



Mekong River Commission

STATE OF THE BASIN REPORT

2010

SUMMARY





MRC 2010. State of the Basin Report 2010 Summary.
Mekong River Commission, Vientiane.

ISBN 978-993-2080-58-8

© Mekong River Commission

PO Box 6101,
Unit 18 Ban Sithane Neua, Sikhottabong District,
Vientiane 01000, Lao PDR
email: mrcs@mrcmekong.org
www.mrcmekong.org

Design by Silkworm Books • www.silkwormbooks.com
Print and bound in Thailand by O. S. Printing House, Bangkok

This summary booklet is available in English, Khmer, Lao, Thai and Vietnamese languages. Sources to support the material presented in this summary can be found in the full report.

For more information contact: mrcs@mrcmekong.org

The State of the Basin Report and this summary are also available as free downloads on the MRC website
www.mrcmekong.org



Preface

About 60 million people live in the Lower Mekong Basin (LMB) and while continued economic growth has led to a significant improvement in living standards in recent years, many of the basin's population still live in poverty. The livelihoods and food security of most people in the basin are closely linked to the Mekong and the resources it supports.

The Mekong River Commission (MRC) has been in existence since 1995 and its role is to help the governments of the Lower Mekong Basin (Cambodia, Lao PDR, Thailand and Viet Nam) sustainably manage the basin's water and related resources and use these resources to lift the population out of poverty. It is important that decision-makers have timely and accurate information on water-related sectors and an understanding of the impact that developing these sectors is having on the economy, environment and people. In support of these objectives the MRC has published the *State of the Basin Report 2010*. This summary highlights some of the report's main findings.

This second *State of the Basin Report* describes the status of the LMB's water and related resources. It provides readers with information about the ecological health of the Mekong river system, highlighting its resilience to current human induced pressures and also the threats it faces. The report outlines some of the development challenges for the LMB – including hydropower development, land use change and climate change. These will be monitored and revisited in subsequent *State of the Basin* reports.

An understanding of the status of water resources in the basin provides a broader perspective on the potential vulnerability of its inhabitants and informs the poverty alleviation objectives of the governments of the

MRC Member Countries, all of which have indicated a desire to supplement the already considerable natural resource benefits that the river provides by including the Mekong Basin in their economic development strategies.

The MRC with its Member Countries is developing an Integrated Water Resources Management (IWRM) Basin Development Strategy as part of the response to the water resources challenges. This strategy is scheduled for completion by the end of 2010.

As with other river basins, informed choices need to be made and some of the proposed developments, especially proposed hydropower schemes on the mainstream Mekong, are contentious. This report provides an important contribution to the ongoing debate that is taking place among stakeholders in Mekong countries on the opportunities and risks associated with various future development scenarios.

The challenges outlined in the report will require further cooperation in monitoring, research and management over the next few years. Many of these already form the core of MRC's work and I trust that highlighting them in the report helps move these issues further into the public domain.

The livelihoods of millions depend on the careful management of the basin in a climate of openness and transparency. To this end, I am confident that the *State of the Basin Report 2010* will be a valuable reference for strategic planning in the Mekong region for several years to come, and will contribute to the foundation for knowledge-based water resources development policy.



Jeremy Bird

Chief Executive Officer

MRC Secretariat

Overview

The MRC's *State of the Basin Report* aims to provide an overall picture of the state of the Lower Mekong Basin (LMB), in terms of its people and their livelihoods, the environment and the economy. Research and monitoring since the first State of the Basin Report was published in 2003 has provided information which helps to build a picture of the status and trends of a number of key indicators. In the light of this information, the report also looks ahead to highlight some of the challenges for the basin countries.

Urbanisation is a trend in the four LMB countries as people migrate from rural areas to seek opportunities in expanding urban centres. While most of the basin's 60 million inhabitants are still based in rural areas, rates of rural population growth are expected to fall in the coming decade. The figures indicate that the overall population has increased by about eight per cent since the figures reported in 2003 (55 million) although the trends vary between countries. The LMB population has increased by 25 per cent in Cambodia, by about six per cent in Lao PDR, has remained

the same in Thailand and increased by about 10 per cent in Viet Nam.

Living standards have generally increased but significant areas of poverty remain, particularly in rural areas. The Human Development Index (HDI), which provides a measure of progress using indicators such as longevity, knowledge and standard of living, is improving in all the LMB countries. The HDI of Thailand is slightly above the average for Asia and Viet Nam's is just below the average, while those of Lao PDR and Cambodia are lower.

The livelihoods and food security of most of the basin's rural inhabitants are closely linked to the Mekong and its waterways. The river is a source of fish and other aquatic products for food and income, water to grow crops, and a transport route which provides access to markets. This close relationship also means that people are particularly vulnerable if the river and its wetland ecosystems become degraded.

The multitude of ecosystems within the Mekong River Basin support a huge diversity



of plants and animals, with new species still being discovered. Wetland ecosystems provide a range of valuable services, including flood protection and waste water purification. Attempts are being made to put an economic value on these services so they can be accounted for in decision making.

Monitoring of Mekong waterways shows the river's resilience to the current human induced pressures. Water quality at most sites is good, except in the Mekong Delta where high nutrient levels are a cause for concern. The river's annual flood pulse continues to support a rich fishery despite some reports of declining catches. However, the outlook for the basin's forests is not so positive, with increasing demand for timber and forest land driving deforestation and degradation.

Agriculture is the single most important economic activity in the LMB and farming is one of the largest water users. Rice is the staple of people's diets and also the most common source of income for rural residents in the Mekong corridor. Yields have been rising in all countries since the 1990s due to

improvements in technology and a larger proportion of land under irrigation.

Navigation on the river is increasing as the Mekong becomes an important link in international trade routes and also increasingly popular for the growing tourism sector. In some areas of the basin, water transport is the only, or at least the most efficient, means of transport available for much of the year.

As living standards increase so does the demand for energy, providing opportunities for hydropower development in Lao PDR, Cambodia and Viet Nam.

Governments of the basin countries increasingly recognise that developing the economic potential of the Mekong river system in a sustainable way to alleviate poverty and improve livelihoods. But the opportunities need to be balanced against the potential impacts on the environment, fisheries and people's livelihoods.

The State of the Basin Report represents a compilation of existing knowledge, a snapshot in time, which will provide a resource for governments, resource managers and other stakeholders in the Mekong Basin.



People and poverty in the Lower Mekong Basin

Millions of people living in different geographical areas of the LMB depend on waters and riverine aquatic products for food, income, livelihood opportunities and their way of life. Many of them live in poor conditions with limited access to clean water and sanitation. As well, many of the population face uncertainties, such as flooding and other disasters, lack of land ownership and consequences from global economic failure. The high degree of dependence on water resources for livelihoods and food security means that people are also highly vulnerable when these resources decline or become degraded.

The UNDP classifies all the LMB countries as 'medium human development' with a human development index (HDI) that has steadily improved over the past few decades.

Nonetheless, beneath the HDI lie many disparities within and between countries.

Despite rapid economic growth over the past two decades, Cambodia is still one of the world's poorest countries. An average of 35 per cent of the population live below the national poverty line but in many rural areas the proportion is almost 80 per cent. Economic growth is increasing, with agriculture the dominant sector, employing 70 per cent of the workforce. About 35 per cent of the population lack access to an improved water source.

Likewise, in Lao PDR, poverty is widespread, with 33 per cent of the population below the national poverty line. Half of all households have no safe water supply and half of all villages are unreachable by all-weather roads during the rainy season. The

Human development indices in the LMB countries (1990–2007)

	HDI			
	1990	1995	2000	2007
Cambodia	n.a.	0.540	0.547	0.593
Lao PDR	0.478	0.524	0.563	0.619
Thailand	0.712	0.745	0.761	0.783
Viet Nam	0.590	0.672	0.711	0.725
Average for Asia				0.724



highest concentrations of poverty are found in the southern highlands along the border with Viet Nam. Lower rates are found in the mountainous villages in the north and the least incidence of poverty occurs in urbanised areas in and around the largest towns. Life expectancy has increased in recent years, especially in Lao PDR, where it has risen from 54 years in 2000 to 64 years in 2007, although both Lao PDR and Cambodia are still below the average of 69 years for developing countries in East Asia and the Pacific.

Health conditions for children in Cambodia and Lao PDR remain poor despite improvements in recent years. From 2000 to 2006 the infant mortality rate in Cambodia fell from 88 per 1000 live births to 65 and in Lao PDR it declined from 92 to 59, both still well above the average for Southeast Asia of 27. In Cambodia, 36 per cent of children under the age of five are underweight.

In Thailand and Viet Nam, the rate of development is further advanced. Thailand has achieved the objectives of the nine Millennium Development Goals well in advance of the 2015 target. The proportion of people living below the poverty line was reduced from 27 per cent in 1990 to 12 per cent in 2004.

Viet Nam has made great progress in overcoming poverty with a decline in the number

of people below the national poverty line from 75 per cent in 1990 to 16 per cent in 2006, although large differences exist between rural and urban populations, where the respective poverty rates are 45 and 18 per cent. Ethnic minorities have not yet shared in many of the benefits of the past decade's developments, especially in rural areas where living standards have improved at a much lower rate.

The Mekong Delta in Viet Nam, the most densely populated agricultural region, has a population of more than 17 million (21 per cent of Viet Nam's population). The delta has become the most important agricultural region in the country, accounting for more than 50 per cent of staple food crops and 60 per cent of fish production.



Livelihoods depend on a healthy river basin

The diverse ecosystems of the Mekong Basin are the basis for a wide variety of livelihoods and give food security for most of the basin's rural population. Flooded paddy fields are used to grow rice and also support a vast fishery which provides a source

of protein and income for rural inhabitants throughout the basin. Large areas of forest contain a unique biodiversity as well as providing fuelwood and other products to the region's inhabitants.

Agriculture built on fertile river soils

Agriculture is the single most important economic activity in the LMB. More than 10 million ha of cultivated land is used to produce rice – the staple for most of the region's inhabitants. In the most productive area, the Mekong Delta, farmers may produce three crops a year. Yields per crop range from 1.0 to more than 5.0 t/ha. In 2005, about 33.8 million tonnes of rice was produced in the LMB, more than half of it in Viet Nam. For more than half the rural residents along the Mekong corridor the sale of rice is also the most common source of income.

In all the LMB countries rice yields have been increasing by about three per cent per year since the early 1990s. In Cambodia, both wet and dry season rice production and yields

are increasing. In Lao PDR, the most important production system is wet season lowland rice, which continues to expand. The area of upland rice, which is often associated with shifting agriculture, on the other hand, has declined. In the Viet Nam delta, although the agricultural area has declined over the past two decades, productivity increases have led to a rise in production. However, this increased productivity is associated with heavy use of pesticides and consequently many rice paddies in the Viet Nam delta are no longer considered suitable for fish production. In northeast Thailand, more than 80 per cent of the cultivated area is used for growing rice or a mix of rice and upland crops. The harvested area of rice in Thailand fell slightly between 2000 and 2005.



Rice is likely to remain the basis for agriculture in the LMB over coming decades. Over the next 20 years production is forecast to improve sufficiently to more than supply the growing population. This increased production will come from a larger area under irrigation and increases in grain yield.

The irrigation sector is the largest water user in the LMB, consuming an estimated 41.8 billion cubic metres of freshwater resources per year. More than half of this water use takes place in the Viet Nam delta, followed by Thailand, Lao PDR and Cambodia. The area under irrigation has expanded gradually in all four LMB countries since 1990. A recent assessment of irrigation in the LMB recorded almost 15,000 individual irrigation projects, varying from small to large scale, and from gravity to pump-fed irrigation.

Along with their main use for growing rice, paddy fields provide many other benefits, such as providing a habitat for fish and other animals, including shrimps, molluscs and frogs, which are an important food source. They also play an important role in flood mitigation.

A significant trend in the basin's agriculture is the accelerating spread of plantations for commercial production of rubber and energy crops, partly due to a rise in energy prices and export demand for biofuels in neighbouring markets. Expansion of agriculture poses considerable challenges in terms of loss of biodiversity and forest cover, with agriculture representing the main cause of deforestation in the LMB. In recent years land clearing for agriculture has had a greater impact on forest cover than logging.



Forests key to sustainable watershed management

Economic development, at both the global and national level, is exerting considerable pressure on the forests of the lower Mekong countries. Population growth, expanding development and policy impacts are all influencing the forest landscape.

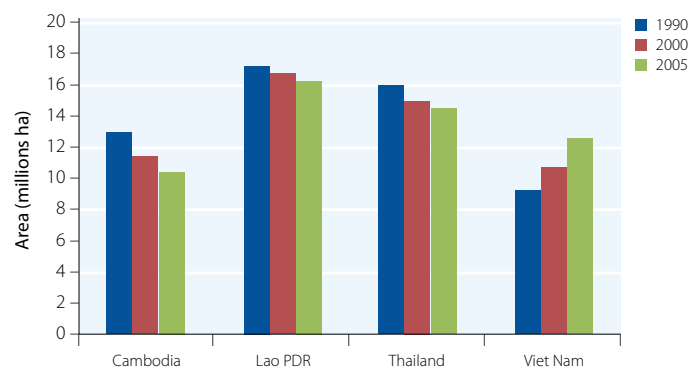
Forest area in the LMB countries totals 54 million hectares and accounts for 43 per cent of the land area. Although the area of forest designated primarily for conservation increased by almost one third between 1990 and 2005 as environmental protection policies and measures to promote reforestation have gained support, the area of primary (undisturbed) forest in the region has continued to fall. The quality of forest resources is also declining as primary forests are converted to secondary (regrowth) forests and monoculture plantations expand.

Viet Nam lost 10 per cent of its remaining primary forest cover each year between 1990 and 2005 while Cambodia lost six per cent annually. Changes in forest resources in Thailand and Viet Nam have begun to follow a different course to Lao PDR and Cambodia. In Viet Nam, where demand for forest products remains high, a vigorous plantation programme means that total forest area is expanding.

In Thailand, forest protection measures initiated two decades ago are having an effect. Although the overall forest area is still falling, the rate of loss has slowed. Teak and pulp plantations make up a large and expanding component of the national forest resource, including 1.1 million ha of protected plantations.

If deforestation continues at the 2000–2005 rate, Cambodia will have lost an

Forest cover in the LMB countries



additional 2.7 million hectares of forest by 2020, Lao PDR and Thailand will lose 1.1 million and 800,000 hectares respectively while Viet Nam will increase its forest cover – mostly through plantation development – by 4.4 million ha.

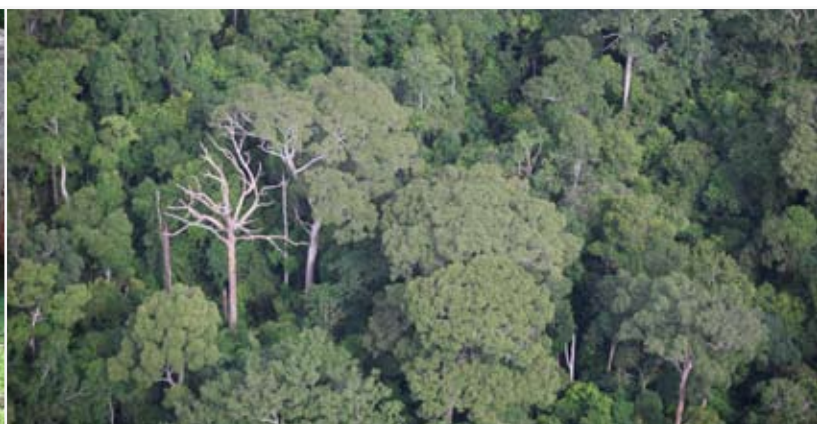
Cambodia and Lao PDR are still in the early stages of forestry development. In Cambodia, the area of plantations is insignificant with little increase while rates of clearance of natural forest are still high. In Lao PDR, plantations are being established at an increasing rate although the area is still low. In response to strong regional demand, the furniture industry has expanded, mainly in Viet Nam, while Thailand has almost doubled production of paper products over the past decade.

In Cambodia, Lao PDR and Viet Nam, protected areas close to areas of development are under serious threat of biodiversity and resource loss. Timber, wildlife and other non-timber forest products are being severely overharvested, causing damage to

habitats and environmental services and also undermining local people's subsistence.

As well as heavy logging, fire has become a major cause of forest loss, which poses a serious threat to ecosystem stability. Farmers use fire to clear land and stimulate regrowth and low intensity fires are used to reduce forest fuel loads. But, each year uncontrolled fires lead to large-scale forest damage. With road densities rising and human activities increasing in previously isolated areas it is likely that, without intervention, the frequency of forest fire will rise in coming years, causing spiralling forest degradation.

Non-timber forest products, such as rattan and bamboo, medicinal plants and essential oils are an important source of income for many thousands of forest dependent people in the LMB as well as providing a safety net during times of scarcity. Sustainable production systems have been developed for some of these products but for others, such as rattan, overharvesting is a widespread problem, which threatens a valuable industry.



World's largest inland fisheries feed the basin

The inland fisheries of the Mekong Basin are among the world's largest, with total production of about 3.9 million tonnes in 2008, comprising 1.9 million tonnes from capture and 2 million tonnes from aquaculture. The total economic value of the Mekong fisheries is estimated at US\$3.9–7.0 billion per year. To this economic value should be added the value of subsistence fisheries as a source of food to millions of the basin's inhabitants. The Mekong fisheries also support many tens of thousands of enterprises, ranging from the shops and food stalls that supply fishing families to boat builders and suppliers of fishing gear.

Underlying the dollar value of the Mekong fishery is the importance of fishing for household economies. In Lao PDR, more than half the population fishes, and fishing provides 20 per cent of household income. In the south of the country fishing is even more important and 80 per cent of households fish. Income from fishing provides cash to buy rice seed at the end of the long dry season but its value can

also be measured in terms of its important role in food security and nutrition.

The Mekong's fisheries play a central role in feeding the basin inhabitants. Fish is the main source of animal protein and a vital source of micronutrients. Consumption of fish and other aquatic animals in the basin ranges from 41–51 kg per person per year (fresh whole animal equivalent weights, country average) with much higher values - amongst the highest in the world - recorded at some places near the Tonle Sap.

Fisheries in the LMB are dominated by small-scale family fishing, which produces most of the total catch. Throughout the basin, fishers are reporting declining catches, falling average sizes and a declining proportion of large predatory species. Although monitoring of the Tonle Sap *dai* fishery over 12 years has not shown a decline in total catch, it has shown signs of overfishing – a reduction in catches of larger carnivorous fish and a dominance of small species.

Estimated consumption of fisheries products in the LMB (000 tonnes, fresh weight)

Country	Inland			Marine Products ²	Total Aquatic Products
	Fish	OAA ¹	Fish plus OAA ¹		
Cambodia	555	121	676	13	689
Lao PDR	185	45	230	3	232
Thailand	740	196	937	134	1070
Viet Nam	746	173	920	140	1059
Total	2217	535	2752	294	3045

¹Other aquatic animals; ²Fish and other marine species imported into the LMB and sold in markets.



A three-year study of catches by commercial fishers along the Mekong River showed no consistent trend with time, but catches appear to be correlated with fish migrations, which are themselves related to river levels or flows.

The role of flooding as a trigger for spawning, the importance of access to flooded areas and the need for fish to migrate between widely separated habitats indicates the importance of preserving natural variations in river hydrology, both within and between years, for sustaining the high fish diversity.

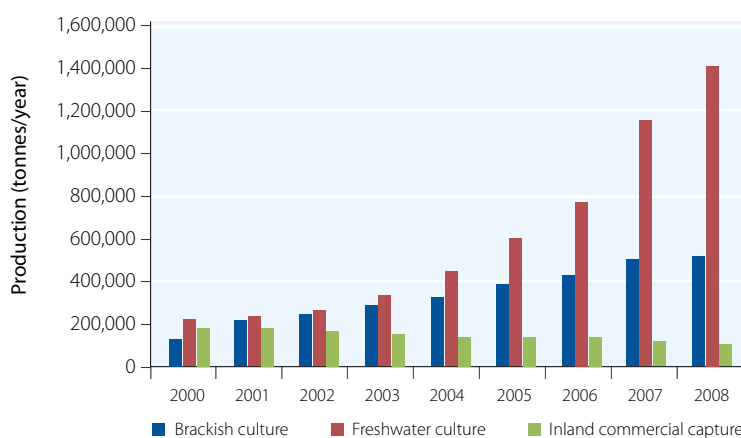
A large proportion of the total fish catch in the Mekong Basin is dependent on migratory fish. These species are at risk from planned mainstream dams. Such a large potential decline in fish production would have very significant basinwide economic and social impacts.

Tropical flood-pulse environments make fish production extremely resilient to fishing pressure because of the huge numbers of fish fry produced each year on vast areas of seasonally flooded land. Changes to these environments through, for example, construction of dams, weirs and other infrastructure, abstraction of water for other uses, clearing of

flooded forest, deforestation of catchments, and local pollution impacts, are all likely to be causing reduced fisheries production which would contribute to declining catches.

Although capture fisheries still provide most of the fish produced in the basin, aquaculture is becoming increasingly important. In the Viet Nam delta (within the LMB), production reached 1.6Mt in 2008. Cultured fish dominate sales in city markets in Thailand and Lao PDR. Much of the increase is due to culture of tilapia, pangasiid catfish and shrimp. Aquaculture exports amount to about one million tonnes per year.

Fish production from the Viet Nam delta, excluding small-scale fisheries.



Water and wetlands return good report card

The health of a river depends on a number of factors, including water quality, river flows and the riparian environment. The annual fluctuation of the Mekong River is the key driver of the high productivity of the river and its associated wetlands and serves to create

critical habitat and food niches for the high diversity of plant and animal species. As development in the Mekong River Basin increases, continued monitoring is needed to reveal any impacts on water quality, the area's unique biodiversity and its wetland habitats.

Water quality

Regular monitoring since 1985 shows that the Mekong River has generally good water quality apart from some areas near urban centres or with intensive agriculture or aquaculture. The concentrations of nutrients at all mainstream monitoring stations are low apart from some stations in the Mekong Delta, where levels of some nutrients are relatively high, most likely due to high population densities and intensive agriculture. Trends in both phosphorus and nitrogen levels in the delta indicate deteriorating water quality. Ammonium concentrations along the river remain well within national standards but increased significantly between 2000 and 2008, with elevated concentrations found in

the upper parts of the basin close to confluences with tributaries, Vientiane and on the Cambodian side of the Bassac River.

Water quality of almost all the mainstream monitoring stations is rated as 'excellent' for the protection of aquatic life for the period 2000–2008. However, the situation is different on some tributaries, where the water is classed as 'moderate' quality, which means that some species may be threatened or impaired. This indicates the effects of agricultural development and associated fertiliser use as well as urbanisation.

While water quality monitoring gives an indication of the status of the environment in which aquatic organisms live, it does not



directly assess the health status of these organisms. Biomonitoring – monitoring the health of key groups of organisms - provides another measure of the ecological condition of the river. Over five years at 60 sites in a range of environments, biomonitoring indicates that the principal rivers of the LMB have not suffered severe harm from the development of water resources or waste disposal although some areas are showing signs of stress.

Recent studies in the Mekong Delta show the presence of persistent organic pollutants in sediment and aquatic organisms (phytoplankton, crustaceans and fish) with DDT as the main contaminant.

Elevated levels of heavy metals have been found in areas with heavy boat traffic and/or high population densities, mainly downstream of Phnom Penh and in the Mekong Delta.

Industrial development in the LMB is still at an early stage although increasing rapidly. The demand for water for industrial use is expected to rise significantly in all LMB countries, especially Cambodia and Lao PDR, over the coming decades.

Water pollution from industrial sources has been identified in the LMB, especially in the capital cities of Vientiane and Phnom Penh, and more generally in northeast Thailand and the Mekong Delta. Generally, treatment of industrial wastewater is limited and handling and disposal of industrial hazardous waste are insufficient. So far, industrial water pollution is mainly concentrated around factories and downstream of major urban areas. The problem is expected to increase over coming years as the sector expands.



Wetlands

Wetlands play a vital role in the lives of the basin inhabitants and the socio-economic development of the region. The river and its tributaries, backwaters, lakes and swamps support many unique ecosystems, such as the river's deep pools, plains of reeds and mangrove forests.

Recent studies show that rural people use a large number of species caught or collected in wetlands. In one season in rice-based ecosystems in Cambodia, China, Lao PDR and Viet Nam these included 145 fish, 11 crustacean, 15 mollusc, 13 reptile, 11 amphibian,



11 insect and 37 plant species. These species are collected from a wide variety of both permanent and seasonally flooded habitats, including perennial rivers, ponds, marshes and flooded forests. As well as their direct use for rice cultivation and freshwater capture fisheries, wetlands have other indirect uses which may be less obvious but are at least as important. Natural wetlands absorb floodwaters that could otherwise be disastrous during the wet season. Cambodia's Great Lake, for example, expands in surface area as much as four to five times during the wet season. Without this natural absorption capacity, Phnom Penh would be completely flooded every year.

Many of the larger cities in the basin, including Vientiane and Phnom Penh, discharge their urban wastewater to large natural wetlands thus achieving a significant level of treatment before waste water flows to the river.

Since wetlands occur in a transition zone where water-based ecosystems gradually change to land-based ones, a small difference in the amount, timing or duration of water flows can result in a profound change in the nature of the wetland and its unique plants, animals and processes.



A rich biodiversity

The Mekong Basin is one of the richest areas of biodiversity in the world and also one of the most threatened. Its wetland and forest ecosystems provide a range of habitats for an astonishing collection of flora and fauna. Recent estimates of the biota of the greater Mekong region include 20,000 plant species, 430 mammal, 1200 bird, 800 reptile and amphibian, and 850 fish species, with new species still being described. However, accelerating economic development, population growth and increased consumption patterns are placing pressure on the environment.

Many important bird habitats have been degraded by wetland drainage, overgrazing, peat mining, reservoir construction, pesticide use and changes to agricultural practices. As well as degradation and fragmentation of habitats, birds are threatened by subsistence egg collection, hunting and trade.

The Mekong's diverse fish fauna include several large fish species whose numbers appear to be declining, including the critically endangered giant catfish (*Pangasianodon gigas*). Threats to many of the giant migratory fish species in the Mekong include infrastructure development, such as dams that alter the natural flow of the river and block migration routes. Without the ability to move up and down rivers, the fish would have fewer opportunities to breed.

The plains of the lower Mekong still retain some areas of near pristine habitat for water birds, with mosaics of open deciduous dipterocarp forests, seasonally inundated wetlands and grasslands and riverine habitats. The Tonle Sap Great Lake is extremely important for large water birds and in 2006 the Government of Cambodia set aside more than 258 km² of grassland to protect this habitat from being converted to rice farms.

Although the Mekong and its tributaries still support some of the few remaining examples of near-intact riverine habitats and bird communities in Southeast Asia, wetland bird habitats are being increasingly used for human settlements which bring with them regular motorised boat traffic. Wetlands and grasslands in the Mekong Delta are also threatened by the large-scale intensification of agriculture.

The Mekong Basin is home to some of the world's most spectacular and threatened amphibians and reptiles but many populations have been destroyed by hunting and trading. Many aquatic or semi-aquatic turtles, snakes and lizards are hunted for subsistence or sold for food or medicine in local markets. Reptiles comprise the largest portion of all animals found in trade in Viet Nam and harvesting practices in some areas are seen as unsustainable and a threat to the survival of some species.



River link for trade and transport

For thousands of years the Mekong River has been an important conduit for people and goods between the many towns along its banks. These days the river is becoming an important link in international trade routes and also increasingly popular for tourism. When transporting large volumes of cargo over long distances, transport on inland waterways provides a cheaper and more efficient option than road transport as well as being more environmentally friendly.

Despite difficulties caused by seasonal variations in water level and narrow, turbulent sections of the river, more than 300,000 tonnes of goods are shipped via the Mekong between Kunming, China and Thailand, each year. The volume of trade moved by inland navigation more than doubled in the four years to 2008. Waterborne trade in the lower Mekong countries of Viet Nam and Cambodia has also increased significantly.

The annual containerized cargo through Phnom Penh Port increased almost two-fold from about 278,000 tonnes in 2005 to about 430,000 tonnes in 2009. For the Mekong Delta in Viet Nam, the growth is even more

remarkable, annual cargo throughput increased from 1,145,000 tonnes in 2005 to 2,843,000 tonnes in 2008.

In an effort to improve safety for traffic on the river, its navigation channel has been surveyed and marked using a number of innovative tools. Lighting for barges along the Mekong River from Phnom Penh to the delta now allows 24 hour navigation. As well as physical aids to navigation, stretches of the Mekong River are now on a par with other international rivers with the provision of modern information systems, such as electronic navigation charts and automatic identification systems to facilitate navigation safety and efficiency.

Cross-border legal agreements for freedom of navigation help provide a strong framework for international shipping in the region. To this end, the MRC worked with Cambodia and Viet Nam to establish an agreement on waterway transportation – a major breakthrough in bilateral economic relations – which was signed in December 2009.

A potential negative aspect of increased navigation is the likelihood of increased



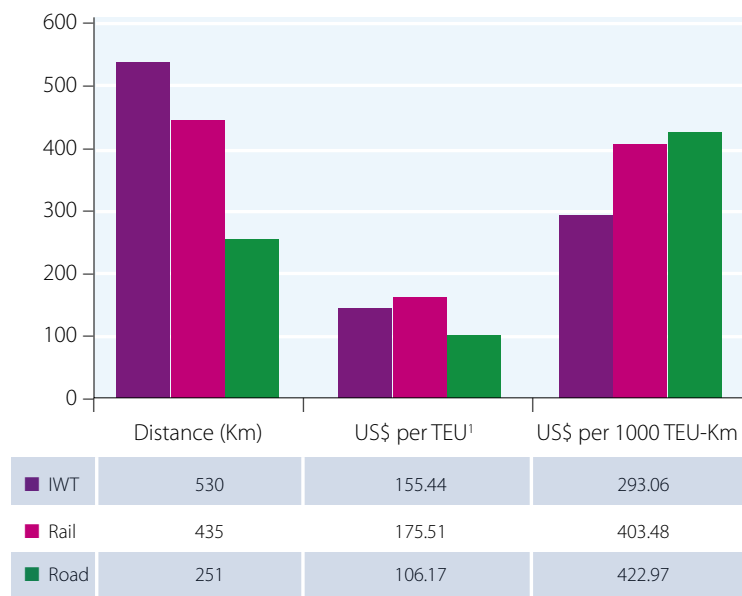
pollution as a growing number of diesel powered vessels use the river. Although the trade of oil, gas and petroleum products between Viet Nam and Cambodia has increased significantly over the past few years, few environmental protection measures exist to ensure the correct handling of dangerous goods. Storage in oil and gas terminals along the river in Cambodia and Viet Nam is a major concern with many of them lacking contingency plans or adequate equipment and resources to respond to oil spill emergencies. Further investment is required to provide resources for preventing and responding to oil spill pollution, to maintain local ports and to ensure compliance and monitoring activities are implemented at regional and local levels.

Hydropower development on the river would increase water levels during the dry season, which will effectively boost shipping capacity and its associated economic benefits.

Tourism is increasing along the length of the river. Between 20,000 and 25,000 tourist cruise passengers take trips on the upper

Mekong (most of them between Houei Sai and Luang Prabang). The lower Mekong is more accessible and a popular tourist destination. Cambodia saw 71,889 visitors arrive by water in 2008, while in the same year Viet Nam had 157,198 people visiting by boat.

Relative costs of different modes of transport in the Mekong corridor



¹TEU = 20-foot equivalent unit



Future challenges

The Mekong River system faces several major environmental challenges over coming decades. Planned hydropower developments, expansion of irrigation and waterway transport together with the impacts of climate change will have major implications for the river environment and, in some cases, threaten the biodiversity of the basin's aquatic systems and the livelihoods of those that depend on them.

All governments of the LMB wish to develop water resources for irrigation, hydropower and other uses to produce benefits for the many millions who live in poverty in rural areas. At the same time governments realise that the need to develop water resources and achieve benefits for rural people must be balanced with the existing needs of subsistence farmers who supplement what they grow by fishing and gathering food and other materials from forests and wetlands.

Hydropower

The Mekong has become one of the most active regions for hydropower development in the world. In the upper basin, China is implementing a cascade of up to eight projects which will significantly redistribute flow from the wet to the dry season. In the lower Mekong, new dams are being planned on both the mainstream and tributaries. The estimated hydropower potential of the lower Mekong is 30,000 MW, of which about 10 per cent has been developed, all on Mekong tributaries. Of the total of 124 existing, under construction and potential tributary projects identified in the MRC hydropower database in 2009, more than 70 per cent are in Lao PDR and 10 per cent are in Cambodia.

Private sector proposals for new hydropower schemes include at least 11 dams on the lower Mekong mainstream.

Installed capacity of existing, under construction and planned/proposed hydropower projects in the LMB

Country	Installed capacity (MW)			Total
	Existing	Under construction	Planned / proposed	
Cambodia	1	-	5589	5590
Lao PDR	662	2558	17,686	20,906
Thailand	745	-	-	745
Viet Nam	1204	1016	299	2519
Total	2612	3574	23,574	29,760



The rapid pace of tributary hydropower development highlights the importance of assessing the cumulative impacts of the tributary dams, including the impacts on tributary river flow regimes, fish passage, water quality and sediment flow. This cumulative impact will become increasingly important as the number of dam projects in the LMB continues to increase in the foreseeable future.

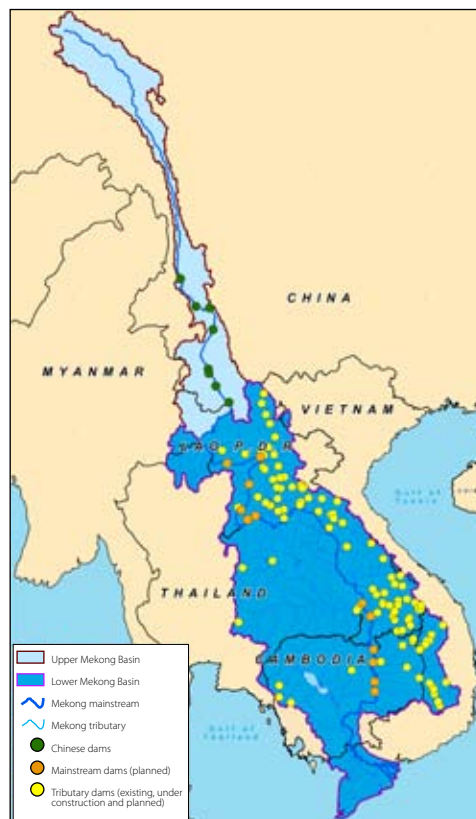
The major anticipated consequence of hydropower development is an increase in regional dry season flows as water stored in the flood season is used to generate electricity in later months. The decrease in flood season flows is proportionally far smaller. It is not just the distribution and volume of seasonal flows that are important. The timing of the onset of the different seasons changes very little from year to year so any small change could have potentially large environmental consequences.

Another long-term impact of dams is sediment trapping. The Mekong carries large amounts of nutrient-rich sediments which are important for the high productivity of wetland areas, such as the Tonle Sap Great Lake and the Mekong Delta. So, the potential reduction in mainstream sediment loads is a serious concern. About half of the total sediment contribution to the Lower Mekong Basin originates from the Upper Mekong. It is estimated that the Yunnan cascade of dams being built in China will trap some 90 per cent of this sediment. Other dams planned on the

mainstream in Lao as well as downstream tributary dams will add to this impact.

While the construction of dams offer an opportunity to improve river navigability by providing more reliable and consistent water depths, dams could also present a threat to long-haul and cross-border river transport on the Mekong. As well, all barriers, such as dams, interfere with fish spawning and migration.

Proposed, planned and constructed mainstream and tributary dams in the Mekong River Basin



Preparing for the impacts of a changing climate

The Lower Mekong Basin is expected to be one of the regions most profoundly affected by climate change. The Intergovernmental Panel of Climate Change (IPCC) indicates that temperatures as well as annual rainfall and runoff will increase and sea level will rise, which would seriously affect the Mekong Delta.

The predicted changes in rainfall and temperature would potentially cause Mekong River flow to increase in both wet and dry seasons. The increased flow would increase water availability in the dry season to benefit agriculture but also increase the risk of flooding during the wet season. Low-lying areas downstream of Kratie and in the Mekong Delta would be particularly at risk. The general patterns mask large differences across the basin.

In the Mekong Delta the most important factor related to flooding is expected to be the sea level rise. Estimates indicate that about 30 per cent of Viet Nam's Mekong Delta region would be inundated if a one metre sea level rise occurs, which is predicted by 2100.

Global warming is expected to shift the potential geographic ranges of species to the north or to higher elevations in mountainous regions as individual species are adapted

to a specific range of temperatures. Species are also closely linked to the seasonal fluctuations of the river. A modified seasonal flow pattern in response to climate change would therefore have a key influence on the future species composition and ecosystem productivity.

A combination of increased temperature and decreased precipitation in some areas of the basin may result in decreased runoff and lowered groundwater levels, causing the shrinking of some wetlands whereas in other parts of the basin receiving more precipitation a change to more open wetland types could take place.

Considerations about how to adapt to climate change need to take into account other drivers of change in the LMB. Basin development scenarios have been constructed for the region based on the development plans of the four riparian countries. A development plan including hydropower and irrigation development looking 20 years ahead, combined with one of the IPCC's climate change scenarios, for example, indicates that some of the potential climate change effects on flow may be offset by planned development. The main reason for this is the storage capacity in hydropower and irrigation dams.



Flood impacts and management

The tropical monsoon climate of the Lower Mekong Basin has a highly seasonal rainfall pattern, bringing an annual flood pulse and two distinct seasons – flood and low-flow. Although large floods can cause great devastation, ‘normal’ flooding brings large benefits

The average cost of extreme flooding in the LMB is estimated at US\$60–70 million a year, whereas the average annual value of benefits of a normal flood year have been calculated at US\$8–10 billion, i.e. some 100 times greater. The challenge is to reduce the costs and negative impacts of flooding while maintaining the benefits.

Flood risk management involves various local initiatives to increase the resilience of flood-prone communities so they can better live with floods and preserve the beneficial effects of flooding.

In 2008, severe tropical storm-induced mainstream and tributary backwater flooding occurred along the upper river reaches of the Mekong River in Lao PDR and Thailand. The severity of mainstream flooding progressively declined downstream of Vientiane. Flooding was ‘normal’ across the Cambodian lowlands and the Mekong Delta. Limited flash flooding occurred in Cambodia and Viet Nam.

Most flood damage related to the mainstream is concentrated in Viet Nam and Cambodia where floods can cost hundreds of millions of dollars in lost rice production. Population pressure and the fertility of the floodplains means that there will always be a large population exposed to flood risk, especially in Cambodia and the Viet Nam delta. Nevertheless, land-use zoning can reduce local flood risks at the community level and assist in the preservation of wetlands, while the flood hazard maps used for zoning are essential for planning flood emergency management measures.

Flood-proofing (building and development controls) can reduce, but not eliminate, the impact of floods on buildings and infrastructure. Village-raising, as is occurring in the Viet Nam delta, is a relatively cost-effective local flood risk management measure that generally has minimal environmental impacts. It provides relief from the immediate community impacts of flooding, while retaining the economic benefits and has considerable potential as a low-key future risk management measure.

Structural risk management measures that ‘control’ floodwaters, such as dams, have little effect on the risk associated with major floods, especially in Cambodia and the Viet Nam delta.





Mekong River Commission

P.O. Box 6101, Unit 18, Ban Sithane Neua, Sikhottabong District, Vientiane, Lao PDR
Telephone (856) 21 263 263 • Facsimile (856) 21 263 264
E-mail: mrcc@mrcmekong.org • www.mrcmekong.org

