The Mekong River: Tracing the Journey from “Mother of Water” to ‘Arena of Dams and Impending Disasters’

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Abstract: The history of the human civilization is inseparably linked to the world’s rivers. Many of the world’s ancient societies developed alongside rivers. The bond between people and rivers is equally strong in urban and rural areas. But the importance of rivers for human development has brought with it pollution, degradation and overexploitation. All over the world water resources are facing challenges stem from a multitude of factors, including the steady increase in population, urbanization, environmental degradation, and industrialization. These challenges are compounding water shortages, and in turn, result in steadily increasing international disputes over water. In no part of the world does the increasing critically relationship of water, food, and energy have more immediate relevance than the Mekong River, a transboundary resource shared by China and five Southeast Asian countries. This article gives an account of understanding the transboundary disputes of Mekong River and examines how multiple dams are an ominous threat to life of the Mekong River.

1. Introduction

The Mekong River is the 12th longest river in the world; about 2,700 miles long and has great influences upon nature and societies of the Indo-China Peninsula [1]. The name “MEKONG” originates in Thai language, Mae Nam Khong [1]. The source of the Mekong River is in Tibet Mountains and is called Dza Chu River (River of Rock). After running through a very narrow valley paralling Yangz Jiang and Salween River, the Mekong reach to Yung-Nan Province of China and is called Lancang Jiang (Turbulent River) via Golden Triangle, the crossing of China, Myanmar and Laos border, the Mekong flow into Vientiane Plain [2]. The term, Lower Mekong means downstream segment from the point. The last segment is the Mekong Delta in Viet Nam, which distributes great influences to agriculture, especially paddy fields here and finally meets the South China Sea [3]. This complicated flow and relationships between each country have created specific history and international relationships of the Mekong River, i.e. many kinds of problems or frictions related to the economy and the politics among the nations. Therefore this river is often called ‘The Danube in Asia’. Although Mekong basin is under the complex social frameworks which can be reasoned from political system like, social republic, kingdom, republic, democratic, however, this region has many common points or connections due to same races in life style and cultures on the backdrop of history over borders of each country.
Cambodia [3]. The perimeter of the Mekong River region incorporates the whole Mekong River Basin (MRB) and the sea shore range contiguous the Mekong Delta (Figure 1). The aggregate catchment range is around 795 000 km², creating a run-off of roughly 475 000 million m³ amid the stormy season [3]. The UMRB is majorly mountains areas while LMRB is the marshes and floodplains areas, covers around 70% of the entire basin and is its most imperative part not only economic point of view but environmental point of view too. Its populace is to a great extent provincial and dependent for the most part in agribusiness or related exercises, with rice as the significant yield [4].

1.1 Climate and water resource of Mekong Basin

The climate plays an extremely essential part in guaranteeing assorted productivity and diversity in the Mekong River Basin. It is driven by a remarkable blend of hydroclimatic components which characterize by the planning and variability of water inputs, transport, and release through the watershed of this area [5]. The blend of two rainstorm administrations is the major driver of the Mekong hydroclimate. The Indian Ocean monsoon occurs during the northern hemisphere summer when temperature differences between the land and the Indian Ocean force moisture laden air to precipitate over the Mekong's mountains [5]. So as per monsoon entire year can be fragmented into the wet (May-late September) and the dry (October-late April) seasons [6]. Thus, the climate ranges from cold temperate and tundra in the Upper Mekong river basin (UMRB) to regularly tropical monsoonal in the Lower Mekong river basin (LMRB). In the UMRB, the crests of the higher mountains in the catchment of the Tibet Plateau are practically perpetually snow-topped. The atmosphere is cool with no reasonable summer season and precipitation is generally low [7]. At lower heights in Yunnan area, the atmosphere is prevalently sub-tropical with higher precipitation (as high as 1 700 mm every year) and purely unglued seasons, however in the LMRB, the climate is up to a great extent tropical monsoonal [4]. Hence, the southwest monsoon frequently starts in the last weeks of May and proceeds to early October. The northeast monsoon begins toward the beginning of November and proceeds to early March. Precipitation in the area shifts with area, hence precipitation is low on the Tibet Plateau and expands southwards through the MRB, being the most astounding in the Mekong Delta, See figure 2.. Thus precipitation ranges from 600 to 3 200 mm for every year. Cyclonic aggravations amid the rainy season may bring about far reaching precipitation of long term amid July-September, bringing about flooding [4]. Flooding in the Cambodian and Vietnamese parts of the MRB is normally grievous with up to 4 million ha of Cambodia's marsh regions and up to 1.8 million ha in the Delta immersed every year. Frigid and snow melt happens just in the Upper Mekong Basin (UMB) however maintains surface water accessibility in the LMB amid the dry season. In spite of the fact that melt waters contribute just 16% to the mean yearly stream in the Mekong River at Kratie, amid the dry season the commitment is close to 40%, while advance upstream dry season stream commitment from melt waters can surpass 60% of the aggregate stream [5] [6]. Due to this precipitation pattern, the Mekong river has a mean annual discharge roughly 475 km³, or 13 000 m³/s, into the South China Sea, positioning it eighth on the world river basins [8]. The Mekong river basin includes a huge system of tributaries, shaping numerous sub-basins. Significant tributary frameworks create in the Lower Basin. These frameworks can be separated into two gatherings: tributaries that add to the real wet season stream and tributaries that channel low alleviation areas of lower precipitation.

1.2 Mekong River - Its people and transboundary disputes

For the people who inhabit the Mekong River Basin, the Mekong River - the "Mother of Waters" as it is called - is much more than just a natural resource [9]. The river is the heart and soul of mainland South-
East Asia. For the people whose lives depend on its waters, the river is a way of life, a home for the spirits, a social arena, a place where life unfolds, a source not only of survival but also of profound meaning. The river speaks of the past and the future, of the eternally recurring cycles of nature, of the people living upstream and downstream, of survival, beauty and danger. The Mekong rivals the Amazon as the world’s most biologically diverse river, and is the world’s largest freshwater fishery and in this way it is central to the livelihoods and food security of an estimated 65 million people in the lower half of the river in Cambodia, Lao PDR, Thailand, and Vietnam, where wild-caught fish and other aquatic animals provide 40-80 percent of the animal protein in local diets [10]. The highly complex human adaption to its extreme annual cycles of flood and drought have made the Mekong Delta the “rice bowl” of Southeast Asia and a major factor in global food security[11]. Nature knows no political boundaries. The hydrological cycle continues irrespective of increasing demarcation of borders by human beings. It is not only nature’s gifts, but also the impacts of human actions on the environment that cross political boundaries freely. Atmospheric pollutants have transboundary impacts and so do adverse changes in the quality of other transboundary resources such as international rivers. Environmental policies that are national in scope cannot completely address the problems that are associated with transboundary resources. International rivers like Mekong are perhaps the most important and perfect example of this issue. As per Mekong River Commission, 2010 major trans boundaries issues associated with Mekong river include the quantity of water flows, and diversions, storage, or other changes to the flow regime, dam construction, changed seasonal flows, and management of water releases, impacts on fisheries and ecological impacts, Declining fish production through overfishing, destruction of spawning grounds or dry season refuges, construction of dams blocking migration and spawning patterns, and any activities affecting fish in any country, impacts of reduced areas of inundation on fish production

2. Research objective:

Key studies have highlighted the importance of Mekong River and counteractive measures for environmental setting and priority areas for environmental action management. The great challenge for the Mekong River future is to be able to respond to growing pressures arising from population growth, urbanization, industrialization, and the increasing and changing demands and sanitation, etc. Meeting this challenge requires careful management of the inevitable tradeoffs between river development and the environment, ensuring positive outcomes for poverty reduction and growth as well as for conservation and sustainability. However, there is a lack of literature on the basis interdisciplinary approach to understand the transboundary disputes of Mekong River and examines how multiple dams are an ominous threat to life on the Mekong River. Hence, this research study aims to overcome the gaps in literature by attempting, by keeping the research questions of the current study “what are the impacts of dam on the Mekong River?” and “What will be the future consequences of dam in the Mekong river basin?”

3. Methodology

This research is based on “Integrative Research Review” and “Theoretical Review”, in which the data and information has been synthesizes in the accumulated state of knowledge on similar or related data to the Mekong River. The data for this study were drawn from a pool of research papers and statistics prepared by international agencies. Secondary data were sourced from annual reports, newspaper articles, journal articles, related books, published reports and international organization websites on Mekong river that affected the riparian countries of Mekong River basin. It is expected that this research will provide a crystal clear answer to question “why Mekong River basin is converting in arena of Dams?”

4. Mekong River basin: Why an arena of dams

Mekong River and its hydrographical basin have been one of the natural cradles of civilization in the Indochina peninsula. For thousands of years, it has been not only the most important source of water within the region, but also the most important trade route in an area laden with jungles and mountains, where even man-made roads have a hard time to make their way [6]. But today, this natural resource is caught in the middle of the clash between the needs of industrialization and conservation efforts. The Mekong and its tributaries store one of the greatest hydroelectric potentials in the world, estimated in 28,930 Megawatts on its lower basin (Laos, Cambodia and Vietnam) and up to 30,000 on the higher one, mainly on Chinese soil [12]. This enormous source of energy is fueling a race to build dams, mainly by China and Laos. But it is also raising the concerns of the countries downstream – Cambodia and Vietnam – as well as the ones of local populations, for the drainage of the vital resources brought by the river. Mekong and its hydrographical basin already have a comprehensive number of 29 hydroelectric dams (see figure 4)
[13]. It’s an explosive growth from 1990, when they were only five, and it is destined to grow further, both in number and in dimension of the barrages [14]. The difference with the past is that these new projects are focused on the mainstream Mekong, not on tributaries. China alone has four barrages under construction on the upper course, to be completed by 2017, for a total of 6000 Megawatts of hydro-power installed [15]. As per 2007 report of OECD if the given current development trends in this region continued as power demands are expected to rise 7% per year between 2015 and 2030, yielding a substantial – and potentially lucrative - energy market. Laos is being portrayed as the ‘battery of Southeast Asia’ [16]. In China, hydropower is promoted as the best possible (‘clean green’) alternative to their coal-fired power stations, and will open the way to the development of the west, however in Thailand, hydropower champions emphasize the ‘greening of Isan’, the drought-prone northeast, to legitimize the development of a spectacular ‘water grid’ that will channel water from Laos, under the Mekong mainstream, and, according to critics, over-emphasize projected energy demands in the country [17]. In Cambodia, hydropower is often seen as central to solving the country’s energy supply problems [18]. Vietnam has highest priority to protect the Mekong Delta which is the ‘rice bowl’ for this country. There had been a considerable expansion of the rice farming industry over the latter half of the 20th century in Vietnam [19]. However, in order to support this industry, significant amounts of water needs to be diverted from the Mekong to irrigate the rice farms. While this could be easily accomplished during the wet season, the Vietnamese needed to maintain as a minimum the existing dry season flows into the delta to prevent salinity intrusion from seawater and to provide for irrigation. For this reason, Vietnam was in favor of dams on the Mekong mainstream because they provided more water availability during the dry season and reduced damaging flooding in the wet season [20]. Similarly The Royal Government of Cambodia (RGC) is building hydropower dams at Kamchay, Stung Atay and Lower Stung Russey Chrum, Kirirom III and Tatay, with 10 other projects undergoing feasibility studies and 13 Memorandums of Understanding signed Cambodia’s highest Mekong water priority is to ensure protection of the Tonle Sap, also known as the Great Lake, which is central to Cambodian culture [21] [22]. Others factors responsible for rapid dam development are as followings:-

4.1 Large scale mining and its thirst for energy

Bauxite, the vital material utilized as a part of the generation of aluminum, is one of the commercially most vital minerals. As indicated by the U.S. Geographical Survey, worldwide bauxite stores are evaluated at 55-75 billion tons out of which Asia contains 17 percent of aggregate worldwide stores [23]. Because of the expanding demand for aluminum, the extent of bauxite exploitation comprehensively has industrialized by 6.5 percent in cent past. Currently the world's aluminum market has been moving to China, where there is popularity for A to Z list of high tech merchandise, for example, air crafts, Spaceships, foils, vehicles, etc. [24]. Countries especially Laos, Cambodia and Vietnam are rich in this mineral resource, but main prohibiting factors of maintaining a full value chain of bauxite mining - alumina refining and finally smelting into aluminum - is the availability of reliable and cheap power. While actual bauxite mining and alumina production do not require significant energy sources - about 200-250 megawatts for one ton of alumina - the aluminum smelter requires a huge amount of cheap energy, which will come mostly from hydropower [25]. With the advance technology available today, the aluminum smelter requires about 14,000 megawatts to smelt one ton of aluminum [25]. Since Laos and Cambodia will exploit their vast rivers for the development of hydropower to be exported to neighboring countries, it would seem cost effective for China to use an alumina refinery and aluminum smelter in one (or all) of the three countries Vietnam and Laos, and to a lesser extent Cambodia, are experiencing an unprecedented interest in exploiting their bauxite resources. Since the aluminum smelter requires a huge amount of cheap energy, which will come mostly from hydropower, hence there is a mad race of developing hydroelectric dams.

4.2 Transportation infrastructure:

The riparian countries are all considering ambitious plans for their railways, and the china, Myanmar, Thailand, and Viet Nam are already making huge investments in new lines or in upgrading existing lines for increasing trade between [26]. In the Lao PDR, proximity to high-growth economies also helps to offset some of the disadvantages of being landlocked. At the same time, Cambodia, the Lao PDR, and Viet Nam benefit from an abundance of natural resources—such as minerals, oil, and gas—that provide a natural basis for developing railway transport [27]. Given all these factors, there will undoubtedly be increasing demand for an efficient transport network to allow trade between the countries to prosper without experiencing delays due to transport bottlenecks. Since development of major transport infrastructure such as railways and roads required huge energy, hence it triggers the need of dams and hydroelectric power stations.
4.3 Insatiable need of water for Rubber Plantation:

Food and Agriculture Organization (FAO) statistical data shows that in 2013 the world’s top six countries for the production of natural rubber were Thailand, Indonesia, Vietnam, India, China and Malaysia and three of them belong to the Greater Mekong Subregion [28]. Since the rubber provides not only valuable income to smallholders, villagers and large-scale production owners, and contributes to national GDP, but it is also recognized as “green produce, such as providing very good wood products with economical price, which is highly appreciated in international market” [29].

Natural rubber industry in Thailand is a major agricultural industry, rubber farmers are more than 6 million, accounting for about 10% of the population. Rubber as one of its top ten export products, exceeded rice in 1997 became the country’s largest foreign currency earner. Currently the rubber planting area of Thailand is more than 2 million hectare, ranking second in the world after Indonesia [30]. Since the 1990s, Vietnam quickly expanded the area of rubber plantation. In 2013, Vietnam’s natural rubber production from less than 100,000 tons in the early 1990s jumped to 949,100 tons, ranking the second largest rubber producing country in the world [30]. Cambodia has about 70,000 hectare of rubber plantation, and 80% are state-owned rubber plantation. According to the FAO estimates Cambodia has about 330,000 hectare suitable land for rubber plantation, and the production potential is more than 600,000 tons [30].

Since the rubber tree plant also needs the right balance of water. During the growing season, it needs to be kept moist [31]. As per the on-line database of Food and Agriculture Organization Water footprint of rubber processing is approx 13748m3/ton [32]. In order to meet such huge requirement of water no of dams created without prior international water transfer scheme in this region for catering the cultivation of industrial crops remained in dynamic equilibrium with the ecology and climate of the basin for thousands of years (Many of the basin ecosystems are tailored to, and reliant on, the predictable seasonal fluctuation of the river). Over the past fifteen years hydropower development has begun to alter the hydrology of the basin [12]. The cumulative effects of hydropower dam construction on the mainstream and its tributaries are transforming the fundamental characteristics of the river regime with pervasive repercussions not only for natural systems, but also social systems and economies [33]. The environmental change created by hydropower development will increasingly constrain the productivity of fishing and agriculture. The altered Mekong hydrology will degrade or diminish a number of the basins natural resources, such as fish stocks, natural nutrients, agricultural land and forested land, all of which are crucial inputs to either agriculture or fishing. The vast majority of the Lower Basin’s sixty million inhabitants rely on these resources for food and economic security [34].

5. Dams: Harnessing the Mekong or killing It?

Dams are rising all along the Mekong. The people of Southeast Asia need the clean electricity—but also the fish and rice that an undammed river provides. As per the WWF 2012 report, the Mekong is “one of the few large river basins yet to be irreversibly modified by large-scale infrastructure and is the last remaining river to still flow freely through five nations. The Mekong’s hydrological system has

Figure 3. Existing and planned hydropower projects in the Mekong River Basin (Image adopted from Planning Atlas of the Lower Mekong River Basin, Mekong River Commission, 2011)
6. Discussion

Although all the dams constructed on Mekong river have emphasized the economic and social benefits to society while largely ignoring any long-term environmental impacts. Since these dams are designed to alter the natural flow regime of rivers and, as such, they have profound impacts on natural river processes both upstream and downstream from the dam. The impacts of dams on Mekong river’s ecosystems are numerous, complex, and varied, some obvious and others more subtle, but all mostly have negative consequences. As the dam interrupts the continuous water flow, deposits sediments before the dam and forms a reservoir upstream, as a result the water density of the reservoir is higher than that downstream. The sediments and nutrients are largely accumulated upstream, whereas the downstream storage decreases significantly, which impedes both environmental and economic development of downstream ecosystems. Hydropower development antagonistically influences the efficiency of farming by debasing or draining various characteristic assets that constitute fundamental farming inputs. Maybe the most evident way hydropower development limits farming efficiency is by decreasing the supply of agrarian area. At least 9,000 hectares of farming area is relied upon to be immersed by the proposed Lower Basin standard dams [35]. The erratic and extreme flooding that can come about because of hydropower development can likewise influence the supply of reasonable farming area also flooding can wash away yields and animals, and there is a solid trepidation in Vietnam that upstream hydropower development could incite salt-water interruption in the Mekong delta [36]. Salt-water interruption increments the saltiness of horticultural area, influencing the richness of the dirt and, in extreme cases, renders the area unsatisfactory for horticultural purposes [37]. Hydropower development further increases soil saltiness by decreasing the wet season surge beat that generally flushes out a great part of the salt every year [38].

Horticulture and fisheries are so essential to rural locales of the Mekong. Fish, together with rice, shapes "the establishment of nutrition security in for all intents and purposes all riparian nations" [39]. The four Lower Basin countries specifically "include the most astounding utilization of freshwater fish on the planet [34]. Any diminishment in fish get will subsequently debilitating nearby jobs and nutrition security. Without access to catch fisheries and other free wellsprings of nourishment, for example, woodland items and wild diversion, lack of healthy sustenance is a significant sympathy toward the poorest individuals of the Mekong river Area. Poor nourishment is as of now normal in the Cambodian and Lao zones of the Mekong Basin [34]. As per Mekong River commission report 2010, Rice "is the staple for the majority of the region’s occupants" and in the Lower Mekong Basin, more than ten million hectares of developed area is used to deliver it and hence rice is by and large eaten at all dinners in the Mekong Basin, and contributes seventy-six percent of the normal day by day calorific value. Eighty-three percent of the monetarily dynamic populace in the Lower Mekong Basin is occupied with a water assets related business as their essential occupation which incorporates "cultivating, fishing, aquaculture, fish processing fish marketing, marketing of other water-subordinate items, net making/repairing, vessel making and/or repairing and cultivate work" [34, p. 48]. Hydropower development in the course of recent years has officially affected locality financial efficiency. Most people have changed occupation due to the declining profitability of oceanic living systems. "The high level of reliance of the populace on water assets for occupations and nourishment security infers a high powerlessness to declining accessibility, quality, and assorted qualities of the assets" as per the report of Mekong River water Commission.
7. Mekong river basin: Zone of impending disasters

Ambitious programme for developing hydroelectric dams, especially those proposed in the lower main stream are strongly supported by the governments which argue there is no alternative for securing energy and financing public spending. Thus acute interest in constructing hydropower is blooming without analyzing the fact what are the future consequences of multiple dams and they are waiting for disaster to be happen. It is evident that impairment of agriculture and aquaculture will reduce livelihood opportunities and cause migration to cities. This migration of people with limited skill for sustainable urban livelihoods will contribute to higher slum population, increased labour supply especially in informal employment and vulnerability to risky behaviors [40]. Water diversion and blocking through dams can fundamentally alter and weaken ecosystem function and services. Thus there will be a disruption in water and nutrient supply through the landscape, which will replace the fields and forest nutrient security. This situation will increase vulnerability of people and reduce residence of food [41]. Forest and mangroves play a crucial role in micro climatic condition, alteration in their pattern may lead to unpredicted rain fall. Evaporation from big reservoir may lead to disaster like “Himalyan Tsunami” or event of cloud burst in this area [42]. Drastic changes in the behavior of the Earth and its natural processes have caused an alarm for massive earthquake. Jean-Philippe Avouac, director of the Tectonics Observatory at Caltech in the US and author of many recent studies, said that the Himalayas may experience an 8 magnitude earthquake from the Ruasi fault line in coming future. What will happen if such devastating earthquake occurs and indeed no can even imagine the impact and intensity of destruction? What will happen if there is collapse of a mine tailings dam and subsequent flood similar Fundão dam disaster of Brazil , occurred on 5 November 2015, preceded by a small-magnitude seismic sequence [43]. Due to climate change , and anthropogenic emission of greenhouse gases, further add impact on this area [44]. Definitely, these impacts cannot be mitigated likely to be irreversible.

8. Conclusion

Dam development is a standout amongst the most expressive anthropogenic nuisances in the Mekong River areas. Since the environmental outcomes brought on by damming are of high multifaceted nature, It is evident from various outcomes of scientific study that the blocking of river water or impacts of dam development are momentous in light of the fact that extensive sums of silt and supplements are impeded in store, which enhance the biomass creation capacity of supply, while penance silt and supplement inputs for the downstream biological community, posting a potential oligotrophic risk for the downstream biological community. The biological community wellbeing states of supply and downstream are subsequently changed by dam development. The professions of the Mekong Basin populace are inseparably connected to the region’s normal assets. A diminishment in the efficiency of fishing and agribusiness will have real results for the nourishment and monetary security of the nearby individuals. Hydropower development will prevent much from securing the bowls populace the capacity to reasonably bolster them. Numerous will be compelled to discover elective jobs, which will frequently prompt further ecological obliteration, highlighting the unsustainability of proceeded with hydropower development. It is essential to take an interdisciplinary methodology while evaluating the effect of normal asset improvement ventures. While ecological effect appraisals have regularly been led for Mekong hydropower ventures, the social effects have by and large gotten essentially less consideration. Surveying just the ecological effects neglects to perceive the estimation of these normal assets, in their present state, to the basin occupants. Mekong is not just a river or natural resource to the people, this is the soul, the life source, for a large number of individuals. So in the name of development, governments cannot commit any huge errors with the Mekong . Hence for the people of the basin , it is necessary for policy makers to must strike a fragile harmony between the quest for financial development and the preservation of characteristic assets .This without a doubt includes taking a gander at more reasonable other options to the proposed hydropower ventures. I think by exploring new approaches and technologies in hydropower that could help maximize the economic, energy and broader developmental benefits of hydropower while minimizing the social, environmental, and economic risks. The Thakho hydropower project, as an example, has no dam or reservoir and will divert water from the Mekong’s mainstream. This means it will not change the flow of water, sediment and nutrients downstream nor will it obstruct the movement of fish and other aquatic organisms. If the exploiting the Mekong river remain same by riparian countries remain same as present course, the Mekong River which is a vital for their economic development and a source of occupation for a huge number of individuals, will be in peril amongst the coming decades. In conclusion, the Mekong River Basin needs the attention of all riparian countries with full commitment and motivation to use it equitably without serious impact on it. This
multilateral cooperation also needs the involvement of all stakeholders to meet the need of the poor in front. Moreover, development projects needs to have impact assessment of the current and future generation and the environment as a whole. Development should not be under the cost of the environment. There is no doubt that the fate of one of the world's most noteworthy river is in their hands.

8. References


[21] “Scoping Study of Existing Frameworks Related to the World Commission on Dams Strategic Framework – Cambodia” by Sam Chamreoun, IUCN, p.4


