

# **Aquatic Resources Management: The Tonle Sap Great Lake, Cambodia**

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## **Abstract**

The paper briefly describes the physical features of the Tonle Sap Great Lake (TSGL) ecosystem and its setting within the Mekong River Basin, and, as the most important inland fishery, its pivotal role for the national economy, food balance, and rural livelihoods. Inland fisheries produce between 290,000 and 430,000 tons of fish each year in Cambodia, 235,000 of which come from the Great Lake ecosystem, contribute 16% to GDP, account for 75% of the animal protein consumption, and, for at least one third of the Cambodian population, provide the primary or secondary source of income and employment.

The history of management is traced, and present problems and issues are discussed in the context of dramatic change of tenure, which followed Government decision, in 2000, to release some 56% of formerly limited access fishing grounds into open access, to be, ultimately, managed by fishing communities.

Problems range from transboundary issues potentially changing the flood cycle of the Mekong, to domestic threats to the resource created by habitat degradation and ever increasing fishing pressure, with community based management capacities little or not developed, government institutions under funded and management and enforcement severely constrained by poor governance.

The TSGL experience shows the validity of the ecosystem approach and the need to include all natural and human factors, including those external to the system. It is further argued that the approach needs to include the socio political dimension and that, particularly in post-conflict countries like Cambodia where governance related problems are still very prominent; an ecosystem approach that encompasses only the natural and anthropogenic processes involved will not be effective.

The paper concludes that an ecosystem is not a scenario frozen in time but a dynamic and dialectic process of interacting players and conditions driven by synergies and contradictions alike. Therefore, it renders sectarian intervention precarious, lends itself with difficulty to “roadmaps” and will frustrate “blue print approaches” to development.

Acknowledgement

## 1. Physical Structure of the Country

Cambodia borders the Gulf of Thailand; its immediate neighbors are Thailand, Laos and Vietnam (see Figure 1 below). The country covers an area of 181,035 km<sup>2</sup>, including 4,869.84 Km<sup>2</sup> of permanent water surface (2.69%) (Thuok & Sina, 1997). It stretches over some 450 km from North to South and around 580 km from East to West, with an alluvial plain comprising the Tonle Sap Great Lake (TSGL), a system of large rivers and the surrounding floodplains. The plains are enclosed by a circle of mountains, i.e. the Cardamon and the Elephant Mountains in the southwest, the Dangrek Mountains in the north and the Eastern Highlands in the northeast.

The country is endowed with a wealth of natural resources that have sustained its people for centuries. The Mekong River, the Great Lake and its wetlands and floodplains form the core area of primary production. Here, highly fertile soils replenished with nutrient-rich sediments by the annual floods, and aquatic habitats teeming with fish and other living aquatic resources provide rice and fish, the main staples of the national food balance.



## **2. The Tonle Sap Great Lake**

The TSGL is part of the Mekong River basin, which covers nearly 800,000 km<sup>2</sup> and is home to more than 65 million people (Ahmed and Hirsch, 2000). In Burma, Cambodia, Lao PDR, Thailand, Vietnam and the Yunnan Province of China, the Mekong River creates a vast inland water system, comprising numerous rivers and lakes, extended into flooded forests, grassland, rice fields and swamps. This water system supports a multitude of freshwater fish species and a plethora of other living aquatic resources.

In Cambodia, inland fisheries rely mainly on two ecosystems: the Tonle Sap Great Lake system (accounting for 60% of current annual commercial fisheries production shown in government statistics), and the lower Mekong-Bassac system and its tributaries. A third ecosystem, consisting of the upper part of the Mekong and the rapids region is considered less important for inland commercial fisheries, but serves as an important ecological link for most of the migratory species and provides fishing opportunities to the local communities.

The TSGL is the largest freshwater lake in Southeast Asia and it abounds in fish and other living aquatic resources. In the dry season, the Great Lake covers an area of 3,000 km<sup>2</sup> (100 km long and 32 km wide) with an average of water depth around 0.8 -1m. During the rainy season, the flood pulse reverts water flows back into the Great Lake, which expands to cover more than 10,000 km<sup>2</sup>, submerging large wooded and scrub areas, the “flooded forest”. This creates an enormous fish breeding, nursing, and feeding ground with depth varying from 10-12 m (Table 1), which around 280 fish species populate over at least six months during the monsoon (Thuok and Sina, 1997, Bailleux, 2003).

**Table 1.** Areas of various types of land and water resources, which support Cambodia's freshwater capture fisheries

<i>Type of land and water resources</i>	<i>Areas (ha) 1985 – 1987</i>	<i>Areas (ha) 1992 – 1993</i>
Permanent water (River, lake, ponds etc.)	567,100	411,100
Flooded forests	795,400	370,700
Flooded secondary forests	28,200	259,800
Flooded grassland	80,800	84,900
Receding and floating rice fields	17,500	29,300
Seasonally flooded crop fields	366,800	529,900
Swamp	12,200	1,400
<i>Total</i>	<i>1,868,000</i>	<i>1,687,100</i>

Source: - Cambodia Land Cover Atlas 1985/87-1992/93, 1994 (There is no current data).

### **3. Role and Importance of Inland Fisheries**

#### National economy

Estimates (by the MRC Capture Fisheries Project at the Department of Fisheries) suggest that the inland fisheries of Cambodia produce between 290,000 and 430,000 tones of fish each year, 235,000 of which come from the TSGL (Bailleux, 2003, Acker, 2003 ), with an estimated value at landing of US\$150-200 millions. A recent estimate by the Ministry of Planning, places the contribution of the sector to Cambodia's GDP at 16%, thus surpassing paddy-culture in terms of importance to GDP. According to CSP: Sectoral Implementation Assessment (August 2003), freshwater capture fisheries, average at least 32 percent of the total agricultural output in Cambodia, more than in other countries<sup>1</sup>.

<sup>1</sup> in US dollar terms, Gross Value Added was \$400 million for fisheries in 2001. This is most probably an underestimate, since much of fisheries production proceeds directly into home-based processing or consumption.

### Food security

The contribution of the freshwater fishery has always been, and is, of primordial importance for food security and nutrition of the Cambodian people. Second only to rice, fish is a vital and generally affordable-food source that accounts for more than 75% of the population's animal protein intake: an average of 67 kg of fish is consumed per person/annum in fish dependent communities particularly in the Great Lake areas as compared to a national average of 151 kg of rice per year (Yak et al, 2002). These consumption figures indicate that the inland fisheries of Cambodia contribute more to the national food balance than any other inland fishery in the world.

Unlike in most other countries, where ever-increasing prices exclude the poor from fish consumption, fish is still accessible to even to the poorest sections of society in Cambodia. The crucial importance of inland fish production to food security of the poor is demonstrated by the role fish paste (*pra hoc*) in the diet of, in particular, poor Cambodians. When the waters of the Great Lake recede, small cyprinids, "trei riel" (most of them caught by the riverine "dai"<sup>2</sup> fishing lots) become so abundant and cheap that tens of thousands of people, the majority of them coming from upland fish deficit areas, harvest, buy or barter fish which they process into fish paste, take home and store as a year-long protein supply. Recent figures suggest that, on average, 10 to 15 kg/person of *pra hoc* are consumed yearly (CDRI, 2003).

Besides fish, a wealth of other aquatic products is harvested from inland waters, flooded forests, wetlands, and rice fields for consumption and sale. These include frogs, prawns, snakes (in particular water snakes), insects, mollusks, snails, turtles, and wetland birds. Rice fields alone yield between 25-300 kg of aquatic organisms per hectare/year, worth 40-80% of the value of the rice harvest (Gregory, 1997; Guttman and Gregory 1999; Acker, 2003).

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<sup>2</sup> A dai is a stationary, anchored trawl stabilized by boats and kept open by the river flow.

### Income and employment

At least one third of the Cambodian population depends on inland fishing for their livelihoods, for household consumption and as the primary or secondary source of income and employment.

For the fishing communities - who have little or no access to cultivatable land - it is the mainstay of their household economy. For many of them fishing, together with hunting and gathering of other “wild” products, is a coping strategy of last resort. They are among the most vulnerable of the people living around the Great Lake and include ethnic minorities like some of the Vietnamese and the Cham. An estimated 1.2 million people pertain to this group, with around 25% living in floating villages or stilted houses.

In addition to those for whom fishing is the mainstay of their livelihood, a large section of the rural population living in the agro-economic and upland areas surrounding the Great Lake depend on the natural resources of the TSGL ecosystem for survival. During the dry season, large numbers of these “secondary users migrate to the lake, to fish for household consumption and revenue, and to practice draw down agriculture, often to the detriment of the environment.

Thus, at least four million people derive employment from inland fishing for their livelihood as the primary or secondary source of income and employment (Schmidt, 2002; Acker, 2003), and for almost all of the rural people in Cambodia – as well as for many peri-urban families - with access to water bodies, fishing provides food and income on an occasional basis and can serve as a buffer at times of distress.

### Gender and culture

Cambodia’s wetlands, lakes, rivers and forests have constituted not only the economic base of Khmer civilization for centuries, before, during and following the era of Angkor. The TSGL and its ecosystem in particular have set the

Cambodian national identity and continue to do so to this day. Such is the importance of fish to Khmer people that it is reflected in the proverbs like *“Mian Teuk Mian Trey”* meaning *“where there is water, there is fish”*.

Overall, it is estimated that in Cambodia 12% more women than men are active in small-scale agriculture, fisheries and other extensive primary production and gathering of “wild” products (Gum, 2000). In fishing communities, all able members of the household participate in fishing, fish selling, fish processing and equipment construction and many other activities related to fishing through out the year. women are particularly active in activities like making and repairing small scale, artisanal fishing gears, grading fish by size and species, processing and marketing but also fish actively. In fact, an increase in fishing pressure is often indicated by an increased incidence of women – and children – engaged in fishing.

#### Eco-tourism

The TSGL with its flooded forests, spectacular flocks of rare water birds (particularly around Preak Toal) and unique floating villages, together with its proximity to Angkor Wat, provides great potential for tourism that, at present, is barely tapped. In particular the flooded forests are enormously complex and fertile habitats, rich in food and serving as refuges for fish, birds, turtles and a myriad for other species associated with the wetlands. The diversity of habitats is shown in the following table:



**Table 2: Ecosystem diversity**

Ecosystem unit	Abiotic condition			Biotic condition		
	DO <sup>a</sup> (%)	Flood duration <sup>b</sup>	Altitude range <sup>c</sup>	Plant <sup>d</sup>	Fish <sup>e</sup>	Wildlife <sup>f</sup>
Open lake and stream area*	105-71.50	Year-round	-1& 0 asl	Phytoplankton	White fish	Water-bird, pelican, tern
Flooded forest**	62.4-46.6	8 months	2-8 asl	Forest, bush, shrub and phytoplankton	Black fish	Large water-bird, turtle, crocodile, monkey, civet, otter, python& cobra, insect
Flooded grassland or veal***	Na	3-5 months	5-8 asl	Grass, floating plant & phytoplankton	Black fish	Bengal florican water-snake, turtle, insect
Agricultural land**** -		5 days	8+ asl	Shrub, rice and cultivated plant	Small fish & black fish	Frog, rice crab, insect, rat, egret

Source: Bonheur and Lane (2002)

a: Based on TCU/SPEC limnological research (September-December 1998) between the surface and depth of 4 m.

b: Tes Sopharit (1997)

c: Topographic map (1960)

d: Andrew McDonald report and field surveys of TCU/UNESCO/SPEC (1996)

e: Numerous reports by MRC/DANIDA (1995-1999)

f: TCU/UNESCO/WCS research activities (1996-2000)

\*: 289739 ha; \*\*: area tall forest: 19646 ha; area shrub abandoned: 34936 ha;

\*\*\*: area: 115291 ha; area grass abandoned: 157662 ha; \*\*\*\*: area: 406020 ha

In addition, both the TSGL ecosystem and connected wetlands encompass an enormous species diversity including rare fish and birds, snakes, turtles, crocodiles and several globally threatened and near-threatened mammal species, all attractive for eco(see Table 3, Bonheur and Lane, 2002).

**Table 3: Species diversity**

Biological unit	Species in Tonle Sap	Common species in Tonle Sap	Endemic Species	Endangered Species
Flooded forest	190	8	Unknown	-
Fish	500	70	-	4
Water-bird	104	89	-	15
Reptile	46	12	1	
Mammal	14	8	-	6
Invertebrate	31			
Total	885			

Source: Bonheur and Lane (2002)

If developed softly and responsibly – with respect to sensitive habitats and the cultural identity of its people – eco-tourism can become a significant and sustainable source of foreign currency for the Cambodian economy.

#### **4. Resource Management to date**

Fisheries resources management has varied, over time, according to the different political regimes of Cambodia's past. First management system can be traced back to the reign of King Norodom (1859-1897) and his predecessors (Mckenny *et al.*, 2002:54), who collected revenue from the fishing sector through the selling of user rights to fishing areas.

In 1908, under the French colonial administration, fishery laws and regulations were first written and published. The purpose of these legislations was to generate revenue for the colonial administration, not to change existing patterns of fisheries exploitation (Degen and Nao, 2000 in Mckenny *et al.*, 2002:54).

During the Democratic Kampuchea regime (1975-1979), fishing was, officially, discouraged; were only a few designated 'fishing units' harvested and processed fish to supply to Cooperatives (Sahakor) and Khmer Rouge cadres. (Thay<sup>a</sup>, 2002, Mckenny *et al.*, 2002, FACT, not dated). The Tonle Sap ecosystem suffered from large scale degradation during this period, however, because large areas of flooded forest were cleared in favor of agricultural development.

After the collapse of the Khmer Rouge regime in 1979, the People's Republic of Kampuchea (1979-89) encouraged collective fishing by solidarity groups called "Krom Samaki". These groups soon proved ineffective and were, consequently, abandoned. In the late 1980s, a first Fishery Law was adopted, defining a framework for fisheries management that included temporal and special arrangements of access rights and gear restrictions, and reintroduced a fishing concession system as a management tool and as a source of Government revenue, the lot system (Thay<sup>a</sup>, 2002).

Since 1993, the Department of Fisheries (DoF) within the Ministry of Agriculture, Forestry and Fisheries has the mandate and regulatory authority to manage, protect, conserve and develop fisheries resources, grant concession and issue licenses, collect fees from these activities and control processing, trade and export activities.

The presently applicable regular and legal framework of inland fisheries management still relies on the 1987 law that combines large-scale fishing exploitation in fishing lots (intended to generate revenues to the State), licensed middle scale fishing and family scale fishing defined by the type of fishing gear permitted. Management measures include the interdiction of fishing gear, closed seasons and fish sanctuaries but are not based on medium or long-term fisheries management plans.

## **5. Present Management of the Tonle Sap floodplain fisheries – Issues and Challenges**

By the end of the last century, the primordial role of the inland fisheries sector for the national economy had become increasingly visible to political decision makers (helped, last not least, by external assistance, most notably MRC's fisheries program). Central strategy documents of RGC, like, for example, the Second Five Year Socioeconomic Development Plan and the National Environmental Action Plan recognized the crucial importance of living aquatic resources for food security, rural livelihoods and the national economy of the Cambodian people and Cambodia at large.

Also at the turn of the century, increasingly violent conflicts over resource utilization, among fishing communities, lot concessionaires and seasonally migrating "secondary users" erupted. Main reasons were the encroachment of public fishing areas by fishing lot operators, sub- and sub-subleasing of lot areas to fishing operators which greatly intensified fishing pressure, and increased use of armed guards to intimidate small scale fishers. All of these practices, as well as large-scale illegal fishing by armed police and military, were in breach of the law but tolerated by the local authorities.

In 2000, RGC took the decision to return 56% of the fishing lots from limited to open access. Enacted by the Prime Minister, this fisheries “policy reform” envisaged a community resource management to replace the lot system. However, with most of the fishing communities lacking the basic means and requirements for participatory fishery management, and enforcement officers being ordered “back to barracks”, this created a power vacuum which increased indiscriminate and destructive resource use to levels never experienced before.

Today, almost three years after having been set in motion, the “reform” is still in its “inception phase”, leaving the challenging task of implementation of the new concept of community fisheries to fishing communities with no tradition and little capacity for community based natural resource management (CBNRM), RGC, in particular the Department of Fisheries (DoF), Ministry of Agriculture, Forestry and Fisheries (MAFF), local government, the donor community and other stakeholders (Thay<sup>b</sup>, 2002). Within MAFF, the Community Fisheries Development Office is responsible for facilitating and coordinating with Provincial Community Fisheries Development Units, NGOs, and local authorities and fishing villages and communities to implement community fisheries successfully and efficiently.

Notwithstanding the considerable progress achieved with respect to the legal framework, with a new fishery law being in the final drafting stage, and a specific “Sub Decree on Community Fisheries” expected to be enacted mid 2004, a lot needs to be done. To date, the only hands on experience available rests with a Belgium funded project implemented by FAO focusing on participatory natural resource management, in particular community based fisheries management, which the project has successfully innovated in Siem Reap Province.

Overall, there are still major problems to be overcome if community based fisheries management is to become a, if not the central instrument of aquatic resource management of the TSGL ecosystem. They concern the generally poor understanding of the concept on the part of many stakeholders (including

most communities), an astonishing (considering the amount of funding which went into scientific research over the last years) lack of data on the state of the living aquatic resources and the ecosystem at large, and the scarcity of other technical and target group related information. In fact, the community level management plans facilitated by the project in Siem Reap Province rely, almost entirely, on local knowledge.

However, these and similar constraints to community based natural resource management (CBNRM) of the TSGL ecosystem can be overcome if sufficient development support, by RGC and/or the donor community (including NGO's) becomes available (several donors are already active in the sector and the Asian Development Bank (ADB) has provided a major loan to Cambodia for the environmental management of the TSGL, including support to community fisheries development. Major threats to the ecosystem concern trans-boundary issues (like dams and other water management devices built upstream, actually or potentially altering the hydrological cycle of the Mekong River and the annual flooding pattern) and other externalities.

Domestically generated problems that affect inland fisheries result from growing population and persistent and widespread poverty (with inequitable land distribution and increasing landlessness as a major issue), and poor governance.

Of the more than 14 million estimated to be the present population, 36% of the live below the poverty line. However, there are large disparities in income distribution, with the coastal and mountainous regions having the lowest (22%) and the Tonle Sap Great Lake region having the highest incidence of poverty (38%), in spite of its abundant resources.

Indeed, rural poverty around the TSGL is believed to follow an upward trend. This will inevitably increase pressure on the natural resources further, making a trade-off between the needs to provide for more equitable and pro-poor development and, at the same, conserve the ecosystem for future generations ever more difficult.

Poor governance, on the other hand, has been and is a prime constraint to the enforcement of legal frameworks regulating the utilization of natural, including aquatic resources. Deficiencies concern the lack of legality and a weak judiciary which, together with the lack of transparency and accountability of public institutions and local leaders, result in insecurity, especially for the poor and disadvantaged and most vulnerable households. A case study (Thay<sup>a</sup>, 2002) and preliminary field research of Policy Reform Impact Assessment Project (DFID-DoF) (2003) provide some empirical information on the rich, powerful and influential benefiting from the still existing legal, institutional and administrative vacuum governing resource utilization in many areas of the TSGL ecosystem.

## **6. Ecosystem management of aquatic resources: the Tonle Sap experience**

The TSGL experience confirms, in general, the validity of the ecosystem approach to NRM, but suggests, at the same time, additional considerations based *inter alia* on the problems encountered with the “fisheries reform”, first experiences with participatory and CBFM, and the consultative process involved in the of drafting of the legal framework.

Although there is still a lack of comprehensive and conclusive data on the interaction of the multiple physical features of the TSGL ecosystem, as hydrology and the flood cycle or pulse, interdependencies with alterations of the environment of the Mekong basin within and beyond Cambodia’s borders are evident and support an ecosystem approach which includes trans-boundary issues.

The validity of the approach for the TSGL ecosystem is further confirmed by the significant inter-dependence between the livelihoods of those reliant on fishery and those who depend on agriculture and forest resources of the larger ecosystem. Farming families of the adjacent agrarian and upland forest area’s, which depend on primary production, (in particular the poor, and

including slash and burn cultivators), fish seasonally and buy/barter fish for pra hoc making; fishers depend on timber for house/boat construction and other forest products including poles, vines and bamboo for artisanal gear manufacture (Schmidt et al, 2003).

In this context is important to realize that livelihoods and coping strategies based partially or mainly on the extraction and harvesting of “wild” resources are particular vulnerable to habitat loss and degradation and loss of biodiversity. To maintain the forests means to keep “last resource activities” (as the collection of timber and no timber forest resources) open to the marginalized rural poor and will result in less pressure on the living aquatic resources, and *vice versa*.

Other strategies to relieve resource pressure, as intensification of agricultural production or pond culture of fish have a much lower potential , as they are often “grabbed” by the better-off farmers, whose livelihoods do not depend on “wild” resources.

Thus, the TSGL experience is a convincing example for the crucial importance, of the understanding of the interaction of people and the environment, for a comprehensive ecosystem approach. Also, the TSGL will, in the - not so far - future, confront development planners and decision makers with the choice, or trade-off, between the contradictory development objectives of pro-poor development and preservation of the natural resource base.

The TSGL experience also shows that an ecosystem approach to natural resource management and development needs to include the socio political dimension. Particularly in post-conflict Cambodia, where governance related problems are still very prominent, an ecosystem approach that encompasses only the natural and anthropogenic processes involved will not succeed. In the absence of an impartial judiciary and legality, of transparent and accountable public institutions and a functioning civil society, the patronages and power webs presently in place will prevail.

Thus, development imitatives and intervention can only be effective and sustainable if the interdependencies of all natural, human and political factors are realized. An ecosystem is not a scenario frozen in time but a dynamic and dialectic process of interacting players and conditions driven by synergies and contradictions alike. Therefore, it makes sectarian intervention precarious, lends itself with difficulty to “roadmaps” and will frustrate “blue print approaches” to development.

The development context of the provinces bordering the TSGL is evolving quickly, with improved communications and accelerated economic development increasing resource pressure. The "carrying capacity" of the existing natural resource base is approaching its limits and, unless the dimensions outlined above are not understood and approached in a holistic fashion, efforts to manage and preserve the resource base of the TSGL will be frustrated.



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**Appendix 1: Distribution of inland capture fisheries production, by province**

Province	Fish production (t)				
	1980	1985	1990	1995	2001
<b><u>Plains region</u></b>					
<b>(Mekong-Bassac)</b>					
1. Phnom Penh	2,000	5,740	4,600	5,935	9,000
2. Kandal	1,500	10,375	12,500	13,570	21,500
3. Kampong Cham	3,700	4,280	5,100	6,850	10,000
4. Prey Veng	1,000	2,138	2,230	3,105	5,000
5. Takeo	600	1,447	1,900	1,760	5,000
<b><u>Tonle Sap Great Lake region</u></b>					
6. Kampong Thom	2500	2470	4100	4100	9,000
7. Siem Reap	2000	8450	9000	8000	15,000
8. Banteay Meanchey	-	-	190	192	3,000
9. Battamabang	1300	3700	4300	4712	15,000
10. Pursat	2500	5410	7200	7848	15,000
11. Kampong Chhnang	3700	10220	12000	14417	21,500
<b><u>Upper Mekong region</u></b>					
12. Stung Treng	-	670	680	515	2,500
13. Kratie	300	1500	1300	1496	2,500
<b>Total</b>	<b><u>18400</u></b>	<b><u>56400</u></b>	<b><u>65100</u></b>	<b><u>72500</u></b>	<b><u>134,000</u></b>
<b>Total including marine</b>	<b><u>19600</u></b>	<b><u>67578</u></b>	<b><u>105000</u></b>	<b><u>103000</u></b>	<b><u>444,500</u></b>

Source: DoF (2002): Department of Fisheries, Fisheries Data Collection and Statistics 1980-2002.