Special Issue on Mekong Economy, the Social Science Review, Saitama University, Japan, March 2019.

《Chapter 4》 Sustainable Development

On the verge of the Mekong River Environment

Takashi Asaeda[1]

Received: 1 September 2018 / Accepted: 20 October 2018

Abstract This paper aims to argue the extreme fragility of the ecosystem in the Lower Mekong Basin in the process of economic development in the Mekong region. The Lower Mekong Basin has been proud of its richness in nature and high biodiversity. The Basin's ecosystem has, however, been endangered by the recent development factors such as the dam construction. The dam construction gives negative impacts on the river basin's fish biodiversity. The dam also traps and curtails almost of all sediment flow to the downstream. The reduced sediment transport would result in the shrinkage of the delta area in Vietnam most seriously, where the channel bet would be eroded and much saltwater would be introduced into the river channel. In a couple of decades later, the modification just for the economic growth may change the river as an artificial unproductive channel.

Keywords Mekong River Environment, Ecosystem, Fish biodiversity, Dam construction, Sediment flow.

JEL Classification Q57, O53

1 Graduate School of Science and Engineering, Saitama University
E-mail: asaeda@mail.saitama-u.ac.jp

1 Introduction

The Mekong is the tenth-largest river by volume in the world. Basin of the Mekong River drains a total land area of 795,000 km^2 from the eastern watershed of the Tibetan plateau to the Mekong Delta. The Mekong River flows approximately 4,909 km through China, Myanmar, Laos, Thailand, Cambodia, and Viet Nam before flowing into the South China Sea.

The climate of the Mekong River basin ranges from temperate to tropical environments. In the Upper Mekong Basin, some of the taller peaks of the Tibetan plateau are glaciated, and most of the basin is snow-covered in winter. Melting snow from the Tibetan Plateau, therefore, feeds the Mekong River's dry-season flow, especially in the middle reaches. In the Yunnan province in China, the climate gradually changes towards the Lower Mekong Basin and the temperature rises.

In the Lower Mekong Basin, June to October is the wet season due to the moisture-laden wind from the Indian Ocean, while except for two brief transition periods, the rest of the year is basically dry covered with high-pressure systems over the Asian continent.

The distribution of the mean annual rainfall has a distinct gradient from east to west in the basin; the precipitation of the uplands in the Laos and Cambodia is approximately 3,000mm/yr, while in the semi-arid Khorat Plateau of northeast Thailand, it is about 1,000 to 1,600 mm/yr. The rainfall is regulated by the monsoon system also in the Upper Mekong Basin, though the precipitation is much less. In Tibetan Plateau, the annual rainfall is approximately 600 mm, while it is 1,700 mm in the mountains of Yunnan.

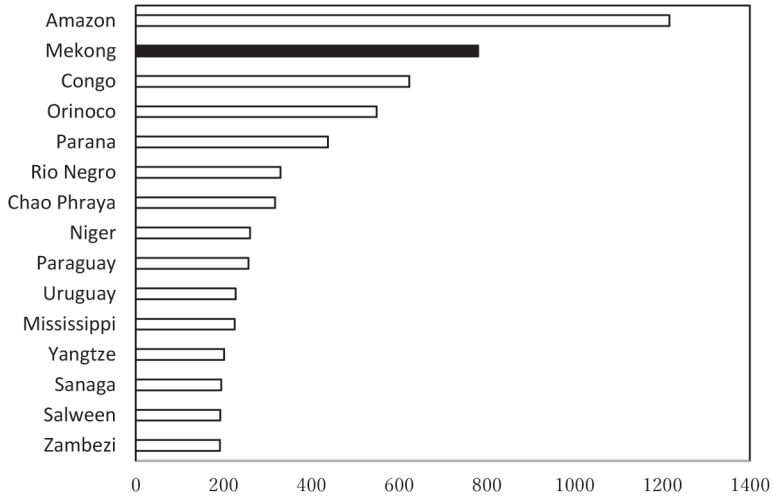
Associated with this seasonal fluctuation of rainfall, the flow of the Mekong changes from approximately 24,000m^3/s in August to September to about 1800m3/s from February to April, at Pakse in Cambodia. Though the contribution of flow from the upstream is only one-fifth of the total annual flow of the Lower Mekong Basin, snow-melt flow from Tibetan Plateau contributes to 24% of the total flow during the dry season. The seasonal fluctuation of the flow is an important feature of the Mekong River.

The Mekong River is characterized by high riverine productivity. The river basin's fish biodiversity is extremely large, compared with other large rivers in the world (Figure 1). The viability of 60 million people in the Lower Mekong Basin is supported by this high productivity. The life-cycles of many Mekong fish species are, however, closely related to the large difference of the inundated area between the two seasons. Fish migrate to deep pools in the mainstream to seek refuge during the dry season, later, during the flood season, they migrate back to spawning and nutrient-rich feeding grounds on floodplains. A large amount of organic matters settles on the riparian ground surface during inundation in the wet season. It fertilizes the soil of the area, supporting the agriculture in the Lower Mekong Basin. (Li and Bush 2015).

Though it is widely known and is stressed that the disappearance of the seasonal water level fluctuation affects the riverine environment, the elimination of sediment load is another important issue along the Mekong River (Shrestha et al. 2016). Sediment flow is inseparably bound up with water flow in

the river system and has an important role in maintaining the environment.

Fig.1 The number of fish species of the major rivers in the world (Fish Base, 2009)

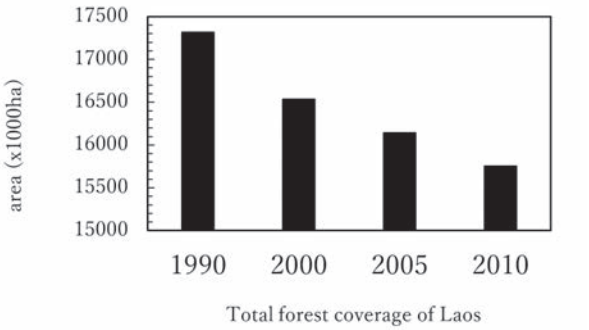


Number of freshwater fish species of the major rivers in the world

There are three types of sediment transport, depending on the sediment size and water flow; bed load suspended load, and wash load. Because of the mild channel slope of the Lower Mekong Basin, sediments are fine, and the majority is wash load except for some particular reaches like the Khon Falls in Cambodia. Sediment yield normally increases by the deforestation of the basin. Forest coverage decreased along the basin, for instance, in Laos (Figure 2). In the Lower Mekong Basin, however, sediment transport loads have been extremely reduced.

Dam traps and curtails almost of all sediment flow to the downstream. Before construction of the first dam of the Mekong River, Manwan dam which completed in 2007, in Chinese territory, there was 150-170 million ton/yr of sediment loads, while it was reduced to 75 million/yr in 2014 in Vietnam, though it is more than 2000km downstream.

Fig.2 The forest coverage of Laos



Total forest coverage of Laos

In several decades ago, there was a plan to construct a series of dams in the Lower Mekong Basin. While, it was canceled afterward for the time being in the Lower Mekong Basin, though being constructed in the Upper Basin inside the Chinese territories. Nowadays, however, due to the increasing demand for electricity in the basin countries, many dams are being planned and constructed (Figure 3).

Fig.3 Dam Cascade Plan of the Lower Mekong River

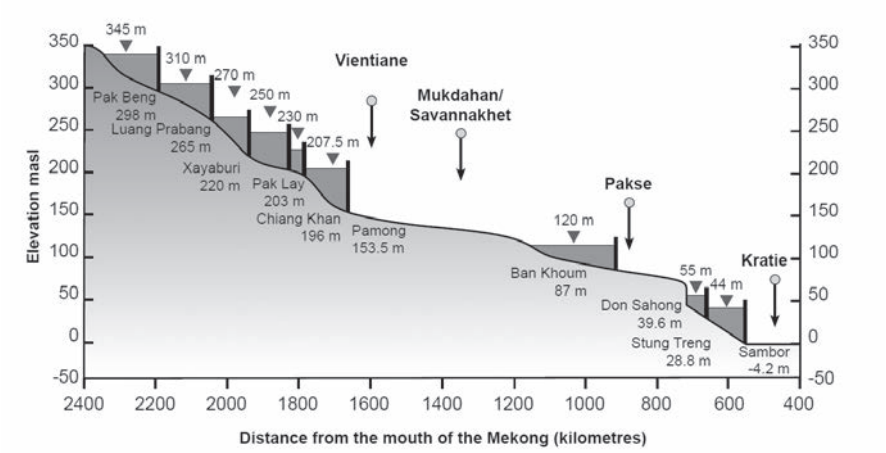


Figure 1.2: Profile illustrating location of proposed hydropower schemes in the Lower Mekong River Basin

The effect of dam cascade on the sediment load is enormous. The sediment trapped by the Lao mainstream hydropower cascade in 2020 is estimated at 10.2 million tons/annum. Sediment trapped by reservoirs will be 67%, and only 33% of its 2007 level of sediment reaches the Mekong Delta. Then, in 2040, 47.1 million tons/annum is trapped by the dam cascade, and only 3% of its 2007 level reaching the Delta (Mekong River Commission, 2014). Dam cascade has an extremely high impact on the sediment flow.

The reduced sediment transport would result in the shrinkage of the delta area in Vietnam. The shoreline of the Mekong delta is maintained by the balance of sediment supply through the Mekong River and wash away by the coastal current. In the delta area, the channel bed is eroded, much saltwater being introduced into the river channel.

The effects on the midstream are also enormous. Accumulated sediments along the riparian zone of the midstream, provides the bed for riparian vegetation on the rock-bedded channel of the Lower Mekong Basin. Without the sufficient supply fine sediments, however, the vegetation colonization is limited (Masumoto et al. 2008, Arias et al. 2016).

Direct impacts on the organisms are also enormous. Dam construction in the main channel impacts, at least, on main channel residents and spawners as well as migratory species. Totally nearly one-fifth of fish species are expected as influenced (Table 1) and its loss is estimated at US$2,500 million (Wecomme

et al 2006; Barlow et al., 2008).

Fig.4 Fish species in the main channel, floodplain, and estuary of the Mekong River (Barlow et al. 2008)

Guild name	Number of species	Catch (kg)	Catch (%)
Rithron resident	6	190	Catch (%)
Main channel resident	38	18,694	0.16
Main channel spawner	14	26,160	15.37
Floodplain spawner	26	17,945	21.51
Generalist	56	43,203	14.76
Floodplain resident (‘black fish’)	22	6,251	35.53
Estuarine resident	42	5,773	5.14
Semi-anadromous	3	80	4.75
Catadromous	3	1,865	0.06
Marine	19	1,290	1.53
Unknown	4	155	1.06
Grand Total:	233	121,607	0.13

The degradation of the channel by rehabilitation is also important. The channels are rocky between Yunnan Province to Laos. Rapid flow in the reach had a unique habitat along the Mekong River. A number of rocks were, however, exploded to expand a navigation canal at the reach.

Countries in the Lower Mekong Basin are among the most vulnerable locations in the world with respect to climate change. Though the impact of climate change is relatively difficult to forecast, several problems are expected for the Lower Mekong Basin in the next 20 to 30 years. The basin-wide temperature rises of approximately 0.79℃ , particularly in the colder catchment in the north. The annual precipitation increases by 200 mm particularly in the dry season in northern catchments, while decreases in southern catchments, resulting 21% increase of total annual runoff, which likely increases floods particularly in the downstream catchments. This will likely create various impacts on natural ecosystems and agriculture throughout the Mekong River Basin.

Once the Lower Mekong Basin was proud of its richness in nature and high biodiversity, while, at the same time, the ecosystem there was extremely fragile. In a couple of decades later, the modification just for the economic growth may change the river as an artificial unproductive channel.

References

Arias M E, Wittmann F, Parolin P, Murray-Hudson M, and Cochrane T A (2016) Interactions between flooding and upland disturbance driver's species diversity in large river floodplain. Hydrobiologia.

Barlow C, Baran E, Halls A S, and Kshatria M (2008) How much of the Mekong fish catch is at risk from mainstream dam development? Catch and Culture, 14, 16-21.

Li S and Bush R T (2015) Rising flux of nutrients (C, N, P and Si) in the lower Mekong River. Journal of Hydrology, 530, 447-461.

Masumoto T, Hai P T, Shimizu K (2008) Impact of paddy irrigation levels on floods and water use in the Mekong River basin. Hydrological Processes, 22, 1321-1328.

Mekong River Commission (2014) Study on the sustainable management and development of the Mekong River, including impacts of mainstream hydropower projects (Council Study): Inception report. Mekong River Commission Secretariat, Vietnam. p.8.

Shrestha B, Cochrane T A, Caruso B S, Arias M E, and Piman T (2016) Uncertainty in flow and sediment projections due to future climate scenarios for the 3S Rivers in the Mekong Basin. Journal of Hydrology, 540, 1088-1104.

Welcomme R L, Winemiller K O, Cowx I G (2006) Fish environmental guilds as a tool for assessment of ecological condition of rivers. River Research and Applications, 22, 377-396.