



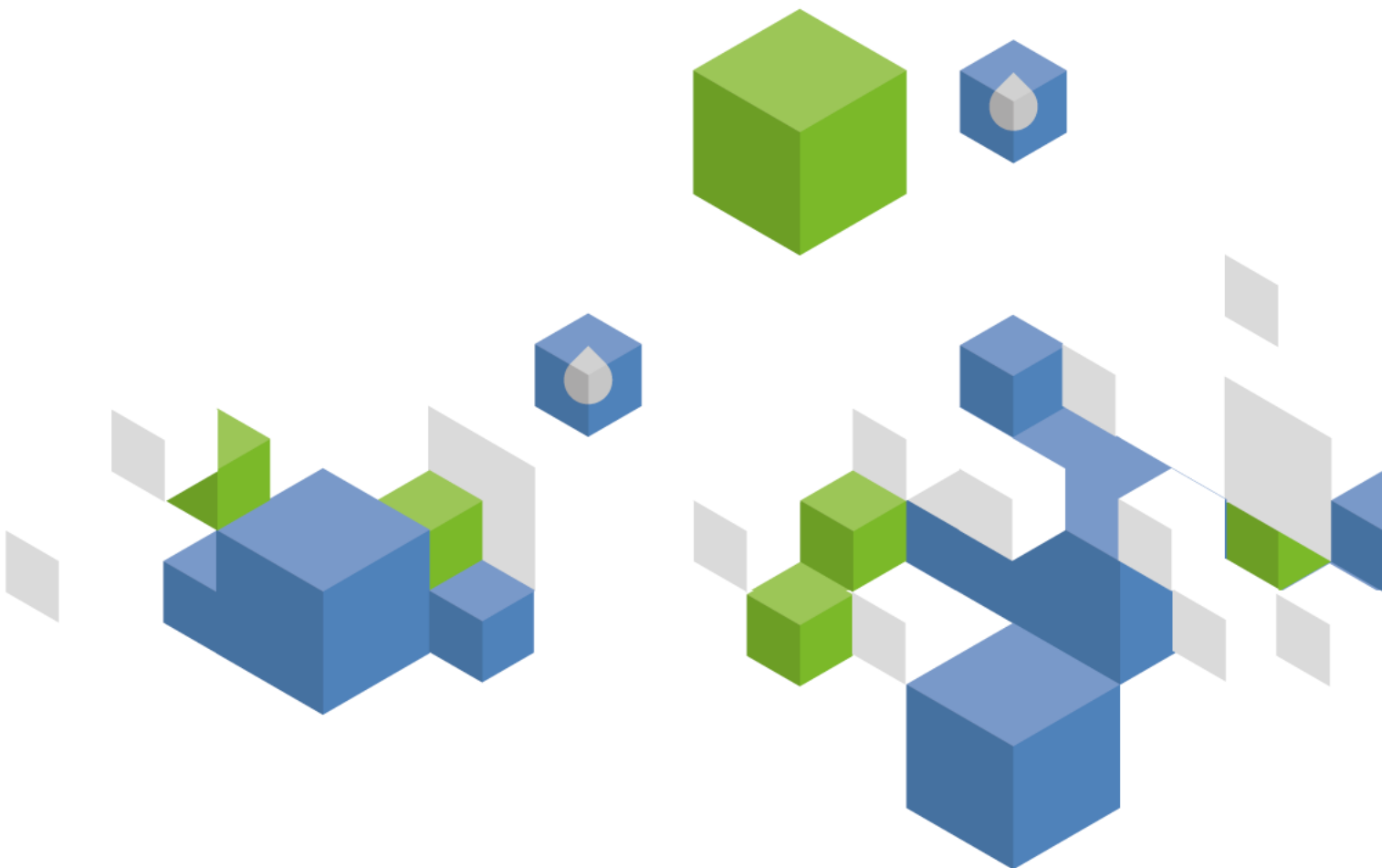
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# Transboundary River Basin Overview – Mekong

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# Mekong transboundary river basin

## GEOGRAPHY, CLIMATE AND POPULATION

### Geography

The transboundary Mekong river basin has a total area of 795 000 km<sup>2</sup>, ranking it the twenty-first largest river basin worldwide, distributed between China (21 percent), Myanmar (3 percent), Lao People's Democratic Republic (25 percent), Thailand (23 percent), Cambodia (20 percent) and Viet Nam (8 percent) (Table 1). The river basin can be divided into two parts: the Upper Basin in China (where the river is called Lancang) and the Lower Mekong Basin from Yunnan (China) downstream to the South China Sea.

TABLE 1  
Country areas in the Mekong river basin

Basin	Area		Countries included	Area of country in basin (km <sup>2</sup> )	As % of total area of the basin	As % of total area of the country
	km <sup>2</sup>	% of Southeast Asia				
Mekong	795 000	3.8	China	165 000	21	2
			Myanmar	24 000	3	4
			Lao PDR	202 000	25	85
			Thailand	184 000	23	36
			Cambodia	155 000	20	86
			Viet Nam	65 000	8	20

The main river in the Upper Basin flows for almost 2 200 km from its source in China near Xizang (Tibet) and decreases in altitude by nearly 4 500 m before it enters the Lower Basin, first becoming the border between Myanmar and Lao People's Democratic Republic, then between Thailand and Lao People's Democratic Republic. This region is called the Golden Triangle. Then the river continues for another 2 600 km in Lao People's Democratic Republic before becoming the border again between this country and Thailand and then re-entering the country. Finally it enters Cambodia and from there Viet Nam where it flows by way of a complex delta system into the sea. The Upper and Lower Basins make up 24 and 76 percent respectively of the total area of the basin (MRC, 2005; MRC, 2010b).

### Climate

The climate of the Lower Basin is dominated by the southwest monsoon, which usually lasts from May until late September or early October and which corresponds to the flood period in the Lower Basin. Heavy rainfall usually occurs, lasting one or two days in most parts of the basin. Later in the season, tropical cyclones occur over much of the area so that August, September, and in the delta even October, are the wettest months of the year. Annual average rainfall is less than 1 500 mm over the Cambodian floodplain and the Mekong Delta and over twice this figure in the Central Highlands of Lao People's Democratic Republic and within the mainstream valley at Pakse.

Figure 1  
Mekong River Basin



**Mekong river basin**

**Legend**

- Capital, town
- International boundary
- Administrative boundary
- Zone of irrigation development
- ▲ Dam
- ☪ Lake
- ~ River
- Canal
- River basin



0 50 100 200 300 400 Km  
Albers Equal Area Projection, WGS 1984

FAO - AQUASTAT, 2011

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Rainfall is less significant in the more temperate northern regions around Chiang Rai in northern Thailand, where July, August and September are generally the months of highest rainfall. Tropical storms and cyclones strongly affect the climate of the basin. This shows up as a double peak in rainfall distribution over most of the Lower Basin during the wet season, and the concentration of maximum rainfall during the last quarter of the year in Cambodia and Viet Nam. Tropical cyclones over central and southern Viet Nam show that the occurrence of the cyclones is more frequent from September to November (MRC, 2005).

In the Upper Basin, Yunnan province in southern China also has a monsoon climate, although there is considerable variation with local topography. The climate varies from tropical and subtropical monsoons in the south of Yunnan, to temperate monsoons in the north as the elevation rises from a mean 2 500 m to 4 000 m above sea level in the most upstream part. The rainfall pattern in the Upper Basin in China is also determined by global monsoon systems, although in Yunnan province there is a much wider variation from year-to-year in the date of the onset of the southwest monsoon. The seasonal distribution of rainfall is the same as for the Lower Basin, although annual amounts decrease towards the north to as little as 600 mm. Snow is rare in the valleys, but significant at higher altitudes and is the major source of water for the dry season and spring flows (April, May) in the upper mainstream part.

The seasonal range of mean temperatures in the lowlands and river valleys of the Lower Basin is not large. Mean summer temperatures are similar from Phnom Penh in the south of Cambodia to the north of Lao People's Democratic Republic and Chiang Rai in Thailand (MRC, 2005). At almost 2 500 m above sea level in the Upper San sub-basin in Viet Nam, Pleiku has mean summer temperatures that are only 2 to 3 °C lower than those typical of the Mekong lowlands. Winter mean temperatures, however, decrease significantly from south to north, from 26 to 27 °C in Phnom Penh and from 21 to 23 °C in Chiang Rai. Winter temperatures are much cooler within the Upper Basin in Yunnan province. At Jinhong, which is 340 km upstream of the hydrological boundary of the Lower Basin, average summer temperatures are only 2 to 3 °C lower, but in winter they are 5 to 6 °C below temperatures at Chiang Rai. However, these differences are generally far less than the changes from day to night. In the far north of Yunnan, the seasonal temperature pattern becomes truly high-altitude continental. Winter temperatures here fall below zero and summer averages may only reach 13 °C (MRC, 2005b).

## Population

The Mekong river basin is a diverse region, in 2007 approximately 70 million people lived across the six countries (CDRI, 2008).

Compared to river basins such as the Ganges-Brahmaputra-Meghna and the Indus average population density is generally low in the Mekong river basin, around 88 inhabitants/km<sup>2</sup>, varying from just over 50 inhabitants/km<sup>2</sup> in the Upper Basin to almost 100 inhabitants/km<sup>2</sup> in the Lower Basin. Density is highest in the Vietnamese part, 260 inhabitants/km<sup>2</sup>, and lowest in Lao People's Democratic Republic, 24 inhabitants/km<sup>2</sup> (UNEP, after 2006).

Population in the Lower Basin was estimated at 60 million in 2007, with about 90 percent of the population of Cambodia (13 million), 97 percent of the population of Lao People's Democratic Republic (6 million), 37 percent of the population of Thailand (23 million), and 20 percent of the population of Viet Nam (16 million in the Delta and 2 million in the Central Highlands) living within the basin. Annual population growth in the basin is 1-2 percent in Thailand and Viet Nam and 2-3 percent in Cambodia and Lao People's Democratic Republic. There are over 100 different ethnic groups living within the basin's boundaries, making it one of the most culturally diverse regions of the world (MRC, 2010; MRC, 2010b).

Although urbanization is occurring in all Lower Basin countries, about 85 percent of the basin's population lives in rural areas. The livelihoods and food security of most of the rural population are closely linked to the river system, with over 60 percent of the economically active population having

water-related occupations that are vulnerable to water-related shocks and degradation. Most basin inhabitants are rural farmers/fishers and, while they may be resource-rich, they are money-poor. One-third of the population lives on less than US\$2 per day. Often lacking access to basic government services, people in the basin are, on average, less well off than their fellow citizens outside the basin. About half of all villages are inaccessible by all-weather roads.

What makes life tolerable for these people are the aquatic resources provided by the basin's rivers and wetlands. While all Lower Basin countries are making good progress towards achieving the Millennium Development Goals (MDGs), more than 35 percent of the populations of Cambodia and Lao People's Democratic Republic have incomes below the poverty line, with much higher percentages in many rural areas. Food security and malnutrition pose great challenges. Throughout the Lower Basin, inequalities are generally increasing between urban and rural groups (MRC, 2010; MRC, 2010b).

In 2008, around 60 percent of the population in Cambodia and Lao People's Democratic Republic had access to safe water, 56 and 51 percent in rural areas of the two countries respectively. In Thailand and Viet Nam, access to safe water supplies is generally more widespread, accounting for 98 percent (both total and rural areas) and 94 percent (92 in rural areas) respectively. In Myanmar access to safe water accounts for 71 percent (69 percent in rural areas) and in China it accounts for 89 percent (82 percent in rural areas). Health conditions for children and women are among the poorest in the world, particularly in less developed areas of the Lower Basin (UNEP, after 2006).

Migration is a transboundary issue, with social and geo-political implications. The search for employment is a major cause of migration. Seasonal and semi-permanent migration to urban areas provides important income for households in rural areas, but the largest movements are between rural areas. People relocate from densely populated rural areas to remote ones to seek new economic opportunities. Economic development in the Lower Basin, especially in urban centres, creates a strong attraction for rural people because jobs are more numerous, better paid and services are more developed (WEPA, 2010).

## WATER RESOURCES

### Surface water

The Mekong river has a mean annual discharge into the South China Sea of approximately 475 km<sup>3</sup>, or 13 000 m<sup>3</sup>/s, ranking it eighth in the world basins (Botkosal, 2009). The per capita water resources are high relative to other international river basins. The flow from the Upper Basin contributes 16 percent of the average annual flow (13 percent according to China), but up to 30 percent of dry season flow (MRC, 2010).

The annual flow from China to Myanmar and Lao People's Democratic Republic is 73.63 km<sup>3</sup>. Leaving China, the river first becomes the border between Myanmar and Lao People's Democratic Republic and then flows over a short distance between Thailand and Lao People's Democratic Republic before entering the latter country. The contribution of Myanmar and Thailand is 17.6 km<sup>3</sup> and 51.9 km<sup>3</sup> respectively. In the south of Lao People's Democratic Republic, near Pakse, the Mekong river enters the country with an estimated 280 km<sup>3</sup>/year at the confluence with the Chi/Mun river coming from Thailand. Annual flow of the Mekong river entering Cambodia is 324.45 km<sup>3</sup>. Other inflows to the Mekong-Tonle Sap system in Cambodia from outside the country amount to 29.9 km<sup>3</sup> from Viet Nam and 1.19 km<sup>3</sup> from Thailand. On average, 470 km<sup>3</sup>/year flows out of Cambodia into Viet Nam through the Mekong channels.

The Mekong river basin comprises a large network of tributaries, forming many sub-basins. Major tributary systems develop in the Lower Basin. These systems can be divided into two groups: tributaries that contribute to the major wet season flow and tributaries that drain low relief regions of lower rainfall. To the first group belong the left bank tributaries that drain the high-rainfall areas of Lao People's Democratic Republic. To the second group belong the tributaries on the right bank, mainly the Mun and

Chi rivers that drain a large part of northeast Thailand (MRC, 2005). Mainstream water transfers have long been considered by Thailand, to complement national approaches to alleviate droughts in the northeast of the country (MRC, 2010).

The Mekong Delta begins in Phnom Penh, where the river divides into its two main distributaries, the Mekong and the Bassac. The Mekong then divides into six main channels and the Bassac into three channels, to form together the 'Nine Dragons' of the outer delta in Viet Nam. The main delta is made up of a vast triangular plain, which is less than 5 m above sea level, large areas of which are flooded every year. The movement of water within this complex channel network cannot be considered natural, owing to the long history of modification. Levees were built hundreds of years ago along some of the main natural channels. Hydrology is not only dominated by the rivers but also by the tide, which has a large expansion in the dry season and which can slow down the drainage of the river during heavy flood periods, mainly downstream (MRC, 2005).

During the end of the dry season (March - April), water flows out from the Great Lake, the Tonle Sap in Cambodia, and joins the Mekong river on its way to the South China Sea. In the wet season (May - September), so much water flows down the Mekong river that it reverses the flow of the Tonle Sap and the lake triples in size. This vast floodplain may be the most productive inland fishery in the world. Its well-being is vital to the people of Cambodia and to the overall health of the basin. In 1997, UNESCO declared the Tonle Sap lake and river system a World Biosphere Reserve (MRC, 2010b). The depth of the lake increases from a dry season maximum of 3.6 m to more than 10 m, and the area of open water increases from 2 500-3 000 km<sup>2</sup> during the dry season up to 13 000 km<sup>2</sup> during the wet season (MRC, 2005).

### Groundwater

Good freshwater aquifers are located in the mountainous regions of Lao People's Democratic Republic and some of these are used for irrigating coffee. Groundwater is also used to irrigate coffee in the Vietnamese highlands, but there is some indication that the groundwater resource is being overused in some areas in Viet Nam with water tables declining over time. The recharge of these aquifers is slow, with farmers sometimes digging horizontally from the base of the wells to extract more groundwater. In northeast Thailand freshwater can be found among the numerous saline aquifers but the volume is not high enough for wide-scale irrigated agriculture. Extensive shallow groundwater reserves are known to exist around Tonle Sap and the Bassac and Mekong rivers in Cambodia and these reserves appear to be constantly recharged from the river but the recharge rate is slow and there is probably insufficient water for intensive irrigation (MRC, 2003).

The Mekong Delta has six aquifers with depths ranging from 15 to 75 m and from 275 to 400 m. Water reserves are large, but exploitation requires careful siting and drilling because much of the water is either brackish or saline and recharge is poorly understood. Water in the lower aquifers is 20 000–30 000 years old and not recharged by local rainfall, which means that there is considerable risk of over-exploitation. In part of the delta, shallow groundwater aquifers have been exhausted. Water levels are thought to have declined through both abstractions and the extensive surface drainage system constructed through the 1990s. The only major areas on the Mekong Delta consuming groundwater for agricultural production are located between and along the Bassac and Mekong rivers. Although the drawdown is significant during the dry season, the shallow aquifers are recharged by floods during the wet season and directly from the river in the dry season (MRC, 2003).

### Water quality, environment, fisheries and forest resources

Water quality is generally good. The composition of the river water shows no deviation from similar international rivers. However, at localized level there appear to be three commonly identified water quality issues: sediment in the water, salinity, especially in northeast Thailand and the delta in Viet Nam



and eutrophication. Salinity, especially in the delta, may increase if predicted salt water intrusion occurs as a result of climate change (MRC, 2009c).

The diverse ecosystems of the basin are exceptionally productive, as are the benefits derived by the inhabitants. The maintenance of high biodiversity represents not only the biological integrity of the ecosystems but also the range of natural resources and products available to both urban and rural populations (MRC, 2009c). The water nourishes large tracts of forests and wetlands, which produce building materials, medicines and food, provides habitats for thousands of species of plants and animals. Known mineral resources include tin, copper, iron ore, natural gas, potash, gem stones and gold (MRC, 2010b). Basin fauna, including 14 critically endangered species, 21 endangered species and 29 vulnerable species, are threatened by rapid developments that will alter habitats and mechanisms that are essential to sustain high ecosystem productivity (MRC, 2010).

The Mekong river is the second most biodiverse river in the world, after the Amazon, and supports the world's largest freshwater capture fishery of about 2.3 million tonnes/year with an estimated commercial value of US\$2 000 million/year (MRC, 2010; MRC, 2010b). The river's annual flood pulse continues to support a rich fishery; although there are reports of declining catches.

The basin is one of the most productive inland fisheries basins in the world. It provides a wide variety of breeding habitats for over 1 300 species of fish and the annual rise and fall of the river ensures a nutrient-rich environment for fish. The fishery provides a livelihood not just for fishers and their families but for thousands more who are employed full or part time making and selling food products and fishing gear, repairing boats and providing hundreds of related services. At the height of the rainy season, the basin is like a vast fish pond teeming with aquatic plants and animals in fields and ponds, lakes, streams and even in roadside ditches. By April and May, fields and ponds have dried up, streams have become trickles and the mainstream itself drops as much as 15 m. Researchers have only recently discovered that a number of valuable fish species have for centuries retreated to deep stretches of the river to wait out the dry season (MRC, 2010b).

The outlook for the basin's forests is not positive, with increasing demand for timber and land driving deforestation and soil degradation. Deforestation impacts on hydrology and related processes, such as flooding, soil erosion and mass soil movement, society and the economy. Progressive disappearance of the flooded forest in the downstream Tonle Sap area is a serious threat to fish reproduction and refuges. The agricultural encroachment that follows deforestation often causes the loss of traditional land-use rights and traditional conservation mechanisms. Water pollution from pesticides and chemical fertilizers used in the development of intensive agriculture is another great concern. Even though persistent pesticides are banned in riparian countries, clearly residual and illegally imported stocks continue to be used because residues of DDT, Dieldrin, and similar chemicals have been found in fish across the Mekong river basin (WEPA, 2010).

## WATER-RELATED DEVELOPMENTS IN THE BASIN

### Agriculture

Mekong farmers have been irrigating farmland since the first century. Today, thousands of farmers throughout the basin are producing a second and some a third rice crop per year in around 12 500 irrigation schemes. Farmers in the Mekong river basin produce enough rice to feed 300 million people per year (MRC, 2010b). Rice is the principal livelihood of people in the region (CDRI, 2008).

Today, 70 percent of the basin's population rely on agriculture for their livelihoods and an increasing population in the region is putting pressure on food security. Agriculture is vital to raising standards of living, improving livelihoods and poverty mitigation in the basin. It is currently the most dominant water-related sector, for both subsistence agriculture and export, particularly in Thailand and Viet Nam where it generates thousands of millions of annual revenue in United States dollars. Agriculture in Cambodia and Lao People's Democratic Republic is currently less intensively developed (MRC, 2009).

It has been estimated that demand for agricultural products from the basin will increase from 20 to 50 percent in the next 30 years. Agriculture, along with fishing and forestry, employs 85 percent of the people living in the basin (MRC, 2010b).

The total area equipped for irrigation in the Mekong river basin is estimated to be around 4.3 million ha, of which Viet Nam accounts for 42 percent, Thailand 30 percent, China 12 percent, Cambodia 8 percent, Lao People's Democratic Republic 7 percent and Myanmar 2 percent. Area actually irrigated is estimated at 3.6 million ha. The equipped area irrigated by surface water accounts for 98 percent while groundwater accounts for 2 percent.

In the Lower Basin, the dry-season irrigated area of about 1.2 million ha is less than 10 percent of the total agricultural area (15 million ha) (MRC, 2010).

The Mekong Delta is one of the most productive regions in the world. Often referred to as Viet Nam's 'rice bowl', the Delta produces more than 16 million tonnes of rice annually for domestic consumption and export in addition to highly productive shrimp farms, orchards and market gardens. Every year, annual floods enrich the delta soils and bring millions of fish to spawn. Sediments carried from far upstream replace the land lost through natural erosion (MRC, 2010b).

Expansion of the present level of agriculture in the basin is limited by the availability of water in the dry season. Proposed dam development, especially reservoir dams upstream, could give a boost to the agricultural sector by redistributing some river flows from the wet to the dry season (MRC, 2009). There are plans to increase dry season irrigation by 50 percent (from 1.2 to 1.8 million ha) over the next 20 years, with Lao People's Democratic Republic planning to expand irrigation in the dry season from less than 100 000 ha to over 300 000 ha. Major irrigation expansion is being studied in Cambodia, linked to investments in flood control in the undeveloped Cambodian delta, and linked to hydropower development elsewhere (MRC, 2010).

Total water withdrawal in the Mekong river basin is estimated at 62 km<sup>3</sup>, or 13 percent of the Mekong's average annual discharge, of which Viet Nam accounts for approximately 52 percent, Thailand 29 percent, China 9 percent, Lao People's Democratic Republic 5 percent, Cambodia 3 percent, and Myanmar 2 percent. Irrigation withdrawal accounts for 56 km<sup>3</sup>, or 90.5 percent of the total.

Existing reservoir storage capacity is insufficient to redistribute water significantly between seasons. Groundwater use in the basin is modest except in China, northeast Thailand and Viet Nam where surface water is scarce during the dry season. Sustainable groundwater development potential requires careful assessment. Surface water and groundwater account for 97 percent and 3 percent of total withdrawals in the Mekong river basin respectively.

The Watershed Management Project aims to put individuals and communities in charge of protecting catchments to ensure clean water. Sometimes, this may involve changing agricultural techniques or sanitation habits, which contaminate nearby water sources. The programme began its third and final phase in 2008 (MRC, 2009).

### **Dams and hydropower**

The Mekong river basin has become one of the most active regions in the world for hydropower development (MRC, 2009c). The total potential for feasible hydropower projects in the four Lower Basin countries is approximately 30 000 MW, more than enough to meet the expected demand in the coming decade. This includes 13 000 MW on the Mekong's mainstream, and the remaining on its tributaries, of which 13 000 MW are in Lao People's Democratic Republic, 2 200 MW in Cambodia and 2 000 MW in Viet Nam (WEPA, 2010).

As shown in Table 2, hydropower projects with a total installed capacity of 2 612 MW are already in operation in the Lower Basin, while projects with a further 3 574 MW are currently under construction.

All of these projects are located on the tributaries, not on the mainstream. Nearly half of them enable some degree of seasonal regulation of streamflow. Much of the electricity produced is used to power cities and industries outside the basin (MRC, 2010b).

TABLE 2

**Existing, under construction and planned/proposed hydropower projects in the Lower Mekong river basin (Source: MRC, 2009c)**

Country	Installed capacity (MW)			Total
	Existing	Under construction	Planned/proposed	
Cambodia	1	-	5 589	5 590
Lao People's Democratic Republic	662	2 558	17 686	20 907
Thailand	745	-	-	745
Viet Nam	1 204	1 016	299	2 519
<b>Total</b>	<b>2 612</b>	<b>3 574</b>	<b>23 574</b>	<b>29 760</b>

Table 3 shows the existing large dams with details on height and capacity, where information was available. Thirteen hydropower dams have a capacity of more than 10 MW.

TABLE 3

**List of completed major dams in the Lower Mekong river basin (2008)**

Country	Name	Nearest city	River	Year	Height (m)	Capacity (million m <sup>3</sup> )	Capacity (MW)	Main use *
<b>Cambodia</b>	Ochum	Lumphat	n.a.	n.a.	n.a.	n.a.	1 H	
<b>Lao People's Democratic Republic</b>	Nam Ngum	Phonhong	Nam Ngum	1971-85	45	7 010	150 H	
	Xeset	Kong	Xeset	1991	n.a.	n.a.	45 H	
	Theun Hinboun	Pakxan	Kading	1998	65	20	220 H	
	Houay Ho	Samakhixai	Kong	1998	80	596	150 H	
	Selabam	Pakse	Se Don	1970	n.a.	n.a.	5 H	
	Nam Leuk	Phonhong	Nam Leuk	2000	45	185	60 H	
	Nam Mang 3	Phonhong	Nam Gnong	2004	34	550	40 H	
				<b>Sub-total</b>			<b>670</b>	
<b>Thailand</b>	Sirindhorn	Ubon Ratchathanee	Lam Dom Noi	1971	42	1966	36 I, H, W, F	
	Chulabhorn	Chaiyaphum	Nam Phrom	1972	70	188	15 I, H, W, F	
	Ubol Ratana	Khon Kaen	Nam Pong	1966	32	2 264	25 I, H, W, F	
	Pak Mun	Ubon Ratchathanee	Mun	1994	17	114	136 H	
	Lam Ta Khong	Nakhon Ratchasima	Lam Takhong	1969	40	310	1 000 I, H, W, F	
				<b>Sub-total</b>		<b>4 842</b>	<b>1 212</b>	
<b>Viet Nam</b>	Dray Ling	n.a.	n.a.	1995	n.a.	n.a.	13	
	Yaly	Pleiku	San	2002	69	1 037	720 H, F	
				<b>Sub-total</b>			<b>733</b>	
				<b>TOTAL</b>		<b>-</b>	<b>2 616</b>	

n.a. Information not available

\* I = irrigation; H = Hydropower, W = Water Supply; F = Flood protection

The governments of Cambodia, Lao People's Democratic Republic and Thailand are now actively considering building dams on the mainstream Mekong river, as well as on tributaries. Private sector interest in tributary development in Viet Nam also remains high (MRC, 2009). Over the next 20 years, further Lower Basin dams are planned, including twelve mainstream projects. Ten of these are dams planned across the river channel (eight in Lao People's Democratic Republic, two of which are on the Lao-Thailand mainstream, and two in Cambodia), one will be partial damming (Don Sahong) and one a diversion project (Thakho) in Lao People's Democratic Republic. Thirty tributary dams are planned, mostly in Lao People's Democratic Republic. All mainstream dams are classified as "run-of-river", with limited storage capacity and regulation potential. Many tributary dams include significant reservoirs, adding 21 000 million m<sup>3</sup> of storage (MRC, 2010).

There is also huge hydropower potential in the Upper Basin. In Yunnan Province (China), total hydropower potential is an estimated 23 000 MW (WEPA, 2010). China is completing its hydropower cascade on the Lancang mainstream. The Manwan, Dachaoshan, Jinghong and Xiaowan dams are currently operational and the Nuozhadu dam will be completed in 2014. The Xiaowan and the Nuozhadu dams, with 15 043 and 22 400 million m<sup>3</sup> of storage, may cause significant seasonal redistribution of flow from the wet season to the dry season and further reduce sediment transport in the Mekong mainstream, providing both opportunities and risks to downstream countries (MRC, 2010).

Table 4 shows the major existing and planned mainstream hydropower projects in the Upper Basin in China. While the first three dams constructed have limited capacity to regulate flows, Xiaowan and Nuozhadu (under construction) have major storage capacity and therefore significant influence on the seasonal distribution of flow entering the Lower Basin (MRC, 2009c).

Table 4 shows the large dams in the Indus river basin.

TABLE 4

**Existing, under construction and planned mainstream hydropower projects in the Upper Lancang/Mekong river basin**

Project	Status	Nearest city	River	Commissioning	Height (m)	Capacity (million m <sup>3</sup> ) Total	Capacity (MW)
Manwan	Existing	Aihua	Lancang	1995	132	662	1 750
Dachaoshan	Existing	Lishu	Lancang	2004	111	933	1 350
Jinghong	Existing	Jinghong	Lancang	2008	108	1 233	1 750
Xiaowan	Existing	Luodang	Lancang	2010-2014	292	15 043	4 200
Gonguoqiao	Construction	Yongping	Lancang	2012	130	510	750
Nuozhadu	Construction	Menga	Lancang	2014	261.5	22 400	5 500
Mengsong	Planned	Jinghong	Lancang	Before 2025	65	-	600
Ganlanba	Planned	Jinghong	Lancang	Before 2025	60.5	-	150
<b>TOTAL</b>							<b>14 800</b>

Navigation is important but largely undeveloped as an integrated transport sector. River-related tourism is important for national revenue and local income generation (MRC, 2010).

There are increasing opportunities for the private sector and foreign state-owned companies in the development of water and related resources, such as hydropower, navigation, large-scale irrigation, and industry (mining, forestry, and tourism). In many of these areas, private sector investment now exceeds that of the public sector. In comparison with conventional public sector driven developments, private sector developments are more opportunity-driven with relatively short planning cycles and assessment processes. While private sector participation is welcomed, it needs to be open to public scrutiny and sensitive to civil society concerns. This will require effective regulatory systems, including enabling legislation and regulations and enforcement capacity, as well as strong and empowered water resource management agencies (MRC, 2010).

## TRANSBOUNDARY WATER ISSUES

### Evolution of cooperation in the Mekong river basin

Cooperation in the Mekong river basin begins in the middle of the twentieth century with the formal signing of the Geneva Accords (1954), when the newly independent nations of Cambodia, Lao People's Democratic Republic and Viet Nam took their places on the world stage (MRC, 2010b). In 1957, the United Nations-founded Mekong Committee (Committee for Coordination of Investigations of the Lower Mekong Basin) was established by Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam during the thirteenth session of the United Nations Economic and Social Committee for Asia and the Pacific (ESCAP) to address the comprehensive development of water and related resources in the Lower Mekong Basin (ESS, 2010).

Studies of the Mekong by the United Nations Economic Commission for Asia and the Far East (ECAFE) and the United States Bureau for Reclamation (USBR) sparked interest in a grand scheme to develop what was thought of as one of the world's great 'untamed rivers'. The Mekong Project, launched in 1957, was the largest single development project the fledgling United Nations organization had ever undertaken. When the Mekong Committee began its work, there were no models to follow. In its early days, the Committee was guided and supported by ECAFE and the United Nations Development Agency (MRC, 2010b).

From 1957 through to the mid-1960s, the Mekong Committee conducted hundreds of surveys and studies. Teams of experts traveled up and down the mainstream and its tributaries in boats, in jeeps, on foot, and on the backs of elephants to map, measure, sample and catalogue a rich diversity of resources. These studies were the basis of an ever-expanding 'knowledge base', now maintained by the Mekong River Commission (MRC, 2010b).

Lack of stability in the region resulted in the interruption of Mekong Committee sessions in the late 1970s. In response to Cambodia's absence, in 1977 Lao People's Democratic Republic, Thailand and Viet Nam adopted a new statute forming the basis of the Interim Mekong Committee. When Cambodia finally requested readmission in 1991, lengthy discussions began which led to the eventual transformation of the Mekong Committee through the 1995 Mekong Agreement (MRC, 2010b).

### The Mekong River Commission

The Mekong River Commission (MRC) was formed in 1995 by the Mekong Agreement between the governments of Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam. The four countries signed The Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin and agreed on joint management of their shared water resources and development of the economic potential of the river. The agreement brought a change of identity to the organization, which was previously known as the Mekong Committee. The MRC consists of three permanent bodies (MRC, 2010b):

- Council: consists of one member from each country at ministerial or cabinet level and meets once a year. It makes policy decisions and provides other necessary guidance concerning the promotion, support, cooperation and coordination of joint activities and programmes to implement the 1995 Agreement. It has overall governance of the MRC.
- Joint Committee: consists of one member from each country at no less than Head of Department level. It is responsible for the implementation of the policies and decisions of the Council and supervises the activities of the MRC Secretariat. This body functions as a board of management.
- Secretariat: is the operational arm of the MRC. It provides technical and administrative services to the Joint Committee and the Council, and is under the direction of a Chief Executive Officer (CEO) who is appointed by the Council. Under the supervision of the Joint Committee, the CEO is responsible for the day-to-day operations of around 155 professional and general support staff. In 2009 it was decided that the Secretariat would be permanently cohosted in two locations, one office in Vientiane (Lao People's Democratic Republic) and one office in Phnom Penh (Cambodia). The Assistant CEO is of the same nationality as the Joint Committee Chair and serves a one-year term. The main counterparts for MRC activities in the four member countries are the National Mekong Committees (NMCs).

Since the 1995 Agreement, the MRC has launched a process to ensure "reasonable and equitable use" of the Mekong river system, through a participatory process with NMCs in each country to develop procedures for water utilization. The NMCs coordinate MRC programmes at the national level and provide links between the MRC Secretariat and the national ministries and line agencies (MRC, 2010b).

In 1996 China and Myanmar became Dialogue Partners of the MRC and the countries now work together within a cooperation framework. On 1<sup>st</sup> April 2002 China signed an agreement on the provision of hydrological information on the Lancang/Mekong river. Under this agreement China now provides water level data in the flood season from two stations located on the Upper Mekong in China. This information is fed into the MRC's flood forecasting system. Talks are under way to expand this data-sharing agreement to include dry season levels (MRC, 2010b).

## Programmes

The MRC promotes regional cooperation to implement the 1995 Agreement. It serves its member states by supporting decisions and promoting action on sustainable development and poverty alleviation as a contribution to the MDGs. It supports the Mekong Programme, a regional cooperation programme for the sustainable development of water and related resources in the Mekong river basin owned by its member countries (MRC, 2010b).

The 1995 Mekong Agreement charges the MRC with the formulation of a Basin Development Plan (BDP) "to promote, support, cooperate and coordinate in the development of the full potential of sustainable benefits to all riparian states and the prevention of wasteful use of the Mekong basin waters, with emphasis and preference on joint and/or basin-wide development projects and basin programmes". The first phase of the BDP (2001-2006) achieved much in terms of establishing processes and creating a framework for participatory planning. It made good progress in the improvement of the knowledge base and tools for water resources development planning. It also established a project database that contains screened and prioritized projects, some of which are being implemented or prepared for implementation with support from development partners. The second phase of the BDP Programme (2006-2010), which started full operations in 2008, is designed to institutionalize the participatory planning process established during BDP Phase 1 and further develop the assessment tools and integrated water resources management (IWRM)-based planning capacity to produce a rolling IWRM-based BDP. The four goals of the organization for 2006-2010 were to:

1. promote and support coordinated, sustainable, and pro-poor development;
2. enhance effective regional cooperation;
3. strengthen basin-wide environmental monitoring and impact assessment;
4. strengthen basin-wide environmental monitoring and impact assessment;
5. strengthen the IWRM capacity and knowledge base of the MRC bodies, NMCs, Line Agencies, and other stakeholders(MRC, 2010b).

The Water Utilization Programme (WUP) ran from 2000-2008, developing 'procedures' for water use that could be agreed upon by the four governments of the Lower Mekong river basin. These procedures were required under Articles 5, 6 and 26 of the 1995 Agreement. The most important were procedures for data and information exchange and sharing, for water-use monitoring, and for maintenance of flows on the mainstream approved in 2001, 2003 and 2006 respectively (MRC, 2010b).

The goals of MRC's Agriculture, Irrigation and Forestry Programme (AIFP) are to ensure that sound river basin management will preserve the natural resource benefits of catchments for the future, to develop improved irrigation and water use methods and engage in research on the best methods for monitoring land-use changes and the complete important baseline studies on river basin management, forestry and land-use planning. The AIFP completed its first phase in December 2005.

In 2010, the IWRM-based Basin Development Strategy for the Lower Mekong river basin was prepared. The participatory preparation of this strategy and its approval by the MRC Council is a major achievement in the move towards sustainable Mekong river basin development and management. The strategy is a statement of the Lower Mekong river basin countries (Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam) setting out how they will share, use, manage and conserve the water and related resources of the Mekong to achieve the goals of the 1995 Mekong Agreement. The strategy

is part of MRC's response to Article 2 of the 1995 Mekong Agreement, which calls for "the formulation of a basin development plan, that would be used to identify, categorize and prioritize the projects and programmes to seek assistance for and to implement at the basin level". It provides initial directions for sustainable basin development and management that are subject to review and updating by MRC every five years (MRC, 2010).

The strategy: (i) defines the scope of opportunities for water resources development (hydropower, irrigation, water supply, flood management) and their associated risks and required actions to optimize the opportunities and minimize the risks; (ii) defines other water-related opportunities (fisheries, navigation, environment and ecosystems, watershed management); (iii) provides a coordinated, participatory and transparent process that promotes sustainable development (MRC, 2010).

As part of the Mekong river basin countries' push for rapid economic growth and development, there is pressure to increase access to water for electricity generation and for irrigation, and to provide water for urbanization and industrial development. Development is uneven. China, Thailand and Viet Nam are investing more in generating electricity to support local production and urbanization, while Cambodia, Lao People's Democratic Republic and Myanmar are still in the process of investing in basic irrigation systems for agricultural production. While co-riparian states tend to be more cooperative when it comes to water than other resources, the degree of cooperation still depends on self-interest and the capacity of the individual states to accommodate individual development interests. Each country needs to strictly implement internal and international environmental codes of conduct and make sure every water-related development project is compliant with human water rights. This requires stronger transboundary coordination and negotiation mechanisms including enforcement of agreed institutional arrangements, and laws and regulations for equal rights of access and sharing benefits from the Mekong river (CDRI, 2008).

Fishery resources management is the perfect example of a transboundary issue that challenges every riparian country. It is obvious that any change in the ecosystem occurring in the upstream region will affect and impact on the livelihoods of hundred of millions of people whose food supply and economic activities rely heavily on fishery resources in the downstream areas. Water quality, water availability, and preservation of the flooded forest are key conditions for the survival and sustainability of fishery resources in Cambodia (WEPA, 2010).

Among the weak points, the 1995 Mekong Agreement does not set any strict upper limits on water use, except for trans-basin diversions in the dry season, but this is not where large potentials lie. Cambodia obtained an assurance that the reversed flow of the Tonle Sap river, following the annual flooding would be allowed. It will also benefit from improved information flow and a higher concern of overall environmental protection in the basin. On the other hand, Cambodia and Viet Nam are vulnerable compared to Thailand and Lao People's Democratic Republic when it comes to trans-basin diversions and other large-scale upstream water use, such as for example hydropower development (WEPA, 2010).

An important challenge of regional cooperation is the cost of upstream effects on ecological systems downstream. Article 7 of the 1995 Mekong Agreement requires each co-riparian state to make every effort to avoid, minimize and mitigate harmful effects that might occur to the environment, especially the water quantity and quality, the aquatic (ecosystem) conditions, and the ecological balance of the Mekong river basin water resources or discharge of wastes and return flows. However, Lao People's Democratic Republic and Viet Nam, for example, have been building dams in the upper catchment of the Kong river basin, to generate electricity for sale to Thailand and Viet Nam. These hydroelectricity dams affect hydrological flows and the livelihoods of the people who live along the San and Srepok rivers, the Kong's tributaries, and the flow into the Mekong, affecting aquatic eco-systems, fish and fish production in the Tonle Sap (CDRI, 2008).

The transboundary implications of hydropower projects on water quality and quantity are numerous. The first risk of hydropower projects development in the upstream area of the Mekong river is the negative impact on the environment and society. These risks have been duly identified as:

- adverse impacts on the ecosystem (aquatic life, animals, birds, vegetation);
- blocking the flow of sediment;
- negative impacts resulting from changes in a river's flow pattern;
- negative social impacts (resettlement, loss of livelihood);
- loss of scenic landscapes (tourism potential);
- negative impacts on water quality because of storage of water (eutrophication, lower temperatures for discharged water);
- negative impacts on other users of water (navigation, fisheries);
- problems during the construction period (noise, vibration, dust, traffic problems);
- when associated with irrigation, land salinization and waterlogging; and
- danger from sudden and unexpected release of water from flood spillage or hydropower generation.

The second type of risk is geo-political, i.e. the inevitable dependence of countries that do not possess hydropower upon those that develop hydropower projects. Cambodia is particularly vulnerable because it will certainly increasingly depend on Thailand, Lao People's Democratic Republic and Viet Nam for power supply. A cut off of power supply by power producers would seriously impede any possibility for Cambodia to achieve its development goals and strategies, such as to alleviate poverty, improve the population's livelihood, welcome further foreign investments, sustain tourism development, etc. (WEPA, 2010).

Table 5 lists the main historical events in the Mekong river basin.

TABLE 5  
Chronology of major events in the Mekong river basin

Year	Plans/projects/treaties/conflicts	Countries involved	Main aspects
1954	Signing of the Geneva Accords	Cambodia, Lao People's Democratic Republic and Viet Nam	Mekong cooperation begins
1957	Mekong Committee formed	Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	Address comprehensive development of water resources and related resources in the Lower Mekong Basin (LMB)
1957	Mekong Project	ECAFE, United States Bureau for Reclamation and LMB countries	
1977	Interim Mekong Committee formed	Lao People's Democratic Republic, Thailand and Viet Nam	In response to Cambodia's absence, in 1977 Lao People's Democratic Republic, Thailand and Viet Nam adopted a new statute
1991	Cambodia requested readmission in the Mekong Committee	Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	Lengthy discussions began which led to the eventual transformation of the Mekong Committee through the 1995 Mekong Agreement
1995	Mekong Agreement	Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	The four countries signed <i>The Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin</i> and agreed on joint management of their shared water resources and development of the economic potential of the river
1995	Mekong River Commission (MRC) formed	Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	Formed by the Mekong Agreement. The MRC consists of three permanent bodies: the Council, the Joint Committee and the Secretariat
1996	China and Myanmar became Dialogue Partners of the MRC	China, Myanmar, Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	The countries now work together within a cooperation framework



TABLE 5 (Continued)  
Chronology of major events in the Mekong river basin

Year	Plans/projects/treaties/conflicts	Countries involved	Main aspects
2002	China signed an agreement on the provision of hydrological information on the Lancang/Mekong river	China	China now provides water level data in the flood season from two stations located on the Upper Mekong in China
2001-2006	Basin Development Plan (BDP) (Phase I)	Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	The 1995 Mekong Agreement charges the MRC with the formulation of a BDP. This first phase achieved much in terms of establishing processes and creating a framework for participatory planning.
2006-2010	BDP (Phase II)	Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	Designed to institutionalise the participatory planning process established during BDP Phase 1 and develop the assessment tools to produce a rolling IWRM-based Basin Development Plan.
2000-2008	Water Utilization Programme (WUP)	Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	Developing 'procedures' for water use that could be agreed upon by the four governments of the LMB
2005	Agriculture, Irrigation and Forestry Programme (AIFP) (Phase I)	Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	Prepared by the MRC
2010	IWRM-based Basin Development Strategy for the LMB has been prepared	Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam	The participatory preparation of this Strategy and its approval by the MRC Council is a major achievement in the move towards sustainable MRB development and management

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