of socioeconomic development on water resources; (2) opportunities for enhancing the support that water provides to socioeconomic development; and (3) opportunities for improving water governance.

In order to establish a rigorous and evidence-based method to assess and prioritize water and green growth opportunities, a specific tool was developed and customized to

the Mekong Delta context, based on the current and upcoming water management risks and opportunities identified throughout this study. The Water and Green Growth (W-GG) Assessment Tool is an MS Excel-based tool that allows to assess each intervention option against the following outcomes: (1) contribution to the economy; (2) reduced vulnerability to external changes (e.g. climate change impacts); (3) reduced environmental pressures; and (4) improvement in the state of the environment. The tool uses 11 key impact indicators to assess each water and green growth intervention option. In turn, the impact indicators are derived from a set of indicators on water resources stocks and flows, as well as on the contribution of water to the economy, environment and society of the Mekong Delta. As such, the tool provides a comprehensive and integrated assessment of the performance of water and green growth interventions, also in relation to the specific socioeconomic context, and especially focusing on sustainability and inclusiveness criteria.

The indicators groups and respective impact indicators included in the W-GG Assessment Tool are:

1. **Contribution to the economy:** This group of indicators assesses the expected impact of a given W-GG intervention option on the economy of the region. In particular, the group is composed of four impact indicators, namely:
    - *Contribution to GDP:* the expected change in the value of GDP, as a result of the implementation of water and green growth policies and investments.
    - *Tax revenue (from water sectors):* the expected change in the annual revenue that the government derives from water related sectors, such as taxes on water provision services, fiscal measures imposed on the transport of freight and passengers by river, etc. This indicator is relevant to assess the potential for the fiscal space for public intervention.
    - *Water expenditure:* the expected change in the public budgetary expenditure in water management. With a green growth approach the operation and maintenance of the water sector should decline (e.g. limiting expenditure on water treatment, otherwise increasing in a business as usual case).
    - *Extra budgetary water expenditure:* the expected change in extra budgetary government expenditure (e.g. for relief expenditure as a result of flood damage, or for the reconstruction of infrastructure, such as roads).

2. **Vulnerability to external changes:** This indicators group assesses the expected impact of a given W-GG intervention on the vulnerability (or resilience) of the region to external changes, including to water related extreme weather events exacerbated by climate change. The group is composed of three impact indicators, namely:

    - *Severity of the impact of water related extreme events:* the expected change in the severity of water related extreme events (e.g. the intensity and strength of floods), resulting from the implementation of the intervention.

    - *Vulnerability to precipitation variability:* the expected percentage change in the vulnerability of households and productive sectors to fluctuating rainfall (e.g. impacts on irrigation, access to potable water, during periods of drought and heavy rain).

    - *Climate change impacts on the ecosystem:* the expected percentage change in the health of key ecosystems (e.g. mangroves, wetlands) as a result of climate variability and climate change driven extreme events.

3. **Reduction of environmental pressures:** This indicators group assesses the effects of W-GG interventions on reducing or increasing environmental pressures, including in particular water use and water pollution. The group is composed of the following indicators:

    - *Water pollution:* the expected change in water pollution from production activities in the region, resulting from the intervention implemented.

    - *Water extraction/use:* the expected change in the amount of water used for residential, industrial and agricultural purposes. The evaluation considers both surface water use and groundwater extraction, and their productivity.

    - **Improvement in the state of the environment:** This indicators group assesses the impact of W-GG interventions on natural capital stocks, and the state of the environment. The group is composed of two indicators, namely:

    - *Forest land:* the expected change in forest cover (or more generally in land use) resulting from the implementation of a given W-GG intervention option. This includes all pressures on land use, e.g. urbanization and expansion of agriculture production.

    - *Groundwater stock:* the expected change in the stock of groundwater resources, and its quality (e.g. as impacted by salinity intrusion).

Given the indicators presented above, data collection spans across sectors and actors and involves the analysis of several indicators. In fact, indicators on the current and historical performance of the system (be it social, economic or environmental) should to be collected to be able to assess the potential impact of interventions to be implemented in the future.

As indicated above, these indicators include the key dimensions of green growth, such as the economic one, with the current contribution of GDP of water-related services and the costs (expenditure) and benefits (tax revenue) to the public sector. Concerning the environmental dimension it is important to consider current pressures and vulnerabilities, to be able to assess the potential contribution of interventions to the state of the environment and indirectly increase resilience and improve economic performance. In other words, indicators are needed that represent the concept of green growth in its entirety, to be able to properly assess the contribution of water and green growth opportunities.

In addition, these indicators are only relevant in the context of a cost benefit analysis if they are compared with the intervention costs (investment required), the avoided costs (cost savings) and added benefits (e.g. employment) created by the implementation of the opportunity. In fact, the indicators of current and historical performance of the system are required to define the extent to which the interventions analysed will contribute to green growth, within and/or across sectors and whether the impact will be relevant or negligible. This is particularly relevant for defining the performance brackets, presented in Table 11 and in Annex II. In fact, the actual performance of a given indicator is defined by estimating (1) how much it would change due to the implementation of the intervention option selected and (2) by assessing whether this change is positive or negative and to what extent it is. The latter part is done by identifying what range of change (e.g. 1% to 3%) corresponds to a (i) neutral, (ii) moderately positive or (iii) positive, or (iv) moderately negative or (v) negative. These ranges are used to normalize the results and make so that the indicators, and indicators groups can be directly compared with each other to estimate the overall performance of the intervention analysed.

Table 11. Water and Green Growth Assessment Tool: Sample quantitative analysis of three intervention options.

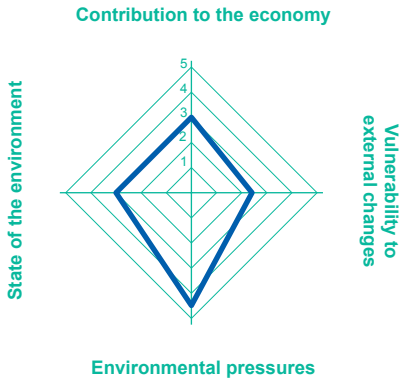
	Indicators Groups	Ranking Check	Ranking Groups	Indicator	Unit
Option 1	Contribution to the economy	100%	25%	Contribution to Agricultural GDP	% change
			25%	Contribution to tax revenue (from water sectors)	% change
			25%	Impact on water expenditure (e.g. infrastructure)	% change
			25%	Impact on extra budgetary water expenditure	% change
	Vulnerability to external changes	100%	33%	Impact on reducing severity of water related extreme events	% change
			33%	Impact on reducing vulnerability to extreme events	% change
			33%	Impact on reducing water salinity	% change
	Environmental pressures	100%	50%	Reduction of water pollution	% change
			50%	Impact on water extrction/use	% change
	State of the environment	100%	50%	Impact on forest land	% change
			50%	Impact on ground water stock	% change

	Indicators Groups	Ranking Check	Ranking Groups	Indicator	Unit
Option 2	Contribution to the economy	100%	25%	Contribution to Agricultural GDP	% change
			25%	Contribution to tax revenue (from water sectors)	% change
			25%	Impact on water expenditure (e.g. infrastructure)	% change
			25%	Impact on extra budgetary water expenditure	% change
	Vulnerability to external changes	100%	33%	Impact on reducing severity of water related extreme events	% change
			33%	Impact on reducing vulnerability to extreme events	% change
			33%	Impact on reducing water salinity	% change
	Environmental pressures	100%	50%	Reduction of water pollution	% change
			50%	Impact on water extrction/use	% change
	State of the environment	100%	50%	Impact on forest land	% change
			50%	Impact on ground water stock	% change

	Indicators Groups	Ranking Check	Ranking Groups	Indicator	Unit
Option 3	Contribution to the economy	100%	25%	Contribution to Agricultural GDP	% change
			25%	Contribution to tax revenue (from water sectors)	% change
			25%	Impact on water expenditure (e.g. infrastructure)	% change
			25%	Impact on extra budgetary water expenditure	% change
	Vulnerability to external changes	100%	33%	Impact on reducing severity of water related extreme events	% change
			33%	Impact on reducing vulnerability to extreme events	% change
			33%	Impact on reducing water salinity	% change
	Environmental pressures	100%	50%	Reduction of water pollution	% change
			50%	Impact on water extrction/use	% change
	State of the environment	100%	50%	Impact on forest land	% change
			50%	Impact on ground water stock	% change

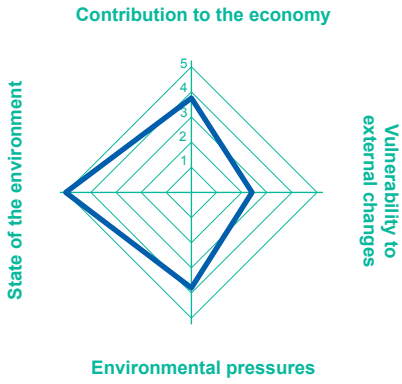
Value	Performance				1	2	3	4	5	Overall Ranking
2.5	3				-10	-5	0	5	10	
1.3	4			2.8	-2	-1	0	1	2	
15.0	2				30	15	0	-15	-30	
15.0	2				30	15	0	-15	-30	
2.0	2				0	5	20	50	>50	
30.0	4			2.3	0	5	20	50	>50	**3.1**
0.0	1				0	5	20	50	>50	
15.0	4				0	2	5	15	>15	
-3.0	5			4.5	2	1	0	-1	-2	
0.5	3				-2	-1	0	1	2	
0.3	3			3.0	-2	-1	0	1	2	

Option 1 Assessment



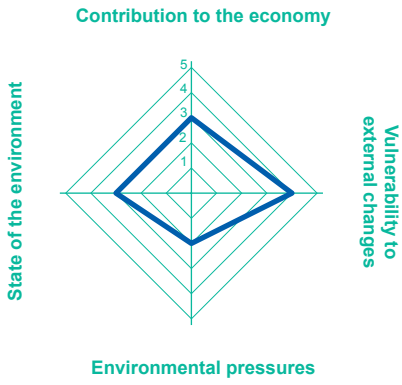
Value	Performance				1	2	3	4	5	Overall Ranking
-1.5	3				-10	-5	0	5	10	
4.0	5			3.5	-2	-1	0	1	2	
5.0	3				30	15	0	-15	-30	
8.0	3				30	15	0	-15	-30	
2.0	2				0	5	20	50	>50	
10.0	3			2.3	0	5	20	50	>50	**3.6**
2.0	2				0	5	20	50	>50	
1.0	2				0	2	5	15	>15	
-5.0	5			3.5	2	1	0	-1	-2	
4.0	5				-2	-1	0	1	2	
5.0	5			5.0	-2	-1	0	1	2	

Option 2 Assessment



Value	Performance				1	2	3	4	5	Overall Ranking
0.0	3				-10	-5	0	5	10	
0.0	3			3.0	-2	-1	0	1	2	
0.0	3				30	15	0	-15	-30	
0.0	3				30	15	0	-15	-30	
50.0	4				0	5	20	50	>50	
50.0	4			4.0	0	5	20	50	>50	**3.0**
50.0	4				0	5	20	50	>50	
0.0	1				0	2	5	15	>15	
0.0	3			2.0	2	1	0	-1	-2	
0.0	3				-2	-1	0	1	2	
0.0	3			3.0	-2	-1	0	1	2	

Option 3 Assessment



3.3.2. Assessing the linkages between Water and Green Growth in the Mekong Delta

In order to conduct an evaluation of W-GG intervention options using the W-GG Assessment Tool, a comprehensive, systemic analysis has to be carried out. In this respect, the tool can be used to produce a quantitative analysis of costs and benefits (including added benefits and avoided costs) of each W-GG intervention. In addition, the tool can be adapted to allow a qualitative evaluation, especially if specific data are not available at the regional level. Finally, these two approaches could be combined into a Multi Criteria Analysis.

Sample qualitative assessment

In order to test and validate the tool in the first phase of the project, a preliminary qualitative assessment of four W-GG interventions was carried out with national experts, primarily to illustrate the analytical process required to compare alternative options. This exercise also requires the convening of several stakeholders with varied sectoral expertise and interests, to ensure that the peculiarities of the local context are taken into account and all the key dimensions of green growth are captured.

The qualitative assessment implies that each impact indicator is assigned an indicative statement describing its expected performance after the implementation of a water and green growth intervention. More specifically, each indicator is ranked based on five possible expected behaviours, namely: Large Decline; Decline; Neutral; Increase; Large Increase. Each statement is associated to a performance score from 1 (worst) to 5 (best), depending on the specific indicator being assessed (e.g. a large increase in water pollution corresponds to a performance score of 1, while a large increase of GDP corresponds to a performance score of 5). The results of the qualitative assessment are presented in the following paragraphs.

Four intervention options were selected among the list of opportunities identified in Section 3.2. Using the W-GG Assessment Tool, the four opportunities were assessed and compared. The options were chosen as illustrative examples, and assessed based on a preliminary analysis of water-related economic, social and environmental trends in the Mekong Delta region. The opportunities assessed include:

- **Option 1: Improvement of eco-efficiency of water-related infrastructure.** Investments are made to modernize existing water infrastructure, with the final objective of reducing water losses, and minimizing the impacts on the environment.

- **Option 2: Improvement of the urbanization process.** Investments are implemented in urban settings to improve water quality and efficiency, increase access to water, and improve the resilience of urban settings to the impacts of extreme weather events. Together with investments, also targeted fiscal policies and regulatory instruments are introduced in order to encourage the responsible use of water resources in urban areas (e.g. environmental taxes; incentives to water efficient technologies).

- **Option 3: Flood management for agriculture production.** Investments and incentives are focused on reducing the impacts of floods on agricultural production, eventually leading to improved food security and better performance of the agriculture sector in the region.

- **Option 4: Improvement of coastal area management.** Investments and regulatory instruments are implemented in the coastal area in order to reduce the impacts of external events, at the same time encouraging the transition to sustainable and integrated water management in coastal villages and cities.

Table 12 provides an overview of the results obtained from the comparative assessment of the four intervention options, conducted with the W-GG Assessment Tool. Although Option 1 obtained the higher overall ranking score, it can be observed that the four interventions have similar overall performance. On the other hand, similarities and differences of the various options can be identified by comparing the performance scores of each indicators and the group they belong to. For example, all the options would lead to a large increase in water expenditure, due to the fact that capital investments in infrastructural improvements are expected under each intervention. At the same time, the analysis of indicators groups shows that Option 1 is particularly indicated for reducing vulnerability to external changes; Option 2 shows a moderate and more balanced improvement of all four indicators groups; Option 3 indicates good results for the contribution to the economy; and Option 4 seems to be most appropriate to reduce environmental pressure (see Table 12).

This preliminary qualitative assessment should be extended to the entire set of opportunities identified, to identify potential synergies and possible overlapping efforts, with the aim to inform decision making. The goal of this phase would be to identify elements of strengths

and weaknesses of each intervention (rather than identifying the best or worst one). This would allow to avoid duplication of efforts and would support the identification of gaps, possibly to be filled through the formulation of new intervention options.

Table 12. Overview of the comparative qualitative assessment of four Water and Green Growth (W-GG) intervention options, conducted with the W-GG Assessment Tool.

Indicators Groups	Weights	Indicators	Indicators Performance Scores* (1 = Worst; 5 = Best)			
			Improved eco-efficiency of water-related infrasturcture	Improvement of urbanization process	Flood management for agriculture production	Improvement of coastal area management
Contribution to the economy	25%	Contribution to GDP	3	5	4	4
	25%	Tax revenue (from water sectors)	2	4	4	3
	25%	Water expenditure (e.g. infrastructure)	1	1	2	2
	25%	Extra budgetary water expenditure	5	4	5	4
	Indicators Group Performance		**2.8**	**3.5**	**3.8**	**3.3**
Vulnerability to external damage	33%	Severity of the impact for water related extreme events	5	3	3	4
	33%	Vulnerability to precipitation variability	5	4	2	4
	33%	Climate change impacts on the ecosystem	5	4	2	4
	Indicators Group Performance		**5.0**	**3.6**	**2.3**	**4.0**
Reduction of environemental pressures	50%	Water pollution	2	5	2	4
	50%	Water extraction/use	4	1	3	4
	Indicators Group Performance		**3.0**	**3.6**	**2.5**	**4.0**
Improvement in the state of the environment	50%	Forest/fallow land	3	4	2	3
	50%	Groundwater stock	4	2	3	3
	Indicators Group Performance		**3.5**	**3.0**	**2.5**	**3**
Overall Scores			**3.6**	**3.3**	**2.8**	**3.6**

Figure 6. **Graphical representation of the performance of each intervention option analysed, considering the four key dimensions of water and green growth identified in this study.**

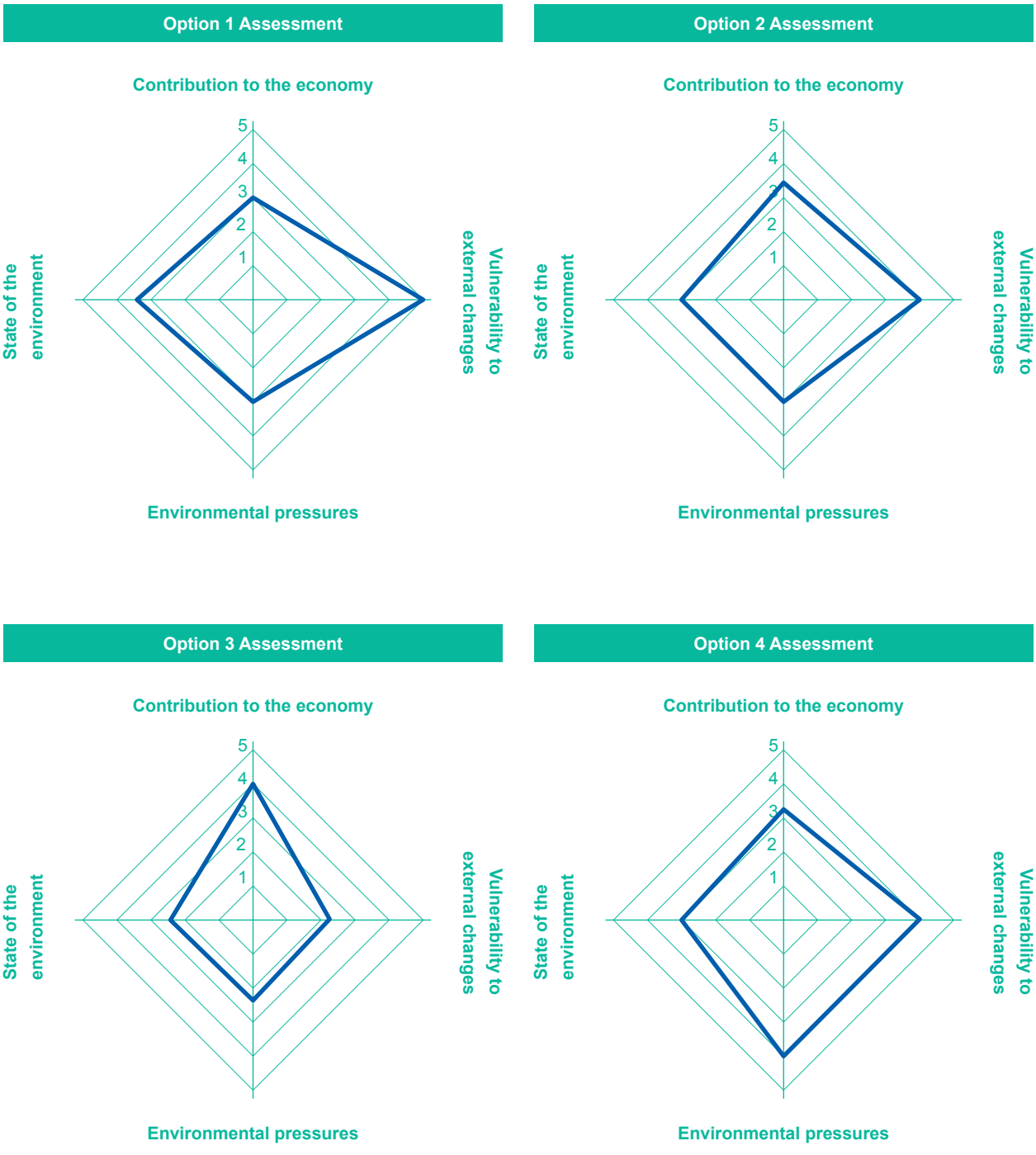


Table 13. Detailed qualitative assessment of four Water and Green Growth (W-GG) intervention options, conducted with the W-GG Assessment Tool.

	Indicators groups	Indicator	Value	Perfor-mance		Overall Ranking
Improved eco-efficiency of water-related infrastructure	Contribution to the economy	Contribution to GDP	Neutral	3	2.8	**3.6**
		Tax revenue (from water sectors)	Decline	2		
		Water expenditure (e.g. infrastructure)	Large Increase	1		
		Extra budgetary water expenditure	Large Decline	5		
	Vulnerability to external changes	Severity of the impact of water related extreme events	Large Decline	5	5.0	
		Vulnerability to precipitation variability	Large Decline	5		
		Climate change impacts on the ecosystem	Large Decline	5		
	Reduction of environmental pressures	Water pollution	Increase	2	3.0	
		Water extraction/use	Decline	4		
	Improvement in the state of the environment	Forest/fallow land	Neutral	3	3.5	
		Groundwater stock	Increase	4		

	Indicators groups	Indicator	Value	Perfor-mance		Overall Ranking
Improvement of urbanization process	Contribution to the economy	Contribution to GDP	Large Increase	5	3.5	**3.3**
		Tax revenue (from water sectors)	Increase	4		
		Water expenditure (e.g. infrastructure)	Large Increase	1		
		Extra budgetary water expenditure	Decline	4		
	Vulnerability to external changes	Severity of the impact of water related extreme events	Neutral	3	3.6	
		Vulnerability to precipitation variability	Decline	4		
		Climate change impacts on the ecosystem	Decline	4		
	Reduction of environmental pressures	Water pollution	Large Decline	5	3.0	
		Water extraction/use	Large Increase	1		
	Improvement in the state of the environment	Forest/fallow land	Increase	4	3.0	
		Groundwater stock	Decline	2		

	Indicators groups	Indicator	Value	Performance		Overall Ranking
Flood management for agriculture production	Contribution to the economy	Contribution to GDP	Increase	4	3.8	2.8
		Tax revenue (from water sectors)	Increase	4		
		Water expenditure (e.g. infrastructure)	Increase	2		
		Extra budgetary water expenditure	Large Decline	5		
	Vulnerability to external changes	Severity of the impact of water related extreme events	Neutral	3	2.3	
		Vulnerability to precipitation variability	Increase	2		
		Climate change impacts on the ecosystem	Increase	2		
	Reduction of environmental pressures	Water pollution	Increase	2	2.5	
		Water extraction/use	Neutral	3		
	Improvement in the state of the environment	Forest/fallow land	Decline	2	2.5	
		Groundwater stock	Neutral	3		

	Indicators groups	Indicator	Value	Performance		Overall Ranking
Improvement of coastal area management	Contribution to the economy	Contribution to GDP	Increase	4	3.3	3.6
		Tax revenue (from water sectors)	Neutral	3		
		Water expenditure (e.g. infrastructure)	Increase	2		
		Extra budgetary water expenditure	Decline	4		
	Vulnerability to external changes	Severity of the impact of water related extreme events	Decline	4	4.0	
		Vulnerability to precipitation variability	Decline	4		
		Climate change impacts on the ecosystem	Decline	4		
	Reduction of environmental pressures	Water pollution	Decline	4	4.0	
		Water extraction/use	Decline	4		
	Improvement in the state of the environment	Forest/fallow land	Neutral	3	3.0	
		Groundwater stock	Neutral	3		

Sample quantitative assessment (case: urban wastewater treatment)

In a later phase, a quantitative assessment could accompany the qualitative one. This would be done to test expectations, as well as to provide more specific inputs to the stakeholder group (e.g. assessing costs and benefits of each intervention option). The following provides a simplified example on the use of the tool to carry out a quantitative assessment of the costs and benefits related to Water and Green Growth interventions, for the case of waste water treatment.

The adoption of a Green Growth approach to water resources management requires assigning a monetary value (to the extent possible and reasonable) to both the financial inflows and outflows directly linked to the implementation of a specific intervention, and the broader social, economic and environmental benefits resulting from the improvement of wellbeing (e.g. access to clean water, reduced illnesses from water pollution), and the preservation of natural capital (e.g. groundwater stock). In this respect, the example presented below makes use of "back of the envelope" calculations, based on available national and international studies. As such, it should only be interpreted as an illustrative example of the application of the tool to a quantitative assessment.

A multi criteria analysis is applied to an investment in urban wastewater management in the Mekong Delta region of Viet Nam. The reuse of water through wastewater treatment plants is among the options identified in Section 3.2 to reduce the impact of economic development on the availability and quality of water resources. In particular, investments under this option would be targeted to the purchase and installations of urban wastewater treatment plants for the treatment of effluent from houses and businesses, in order to prevent downstream river pollution, increase access to potable water, and increase water supply to key economic activities, such as agriculture and aquaculture.

More precisely, the W-GG intervention was assessed against the 11 impact indicators contained in the W-GG Assessment Tool. The results of the analysis are presented hereafter, and the scores of the assessment are presented in Table 15 and Figure 7.

- *Contribution to GDP.* According to a study conducted by the World Bank, economic losses deriving from poor wastewater management in Viet Nam amount to 1.3% of GDP (World Bank 2013). Assuming that the same figures can be applied to the Mekong Delta region, it is possible to conclude that investing wastewater treatment would increase regional GDP by 1.3% every year. However, the intervention proposed

only targets untreated urban wastewater, which amounts to about 500,000 m^3/day, corresponding to about 35% of total wastewater (VUFO-NGO n.d.). Consequently, the intervention is likely to produce an increase in annual GDP by about 0.45%.

- *Tax revenue (from water sectors).* Urban wastewater treatment would increase regional GDP by 0.45%. Since such increase would derive especially from improved performance of water related sectors, it is reasonable to assume that tax revenues from these sectors would increase at the same annual rate of 0.45%.

- *Water expenditure (e.g. infrastructure).* The World Bank estimates that US$ 8.3 billion would be needed to provide sewerage to a 35 million population in 2025 (World Bank 2013). Since urban population in the Mekong Delta region is about 4.3 million people, it can be deduced that the investment needed to provide wastewater treatment service to 4.3 million urban population of the Mekong Delta, total capital investment cost would be about 1 billion US$ (this is an oversimplification, but provides information on the possible magnitude of the investment required). Considering that the annual national government expenditure on water-related infrastructure is about US$ 1.1 billion (UN-Water 2012), the total capital investment in wastewater treatment plants would be less than 38% of annual water expenditure. On the other hand, overall running costs are calculated at about 0.11 US$ per m^3/day (COSTWater n.d.). Consequently, total annual running costs of treating 500,000 m^3/day of urban wastewater would be about US$20 million.

- *Extra budgetary water expenditure.* The additional amount of urban wastewater that would be treated annually after the investment would be about 182.5 million cubic meters, compared to a total regional water demand of about 13 billion cubic meters. Since treated wastewater would represent a very limited share of total water demand, the impact on extra budgetary water expenditure would be very small.

- *Severity of the impact of water related extreme events.* This specific intervention is not intended to reduce the severity of climate change impacts, such increased flooding, or droughts.

- *Vulnerability to precipitation variability.* To estimate the impact of wastewater treatment on reducing the vulnerability to precipitation variability, the annual amount of treated wastewater was compared with the annual average rainfall variability over the last 10 years (2003-2012). In particular, the average rainfall oscillation is 221 mm, corresponding

to 8,619 billion cubic meters over the Mekong Delta area (39,000 km^2). Since the annual amount of treated urban wastewater (182.5 million) would correspond to 0.002% of rainfall oscillation, the impact would be very limited.

- *Water pollution.* Urban wastewater treatment could potentially reduce water pollution by 35%. This calculation is based on the assumption that water pollution from urban wastewater, which accounts for about 35% of total wastewater production (VUFO-NGO n.d.), would be prevented from the installation of wastewater treatment plants.

- *Water extraction/use.* Considering that total water demand in the region amounts to about 13 billion cubic meters, the reuse of 182.5 million cubic meters from wastewater treatment would reduce regional water demand by 0.14%.

- *Forest/fallow land.* The increase of water supply to agriculture from wastewater treatment would increase the productivity of agricultural land, thereby reducing the need for creating new fertile land through deforestation. Since the demand of water for 1 hectare of agricultural land amounted to about 4,701 m^3/ha in 2012, and the total amount of waste water treated annually would be 182.5 million cubic meters, it can be deduced that about 38,821 ha of forest could be potentially preserved as a result of this intervention, corresponding to about 13% of total forest land in the region.

- *Groundwater stock.* Between 2011 and 2012, about 26,6 million cubic meters of water were extracted from groundwater reservoirs in the region. A share of annual 182.5 million cubic meters of treated wastewater could be used for irrigation in agriculture, thereby reducing groundwater extraction. Assuming that 10% of treated water could be reused for irrigation, groundwater extraction in the region could be reduced by about 68%. In absolute terms, this would correspond to 18 million cubic litres that would not be extracted every year, or 0.22% of groundwater stock.

While the qualitative analysis already provides information on the costs and benefits of each intervention, a more detailed assessment would increase confidence in the analysis while supporting the assessment of whether the interventions being considered allow to reach stated targets (e.g. for economic growth and/or groundwater quality). In fact, the indicator group “contribution to the economy” already highlights the impact on costs (budgetary and extra budgetary) as well the revenues of the public sector (contribution to GDP and tax revenue). These categories can be closely related to the costs and benefits of a project in the context of a CBA. Further, the more intangible impacts of policy implementation, such

as the reduction of the vulnerability to external changes, which cannot be easily monetized, as included in the second indicator group. This represents the impact that interventions can have on resilience, and hence can also be connected to a more conventional CBA. Finally, the remaining two indicator groups ("reduction of environmental pressures" and "improvement in the state of the environment") are those that typically do not feature in a CBA, mostly because these groups do not directly impact economic performance, especially in the short term. On the other hand, since these factors are very important to reach sustainable development, the indicators are included to fill a gap in the conventional CBA carried out at the project level.

On the basis of the results of the assessment, conducted collectively with stakeholders, decision-makers will be able to make informed decisions on what interventions better fit their specific needs, so that these can be prioritized in order to achieve the results that are best aligned with regional and national water management and sustainable development goals (SDGs).

Table 14. Detailed results of the quantitative assessment of the W-GG intervention option "Urban Wastewater Treatment".

	Indicators groups	Ranking Check	Ranking Groups	Indicator	Unit
Urban Wastewater Treatement	Contribution to the economy	100%	25%	Contribution to GDP	% change
			25%	Tax revenue (from water sectors)	% change
			25%	Water expenditure (e.g. infrastructure)	% change
			25%	Extra budgetary water expenditure	% change
	Vulnerability to external changes	100%	33%	Severity of the impact of water related extreme events	% change
			33%	Vulnerability of precipitation variability	% change
			33%	Climate change impacts on the ecosystem	% change
	Reduction of environmental pressures	100%	50%	Water pollution	% change
			50%	Water extraction/use	% change
	Improvement in the state of the environment	100%	0%	Forest/fallow land	% change
			100%	Groundwater stock	% change

Box 5. How to frame an extended Cost Benefit Analysis (CBA)

Developing a list of scenarios that may be worth analysing, for selected climate change impacts, demand, supply interventions and actions aimed at reducing the likelihood of extreme events, or enhance recovery after such occurrences.

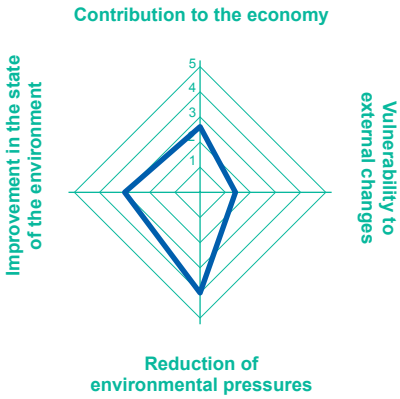
Framing the economic analysis using information on costs of intervention, potential avoided costs and added benefits, creating a clear link with green growth.

The approach will consist of an extended (or more comprehensive) Cost Benefit Analysis (CBA). A CBA is a systematic process for calculating and comparing benefits and costs of a given decision, and it is based on assigning a monetary value to all the activities performed (either as input or output). Different CBA techniques are commonly used to evaluate the feasibility and profitability of business strategies and projects, as well as (in some cases) public policy interventions. These techniques generally compare the total investment required for the implementation of the strategy/project against its potential returns. Among the most common CBA techniques utilized, it is worth mentioning the payback period, net present value, and rate of return.

- The **payback period** is the most basic of all cost-benefit analysis techniques. First, all costs associated with a specific strategy/project are quantified and aggregated. In particular, costs might include investment in fixed assets, labour and training costs, as well as the time lost for training or implementation. The total aggregated costs are then divided by the expected financial returns deriving from the implementation of the strategy/project. The result obtained corresponds to the indicative time needed for the investment to pay for itself.

Value	Performance					1	2	3	4	5	Overall Ranking
0.45	3					-10	-5	0	10	20	
0.45	3				2.5	-2	-1	0	1	2	
84.8	1					30	15	0	-15	-30	
0	3					30	15	0	-15	-30	
0	1					0	5	20	50	>50	
0.0002	2				1.3	0	5	20	50	>50	**2.7**
0	1					0	5	20	50	>50	
35.0	5				4.0	0	2	5	15	>15	
-0.14	3					2	1	0	-1	-2	
13.0	5				3.0	-2	-1	0	1	2	
0.22	3					-2	-1	0	1	2	

Urban wastewater treatment



- The **Net Present Value (NPV)** analysis follows the same procedure as the payback period technique for the calculation of total costs and benefits associated with strategy/project implementation. In addition, the cost of capital associated with outside funds needed to start the strategy/project is estimated. Based on the comparison between present and estimated future value of financial costs and benefits (including estimation of future inflation trends), the net present value of a given strategy/project is calculated. If the final result is a negative value, the project is generally not considered as worthwhile, and thus rejected.

- The **rate of return** technique is generally used to assess single or small investments. The formula consists of subtracting the total costs associated with the investment from the expected added benefits, and then to divide the obtained value by the investment's costs. The value obtained at the end of the analytical process is the percentage return on investment, which gives an idea of the profitability of the proposed strategy/project.

Policymakers may also use alternative techniques to assess the viability of investments, including, for example, **cost-effectiveness analysis (CEA)** and **multi-criteria analysis (MCA).** A CEA is a form of economic analysis that compares relative costs and outcomes (effects) of two or more courses of action. It is broader than a CBA and includes the analysis of non-monetary impacts, evaluated qualitatively, or ranked, for instance, on a scale from 1 to 5. An MCA is a decision-making process that allows the assessment of different options against a variety of criteria, including quantitative and qualitative indicators. In contrast to CBAs and CEAs, MCAs can be conducted in cases where multiple objectives and criteria exist.

4. Conclusions

The National Green Growth Strategy of Viet Nam, acknowledging the current challenges facing water resource management, states that economic growth is increasingly fuelled by the use of natural resources, leading to environmental losses that have impacted 70% of the population relying mainly on natural resources for their livelihood; the increase of population, fast urbanization and infrastructure building, and the enlargement of agriculture have deteriorated ecosystems and caused biodiversity loss; and urban and industrial pollution have negatively impacted adjacent water sources and contributed to the spreading of health diseases.

This is particularly true for the Mekong Delta, a region characterized by strong economic growth and home of a flourishing (and fundamental) primary sector. Here agriculture and fisheries have grown in symbiosis with water availability and water quality, now being challenged by urbanization (including growing pollution and competing demand for alternative uses) as well as climate change.

In consideration of these issues, a conceptual framework and methodology were developed to determine the most appropriate steps and effectively inform decision making for the integration of green growth principles in the planning process, within the context of water resource management in the Mekong Delta.

The framework includes three main categories: (1) water contributes to socioeconomic development; (2) water can curb the economy and negatively affect well-being; (3) sustainable water resources management enables green growth.

The methodology uses a four-step approach consists of the following four activities: (a) stocktaking; (b) development of the ranking methodology; (c) assessment; and (d) analysis.

A total of 20 green growth policy options for the Mekong Delta were identified considering the experience accumulated on the management of water resources in the Mekong Delta. These opportunities underline the importance and necessity of integrating the green growth approach into the management of water resources. The opportunities are grouped into three categories, according to their main expected contribution: (i) mitigation of the impacts of socioeconomic development on the water sector, (ii) removal of the constraints that the water sector imposes on socioeconomic development, and (iii) improvement of water governance.

The Water and Green Growth (W-GG) Assessment Tool was created to support the assessment of the opportunities identified, and was customized to the unique context of the Mekong Delta with VNMC being an instrumental partner to make this process relevant and useful. Specifically, the tool allows to assess intervention options against the following outcomes: (i) contribution to the economy; (ii) reduced vulnerability to external changes (e.g. climate change impacts); (iii) reduced environmental pressures; and (iv) improvement in the state of the environment.

The work carried out during this project has shown considerable potential in supporting the identification and selection of intervention options that would support green growth. This would be achieved by the incorporation of water in the development plans of the Mekong Delta, to highlight its several roles in supporting the sustainable socioeconomic development of the region. In particular, the opportunities identified and the analytical tool developed by GGGI represents a first step in the operationalization of the process, which could be extended for an extended version of CBA in collaboration with VNMC and other ministries. Finally, the same participatory and multi-stakeholder process could be replicated at the basin level, reaching beyond the Mekong Delta to support upstream planning and create synergies with downstream sustainability. Such process will be impossible unless is supported by a clear set of vision based on common understanding of water and green growth, and a master plan that can foster green growth implementation in the region.

In relation to the above, the main activities which will need to be carried out to build on the outcomes of this project should include:

1. The development of a framework and methodology to:

    a. Assess selected policy interventions and investments; (see Annex I)

    b. Select the most appropriate policy(ies) for implementation;

2. The provision of effective support for green growth planning, with a framework customized to the unique context of the Mekong Delta, while encouraging to set up water and green growth vision and master plan or action plan for the Mekong Delta.

3. The assessment of the potential to effectively replicate the process for the Mekong basin, with required customizations relating to the diversity of the socioeconomic and environmental context of the other countries involved.

4. Capacity building of key stakeholders, especially for decision makers at public and private sectors on a) green growth, b) water and green growth, c) water for green growth in the Mekong Delta, d) methodologies for the identification of green growth opportunities in the Delta, and e) global best practices.

Abbreviations

BOD5	5-day Biochemical Oxygen Demand Test
CBA	Cost-Benefit Analysis
CEA	Cost-Effectiveness Analysis
DARD	Provincial Department of Agriculture and Rural Development
DMC	Disaster Management Centre
DONRE	Provincial Department of Natural Resources and Environment
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GGAP	Green Growth Action Plan
GGBP	Green Growth Best Practice
GGGI	Global Green Growth Institute
GGKP	Green Growth Knowledge Platform
IWRM	Integrated Water Resources Management
LWR	Law on Water Resources
MARD	Ministry of Agriculture and Rural Development
MCA	Multi-Criteria Analysis
MIT	Ministry of Industry and Trade
MOC	Ministry of Construction
MOF	Ministry of Finance
MOH	Ministry of Health
MONRE	Ministry of Natural Resources and Environment

MOST	Ministry of Science and Technology
MOT	Ministry of Transport
MPI	Ministry of Planning and Investment
MRC	Mekong River Commission
NCHMF	National Centre for Hydro-meteorological Forecasting
NPV	Net Present Value
NWRC	Natural Water Resources Council
OECD	Organisation for Economic Co-operation and Development
PCERWASS	Provincial Centre for Rural Water Supply and Sanitation
RBPMB	Management Boards for River Basin Planning
SDC	Swiss Agency for Development and Cooperation
SIWRP	Southern Institute for Water Resources Planning
VND	Vietnamese Dong
VNMC	Viet Nam National Mekong Committee
W-GG	Water and Green Growth

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Annex I: Sample opportunity assessment

Water Sample Project / Opportunity Sheet: Urban wastewater treatment

Project description

Investments in urban wastewater treatment plants for the treatment of effluent from house and businesses before water discharge into the river. It is expected to reduce water pollution, thereby increasing access to potable water, and bringing higher revenues from water related economic activities, such as agriculture and aquaculture, in the Mekong Delta.

Rationale for proposing this opportunity

- ☑ Contribution to the economy
- ☑ Reduction in the vulnerability to external changes
- ☑ Reduction in environmental pressures
- ☑ Improvement of the state of the environment

Logical Framework

Goals

i. Improved access to freshwater.
ii. Higher returns from agriculture and aquaculture.
iii. Reduced water borne diseases.

Objectives

i. Treatment of wastewater in all main urban settings in the Mekong Delta region.

Inputs

i. Upfront investment for the purchase of wastewater treatment plans.
ii. Capacity building for the use and maintenance of the plants.

Outputs

i. Wastewater is treated in all main urban settings.
ii. Water borne diseases are reduced.
iii. Water quality is improved.

Estimated costs

VND 6,300 billion to be invested for the purchase of the plants and capacity building

Funding sources

- Allocation of national budget
- Possible creation of public-private partnership
- International donors

Beneficiaries

- Households (access to water; income)
- Private sector (agriculture; aquaculture)
- Government (revenues from productive sectors; reduced public health expenditure)

Proposed timeframe

5 Years

Executive bodies

Ministry of Planning and Investment

Cost-benefit analysis

i. Investment in treatment plants (VND / year)
ii. Improved access to water (%);
iii. Reduced public health costs (VND / year);
iv. Improved agriculture production (ton / year);
v. Increase in aquaculture GDP (% / year);

Risks

- Lack of funding.
- Lack of maintenance of treatment plants.

International experience

- The Thai government has invested in sewerage and treatment systems about 83,000 million Baht to construct 101 community wastewater treatment plants throughout the country.
- In Cambodia, wastewater has to be treated on site before the discharge. Violators incur severe penalties according to the law.

Experts required

Profile

Local expertise in the installation and maintenance of wastewater treatment plants.

Key tasks

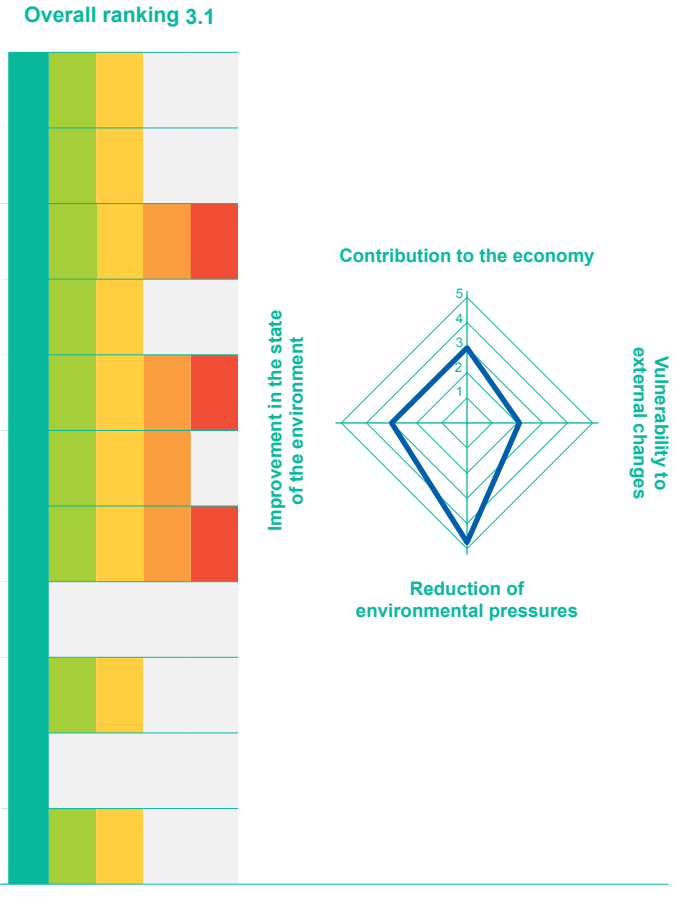
- Identify urban settings for the installation of wastewater treatment plants.
- Identify the most cost-effective technology.

Water Sample Project / Opportunity Sheet: Urban wastewater treatment						
Qualitative assessment of the intervention						
Effectiveness	**Cost**	**Technical feasibility**	**Social / Cultural Feasibility**	**Inclusiveness**	**Required Time**	**Impact**
High	Medium	High	High	High	Medium	High

Notes:
The qualitative assessment is based on the review of case studies and best practices from similar country contexts, such as the case of Thailand.

Quantitative assessment of the intervention

Indicators Groups	Indicator
Contribution to the economy	Contribution to GDP
	Tax revenue (from water sectors)
	Water expenditure (e.g. infrastructure)
	Extra budgetary water expenditure
Vulnerability to external changes	Severity of the impact of water related extreme events
	Vulnerability of precipitation variability
	Climate change impacts on the ecosystem
Reduction of environmental pressures	Water pollution
	Water extraction/use
Improvement in the state of the environment	Forest/fallow land
	Groundwater stock



Notes:
Investments in urban wastewater treatment plants are expected to produce economic, social and environmental benefits in the Mekong Delta region. In particular, improved access to freshwater resources would increase the well-being of the population. Moreover, this project is expected to improve the economic performance of key productive sectors, such as agriculture and fisheries, which are highly dependent on water quality. Overall, the project would contribute to the preservation of key ecosystems.
The establishment of public-private partnership is strongly recommended for sharing upfront investment costs.

Annex II: Documentation of the analytical tool

Introduction

The Water and Green Growth (W-GG) Assessment Tool is an MS Excel-based tool that supports the assessment of alternative W-GG interventions for sustainable water resources management in the Mekong Delta region of Viet Nam. Each intervention option is assessed against the following expected outcomes: (1) Contribution to the economy; (2) Reduced vulnerability to external changes (e.g. climate change impacts); (3) Reduced environmental pressures; and (4) Improvement in the state of the environment. The tool uses 11 key impact indicators to assess each W-GG intervention option. In turn, the impact indicators are derived from a set of indicators on water resources stocks and flows, as well as on the contribution of water to the economy, environment and society of the Mekong Delta region. As such, the tool provides a comprehensive and integrated assessment of the performance of W-GG interventions, also in relation to the specific socioeconomic context, and especially focusing on sustainability and inclusiveness criteria.

Overall Objectives

The W-GG Assessment Tool aims to:

- Provide policy support with a flexible, objective and structured approach, that is also replicable in other regions, or countries;
- Expand conventional analysis of water management policies by including an integrated assessment of social, economic and environmental dimensions.
- Highlight strengths and weaknesses of each W-GG intervention option to prioritize those that provide synergies and the highest overall effectiveness.

Step-by-Step User Guide

STEP 1: Assign weights to indicators

As a first step, users should assign weights to indicators using the light-green coloured “Ranking Groups” column. The weight indicates the relevance of each indicator within its indicators group: the higher the weight, the greater the importance of the indicator in determining the assessment score of the indicators group. For each indicators group, the sum of weights of all indicators must be 100%. If the sum is different from 100%, the corresponding cell in the “Ranking Check” column will turn from grey to yellow.

STEP 2: Assign ranking intervals to indicators

After having defined indicators weights, users can modify the ranking intervals of each indicator (also according to the unit of measure of the indicators utilized). Ranking intervals are the ranges of indicators values that are used to assign a final score to each indicator, on a scale from 1 (worst performance) to 5 (best performance). In the sample version of the tool, default rankings are assigned to each indicator.

STEP 3: Assign values to indicators and evaluate the performance

After having assigned weights and rankings intervals, the value of each indicator can be entered in the respective light-green coloured cell in the “Value” column. Indicator values can be expressed in absolute value, percentage change or qualitatively, and indicate the expected change in the indicator as a result of implementation of a specific W-GG intervention option being assessed.

After an indicator is assigned a specific value, a performance score is automatically associated to that indicator, on the basis of the ranking interval previously set (see Step 2). The performance score is displayed as a numeric value from 1 (worst) to 5 (best), and as a colour responding to the following coding: Red = 1; Light red = 2; Yellow = 3; Light green = 4; Green = 5.

Once the values of indicators are entered, the tool automatically calculates the weighted score of each indicators group. The scores of the indicator groups are calculated as a weighted average of the performances of the indicators composing each group. The weight of each indicator corresponds to the percentage value assigned at the beginning of the process (see Step 1).

In addition to the performance of single indicators and indicators groups, users can evaluate the overall performance of W-GG intervention options. An overall ranking score is assigned to each intervention option, calculated as the average of the scores of the four indicators groups. Moreover, the overall assessment is presented on a radar chart, which displays the performance scores of the four indicators groups.

Overview of the W-GG Assessment Tool

The W-GG Assessment Tool is composed of different elements, which are illustrated in Table 11 and described hereafter:

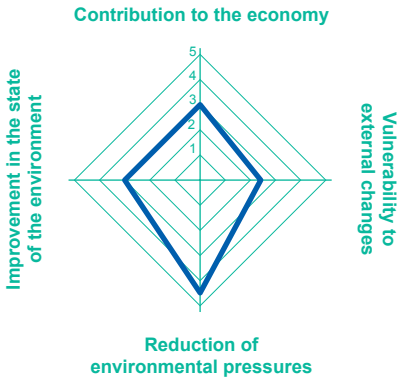
1	2	3	4	5	6
	Indicators groups	Ranking Check	Ranking Groups	Indicator	Unit
Option 1	Contribution to the economy	100%	25%	Contribution to GDP	% change
			25%	Tax revenue (from water sectors)	% change
			25%	Water expenditure (e.g. infrastructure)	% change
			25%	Extra budgetary water expenditure	% change
	Vulnerability to external changes	100%	33%	Severity of the impact of water related extreme events	% change
			33%	Vulnerability of precipitation variability	% change
			33%	Climate change impacts on the ecosystem	% change
	Reduction of environmentalpressures	100%	50%	Water pollution	% change
			50%	Water extraction/use	% change
	Improvement in the state of the environment	100%	50%	Forest/fallow land	% change
			50%	Groundwater stock	% change

1. **Name of the W-GG intervention option:** the name of the specific W-GG intervention option needs to be written in this cell.
2. **Indicators Groups:** four indicators groups are assessed for each intervention option, namely “Contribution to the economy”, “Vulnerability to external changes”, “Reduction of environmental pressures”, and “Improvement in the state of the environment”.
3. **Ranking Check:** the user can check whether the sum of the weights assigned to the indicators composing the indicators group is equal to 100%; in case the sum is different from 100%, the cell’s colour turns from grey to yellow.
4. **Ranking Groups:** in this column, users need to assign a weight to each indicator, doing so that the sum of weights of indicators composing an indicator group is 100%; the higher the weight, the greater the importance of the indicator in determining the assessment score of the indicators group.
5. **Indicators:** 11 indicators are evaluated to assess the expected impacts of each W-GG intervention; indicators are aggregated into four indicators groups.
6. **Unit:** the unit of measure for each indicator is specified in this column.

7 Value	8 Perfor-mance	9	10	11 1	2	3	4	5	12 Overall Ranking
-8.00	2			-10	-5	0	10	20	
1.30	4		2.5	-2	-1	0	1	2	
15.00	2			30	15	0	-15	-30	
15.00	2			30	15	0	-15	-30	
2.00	2			0	5	20	50	>50	
30.00	4		2.3	0	5	20	50	>50	3.1
0.00	1			0	5	20	50	>50	
15.00	4			0	2	5	15	>15	
-3.00	5		4.5	2	1	0	-1	-2	
0.50	3			-2	-1	0	1	2	
0.30	3		3.0	-2	-1	0	1	2	

13

Option 1 Assessment



7. **Indicator value:** in this column, users should assign a value to each indicator, expressed in the unit indicated under the “Unit” column.

8. **Indicator performance:** based on the value assigned by the user, a score is automatically assigned to each indicator on a 1 (worst)-to-5 (best) scale.

9. **Colour code of indicator performance:** based on performance scores, a colour code is automatically assigned to each indicator, ranging between red (worst) and green (best).

10. **Performance scores of indicator groups:** it is calculated as the weighted average of indicators performance scores.

11. **Ranking intervals:** users can change the ranking intervals to assign ranges of values to each performance score.

12. **Overall ranking score:** it corresponds to the overall performance score the W-GG option assessed.

13. **Radar chart:** it displays the performance of the W-GG option against the four indicator groups.

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