The False Solutions to Climate Change: A Case Study on Hydropower in the Mekong River Basin

By Towards Ecological Recovery and Regional Alliance/ Foundation for Ecological Recovery (TERRA/FER)

1. Trends of Hydropower Investment in the Mekong River Basin

History of dam development in the Mekong Basin dates back several decades since the Mekong Committee came into being in 1957. Key supporters at time were such agencies as USAID and UN-ESCAP. Later, promoters of dam included both bilateral and multilateral agencies such as the World Bank. The aim of this endeavor was not only to put into reality the engineering dream of damming the Mekong River but turning it a source of economic development. At time, the Mekong Committee studied and recommended hundreds of dams. However, conflicts and wars in the region throughout the period 1970s-1980s prevented these projects to proceed except few relatively small projects developed on the Mekong tributaries. After the cold war was over around the early 1990s until 2003, attempt to dam the Mekong as well as its tributaries continued although little progress was made. The year 2003 witnessed a remarkable progress when the World Bank together with the Asian Development Bank (ADB)endorsed the 1,000 MW Nam Thuen 2 dam on Thuen River in central Laos.

The Nam Thuen 2 dam was a breakthrough for respective governments.Dam industry in the Mekong region was thus set to proliferate with at least four factors involved. First, Laos in which majority of the Mekong main tributaries are situated decided to adopt the policy of turning Laos itself the “battery of Asean”. Second, Thailand whose natural resources started to dwindle rose as a rapidly emerging industrializing country and was in thirst of cheap natural resources. Third was the stronger dynamics of the “Greater Mekong Subregion Economic Cooperation Program” promoted and facilitated by the ADB (ADB-GMS Program) in which the interconnection of the power transmission lines within the Mekong region (so-called Mekong Power GRID) is included as a ‘flagship’ project. And forth was governments (as in the case Laos and the Nam Thuen 2 project) adopting the privatization of large infrastructure projects e.g. hydro dams, power plants and extractive industry as one of the development strategies to catch up with the richer neighbours such as Thailand.

In more recent years, plans to dam the Mekong River and its tributaries have been even more heavily pushed and promoted with a new set of factors as well as forces and actors on the scene. First, China devised the policy to speed up development of its marginalized Western Region especially the province of Yunnan – the upper stream of the Mekong known in Chinese as Lancang River. This policy has driven China’s need for stronger relations with its southern neighbours (or other member countries of the GMS) as well as with the ASEAN for better investment opportunity. Currently, China is involved in numerous mega dam plans as well as resource intensive projects in Laos, Cambodia and Vietnam. The rapid economic growth of Mekong countries especially Vietnam also contributes to skyrocketing demand for power. The ASEAN economic liberalisation [1] combined with the domestic restructuring in respective countries to harmonise national policies with that of the ASEAN has led to further opening the national economies to foreign investment and hence the freer movement of large capital from within the ASEAN into poorer-but-resource-rich countries e.g. Laos, Myanmar and Cambodia.

In the wake of the regional privatization and liberalization, the role of Western donors and International Financial Institutions (ADB, World Bank) declines while that of the private sector especially from within the region becomes greater. As a result, nexus of vested bureaucratic, political and business interest expands. Project developers/concessionaires in

some cases are able to mobilize political support (from their own government) by being promoted as necessary not only to improving political and economic relations but also advancing national interest (as in the case of Thailand and Vietnam against China's fast growing influence in the region). So-called 'private' includes not only dam builders or developers; but international contractors, the region's commercial banks and public utilities in the guise of private companies and consultancy business. Today, these interests are behind the push for several hydropower dam proposals despite the fact that better energy options are available. The new generation of dam developers and financiers are now largely from Thailand, Vietnam, China, Malaysia. Notably, these new actors have limited commitment to international standards, and are not prone to international criticism.

Mekong in brief

Being the world's 12th longest river at 4,909 kilometers, Mekong is the largest river in Southeast Asia and it's unique in many respects. First of all, the Mekong is an international river flowing pass six countries (China, Myanmar, Thailand, Laos, Cambodia and Vietnam). The region the Mekong stretches across is one the world's ethnically and culturally diverse region. The Mekong basin (with water catchment area over 800,000 square km.) is home to more than 65 million people who still mostly live on subsistence livelihoods including freshwater fisheries and rice cultivation.

From its source in Tibetan plateau to the Mekong delta in Vietnam, Mekong has very unique ecosystems that make it one of the world's most abundant river systems. Aquatic species found in the river exceeds 1,300, only second to the Amazon. Besides, its fishery productivity is perhaps second to none. Mekong fisheries produce around 18% of the world's freshwater capture fish. The 2009 estimate values Mekong fish resources at USD 2.1-3.8 billion on first sale and between USD 4.2-7.6 billion on retail markets*.This implies the size of the population that depends on the Mekong river system is larger than those depending on all other rivers. A vast proportion comprises of hundreds of ethnicities, tens of millions rural peasants and artisanal fishers who are mostly in impoverished condition. Apparently natural resources that remain abundant allow them to sustain their livelihoods which depend very highly on such resources along the Mekong mainstream and its tributaries or in the watershed areas.

*MRC SEA for Hydropower on the Mekong mainstream, FISHERIES BASELINE ASSESSMENT WORKING PAPER, 10 April 2010.

Last but not least important is the emerging climate change factor. Dam proponents in the region have started to exploit climate change discourse (for instance, the extra benefit of dams – a source of clean, emission-free and renewable energy) to regain their space narrowed down by increased environmental activism. For instance, developers of the proposed Ban Koum and Pak Chom dam projects on the Mekong mainstream claim that the dams will help reduce carbon emissions by 5.49 and 3.46 million ton carbon dioxide (CO_2) per year respectively [2]. Besides, CDM status is being sought for a number of hydro dams such as Nam Ngum 5 (Lao PDR), Sesan 4A (Vietnam) and Stung Tatay (Cambodia). In Thailand, in particular, 'pro-dam agenda has secured its place in the country's climate change policy. For instance, Thailand Greenhouse Gas Management Organisation (public organization) recently granted the Electricity Generating Authority of Thailand (EGAT) – the country's biggest dam builder – the right to claim 'carbon credit' from electricity purchased from hydropower projects in the region.

Figuring out what a worst scenario would be like for the Mekong basin, a most convenient way is to take into account all large dams including those respective countries have wished to develop. Vietnam has 13 dams operational, two under construction, one in planning stage. There is no dam yet in Cambodia but five dams have been approved, 12 in planning stages. Laos has 13 operational, 12 under construction, 25 in planning stages, 34 under feasibility, one with no clear status. Thailand has only 6 projects and no further dam plans dams.[3] If all could materialize, impacts could be accumulated to have become far too great for anyone to imagine.

Focal in this section of the report are among the most controversial cases namely: 1) dams built in the upper part of the Mekong (Lancang-Mekong River) in China, 2) the proposed dams on the mainstream of the Lower Mekong and 3) dams built by Vietnam on Sesan and Srepok Rivers which originate in Vietnam and flow through Cambodia's northeast, particularly the planned Lower Sesan 2 (LS2) dam.

2. Impacts of hydropower dams on the ecosystems of the Mekong Riverand Loss of fishery livelihood

2.1 Projects on the Mekong mainstream

To date, five dams have been built on the Mekong mainstream. All are on the upper reaches in China's Yunnan province or the Lancang-Mekong. First built is Manwan dam (completed in 1996). Four other projects includeDachaoshan, Jinghong,Xiaowanand Nuozhadu. Installed capacity combined is 15,650 Megawatts, and storage capacity totals 40,513 million cubic meters.

In the lower Mekong passing Laos, Thailand, Cambodia and Vietnam, 12 projects, 11 of which were studied and recommended by the Mekong Committee[4] in 1994, are currently considered by governments of respective countries. Installed capacity combined is 13,350 MW. Laos is ahead of all others in pursuing the mainstream dam plans with the highly controversial Xayabouri project amid fierce criticisms from within the region and international community. Construction of Xayabouribegan in 2011 and was scheduled to be operational in 2019.

2.1.1 Impacts of China's dams

Ever since Manwan began impounding water in 1992, the flow regime of the Mekong prior to 1992 has disappeared, water level has become fluctuated with unnatural/unusual rise and decline of water level in much shorter length of time both in wet and dry seasons.

A report by Thailand's Department of Water Resources (2004) examining water flows in the upper Mekong shows that during 1962-1992, prior to the completion of Manwan dam, the average minimum discharge was 752 cubic-meter-per-second (cumecs).But during 1993-2003 this had dropped by 25 per cent to 569 cumecs. In 1993 the year that in-filling of Manwan dam's reservoir was reportedly completed, the minimum discharge averaged only at 315 cumecs – nearly 60 per cent lower than the average for the previous forty years.[5]

The hydrological regime of the lower Mekong has been further altered as more dams have been built on the Lancang-Mekong. The rise and fall of the water has beenincreasingly unusual andthe water level abrupt as a result of the China's dam operation. For instance, flow in dry season was doubled the average in 2010. Besides, the amount of food nutrients locked behind the Lancang-Mekong dams was as much as half of the total. This is also the case for the controversial cascades of dam on Sesan and Srepok Rivers shared between Vietnam and Cambodia.[6] For this reason, fish food fertility in the lower Mekong has been quickly lost. This affects not only Mekong fisheries but also soils along the river bank used for cultivating crops. The fertility of these soils needs to be replenished with the nutrients carried by the sediments.

Fish of the Mekong and its tributaries are migratory and are triggered by rain water to migrate in flood season. Mekong fish spawns more at the onset of rainy season than other times of the year. Dams cut off the flow and disrupt food chains especially in dry season. This is because fish feed is accumulated of the surface of the soil in the form of the growth of plants and animals which occurs after water declines. Besides, the altered rise and fall of water level causes severe damage to aquaculture. Also, the edible freshwater weed, that usually grew during February-March and earned local people 800-1000 baht daily, was un-recoverably damaged by the changed pattern of water flow.

TERRA's study (May 2012) found that water impoundment Xiao Wan dam's reservoirin 2010 caused the water level during January-February 2010 to lower drastically. This severely impacted wetlandsin Cambodia's north where fish migrate from Tonle Sap lake to mate and spawn. Many large trees in these wetlands wilted and died. An area of 14,600 hectares of wetland here was designated as Ramsar site.[7] It provides a refuge for endangered fish such as Irrawaddy Dolphins and some rare birds, and important breeding and feeding ground for rare species of fish and globally threatened wetland dependent birds, including the critically endangered white-shouldered ibis (*Pseudibisdavisoni*) (Timmins 2006)

2.1.2 Twelve proposed dams on the Lower Mekong Mainstream

The cascade of eleven dams (a 12th dam – ThaKor – was recently added to the cascade)[8] on the mainstream of the Lower Mekong were studied and recommended in 1994 by the Mekong Committee River. However, these dams could not proceed because of criticisms from experts and civil society. Based on the Strategic Environmental Assessment (SEA)(on the proposed Mekong mainstream dams)commissioned by the MRC Secretariat. The SEA began in May 2009 and the final report was published inOctober 2010. Following are just only some of the highlights of the findings re: potential irreparable impacts of these dams taken from the SEA report:

Fishery and agriculture: The losses in fisheries, if all dams were to proceed, are expected to be worth USD 476 million/year, excluding effects on the coastal and delta fisheries which arelikely to significant but have not been studied.Fifty four % of all riverbank gardens on the Mekong River will be lost which combined with the losses in agricultural lands for mainstream reservoirs and transmission lines is expected to be worth USD 25.1 million /year.Reduced nutrient loading will require an estimate USD 24 million/year to maintain the productivity of floodplain agriculture – 33 per cent directly due to mainstream hydropower.

In short to medium term poverty would be made worse by anyone of the mainstream projects, especially among the poor in rural and urban riparian areas. Fishers in particular are over represented in the poor and vulnerable LMB communities which would be affected by fishery losses. Poorer households would also be adversely affected by the direct impacts of hydropower development including resettlement, loss of land and impacts during the contraction period.Loss of fisheries and associated proteins would lead to decline in nutritional health particularly in Cambodia and Lao PDR where up to 30 % of the national protein supply would be at risk if all dams were to go ahead.

The loss in LMB biodiversity would be a permanent and irreplaceable global loss which could not be compensated. With development basin wide including a total of 77 dams on LMB tributaries and on the Lancan-Mekong mainstream, the loss of fish production compared to the 200 baseline is expected to be 210,000-540,000 tonnes or 10-26 % *in the absence of the mainstream dams*. If 11 mainstream dams were in place, the total loss in fish resources would be 550,000-880,000 tonnes or 26-42 % compared to the 200 baseline – 340,000 tonnes of that estimate directly due to mainstream dams. The amount of protein at risk of being lost annually if 11 mainstream dams were built by 2030 represents 110% of the current total annual livestock production of Cambodia and Lao PDR.If 9 mainstream dams were operating upstream of Khone Falls, the loss in fish resources would amount to 350,000-680,000 tonnes or 17-32 % compared to 200 baseline, 140,000 tonnes of that due directly to the mainstream dams.

Fish passes are not a realistic mitigation option for the Mekong mainstream dams. Eight of the proposed mainstream dams are higher than the maximum height at which fish ladders are operational. World-wide fish ladders are efficient when specically designed for a few particular species that migrate once a year in limited numbers. The Mekong is characterisaed by more than 50 different migrant species, huge densities during migration peaks and several migration pulses per year. In addition, a cascade of dams would exponentially reduce the overall upstream fish passage rate.

Some 29.6 million people live and work within 15 km of the Mekong River throughout the LMB. Of these, 2.1 million are local riparian communities living within 5 km of the river who are expected to be most at risk to the direct and indirect impacts of the mainstream dams. Of these, 106,942 people will suffer direct impacts from the 12 mainstream projects losing their homes, land and require resettlement. More than 2 million people in 47 districts living within the project reservoirs, dam sites and immediately downstream of the 11 mainstream projects are at the highest risk of indirect impacts from the mainstream dams.

2.2Cambodia’s 3S Rivers and the Case of the Planned Lower Sesan 2 Dam

Standing for Sekong, Sesan, Srepok, 3S are among Mekong's major tributaries situated in Cambodia's north and northeast. More importantly, the 3S, too, are international rivers. Sekong originates in Laos and passes Cambodia. Sesan, Srepok originate in Vietnam and flow past Cambodia. The 3 rivers converge in Cambodia's Stung Treng province and become mighty Sekong that flows into the Mekong. Contribution of water from 3S to the Mekong is over 100 billion cumecs per year, or 22 % of the Mekong's total flow which amounts to 457 billion cumecs per year.[9]

Sub-areas per Country and per Basin [10]

Sub-basin	Cambodia (km^2)	Laos (km^2)	Vietnam (km^2)	Total (km^2)
Sekong	5,565	22,565	690	28,820
Sesan	7,630	-	11,260	18,890
Srepok	12,780	-	18,160	30,940
Total	25,975	22,565	30,110	78,650
Total (%)	33	28.7	38.3	100

Originating in Vietnam, Sesan River passes Cambodia's Rattanakiriprovince and flows into Sekong River at Stung Treng province. The river stretches 233 km and has around 60 villages along it. The people depend on the river number 30,000 – 50,000.[11]

Vietnam's first dam on Sesan, Yali Falls dam, sited 70 km from Vietnam-Cambodia border, began impounding water in 1998. In 2000, generating electricity, the dam released massive water that caused big waves. Mud came along the released water that rose sharply and smelled badly. Even when the water receded, the smell remained and the river was full of rotten plant debris. The people's health was affected and sanitation became a serious problem not only for humans but also cattle. Food became scarce as fish catches decreased significantly and riverbank garden was no longer possible. Over 1,800 households that had riverbank farms were directly affected

Wyatt and Baird[12] estimates that the Yali Falls dam affects around 55,000 people in 90 villages (60 are on Sesan, 30 on its tributaries). Water released from dams erodes riverbanks, increases sediments and wastes. Particular fish species endemic for the areas were depopulated or nearly disappeared. Some fish that migrated from Tonle Sap lake were less in number. Reduced fish catches by 70-90 % was a serious problem because fish was the people's only main source of protein. To date, 12 dams have been built by Vietnam on Sesan and Srepok, each of which has 6 dams, resulting in both rivers to have deteriorated to a very critical point.

TERRA's initial study during February-April 2013 in 4 villages on Sesan and Srepok found that there still remains some 180 fish species in both rivers (124 found in Sesan, 141 found in Srepok and some 56 species came from Mekong River). This illustrates a sharp decline in fish diversity as the figure has decreased from 268 species (of which, 89 came from Mekong River) found in both river in the previous 10 year period showed in respective reports[13]This

clearly indicates the current critical ecological degradation of both rivers caused by dam upstream in Vietnam's territory.

Cambodia has now planned four projects, two on Sesan (400-MW Lower Sesan 2and 375-MW Lower Sesan 3) and two onSrepok (300-MWLower Srepok 3and 100-MW Lower Srepok 4). In November 2011, Cambodia's government approved the Lower Sesan 2 (LS2). The LS2 is to be sited at the point 10 km downstream of the Sesan confluence with Srepok River. It will create a 83,099-hectare reservoir inundating a fertile dry evergreen forest and cover 60 % of the reservoir area, requiring resettlement of 4,574 people of 7 villages. Moreover, the dam will affect 38,675 people living in 87 fishing villages upstream of the dam.[14]

The LS2 dam will likely become the 'last straw' as it will lead up to the demolition of the rivers' ecosystems that will become ecologically dead. Even the villages upstream of the planned dam that are not required to resettle would not be able to make a living as the dam would completely cut off the fish migratory route and there would virtually be no fishery resources left over.

3. Hydropower dams will undermine local community's ability to adapt to the impact of climate change

3.1 Climate change trends for the Mekong Basin[15]

A study of the Mekong region's climate change showed similarity among several aspects. For instance, temperature would rise, rainfall intensity would increase during rainy season and decrease in some areas and for some months during dry season, flooding would occur more often for a longer period of time especially in the Mekong delta. All these will directly affect natural resource base on which communities depend for livelihood.

A future model simulation created by the Intergovernmental Panel on Climate Change (IPCC) pointed out main changes that would happen within 2030. Those are: basin wide temperature would increase 0.79°C especially in the upper area of the basin in Tibet. Average annual rainfall would apparently increase 0.2 m. or 200 mm. equivalent to 15.3%, in rainy season. The snow would increase during the dry season in the upper Mekong Basin and rainfall would decrease in the lower area. Average annual runoff water would increase 21%. However, the water level in dry season remains a major problem in northeastern Thailand and in Cambodia's Tonle Sap Lake. And, there would be flood problem in all parts of the Mekong Basin, the most severe one would take place at the end of the Mekong Basin.

National scenarios

National scenarios predicted by the GCM (General Circulation Model) are similar, especiallythat of Vietnam where changes would be drastic. Cambodia's and Laos'

temperature would rise between 0.3-0.6 °C (by 2025), and 0.68-0.81°C (within 2030) respectively. Large land areas of Cambodia stretching from southeast to northwest whose annual rainfall has historically been under the national average would be vulnerable to floods and droughts. While in Laos, increased severity, duration and frequency of floods and droughts would be among most probable risks. Besides, increased rainfall would directly affect agricultural productivity within around 800,000 ha of cultivated areas both lowland and upland as the soil erosion problem would significantly increase and explicitly lead to soil degradation.

As for Thailand through Conformal Cubic Atmospheric Model (CCAM model), average temperature would most probably rise, dry season would be longer while cool season shortened. Rainfall would increase, drought and flooding would be more frequent. Rice productivity would considerably decline due to temperature increase during the flowering period of the crops by 1-7°C.

Vietnamwould be most severely impacted by climate change, particularly in the delta areas of the Mekong and the Red River as a result of increased inundation. The average temperature is estimated to increase by 2.5°C in 2070 and this is predicted to be more visible in the highlands region; while coastal temperature is predicted to increase by 1.5°C. In the North and the South, rainfall would decrease during July and August but would increase during September to November. In the central region, rainfall is predicted to increase by 19% in the rainy season by 2070; while rainfall would decrease in the dry season and drought conditions are predicted to become more frequent. Each year, the typhoon intensity will be stronger, especially during El Ninõ years.

Over the past 30 years, sea level in Viet Nam has increased only 5 cm, it is however expected to rise by another 9 cm in 2010, 33 cm in 2050, 45 cm in 2070 and 1 m in 2100. With a sea level rise of 1 m, approximately 10% of the population could be directly affected and it could also cause 10% losses of the GDP. Only at the Mekong Delta area of approximately 1,100 square kilometers where located 12 provinces of this region with about 5 million affected populations (of the total 27 million populations) would be inundated. Furthermore, when the sea level rises, the mangrove forests in such areas are consequently decreased.

3.2 Impacts on the flow of the Mekong River as a result of climate change and development

Based on the MRC's assessment in 2009[16],snow melting in the headwaters of the upper Mekong would add 5.5%-8% of water quantity which is a high proportion especially in March to the Mekong at the China- Laos border. Nonetheless, the aforesaid snow melting would not have a significant effect on the total annual runoff water, according particularly to the downstream water measurement. The rainfall would increase from the current year until 2050 about 1.2-1.5 mm per year and the temperature would increase 0.023°C per year.

In flood season, the impacts of global warming as well as the Mekong Basin's (hydropower dam) development go in the opposite direction. Under the old style of climate conditions during 1985-2000, the development of the Mekong Basin decreased between 8-17% of water quantity whereas under the climate change conditions during 2010-2050, Mekong water quantity would reduce to a minimum of 7-14% comparing to the past. Each water measurement station will have a lower statistic of water flow varying by location in the watershed, the water may decrease up to 13% in some stations; while only 3% in others.

In dry season (drought), although the effects of global warming and the Mekong Basin's development appear identical which means the water increased, under the same climatic conditions during 1985-2000, there has also been a lot of complexity though. The

development of the Mekong Basin would increase water quantity 30-60%; while under the new climatic conditions, water quantity would increase up to 18-40%. Therefore, the impacts of global warming and the development in the Mekong Basin would cause the flow rate increased 40-70% in dry season, it would after all depend on the climatic conditions in each measurement station at that time.

Impacts of the development of the Mekong Basin (dams and water diversion), under both old and new climatic conditions, would result in a lower flow rate of 3-8% per year. Besides, the climate change would increase the flow rate of approximately 6-16% per year under every watershed development situations (model).

Global warming would increase the number of days at a higher-than-average flow rate in flood season; therefore, the development of the Mekong Basin (which refers to dam construction) could reduce the number of days with flow rate higher than the average. This is more obvious in the upper Mekong water measurement stations that dams could alleviate flooding problem.

3.3 How is the local adaptation to be undermined?[17]

This section brings up the case of five villages in Ubon Rachathani province in Thailand's northeast that are representative of hundreds of communities along the Mekong River. TERRA together with local groups researched these villages and a particular section of the Mekong flowing past the villages. It was found that a 30 km stretch of the river consists of complex and fragile ecosystems and sub-ecosystems. The river's productivity and abundant resources result from these ecosystem complexes interacting with seasonal changes and the rise and fall of the water level.

Besides, local livelihood is so dependent on the Mekong. Income derived from the river mainly through fisheries and riverbank cultivation constitutes 27-50 % of the households' total income. Aggregate income of the five villages from the Mekong amounted to 15,407,390 Baht (over half a million USD).

In eco-cultural dimension, lifeway of the five villages exemplify profound relations between the people and the Mekong. The people of the Mekong basin have inherited and accumulated experience and knowledge on the river ecosystems since time immemorial. Hence their intimate understanding of the river's ecosystems and sub-ecosystems as well as their interaction with the cycles of rise and fall of the river flow regime. Communities can describe the correlation between sub-ecosystems and life cycle of flora and fauna, in particular, hundreds of fish species requiring the river's seasonal flows to trigger their migration to seek breeding and feeding grounds and shelters in the sub-ecosystems. Local ecological knowledge is based on the people's understanding of the dynamics of nature. It is where the artisanal fishery is founded on and, more broadly, the root of the traditional way of living on sustainable utilization of natural resources. It has over time evolved through the local people's experiential learning and adaptation and been handed down from generation to generation.

In other words, local ecological knowledge reflects the communities' need to rely on the Mekong. Men engaged with fisheries know profoundly the ecosystems and sub-ecosystems. They also possess a good knowledge of the fish hotspots called *luang*, as well as the ability to choose the right fishing gear that matches fish habits as well as the flow of the river. At the same time, women know the ecology and diversity of plants and aquatic animals that can be harvested from *bung* (ponds), as well as the knowledge of how to utilize riverbanks for dry-season cultivation.

The very fact is the Mekong ecosystems are complex and sensitive to hydrological changes, and dams in the Mekong basin as well as global warming will cause these changes to become permanent. Even China's dams far upstream (2,300 km) have impacted the flow and water level of the Mekong and affected fishing livelihood in the research areas. This implies that the people of the Mekong now live in a vulnerable condition. Threat from climate change is not as critical as that of hydropower. Chance would remain for the people to adapt if they face threat from climate change alone given their ecological knowledge and livelihood skills as well as the current condition of the river that remains healthy. But hydropower dams especially the projects on the Mekong mainstream will demolish the river ecosystems in a relatively short period of time. The people will find their knowledge and skills become irrelevant. With limited livelihood alternatives, they will have to struggle to adapt to the extremely new condition.

4. Carbon emissions from dams

Study on "carbon emissions from dams" is relatively new in the Mekong region. At time of preparing this case study report, TERRA collaborates with the Thai Working Group for Climate Justice (TCJ) to take an initiative to address this question starting with dam projects in Thailand proposed as parts of the massive anti-flood scheme. Here in this report TERRA extends the study to cover the soon-to-be-built Lower Sesan 2 above discussed.

The LS2 will create a reservoir of 83,099 hectares or 831 square km 60% of which, approximately 500 square km, is still well covered with dry evergreen forest. The other 40% are the people's farmlands. 500 square km area of dry evergreen forest is estimated to have capacity to store 250,000 tonne carbon.[18]A square meter of the forest is able to tap a kg of carbon dioxide or approximately 500,000 tonnes of carbon per year. While at the same time, the 40% farmlands sizing 331 sq. km is able t tap 0.2kg of carbon or approximately 66,200 tonnes per year.[19]

Thus, assuming that the controversial LS2 with 50 year life-span inundates 831 sq km, Cambodia would lose capacity to absorb CO_2 (through converting it into plant textures) amounting to 500,000 tonnes per year for 50 years plus 66,200 tonnes, totaling 25.0662 tonnes carbon[20] or approximately 92 million tonnes of CO_2.Cambodia's CO_2emission in 2008 amounted to 4,602,090 CO_2/carbon- equivalent tonnes[21].The forest that will be submerged by the LS2 dam has capacity to tap 500,000 tonnes of carbon or 1,833,350 tonnes of CO_2or40% of the country's total CO_2 emission in 2008.

In addition, if there would be burning of the forest to reduce organic materials in the reservoir area prior to in-fillingthe reservoir, this is comparable to setting on fire a 500 sq. km. degraded forest land.A sq. km. would release CO_2amounting to 37,200 tonnes. Thus, burning the land area of 500 sq km would emit approximately 18.6 tonnes of CO_2 into the earth atmosphere.[22]

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[1] One of the key provisions of the ASEAN's Charter requires all its members to gradually liberalise the national economies. This agreement – known as AEC (ASEAN Economic Community) – is scheduled to take full effect in 2015.

[2] Panya Consultant and Macro Consultant Companies, Pre-feasibility study for Ban Koum and Pak Chom Hydropower Dam,April 2008, p 6

[3] Sources: Report of Ministry of Energy and Mines of Laos, March 2013; International Rivers, factsheets on 3S rivers hydropower projects; Dams visual identification through Google Earth Maps; News reports from different media

[4] The Mekong Committee was transformed to the Mekong River Commission after Laos, Thailand, Cambodia, Vietnam signed the Mekong Agreement 1995 which require all four members to commit a set of rules, guidelines and procedures dictated by the principles of sustainable development.

[5] Chantawong, Watershed Vol. 11 No. 2, p 16

[6] Strategic Environmental Assessment Report, commissioned by the Secretariat of the Mekong River Commission, 2010, p 77

[7] STATE OF THE BASIN REPORT 2010, Mekong River Commission, April 2010 (p. 77)

[8] The Cascade of these dams include: 1) Pak Beng, LuangPrabang, Pak Lay, Sanakam in Laos' north 2) Pak Chom and Ban Koum on the Mekong that borders Thailand and Laos 3) LatSua, Don Sahong, ThaKor in southern Laos and 4) Stung Treng, Sam Bor in Cambodia

[9] STATE OF THE BASIN REPORT2010, Mekong River Commission, April 2010, p.20

[10] Source: 3S ADB RETA project quoted in"Fish and Fisheries in the Sesan River Basin" by Eric BARAN, SARAY Samadee, TEOH ShwuJiau, TRAN Thanh Cong, World Fish Center, December 2011.

[11] Ibid, 2011, p 17

[12] An independent study by Wyatt and Baird, 2007

[13] These reports by Baird 1995, MFD 2003, Baird and Meach Mean 2005, Nguyen HuuDuc et al. 2006, Chan Sokheng et al. 2008 and Kottelat2009, all of which are quoted in World Fish Center's report, December 2011

[14] Power point presentation, Community and ProjectDevelopment in the 3S Region by Meach Mean, 3SPN in the Regional Public Forum, Mekong and 3S Hydropower Dams:People's Voices across Borders on River Crisis and Way forward3-4 June 2013, Cambodia-Japan Cooperation Centre (CJCC) Phnom Penh, Cambodia

[15] Taken from "Adaptation to Climate Change in the Countries of the Lower Mekong Basin: Regional Synthesis Report", MRC Technical Paper No. 24, September 2009

[16] Taken from "Impacts of Climate Change and Development on Mekong Flow Regimes, First assessment – 2009, MRC Technical Paper No. 29 June 2010

[17] Excerpt from the report: "The Ability of Local People along the Mekong to Adapt to the Impacts of Hydropower Projects and Climate Change", a participatory action research in 5 villages along the Mekong River, UbonRatchathani province, Thailand's northeast by TERRA with local civil society organizations, 2011-2012, p 39 (Thai version)

[18] Calculating methods taken from the article, "Thailand has 4.5 tonnes of Carbon Credits", Thai Rath, Issue 18180, 31 October 2003, p. 5

[19] http://e-book.ram.edu/e-book/g/GE410/chapter11.pdf.

[20] CDM Plantation Project, JesadaLuangjame, the Office of Forest Research and Development, Royal Forest Department, Ministry of Natural Resources and Environment, October 2013 indicating the CO2/C ratio of 44:12 or CO2 is 3.6667 times more than C)

[21] http://www.tradingeconomics.com/cambodia/co2-emissions-kt-wb-data.html

[22] Calculating methods taken from http://www.ldd.go.th/web_ord/hotsport/"Global, "Global Warming and Baseline Data re: Forest Fire in Agricultural Areas",YuttachaiAnuluxtipun, Chief of 'Climate Change Research and Development Group, the Office of Land Management Research and Development, Ministry of Agriculture and Cooperative