Basic trends and strategic viewpoints for sustainable development in adaptation to climate change in the Mekong delta

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Abstract:

The Mekong delta is the southernmost region of Vietnam, with a population of approximately 20 million and a total area (excluding islands) of about 4 million hectares, of which about 2.60 million hectares are used for developing agriculture and aquaculture. The Mekong delta is particularly important for the overall development of the country. However, in recent years, under the impact of global warming, the Intergovernmental Panel on Climate Change has defined the Mekong delta as one of the three most vulnerable plains, due to climate change, sea level rise, and land subsidence. Especially, the impact of water resources exploitation of upper Mekong countries has been posing great challenges to the sustainable development of the region. Recognizing the nature and development trend of the Mekong delta, new threats and challenges that help to form scientific bases for development models and solutions for the region is very important. This article presents assessments on the challenges and strategic viewpoints in regard to sustainable development and adaptation to climate change of the Mekong delta.

Keywords: *climate change, sustainable development, water resources, water resources security.*

Classification number: *6.2*

Introduction

Located in the southern-most part of the country, right next to Ho Chi Minh city (the second centre of political and lead economic development of the country), Mekong delta has a population of nearly 20 million (approximately one quarter of the country population); its agricultural production accounts for over 50% of the country's total production while food export and fruit and fishery export amount to over 90% and 70% of the country respectively. The development of the Mekong delta in the last decades (where agriculture is the mainstream occupation) is a miracle that has been recognized by international communities. This is also a brave base-region, its resilience marked by the nation's historic victory on April 30th. It can be said that the Mekong delta has confirmed its extremely important position in all aspects of economy, politics, society and national security and has received the trust of all the people of the country.

The Mekong delta has experienced the adverse impact of intense human and natural activities. It is a new delta with diverse ecosystems and fertile soils. However, much of the soil suffers from saline contamination and is heavily affected by aluminum. In addition, this area has been influenced adversely by climate change and the over-exploitation of water resources by upstream countries.

However, no long-term investment strategy has been proposed for the Mekong delta, in its development planning; there has been no regional planning, with consideration of technical, economic, social and ecological factors. Meanwhile, we have planned for short-term periods or individual sectors. We have not yet evaluated the full of challenges and opportunities of the region, nor created a breakthrough and positive change. Therefore, it is urgent to have a sustainable development strategy for the delta, which

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will not only substantially contribute to the development of Vietnam, but also receive the special attention of international community.

Basic trends and viewpoints of challenges in the Mekong delta

In recent years, the Mekong delta has been adversely affected by climate change and the over-exploitation of water resources by the upstream countries. This has considerably impacted the local people, as also development and production activities in the region. This poses great challenges to the sustainable development of not only the Mekong delta, but the country as a whole.

A large number of studies have been carried out on the Mekong delta by researchers and scientific institutes, for identifying an optimal solution to the delta's problems and challenges. However, there is still not the same point of view between the solutions.

Scientists and research organizations from both Vietnam and foreign contries have put forth quite a few ideas and viewpoints on the trends and impacts of these issues on the life and development of the Mekong delta. Research results and viewpoints are very positive, with the desire to help detect the true nature of the impact, in order to find the optimal solution for the region. However, there are still some issues on which there has been no consensus, in terms of assessment viewpoints. So it requires a comprehensive understanding of the mechanism of existing issues and challenges in the region.

Land subsidence in the Mekong delta

Mekong delta was formed about 8,000 years from alluvial deposition. Morphological evolution of the Mekong delta includes two primary processes, viz., alluvial deposition (during flood seasons) and natural subsidence (a continuous slow process lasting centuries) [1]. Currently, a decrease in fluvial sediment supply and widespread over-exploitation of the groundwater and sand have resulted in enhancing subsidence through aquifer compaction (Fig. 1). It is important to note that people are not aware of the land subsidence, as the process is normally slow and hidden from morphological changes, due to deposition or erosion.

In fact, as many major river deltas in the world such as Mississippi (USA), Colorado (USA), Yellow river (China)… [3], due to the combined effect of natural subsidence, global sea-level rise and reduced alluvial deposition, the Mekong delta has become vulnerable to inundation. Recently, in the Mississippi river delta, where tens of hydropower dams have been constructed along the 3,734 km of Mississippi river bank, through 10 states. From 1932 to 2010, in the coastal areas of Louisiana and Mississippi, river deltas have been flooded, with a total affected area of 5,000 km^2 (Fig. 2), which is equivalent to half the area of the southern Ca Mau peninsula.

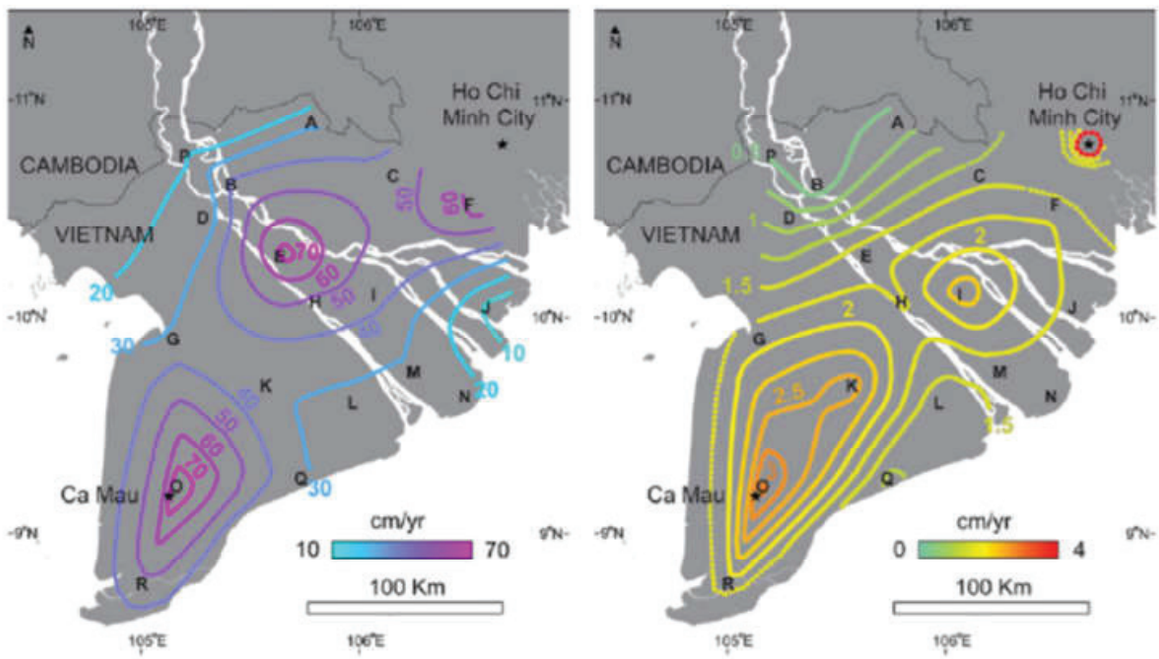

Fig. 1. The rate of lowering of the groundwater table (left) and surface subsidence of the Mekong delta (right) [2].

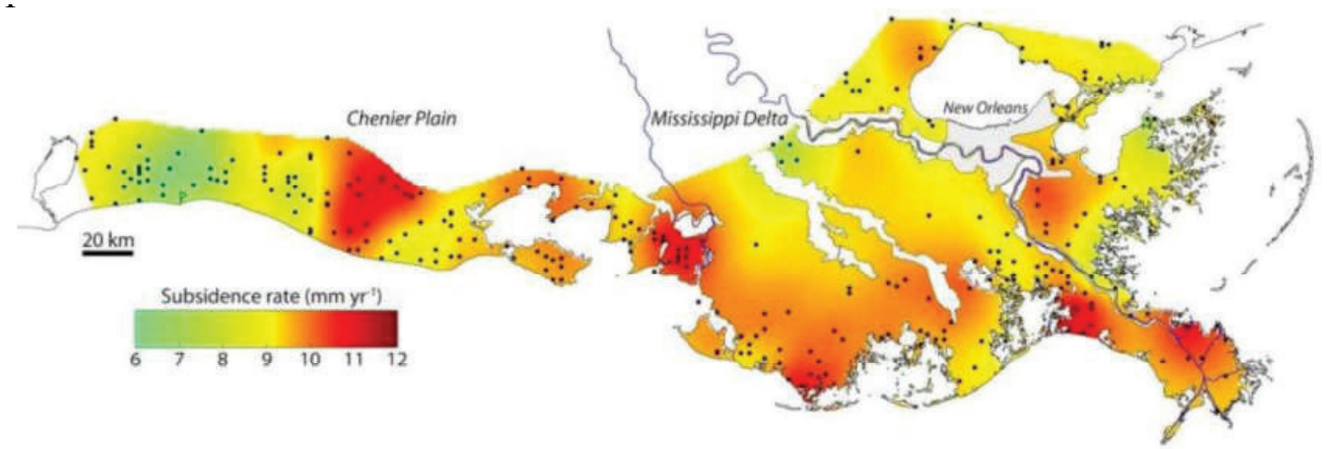

Fig. 2. Natural subsidence in coastal areas in Louisiana and Mississippi river deltas (black dots are observation locations) [4].

From the realities facing us in the major deltas of the world with conditions similar to those of the Mekong delta, it has been found that natural land subsidence in the deltas is a clear and irreversible trend. Groundwater over-exploitation is one of the primary factors responsible for the increasing subsidence in the Mekong river delta. Therefore, it is necessary to have properly observation, management, and analysis. In other words, a comprehensive survey should be conducted for formulating proper solutions.

River and coastal erosion

Beside the natural changes, overexploitation and operations from human activities in the upstream countries and the Mekong delta have resulted in raising the challenges to the Mekong delta. Climate change will have considerable impact on the delta such as flow regime changes, sea-

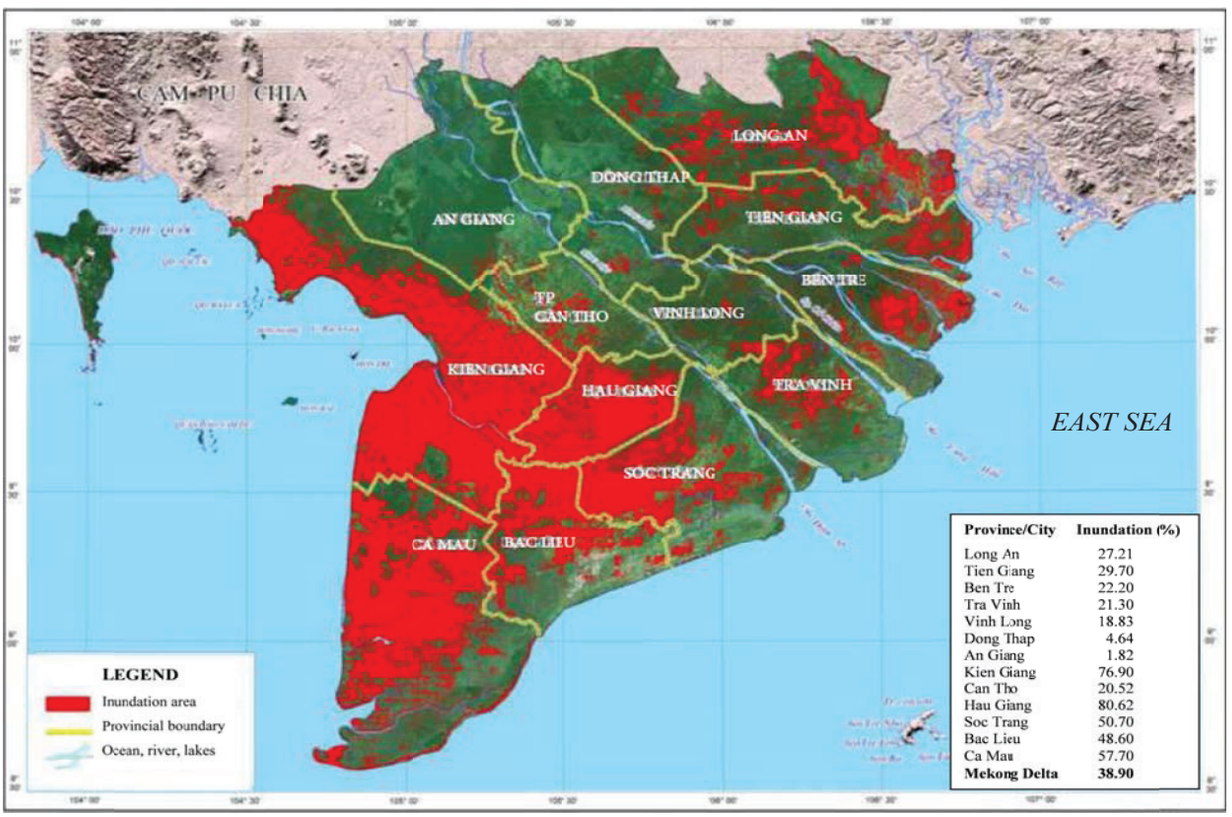

Fig. 3. Inundation map of the Mekong delta projected according to climate change scenario and sea level rise [5].

level rise which causes increased inundation hazard (Fig. 3) and severe erosion in coastal areas [5]. In addition, the operation and over-exploitation of water resources in the reservoirs have resulted in changing of bankfull discharge and decreasing of alluvial deposition, which causes increased erosion in rivers, channels, and coastal areas. Thus, downstream rivers and coastal deposition locations are generally unstable, as per inherent nature.

The recovery of eroded coastal areas due to natural cycles is infeasible; maintaining the sustainability and reduction of eroded locations appears unrealistic, as the capability for controlling these locations has been eroded. The trend of river and coastal erosion is increasing and is unavoidable, in view of the natural condition and exploitation of water, both by domestic sources and by other upstream countries of the Mekong delta. For example, the volume of sand exploitated is in exceess of the fluvial sediment supply. Therefore, using non-structural or structural strategies to restore the eroded bank to its original condition is infeasible. In the Red River delta, the river bed has been declining gradually after hydroelectric power dams were built upstream. For example, in Hai Hau beach - Nam Dinh province, one of the famous Churches has collapsed due to beach erosion. These phenomena are also found in coastal areas of large-scale river basins around the world. America has recently been studying solutions for partial sediment restoration in the coastal areas of Louisiana and Mississippi river deltas (Fig. 4).

Therefore, in order to protect the land, we need to find solutions and accept the lowering of the river bed and elevation of coastal plains. It is easy to recognize that the Mekong delta is unified and has inter-connected canal systems, due to which any changes in a local area will affect the whole system. Any solutions proposed to protect the river and coastal banks should be considered carefully, to avoid other unwanted effects.

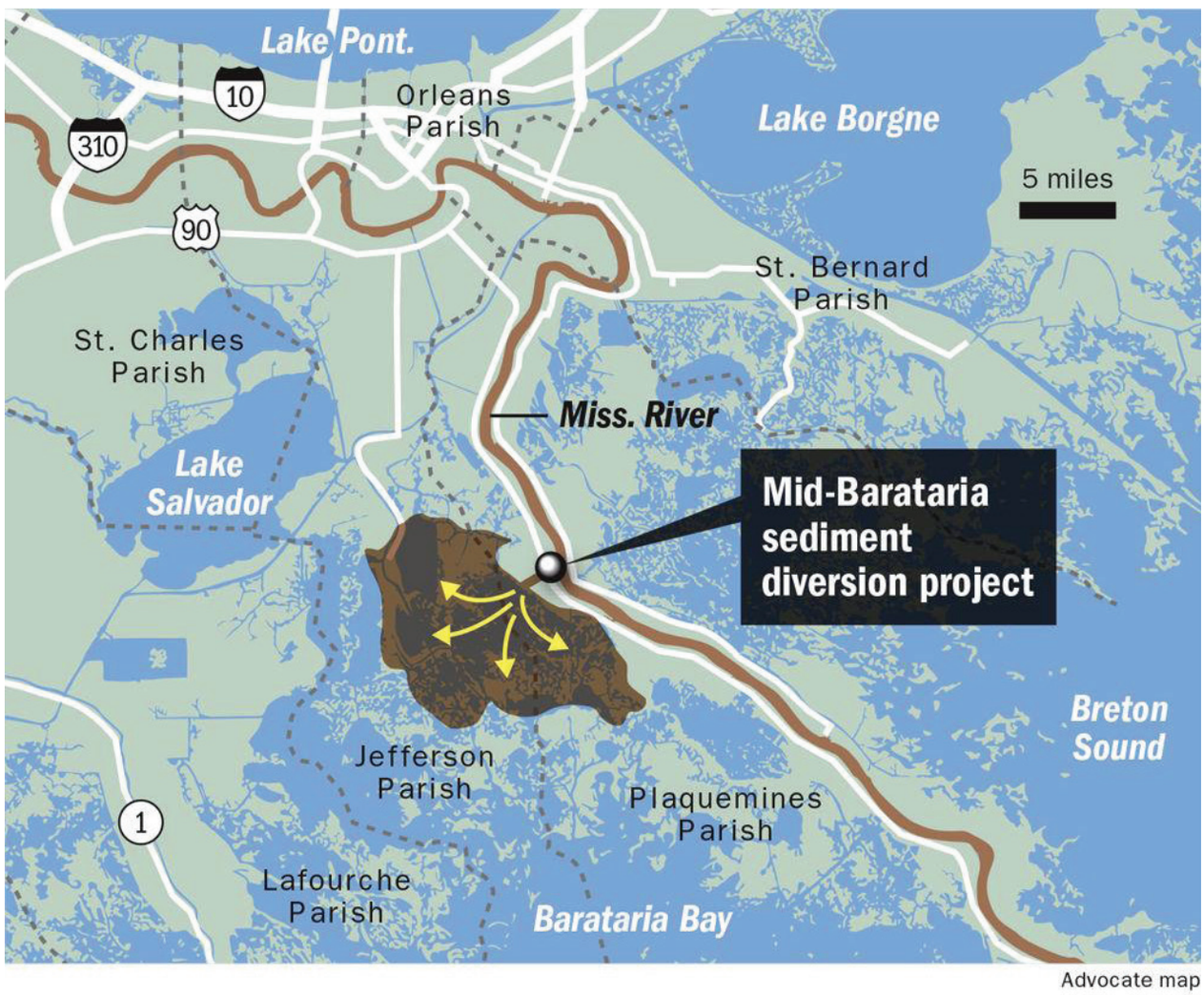

Fig. 4. Pilot project to transfer sediment from the river to plains [6].

Degradation of water resources

Till the time of this report, the total volume of the flows to the Mekong delta have not decreased significantly. The reduction of the total flow volume will become severe, when all the proposed upstream works have been completed. In particular, if the regulation works on the Tonle Sap river for flood protection and rising water level in the Tonle Sap purposes, as well as oil and gas exploitation, and projects of Thailand, Laos, Cambodia to lift water from the Mekong river for agricultural development (covering an estimated total area of more than 1.8 hectares) are implemented, it will lead to extreme conditions of flood and drought flows [7].

The impacts from exploitation of water resources projects upstream are not only reducing the quantity of water, but also its quality, causing reduction of organic elements in water. Further, the pollutant water from pesticides, posing a grave threat to biodiversity, yield, and quality of fisheries, will be a great challenge for the Mekong delta. Along with that, the pollution from waste water and sewage from aquaculture are getting worse. Although the coastal zone in the Mekong delta is conducive for aquaculture and biodiversity, production is unstable due to the frequent occurrence of epidemics. These effects are more severe than the lack of water.

Viewpoint on renovation and sustainable development in the Mekong delta

In the context of international integration, local and regional levels across the country having strategic development based on the strength of each region, there is essential to recognise advantages and minimise shortcomings in order to maximise the available resources. By analyzing and identifying the challenges for the Mekong delta as described above, sustainable development of the delta must be harmonised with three core elements: "*Land - Water - People*". The development history of Vietnam is always associated with "*Water*". Especially the Mekong delta, the development of the region over the past 300 years was always associated with the way which people behaved, vis-a-vis the relationship between "*Land*" and "*Water*". With relatively flat terrain characteristics, an inter-connected canal system and similarity in culture pervading the whole region, it can be said that the Mekong delta is a unified form and has a great interaction with each other. Therefore, Mekong delta needs to have regional linkages, highly systematic activities that bring more efficiency in economic development as well as in adaptation to climate change and other factors.

Placing the Mekong delta in the context of water degradation in terms of quantity, quality, and suspended particles, and increasing environmental pollution, it is very likely that development orientation for the Mekong delta will have to "*Concentrate on the large-scale agricultural production of high quality and productivity; combining services, ecotourism and appropriate industry*". It is time to change the "*traditional food security*" strategy of the recent decades into "*high-quality food security*", by promoting high-value and export-oriented products and looking into large-scale and professional production models.

Conclusions

It can be concluded that a key issue for strategic orientation transformation of the Mekong Delta is the drastic restructuring of its agricultural sector, including: (i) Reorganizing and redistributing land use and farming practices in respect of the decreasing rice cultivation and the number of crops; (ii) Increasing the area of aquaculture; (iii) Increasing the area of fruit trees; (iv) Promoting and using land for ecotourism; (v) Increasing the area of mangroves; and (vi) Re-planning the whole system of irrigation works with respect to ecological areas: fresh water, salt water, and brackish water.

All these strategies will not only enhance local standards of living, but also ensure harmony and conformity with the laws of nature. In other words, "*challenges*" can be turned into "*opportunities*" for development.

REFERENCES

[1] Ta Thi Kim Oanh, Nguyen Van Lap, M. Tateishi, I. Kobayashi, Y. Saito (2005), *Sediment facies changes and delta evolution during Holocene in the Mekong river delta, Vietnam*, in: Mega-deltas of Asia, China Ocean Press.

[2] Laura E. Erban, Steven M. Gorelick, Howard A. Zebker (2014), "Groundwater extraction, land subsidence, and sea-level rise in the Mekong delta, Vietnam", *Environ. Res. Lett.*, **9(8)**, doi:10.1088/1748-9326/9/8/084010.

[3] B.R. Couvillion, J.A. Barras, G.D. Steyer, W. Sleavin, M. Fischer, H. Beck, N. Trahan, B. Griffin, D. Heckman (2011), *Land area change in coastal Louisiana from 1932 to 2010*, USGS - Scientific Investigations Map 3164, scale 1:265,000, 12pp.

[4] Jaap H. Nienhuis, Torbjörn E. Törnqvist, Krista L. Jankowski, Anjali M. Fernandes, Molly E. Keogh (2017), "A new subsidence map for coastal Louisiana", *GSA Today*, **27**, pp.58-59, doi: 10.1130/GSATG337GW.1.

[5] Ministry of Natural Resources and Environment (2016), *Climate change, sea level rise scenarios for Viet Nam*, 170pp.

[6] Louisiana's 2012 Coastal Master Plan.

[7] To Quang Toan (2016), *A study on the impacts of cascaded hydropower dams on the Mekong mainstream to flow, environment, socio-economic situation of the Mekong delta and propose of mitigation measures*, State level research report (KC08.13/11-15).