

Tonle Sap

EXPERIENCE AND LESSONS LEARNED BRIEF

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1. Introduction

Over the past decades, Cambodia has suffered from serious internal problems that were the main cause for the country's poor development and its poverty. Since the beginning of the 1990s, however, the country has stabilized remarkably, now being clearly on the path of development and democratization. Tonle Sap Lake (also known as the Great Lake or simply Tonle Sap; see Figure 1) is situated in the central plains of the country, and has enormous significance for Cambodians. Tonle Sap Lake, along with the Tonle Sap River, forms a unique hydrological system, as well as an enormously diverse aquatic ecosystem. The lake also is an invaluable natural resource that provides sources of livelihood for the people living around it. Further, Tonle Sap Lake acts as an extremely important fish breeding ground and flood mediator for the Mekong River. Thus, the importance of the lake reaches far beyond Cambodia.

2. Background

2.1 Geography

Cambodia is situated in Southeast Asia (southwestern part of the Indo-Chinese peninsula). It covers an area of about 181,035

km². The country is surrounded by the Cardeman mountain chain—a rich biodiversity reserve—on the west, the Dangrek mountain chain on the north, and hilly plateaus in the east, with huge flood plains in the central part of the country. In the southwest, Cambodia has a coastline of about 450 km in the Provinces of Koh Kong and Kampot, and the cities of Sihanoukville and Kep. Less than 10% of the country's total population lives in this region. The majority of Cambodians live in the area associated with the Mekong River Basin, which covers more than 86% of the country's territory.

The Mekong River is a transboundary river flowing through six countries, with a total annual runoff of 475 billion m³ and a total length of over 4,800 km, making it the 12th longest river

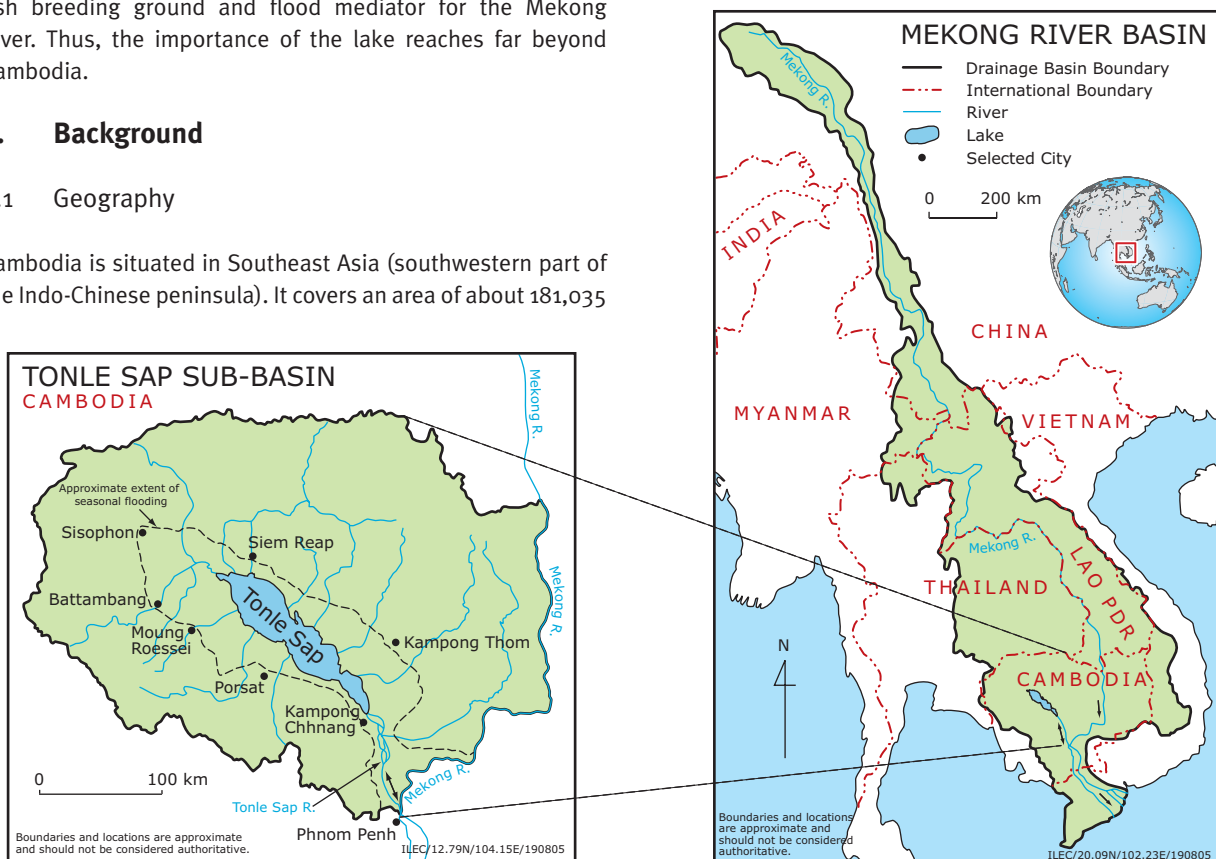


Figure 1. The Tonle Sap and Mekong River Basins.

in the world. As it flows through Cambodia, the Mekong River grows wider, being deep enough for sea-going vessels of up to 100 tons. After passing the last rapids at the northern part of Cambodia, the Mekong River traverses a series of levees, emptying into an extended floodplain. Tonle Sap Lake is an integral part of the Mekong River system, with some regarding it as the beating heart of the whole hydrological system because of its annual fluctuations. In short, the Mekong River system dominates the hydrology, cultural life and the livelihood of the people in this region.

After flowing down to Phnom Penh, the capital of Cambodia, the Mekong River is joined by the 120-km long Tonle Sap River, linking Tonle Sap Lake to the Mekong River. Shortly after that, the Mekong divides into the main Mekong River and the smaller Bassac River, which flow through the Mekong Delta of Vietnam to the South China Sea. The Mekong River is so strong that when it meets the Tonle Sap River near Phnom Penh, it creates a hydrologic wonder of the world. During the flood season (June to October), when the water level in the Mekong River is highest, it forces the Tonle Sap River to flow backwards into Tonle Sap Lake.

2.2 Tonle Sap Lake and Floodplain

Tonle Sap Lake, the largest freshwater body in Southeast Asia, and the heart of the Mekong River system, covers an area of 250,000-300,000 ha (2,500-3,000 km²) in the dry season and 1,000,000-1,600,000 ha (10,000-16,000 km²) in the wet season. It extends over 300 km from northwest Cambodia to the Mekong River at Phnom Penh. At the peak of the flood season, the lake is four to six times larger in area than during the dry season, and deepens from a depth of a meter or less to ten meters or more. Due to its unique hydrology and enormous aquatic productivity, its significance extends to the entire Mekong Basin, particularly the Lower Mekong Basin. Only about 25-30% of Tonle Sap Lake's waters originate from the Tonle Sap drainage basin, which covers an area of almost 70,000 km². The majority (i.e., around 70%) of the lake's waters actually originate from the Mekong River, making the river extremely important to the lake.

As previously noted, the water flow from the Mekong River to Tonle Sap Lake occurs during the flood season (between June and October), when the rising water level of the Mekong River forces the Tonle Sap River to flow backwards into Tonle Sap Lake. The incoming water causes intensive flooding that extends the lake over vast floodplains, consisting mainly of forests, shrubs and rice field. As a result, the size of Tonle Sap Lake varies from approximately 160 km long and 35 km wide during the dry season, to 250 km long and almost 100 km wide during the peak of the flood season. Similarly, the lake's water depth varies from a mere one meter to 9-10 meters during the peak of the flood season (Keskinen 2003).

The periodic flooding that carries sediment-rich water from the Mekong River to the lake, combined with the area's high biodiversity, are the main reasons for the development of this

unique and rich ecosystem. The Tonle Sap ecosystem is one of the most productive inland waters, and one of the most fish-abundant lakes in the world where flooded forests and shrubs offer shelter and breeding grounds for fish and other aquatic animals. The total fish catch from the lake is about 230,000 tons/year, almost half of Cambodia's total fish production. The lake supports one of the richest stocks of water birds in Asia, including many endangered species. It is also home to a variety of mammals, reptiles and insects. Flora in the area includes almost 200 different aquatic plants, as well as a range of other plants (Tonle Sap Biosphere Reserve 2002). Migration of different fish species between Tonle Sap Lake and the Mekong River is extensive and diverse. During the water inflow from approximately June to September, there is mostly a passive migration of eggs, fry and fish to Tonle Sap Lake and its floodplains. Later, fish follow the receding floodwaters back to the lake and finally back to the Mekong River (Keskinen 2003).

Among others, the lake provides the following benefits and values:

- **Flow regulation.** The lake and river of Tonle Sap act as natural flood regulators for southern Cambodia (including its capital city of Phnom Penh) and the Vietnam Mekong Delta by decreasing the flood peak. From mid-May to early-October, the flow of the Mekong River system becomes so great that the Mekong Delta cannot support the volume. At that point, the water of the Mekong River reverses its flow, flowing up the Tonle Sap River to fill Tonle Sap Lake and its surrounding flood plain. In addition, the delayed release of monsoon-related floodwater from the lake to the Mekong River (approximately 76.5 billion m³ between October and April) provides water for irrigation and controls seawater intrusion in the Mekong Delta (thereby supplementing about 16% of the lower Mekong River flow).
- **Flora.** The flooded forest is central to the overall ecology of the Tonle Sap lake and river system and its biological productivity.
- **Fish.** The hydrologic cycles influence fish eco-dynamics. The Mekong River brings organic matter and fish into the lake. The lake system, together with its surrounding seasonal flood forests, is a highly biodiverse habitat, containing a large number of fish species. The economic significance of fish resources provided by the lake is enormous, representing 60% of Cambodia's total inland fisheries (average of 41,740 tons/year). Furthermore, fish migration from Tonle Sap Lake to the Mekong River represents a crucial re-stocking source for the river as far north as the Yunnan Province of China.
- **Other fauna.** The lake and its flood plain provide a refuge for a wide variety of birds. A number of breeding colonies of large water birds, including endangered birds, also are found here.

- **Cultural heritage.** Tonle Sap Lake and the associated cultural heritage of Angkor complex contribute enormously to Cambodia's national identity.
- **Tourism.** As an additional factor, the potential for tourism in the region is high, with the Angkor temple complex at Siem Reap alone attracting some 20,000-30,000 visitors each year. The figure is reported to have tripled between 1993 and 2000.

2.3 Population and Socio-economic Issues

The main sources of economic livelihoods in the Tonle Sap area are fishing and cultivation of wet-season rice. Overall, the majority of the people around the lake (area between National Roads 5 and 6 which roughly follow the floodplain area depicted in Figure 1) are heavily dependent on the exploitation of common property resources for their economic livelihood. In addition, people living in the areas closest to the lake are often in a worse situation than the ones living in higher areas. Most of the former live in floating villages, with very few livelihood options other than fishing and fish-related activities. Although the lake is rich in aquatic resources, unjust fisheries management, through private fishing lots, has resulted in a situation whereby the enormous resources of the lake mainly benefit those with the possibility for large-scale fishing, while the small-scale fishermen living next to the lake are left with remarkably fewer resources. During the past few years, however, the Cambodian Government has taken some

important steps toward improving the unjust and corrupt fisheries management system (Keskinen 2003).

People living farther away from the lake rely heavily on rice cultivation for their economic livelihood. However, the lake and its floods are still significant, especially for cultivating both floating and recession rice. Although the main source of economic livelihood is rather homogeneous in the rural area, individual families are dependent on a great variety of different and seasonally varying occupations. In urban areas around the lake (essentially the six provincial capitals), the dependence on natural resources is much lower, and the occupational structure totally different from the rural areas. The main source of economic livelihoods for the former is more varied, while involvement in secondary occupations is significantly less than in the rural areas. In the future, improved infrastructure—most notably improved road networks—will have significant effects on both rural and urban areas, since the access to the markets will also be easier for the more remote rural areas (Keskinen 2003).

The extensive poverty, and a significant dependence on natural resources, is particularly alarming in this region, since the products from most of the natural resources in the area are clearly in decline. The main reason for this decline is over-exploitation. The decrease in natural resources, and the rapid population increase, has already resulted in a decreased level of economic livelihoods throughout the Tonle Sap Area (Keskinen 2003). A statistical overview of the socioeconomic conditions in the country is provided in Table 1.

Table 1. Socioeconomic Indicators for Cambodia.

Indicator	Data	Year	Source
Population	10.144 million (Population growth rate: 2.4%/year)	1998	b)
Race	Khmer 90%, Vietnamese 5%, Chinese 1%, Others 4%	1997	d)
Religion	Hinayana Buddhism 95%, Others 5%	1997	d)
Literacy rate	City: Male 88.2% Female 70.8%, Average 79.1% Village: Male 77.6% Female 54.3%, Average 64.9% Average: Male 79.5% Female 57.0%, Average 67.3%	1998	a)
City population growth rate	15.7%	1998	a)
Average life expectancy	Male 50.3 years, Female 58.6 years, Average 54 years	1997	b)
Infant mortality	147 persons/1,000 (under 5 years)	1997	b)
GNP	\$3 billion (\$280/person)	1998	c)
GDP	\$3.1 billion (\$288/person)	1998	c)
GDP percentage	Agriculture 51%, Industry 15% (manufacturing industry 6%), Service 34%	1997	b)
Industry	Rice cleaning, Fisheries, Wood, Woodwork, Rubber, Cement, Jewelry	1997	d)
Natural resources	Wood, Jewelry, Iron ore, Manganese, Phosphoric acid, Hydropower	1997	d)
Water distribution coverage	City 60.3%, Village 23.7%, Average 29.0%	1998	a)
Sewage service coverage	City 49.0%, Village 8.6%, Average 14.5%	1998	a)
Human Development Index (HDI)	0.514 (Rank 137 in the world)	1997	e)

Source: Adapted from Japan International Cooperation Agency, 2000 with a) Country Profile on Environment Cambodia, 1999, Altaf Ali; b) World Development Indicators, 1999, World Bank; c) World Development Report, 1999, World Bank; d) World Fact Book, 1999, CIA; e) Human Development Report, 1999, UNDP.

3. Biophysical Environment

3.1 General Environmental Conditions

The Tonle Sap River connects Tonle Sap Lake and its vast peripheral wetlands to the mainstream Mekong River. As the main Mekong flood level rises each year during the southwest monsoon in June or July, the water flow direction of the Tonle Sap River reverses, creating an exceptional water regime, including huge changes in the lake's water level and volume between seasons. The total area covered by water can be more than 1.6 million hectares at the peak of the flood season each year. About 1.2 million Cambodians in approximately 160 communes live in the area of maximum flooding around the lake. About three-quarters live around the high water level of the lake, with one-quarter living in some 170 floating villages on the lake, or on the floodplain in stilt-supported houses.

The lake's water balance has been estimated by the Infrastructure Development Institute of Japan (2002, p.70). Water inflow (expressed in $10^9 \text{ m}^3/\text{year}$) to the lake comes from precipitation (14), reverse flow from the Tonle Sap River (45) and flow from other rivers in the sub-basin (24). Water outflow is by evaporation (10) and flow through the Tonle Sap River (73). Figure 2 shows how the water level and discharge volume of the Tonle Sap River vary greatly over the course of a year.

Approximately 23% of the floodplain, extending over approximately 350,000 ha, is cultivated. Much of the cultivated crop is rice (450,000 tons of rice per year, equivalent to 12% of Cambodia's total production), along with mungbeans, melons and a variety of other vegetables. They are planted as the floodwaters recede, with shifting cultivation being a very minor component, covering less than 300 ha. The flooded

forests are a source of firewood, construction material, and many non-timber forest products (e.g., honey, rattan, snakeskin, meat). Up to 97% of Cambodian households use fuel wood and charcoal as their main energy source, with the effectively open-access flooded forests serving as a cheap source. Some efforts have been made by the government, however, to provide alternative energy sources. Because of the composition and structure of the flooded forests, their timber is not of significant commercial value. The dry season encroachment and land clearance of flooded forests are also seriously affecting the integrity of the watershed forestland.

3.2 Siltation, Eutrophication and Other Water Quality Issues

One of the concerns regarding the condition of Tonle Sap Lake is the vast quantity of silt carried into it through the Tonle Sap River during times of flooding. According to a recent study on water quality and hydrological modeling (WUP-FIN 2003), much of the incoming sediment is deposited in the floodplains (i.e., flooded forests and rice fields), not in the lake itself. While changes in siltation rates have occurred, their impacts on fishery and biodiversity are not as clear, compared to over-exploitation of the native flora and fauna, over-exploitation of fish resources, and introduction of exotic species. According to some of the externally-funded water quality monitoring programs (e.g., funded by FINNIDA), the general level of lake pollution is fairly low at present, although some local problems exist in and around the floating villages mainly due to untreated domestic wastewater containing pathogens.

The key to the success of a large-scale, multi-disciplinary program for lake water quality, biodiversity conservation and natural resource management will depend heavily on the levels

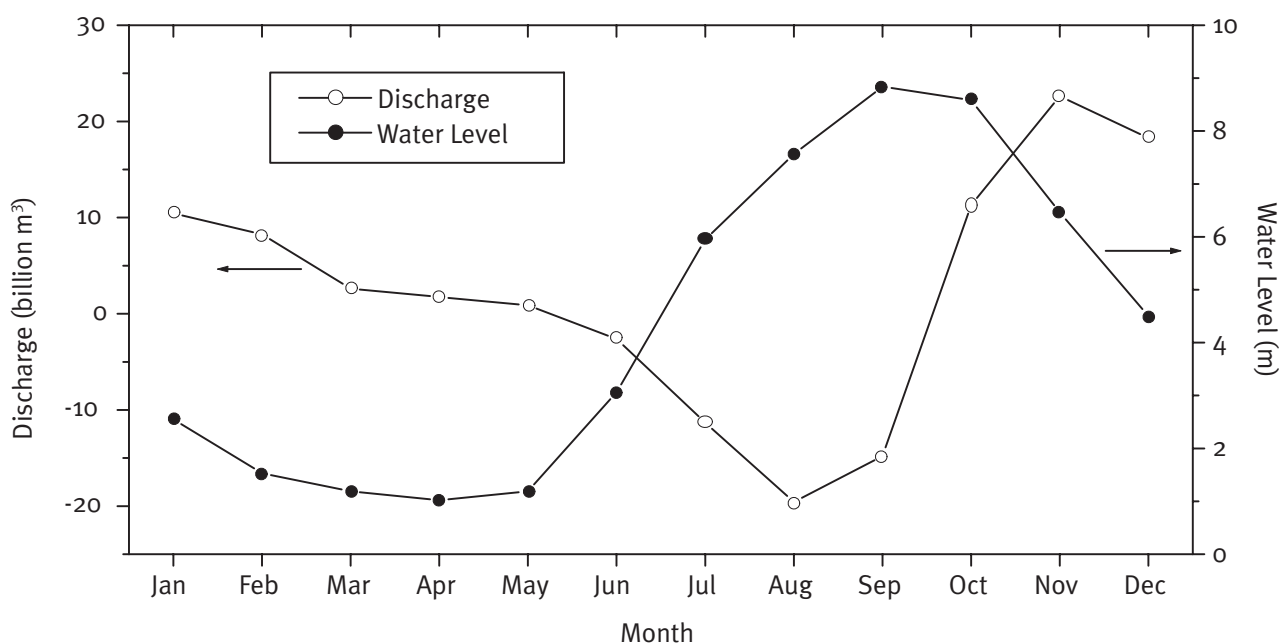


Figure 2. Water Level Changes in Tonle Sap River (Source: Toward a Comprehensive Scientific Study of Tonle Sap Lake (Field Survey Report) March 2002, Infrastructure Development Institute—Japan, p. 70).

of inter-agency cooperation and technical capacity within Cambodian implementing agencies. Sustainable use and management of “shared” natural resources within the Tonle Sap area requires coordinated, multi-sectoral approaches.

3.3 The Tonle Sap Biodiversity and Biosphere Reserve

The Tonle Sap Biosphere Reserve (TSBR), which covers the lake plus a significant part of the floodplain, was established by Royal Decree in 2001. It is divided into three zones, including core zones, buffer zones and transition zones. In the transition zone, sustainable natural resource management practices are to be established, while the buffer zone is an area where activities are to be compatible with conservation, in order to protect the core zones. The three core zones are Prek Toal for bird colonies (21,342 ha), Boeng Chhmar as bird feeding areas (14,560 ha) and Stung Sen as unique gallery forests (6,355 ha). Boeng Chhmar also has been designated as a Ramsar site. At present, only Prek Toal is protected to some degree, although even here poaching remains a significant problem.

There are eight fish sanctuaries, seven located inside the permanent lake and one near the mouth of the Tonle Sap River, which are established and managed by Department of Fisheries under the Ministry of Agriculture, Forestry and Fisheries (MAFF). They were set aside to protect fish stocks, improve fish recruitment, and provide dry season refuge areas for mainly non-migratory fish. All fishing activities, including small-scale fishing, are prohibited in the sanctuaries year-round, although illegal fishing is reportedly rampant.

3.4 Protected Areas within the Tonle Sap Floodplain

While it is reported that most of the protected area zoning based on environmental law roughly matches the most important areas for biodiversity conservation, the zoning is purely administrative, and does not imply that good management systems or regulation are in place. In general, the enforcement is poor. Furthermore, the current zoning can be regarded as focusing on commercial exploitation and sustainable management of the fish resources. Most of the biodiversity hotspots are located within the fishing lots because they are better reserved, less accessible to people and include the most productive fishing grounds. The strictly protected fisheries domain area was classified as *Multiple Use Management Area* by the Royal Decree on the Creation and Designation of Protected Areas (1993).

4. Management Environment

4.1 Lake Management Programs and Processes

4.1.1 Chronology of the Evolving Governance System

The environmental governance in Cambodia has evolved through a series of administrative initiatives from the early 1990s. His majesty, King Norodom Sihanouk, for example, requested the inclusion of Tonle Sap Lake on the list of

World Heritage sites in October 1992. The Royal Decree on multi-purpose protected areas (including the Tonle Sap floodplain) was promulgated in November 1993. The Technical Coordination Unit (TCU), within the Ministry of the Environment, was established in November 1995 and the first inter-ministerial forum on the preservation of Tonle Sap was held in March 1996.

A major step toward establishment of environmental governance structure in the Tonle Sap region took place when the region was designated as a UNESCO “Man and Biosphere” site in 1997. Tonle Sap Lake was found particularly suitable to the Biosphere Reserve concept, in which human and cultural dimensions are particularly important. To be designated as a Biosphere Reserve, the site must combine: (a) conservation of the landscapes and species of the area; (b) development activities which respect the local culture; and (c) environment and society, research, educational and information exchange related to issues of conservation and sustainable development. These three functions are made possible through appropriate zoning. To that end, the Reserve is actually sub-divided into a core area, a buffer zone and a transitional area. The harmonious relationship between humans and the environment, for example, means recognition, as well as promotion, of the economic values of the lake, celebration of the reversal of river flow direction in several festivals, pursuit of the traditional knowledge and use of resources, ecological and cultural links with Angkor, among others.

To echo such United Nations initiatives, the Cambodian Government developed a key policy document illustrating support for the project goals. The *National Environmental Action Plan* (NEAP), adopted in 1997, seeks to integrate environmental concerns into economic activity, and ensure the future maintenance of the absorptive and regenerative capacities of Cambodia’s ecosystems. Among the priority areas of intervention are fisheries and floodplain agriculture at Tonle Sap Lake, biodiversity and protected areas, and environmental education. NEAP was followed by the adoption of the *Strategy and Action Plan for the Protection of Tonle Sap* (SAPPTS) in February 1998, and by the issuance of the Royal Decree officially making Tonle Sap Lake a Biosphere Reserve in 2000.

More recently, the *Governance Action Plan* (GAP) was adopted by the Council of Ministers (CoM) in March 2001. GAP is a plan to promote actions for enhancing governance by sequencing and benchmarking the expected results and potential risks of the initiatives in the areas of Land Management, Forestry Management and Fisheries, so that the Royal Government of Cambodia (RGC) may pursue its governance objectives with greater explicitness, and in a more systematic manner. The GAP covers the four cross-cutting areas of judicial and legal reform, public finance, civil service reform and anti-corruption, and stipulates the “specific issue” of natural resource management, encompassing the issue of access of the poor to natural resources. The draft *Second Socioeconomic Development Plan, 2001-2005* (SEDP-2) provides a general framework for socio-economic development in Cambodia. One

of its primary objectives is the sustainable management and use of natural resources and the environment, and includes natural resource management in the areas of land, forestry and fisheries, together with sectoral policies and actions, community-based forestry and agro-forestry, land tenure and tilting, and environmental management and conservation as part of governance issues and actions.

4.1.2 Tonle Sap Environmental Management Project (ADB, GEF, UNDP, Cambodia)

A major new international initiative, the Tonle Sap Environmental Management Project (TSEMP), was launched in 2002, with joint funding from the Asian Development Bank (\$10.9 million), the Global Environmental Facility (\$3.9 million), the UN Development Programme (\$0.623 million) and the Government of Cambodia (\$3.9 million).

As reported on the ADB project website (www.adb.org/Projects/Tonle_Sap/overview.asp), “the objective of the Tonle Sap Environmental Management Project is to enhance systems and develop the capacity for natural resource management coordination and planning, community-based natural resource management and capacity for biodiversity conservation in the Tonle Sap biosphere reserve.”

To accomplish this objective, the project has three closely interrelated components:

Component 1 aims to strengthen natural resources management coordination and planning through:

- Establishing a coordination framework and information dissemination mechanisms;
- Mapping the Tonle Sap biosphere reserve; and,
- Improving regulation and management planning.

Component 2 aims to organize communities for natural resource management through:

- Formulating and implementation structure;
- Empowering communities; and,
- Evaluating technical packages in support of sustainable livelihoods

Component 3 aims to build management capacity for biodiversity conservation through:

- Enhancing management capacity;
- Developing systems for monitoring and management; and,
- Promoting biodiversity conservation awareness.

The ADB finances and administers Components 1 and 2, while the GEF finances and UNDP administers Component 3 (under the title Tonle Sap Conservation Project).

4.2 Institutional Facilitation for Biodiversity Conservation and Sustainable Natural Resource Use

4.2.1 Poverty Reduction Linked with Biodiversity and Wetland Conservation

The overall poverty reduction strategy, supported by the integration of the concept of biodiversity conservation and sustainable natural resource use, culminated in the development of the *National Biodiversity Strategy and Action Plan* (NBSAP). The elements of NBSAP relevant to Tonle Sap Lake include the protection of natural resources, freshwater fisheries and aquaculture, forest and wild plant resources, agriculture, tourism, environmental security, land use planning, water resources, community participation, awareness, education, research, legislation and institutional structure. In 1999, in response to international policy commitments, the NEAP and other domestic decrees on the use and protection of natural resources, MOE coordinated line ministries and NGOs to prepare the *National Wetland Action Plan* (NWAP). The NWAP provides a policy framework for the conservation of wetland biodiversity throughout the country, covering institutional and policy issues, information and inventory requirements for management, a description of the natural aspects of wetlands in Cambodia, wetland management issues and the social dimension of wetland conservation. It further states that wetlands cover 30% of the land area of Cambodia, with Tonle Sap Lake being the country’s most important wetland site (<http://www.icem.com.au/bioplan/cambodia.pdf>).

4.2.2 Institutional Complexities in Fishery and Biodiversity Management

The institutional arrangement for the management of fishery, forestry and other related resources within the Tonle Sap region is rather complex, as illustrated in the short descriptions below.

- The Department of Fisheries (DoF) has jurisdiction over fisheries resources and their management in the protected fisheries domain of the Tonle Sap, as well as *de facto* responsibility for forestry resources within that zone as well.
- Within the Ministry of Environment, the Department of Nature Conservation and Protection (DNCP), through its Protected Areas Office (PAO), is responsible for the management of the national system of protected areas of which Tonle Sap Lake and its core areas are part. In 2000, PAO was divided into two separate offices: Office of Natural Park & Wild-life Sanctuary and Office of Multiple Land-use and Protected Landscape. Within DNCP-MoE, there also is an Office of Wetlands, Watersheds and Coastal Zone Management, Office of Community Forestry and Buffer Zones, while at the

provincial level, there is an Office of Nature Conservation and Environmental Data Management.

- The Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Ministry of Environment (MoE) are the two main Government agencies responsible for protected areas, wildlife management and environmental law enforcement in Cambodia. More specifically, within MAFF, the Wildlife Protection Office (WPO) of the Department of Forestry and Wildlife (DFW) has jurisdiction over wildlife protection and enforcement within the core areas of the TSBR.
- Until recently, the Technical Coordinating Unit (TCU), directly under the Minister, was the main office within the MoE with direct responsibility for TSBR activities. With the establishment of the TSBR Secretariat within the CNMC, the TCU will be absorbed into the technical units of the MoE, and the TSBR Secretariat will take on its remit.
- The international NGO, Wildlife Conservation Society (WCS), has an active program to support the wildlife conservation and protection efforts of the DFW-MAFF and the DNCP-MoE, with a special focus on the Prek Toal core area and, more recently, on floodplains near Kompong Thom. Staff from these agencies have been seconded by WCS, and trained and supported to undertake their work more effectively. An excellent network and a pool of resourceful and motivated Cambodian wildlife conservationists have been developed as a result of this support.
- There are currently no known programs for managing or controlling recognized exotic species in Tonle Sap Lake. An international workshop in May 2001 in Vietnam on “Weed Control Techniques and Occupational Health and Safety Issues” focused on control of the major invasive weed, *Mimosa pigra*, in the lower Mekong River countries. Two Cambodian delegates attended this workshop.

4.3 Institutions for Lake Basin Management

4.3.1 *Cambodian National Mekong Committee (CNMC) and Mekong River Commission (MRC)*

The primary government agency involved in the management of natural resources in the Tonle Sap drainage basin is the Cambodian National Mekong Committee (CNMC), with membership of ten ministries and direct linkage to the regional Mekong River Commission (MRC). Functioning as a national institution accountable directly to the Cambodian Government, it assists and advises the Government in all matters relating to water policy and strategy as well as management and development of the water and related natural resources of the Mekong River Basin in the country. CNMC's most important role is to coordinate and promote sub-regional cooperation

and growth among the member countries of the MRC, and promote cooperation with the donor community.

4.3.2 *The Tonle Sap Biodiversity Reserve (TSBR) Secretariat*

The TSBR Secretariat has three objectives: to serve as an information clearinghouse open to all; to conduct a nationwide public awareness and mobilization campaign for the protection and sustainable use of Tonle Sap Lake and its watershed, including Angkor; and to develop long-term revenue sources for conservation and research activities of the TSBR Secretariat, as well as for the provision of appropriate incomes for enforcement and monitoring officials from the Fisheries Department, MoE and relevant government bodies. The primary government agencies responsible for managing natural resources in the TSBR are the Department of Fisheries (DoF) of MAFF and MoE. They currently exercise a range of management responsibilities over various zones, including the TSBR core areas, the buffer and transition zones, fish sanctuaries, community fishing areas, open access areas and fishing lots. Many of the zones are overlapping. This is complicated by the general lack of demarcation of these different zones, and recent changes in management of the fisheries. These changes can, and do, interfere with the MoE's responsibility to implement the international convention on wetlands and biodiversity, as well as to manage the core areas of the TSBR.

4.3.3 *The Ministry of Environment (MoE)*

The responsibilities of MOE include: developing policies to ensure sustainable development; developing and implementing legal instruments and the Environmental Impact Assessment (EIA) process; advising other sectors on all aspects of natural resources and environmental management; administering the national protected areas system; preparing pollutant inventories; developing inspection procedures; implementing environmental education; compiling, analyzing and managing environmental data; ensuring Cambodian compliance to international environmental conventions and treaties; promoting investments in environmental protection and conservation; and cooperating with national and international organizations, foreign governments and local communities to ensure environmental protection.

4.3.4 *The Ministry of Agriculture, Forestry and Fisheries (MAFF)*

The main tasks of MAFF are to develop and implement relevant sectoral policies aimed at improving the livelihoods of the Cambodian people; to coordinate, monitor and evaluate the implementation of these policies; to monitor agriculture, fisheries and forestry resources and to facilitate their sustainable use; to establish regulations for management, and to preserve and protect natural resources; to build capacity and human resources in various fields in order to take part in the development of the agriculture, fisheries and forestry sector; to provide technical support and guidance to farmers to improve production and farming productivity in order to ensure high yields based on sustainable practices; to improve

vocational training in relation to agriculture; to conduct research on fisheries, forestry and agronomy, including the economics of these activities and dissemination of the results; and to collaborate with other line ministries and cooperate with NGOs and donors to develop agriculture, forestry and fisheries.

The Department of Fisheries of MAFF, central to natural resources management in the Tonle Sap basin, has included the following elements in its Second Five-Year Fisheries Sector Development Plan (2000-2005) and its 10-year Master Plan: conservation and improvement of fish habitat; cooperation with local authorities and fishing community co-management; revision of burden book and definition of gear for appropriate fishing area; disseminate fisheries technologies, science, aquaculture technologies and fisheries law; improve fisheries sector management through revision of the fisheries law and improvement of the structure of fisheries administration; encourage cooperation with international organizations and NGOs; fishing lot reform, to release some lots for family fishing; and establishing community fisheries in areas that have been opened.

One important, but currently halted program (due to lack of funding) established by the MRC, and carried out by the Department of Fishery of MAFF, is the Fish Catch Assessment Program that produces important information about fish catches in the Tonle Sap Lake and River.

4.3.5 *Sub-national Level Institutions*

The Government of Cambodia's recent decentralization policies (known as *Seila* which means "foundation stone") are expected to increase local influence on the TSBR during the project period. The decentralization strategy involves the election of hierarchical representative bodies such as Village Development Committees (VDCs), Commune Development Committees (CDCs), District Development Committees (DDCs) and Provincial Rural Development Committees (PRDCs) in selected provinces, four of which are riparian provinces of the TSBR (UNDP-GEF Portfolio Search Results, Tonle Sap 2000). It is expected that efforts from those in Phnom Penh to alter the traditional provincial authorities operating more or less autonomously from the national authorities will naturally meet with some resistance from those who favor the status quo.

4.3.6 *Regional Level Institutions*

The 1995 Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin established the Mekong River Commission (MRC), the focal regional institution. The MRC objective is to cooperate in all fields of sustainable development, utilization, management and conservation of the water and related resources of the Mekong River Basin, including, but not limited to, irrigation, hydro-power, navigation, flood control, fisheries, timber floating, recreation and tourism, in a manner to optimize the multiple-use and mutual benefits of all riparian entities and to minimize the harmful effects that might result from natural occurrences and human activities.

4.4 National Environmental Laws

The legal framework for conservation and management of natural resources serves two purposes, including regulating human activities through rules and enforcement mechanisms, and providing for institutional mandates and functioning to carry out the administration of the law. Major national environmental laws include:

- Royal Decree on the Creation and Designation of the Protected Area (1993);
- Law on Environmental Protection and Natural Resource Management (1996);
- Sub-Decree on the Organization and Functioning of the Ministry of the Environment (1997);
- Sub-Decrees on Water Pollution Control, Environmental Impact Assessments, Solid Waste Management, Organization, Structure and Functioning of the CNMC (1999);
- Royal Decree on the Establishment and Management of the Tonle Sap Biosphere Reserve (2001); and,
- Law of Protected Areas (draft).

4.5 Capacity Building and Stakeholder Participation

4.5.1 *FAO Programs*

The first phase of the FAO project, "Participatory Natural Resources Management in the Tonle Sap Region" (1995-1998) conducted research and data collection on the flora and fauna of the flooded forest ecosystem, as well as the socio-economics of fishing and agricultural communities. Resource management trials also were initiated. The second phase (1998-2001), "Participatory Natural Resource Management in the Tonle Sap Region", focused on the development and implementation of natural resource management by local communities, with an emphasis on the Tonle Sap ecosystem (but also in the surrounding rain-fed agriculture and upland areas). It is reported that by April 2001, the project had facilitated the development of community resource management in 33 different locations, covering over 20,000 ha and involving more than 100 villages (of which 7 locations, covering 12,000 ha, are in flooded forests). The third phase, scheduled for completion by the end of 2003, will focus on expansion of successful previous trials, particularly to fishing villages, and trials of fisheries resources (community fisheries) will be undertaken to capitalize on recent reforms in fisheries management.

4.5.2 *ADB/GEF/UNDP Project*

As noted above, the third component of the Tonle Sap Environmental Management Project (TSEMP) builds management capacity for biodiversity conservation. Financed by the GEF and administered by UNDP, and under the title Tonle

Sap Conservation Project, the TSEMP as a whole makes special efforts to involve women and poorer sections of communities (www.adb.org/Projects/Tonle_Sap/features.asp).

4.5.3 NGO Initiatives

International NGOs with a focus on wildlife conservation also have undertaken considerable capacity building programs for national staff and counterpart agency staff. In particular, the WCS was able to train counterpart staff from the MAFF and MoE in the techniques of biodiversity survey and assessment, report preparation, environmental education and awareness. Other NGOs, such as WWF-Cambodia, have undertaken similar projects. Training needs analyses (TNAs) have been undertaken as part of the donor-supported natural resource management projects in Cambodia. They will form the basis for developing a TNA for the GEF project (UNDP-GEF Portfolio Search Results, Tonle Sap 2000).

5. Lessons Learned and Recommended Initiatives

The exceptional hydrology of the lake, and the resulting close relationship and interaction between Tonle Sap Lake and the Mekong River, necessitates that management of the lake be pursued in almost full consonance with management of the river basin. With the lake surface and floodplain extending over an area encompassing six Cambodian provinces, the responsibility for lake management lies with the central government. No single lake basin management organization exists with responsibility for comprehensive management of the lake, thus making management and implementation responsibilities too fragmented and uncoordinated among several different ministries, despite attempts made by CNCM to coordinate them. A Lake Basin Management Organization, such as the one proposed in the ADB study, may be usefully explored in this regard.

Although still in a transient stage, with various external inputs gradually merged with local socio-economic and environmental concerns, the management experience for Tonle Sap Lake is rapidly becoming rich in its quality and quantity. They may be described both in terms of more generic subjects, ranging from political interest and sustainable institutions to scientific research on lake management.

5.1 Changes in Political Interest and Commitment

Tonle Sap Lake's vast water volume and its rich biodiversity have seen the survival of Cambodia from the War of Indochina, the Khmer Rouge upsurge and the resulting devastation of the nation, and the subsequent three decades of extreme violence and political volatility that deprived almost everything from the people and the communities. Having gone through this nightmarish experience, the Cambodian government and the international communities, typically represented by such agencies as MRC, FAO, UNDP, ADB and GEF, have reached an implicit political consensus that the rich natural resources and biodiversity of the lake and its surroundings be sustained

through an "International Commons" where collaborative and facilitative management be introduced. The concepts of biodiversity conservation and sustainable natural resource use have been integrated into the overall poverty reduction strategy through the *National Biodiversity Strategy and Action Plan* (NBSAP), through the ADB-initiated participatory Tonle Sap Environmental Management Project (TSEMP), emphasizing the importance of intergovernmental cooperation to create the policy, management and research conditions necessary to advance ecological management. This is unique in one sense, but typical of many lakes in another sense. While it appears that Tonle Sap Lake's unique natural setting has a lot to do with allowing this International Commons to be formed, many lakes in other parts of the world also have a lot in common in the pursuit of sustainable management of rich, and yet vulnerable, resource values.

5.2 Sustainable Institutions and Institutional Constraints

The issue of sustainable institutions may be addressed in three broad issue domains with regard to lake management. One is participatory community actions (i.e., participatory management of forestry, fishery and other livelihood resources). Another is the government institutional linkages on lake resource development and environmental conservation, while the last is international initiatives, collaborative facilitation and resource mobilization toward sustainable development of the nation and the lake region. The participatory community actions for resource use, conservation and management have wide-ranging implications, such as the location of communities relative to the lake, ethnic minority roles and functions in the access and management of community resource base, access to markets and other economic opportunities rather than just sustaining their subsistence living. A major concern pertaining to institutional linkages of the government system is probably the need to adopt the evolving decentralization policies, such as Seila, against the seriously disintegrated hierarchical system of governance, from the MRC through national and provincial authorities, to the poorest and most isolated communities across the lake's watershed and flood plains. As for many of the well-intentioned international initiatives, facilitation and resource mobilization, the direction, extent and eventual goal of the collective whole, in relation to the political and economic realities of the nation and the regions, if not specifically such well-defined subject issue such as TSBR, has yet to emerge. The lessons are being formed as the experience unfolds.

On the other hand, the rapidly accumulating experience in the management of protected areas, such as TSBR, gives many practical clues on resource management of a lake that is to be sustainably managed and protected (e.g., through the formation of core areas, buffer and transition zones, fish sanctuaries, community fishing areas, open access areas and fishing lots). The overlapping zones, complicated by a general lack of zone demarcation, and the changing fishery management practices, make national and international initiatives on wetland and its biodiversity management highly

complicated. Various ministries, as is typically the case with many developed and developing nations, the line ministries and agencies responsible for natural resource management within a large region endowed with vast natural resources do not seem to be able to maintain a good track record of cooperation.

5.3 Linkage Between the Lake Management Program and National and Regional Resources Management Efforts

Water Utilization Programme (WUP). The WUP was commenced in early 2000, and is planned to run for 6 years. It will help establish permanent and functional mechanisms to support Mekong Basin water resources management, consistent with the 1995 Agreement. Its goal is to achieve “reasonable and equitable” water use among member countries, while maintaining the basin’s ecological integrity, including ensuring the natural reverse flow in the wet season into Tonle Sap Lake in order to conserve its biological productivity and its function as a floodplain. The WUP supports the Basin Development Plan of the new era that emerged out of the initial wartime attempts, followed by one in the 1980s, both of which failed in all practical sense. The WUP-FN, a complementary project to the WUP, co-financed by the Finnish Government, addresses the environmental and socio-economic issues in the region caused by the unique nature of the lake, its floods and diverse ecosystems, seasonally changing style of living among the culturally-and ethnically-diverse population around the lake, vaguely defined and ineffectual land tenure, and the transient fishing legislations undergoing major transition. The extremely subtle, but highly complicated, social and economic situation, with the requirement for poverty elimination, make development and implementation of the WUP far beyond the local capability, where focused and yet far-reaching scientific analyses of social and economic variables imminent. The WUP, and its resultant water sharing arrangements, are specifically designed to facilitate agreed-upon means of conflict prevention and resolution among member countries. The WUP covers planning, data collection, development of a decision-support framework and knowledge base, establishment of a mechanism for water use monitoring, and maintenance of river flows and water quality.

Basin Development Plan (BDP). Formulation of the Basin Development Plan (BDP) commenced in October 2001, and will run until late 2004. The output will be both a general planning tool, and an enduring, dynamic process, for use by MRC’s Joint Committee to help identify and prioritize development programs and projects. These are to meet not only the sustainability and equitability requirements of the 1995 Agreement, but donor and lending institution criteria for grant support and investment. The BDP relies substantially on inputs from the WUP, the Environment Programme and Sector Programmes, with regard to information and assessment tools concerning issues such as water quantity and quality, and environment and socio-economic impacts. The BDP aims to identify transboundary economic development activities

that balance the peoples’ development needs with the need for maintaining the long-term environmental integrity and ecological balance.

Environment Programme (EP). The MRC Environment Programme aims to fulfill the provisions in the 1995 Mekong Agreement related to protection of the environment, and maintenance of the ecological balance of the basin. It also supports the other Core Programmes, through provision of environmental data and development of tools for environmental planning and management. Assessment and monitoring of water quality and ecosystem health form an important basis for data provision. The Programme also aims to improve environmental policy and management by providing advice to, and promoting cooperation among, environmental agencies. Through compilation of existing knowledge and facilitation of research activities, it also promotes a better understanding of the environmental and ecological aspects of the lake and its basin.

5.4 Adequacy of Capacity Building and Stakeholder Participation

Capacity building initiatives in lake management typically require strengthening institutions, both for promoting participatory management of natural resources and for effective environmental education, communication and awareness raising on sustainable development and conservation of lake environments. In the case of a lake such as Tonle Sap, where the lake serves as the nation’s most important economic resource base, as well as home to millions residing in the area, the initiatives have to be multi-fold. Over the long term, in order for such initiatives to eventually be sustained by the Cambodian people themselves, the prerequisite for such initiatives is the enhancement of basic human-resource capacity for implementing and addressing the principles of sustainable resource use. It is essential, therefore, that a range of educational opportunities be provided widely to the population in general and, in particular, to the prospective leaders of the new generation.

NGO initiatives seem to have formed a successful basis for various international donor-supported projects, including those funded by GEF, and executed by the UNDP and ADB. The important NGO-donor collaboration projects, including those executed by UNDP and ADB, have taken root in regard to the fisheries. Another NGO activity—a three-phase FAO project focusing first on ‘dryland’ communities, then on natural resource management in community fisheries and forestry skills, and more recently on expansion of fishing villages and fisheries resources (community fisheries)—seems to have set the foundation for sustainable fishery management in the Tonle Sap region. Numerous new ‘community fisheries’ projects have been planned and implemented, including both government agencies (primarily by the DOF and provincial offices) and NGOs, in the TSBR in response to reforms in the fisheries sector.

Because Cambodia has only recently emerged from social and political instabilities, the governmental line agencies are still weak in administrative capability and short on resources. Thus, the role played by domestic and international NGOs in lake management has become very important. On the other hand, the diverse roles and orientations of different NGOs may lead to conflicting interests and approaches in the provision of services to the local population. What is urgently needed, therefore, is a strengthening of the institutional capability of government agencies to be able to achieve long-term management objectives. In addition, enforcement capability has to be greatly improved for laws and regulations already in place to be properly enforced.

In general terms, because social and environmental issues are closely interrelated, dealing with each in isolation will not result in the sustainable use of the lake and its watershed resources. While conceptually clear, it would be extremely challenging to pursue this notion, particularly in view of the prevailing realities surrounding population growth, people's deep dependency on natural resources, the decreased availability of natural resources, and unjust (although lately improved) fisheries management. Apparent gross inadequacies in the enforcement of environmental laws and regulations actually stem from the fact that environmental and social development conflicts have not yet been adequately addressed.

5.5 Scientific Research on Lake Management

Long-term, sustained monitoring activities by resident institutions in the Tonle Sap region on water quantity and quality and other environmental parameters of the lake and its watershed have yet to be firmly established. A number of short-term natural and social science research activities, however, have been conducted, particularly by international technical collaboration agencies and scientific programs, including the Tonle Sap Environmental Management Project discussed in section 4.1.2. The information generated by these activities would serve very useful purposes if systematically compiled and widely shared. Thus, a collaborative system of information generation, compilation and assessment is urgently needed, as well as its widespread dissemination through electronic media.

Tonle Sap Lake is confronted with a number of socio-economic, environmental, cultural and political issues that collectively constitute root causes of degradation of resource values endowed by the great nature of the Mekong River system. The collective inputs from the ongoing technical collaboration activities would serve as a basis for developing a long-term, sustainable development of the lake and its drainage basin. One of the keys to success would be application of the precautionary principle (Principle 3 of the World Lake Vision).

Despite the extreme importance of the lake for Cambodia and the region, neither the lake's exceptional hydrology nor the driving forces behind high aquatic production are yet fully understood and analyzed. The main reasons for this

are the lack of resources and information as well as lack of comprehensive management of the lake. However, several ongoing and planned initiatives and projects aim to improve the understanding of this exceptional ecosystem. These projects include the Tonle Sap Modeling Project (WUP-FIN) under the Mekong River Commission (WUP-FIN 2003), the on-going Tonle Sap Sub-area Analysis Process by the Cambodian National Mekong Committee (CNMC) and the MRC, the operation of the Tonle Sap Biodiversity Reserve Secretariat as well as the ADB-funded projects for the Tonle Sap that also include initiative for the formation of basin-wide lake management organization (ADB 2003).

The exceptional symbiosis between the Mekong River and Tonle Sap Lake also requires extremely close linkage between the management of the river and the lake. For example, the possible building of upstream dams can result in serious reduction of the water flow to the river, as well as decreasing the quantity of sediments in the lake. This would have serious effects on the functioning of the lake and would likely dramatically reduce the lake's aquatic production, since the sediment concentration appears to be extremely vital for the aquatic production of the lake (van Zalinge et al. 2003).

5.6 Other Observations

A sustainable livelihood approach should be applied. The level of dependency of the people on the lake's water and related resources is very high. More than a million people live in the immediate surroundings of Tonle Sap Lake and its flood plain, many with annual per capita incomes as low as US\$300. The extensive poverty and the people's significant dependency on the natural resources in the Tonle Sap Lake area is alarming, given that the products from all natural resources are clearly in decline. The decreasing natural resources, and the rapid population growth, is an unsustainable combination that has resulted in the decreased level of the people's livelihoods.

Complex interlinkage (basin-wide). The 1995 Mekong Agreement recognizes the complex inter-linkage between the Mekong River, Bassac River and Tonle Sap Lake in ensuring an acceptable natural reverse water flow to Tonle Sap Lake during the wet season. The observation of the fishery for migrating fish in the Tonle Sap River, for example, shows that year-to-year variations in maximum Mekong River flood levels and related Tonle Sap Lake floodplain inundation strongly affect the yield of this fishery. It is hypothesized that sediments carried by the Mekong River to Tonle Sap Lake bring in the essential nutrients that feed the lake's food webs. The higher the flood level, the more sediment is brought to the lake. This leads to improved survival and growth of fish and, therefore, improved fish yields. When defining the conditions for acceptable reverse water flows, both water quality and quantity impacts must be taken into account. Upstream developments, such as dam and reservoirs construction/operation, may lead to significant trapping of sediment and nutrients, thereby reducing the fertility of the Tonle Sap system.

Research and development: Make information count. Tonle Sap Lake currently is one of the least-spoiled lakes in the world, qualifying it to be considered a world heritage site. Development pressures, however, in the lake basin are great. The long-term sustainability of the Tonle Sap system is reportedly threatened by logging, over-fishing, pollution and sedimentation. Despite growing concern over the health of this ecosystem, there has been relatively little scientific research into the nature and rates of change in the Tonle Sap Lake drainage basin. For example, sedimentation of Tonle Sap Lake recently has given cause for concern. Due to a lack of strong scientific data and confusion over existing evidence, many scenarios of the lake's future have been developed. The most pessimistic one forecasts a drying up of the lake in a ten-year period, while other studies estimate the lake would take 600 years to dry up. The diverse physical, bio-geo-chemical and socio-economic conditions in the Tonle Sap Lake area, and its importance for the livelihoods of the local and regional population, pose extraordinary challenges for decision-making and lake management. These challenges can only be met with strong political will, financial sustainability, first-hand knowledge and proper decision support tools. Although some research is being carried out in the area, the outcomes are rarely easily available for consultation and reference. In addition, various Tonle Sap Lake frameworks and initiatives have been/will be carried out but stronger coordination and information exchanges among them is required. The success and effectiveness of any project should be measured by increased knowledge, formation of cooperative networks and extensive use of the results.

Effective means for conflict prevention and resolution. People rely so heavily on Tonle Sap Lake resources that conflicts can be severe, including the following:

- Conflict/competition within the fishery sector (household vs. commercial fishery);
- Conflict/competition between conservation and development (e.g., clearance of fish habitat for other development purposes);
- Conflict/competition among different sectors; and,
- Transboundary conflicts.

6. References

The core portion of this report depended heavily on the information provided in UNDP-GEF Portfolio Search Results, Tonle Sap (2002). Also referred to rather extensively within the general context of this report are Varis and Keskinen (2003) and Keskinen (2003). Data and information obtained from these and other sources, however, were often referred to in multiple places, making it difficult to clearly identify the original source. Referencing of the sources of specific data and information, therefore, was not attempted.

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