MEKONG RIVER COMMISSION/DOF/DANIDA

**Project for Management of the Freshwater Capture Fisheries of Cambodia**

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# Where there is water, there is fish? Fisheries issues in the Lower Mekong Basin from a Cambodian perspective[1].

by

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## 1. Introduction

The fishery situation in the Lower Mekong River Basin can still be characterized by the Cambodian proverb "mijin tak, mijin trey" (where there is water, there is fish). Particularly in the Lao PDR and Cambodia the basin is still relatively untouched, but regional development is accelerating, causing pollution and erosion through deforestation and leading to increased water usage for:

- urban and industrial water needs
- irrigation schemes (15 dams, mainly Thailand and Viet Nam)
- hydropower generation (10 dams, mostly in Thailand)

So far only 1 dam on the Mekong main stream has been built in China, although a second one is under construction. However, more than 130 potential sites have been identified, including 18 on the main stream, and implementation of only a part of these schemes will have consequences for the fisheries in the basin. At some of these dams reservoirs will be created, which will locally boost fish production, although downstream losses are hardly ever assessed in environmental impact assessments. Negative effects will be caused through changes in flow regime of the river, flood control measures will result in lower peak floods and of course dams will block fish migrations, although properly designed fish ladders may alleviate this problem somewhat.

Developments particularly in Lao and Cambodia are still in their early stages with developments in Viet Nam and particularly so in Thailand much more advanced. Therefore, now is the time for research, consultations and discussions that should lead to a Mekong River water utilization agreement in order to avoid potential conflicts that are likely to arise with increasing water needs. Cambodia, Lao PDR, Thailand and Viet Nam signed the latest Mekong Agreement in April 1995. China and Myanmar also sharing the Mekong waters

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[1] Contribution to the **Mekong Panel** at the Seventh Common Property Conference of the International Association for the Study of Common Property, Vancouver, Canada, 10 - 14 June 1998

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have so far declined to join. The contribution (in %) of each country to the average river flow (MRC 1998) is as follows:

- China 16%
- Myanmar 2%
- Lao PDR 35%
- Thailand 17%
- Cambodia 19%
- Viet Nam 11%

MRC 1998 advocates the need for national natural resources policies, which would reflect the implications of a shared vision of the objectives for water management and regional cooperation. In addition, an institutional framework is needed with programs to strengthen the knowledge base, hydrological modeling, benchmark surveys and community awareness and participation.

In the field of fisheries in Cambodia, presently, work on institutional capacity building for research and management, expansion of the knowledge base and benchmark surveys, including ways to facilitate community participation, is on going. This paper gives an overview of some of the achievements and identifies major gaps in knowledge and experience.

## 2. Importance of fisheries in Cambodia and the Lower Mekong River Basin

### 2.1 Basis of fish productivity, fish migrations and bio-diversity

Floodplain productivity and fish migration

Wild fish production takes place in a wetland ecosystem that is driven by the annual flooding of the Mekong river under influence of the southwest monsoon (June – October). In Cambodia the Tonle Sap River flowing from the Great Lake to Phnom Penh reverses its direction due to a faster rise in Mekong water levels and this results in an expansion of the Great Lake of 4 to 6 times (Fig.1). In a similar, though less dramatic way, everywhere along the Mekong River and its tributaries thousands of square kilometers of floodplain forests and shrub lands are temporary submerged, thereby making abundant food resources accessible and providing shelter for numerous fish species.

When the floods recede, the direction of the Tonle Sap River flow changes again. Water levels on the submerged lands start dropping, signaling to most fish species to migrate to deeper water in the lake or tributaries (lateral migration). Many species will then undertake longer (longitudinal) migrations from the lake or tributary to the Mekong River, probably moving up as well as downstream. In particular, the large- and middle-scale fisheries are geared to intercept these migrations, when water levels start falling.

Fish species with longitudinal migrations begin to spawn in the Mekong River at the beginning of the rainy season (May-July), when normally the first flood waters are coming in and water levels start rising again. Fish eggs and fry are carried by the currents and swept into the flood plain areas that are being inundated. Synchronization in the arrival of the first floods and the spawning process may be crucial. The filling of hydropower storages will cause delays in the patterns of flooding and diminish it. It may disrupt this cycle and lead to

a decrease or a failure in recruitment and a decline of the migratory fish stocks, especially of the longitudinal migrants, which, constitute about 63% of the total catch taken in the Tonle Sap area.

The fish migrations described above seem to be largely restricted to the Mekong and tributaries below the geological fault line at the Khone Falls close to the Lao-Cambodian border, where the extensive rapids and falls (10 -15m) allow for the passage of a small number of species in apparently not very large numbers. On the other hand the existence of a Dai fishery (see below) in the Viet Namese part of the river suggests a massive dry season (November – March) movement downstream out of the Cambodian floodplains (data on catches, species composition are needed). This has to be matched with an early wet season spawning migration upstream, as large numbers of fish fry are coming down the Mekong around Phnom Penh in June – July.

Biodiversity

Due to geological processes several river systems were joined to eventually form the Mekong River. This brought together fish faunas that had evolved in distant parts (Rainboth, 1996). At present 1200 fish species are known to occur in the river system. The 500 species found in Cambodia are described in a new identification guide, "Fishes of the Cambodian Mekong", (Rainboth, 1996). The guide will be expanded to cover the entire fish fauna of lower Mekong basin. In the on-going research several species - unknown to science - are likely to be discovered.

Most of these species have little direct commercial value, although most will serve as forage fish for the predators among the commercial species.

The important commercial species are often broadly categorized (MRC 1992) as:

- Black fish, species able to survive in swamps and plains year round with limited lateral migrations. Mostly carnivorous and detritus feeders. This group includes: Channidae (Snakeheads), Clariidae, Bagridae (*Mystus* spp.) and Anabantidae.
- White fish, most species show strong lateral and longitudinal migrations. This group includes many cyprinids, various *Pangasius* spp., Siluridae and Notopteridae. Also included is the group of small, short-lived cyprinids, among which Trey Riel (*Henicorhynchus* spp.) is the most common and which are mainly utilized for fish paste (prahoc), fish sauce or feed for cage culture.

Lifecycle research work needs to be done on these species including habitat preferences, which should elucidate the roles of the flood forest and other wetland areas.

## 2.2 Types of fisheries and employment

Types of fisheries

The large- and middle-scale fisheries require fishing licenses, which were estimated to add about US$ 2 million annually to government coffers (Nao and Ly 1997). Family and rice-field fisheries are unlicensed fisheries.

- Large-scale fishing

**Fishing lots** (loh nesaat). Fishing lots are concessions auctioned by the Cambodian Government to the highest bidder for exclusive exploitation over a 2-year period. It is one of the government's main instruments for extracting a resource rent from fisheries. At present the lot system is only found in Cambodia, but in the past it also existed in Thailand (Leelapatra, pers.com.). Nowadays there are 164 lots comprising lake, riverine and river beach lots and covering an area of 852,900 ha. In addition, there are 84 dai (bagnet) fishing lots (see below) and 15 fish sanctuaries. Lots are allowed to operate under the fishery law and some individual (burden book) regulations between October and June, but tend to start operations in the Great Lake in January. The catch range and breakdown by (main) species are given in Tables 2 and 3.

In particular, the lots surrounding the Great Lake are very large (the largest is 506 square km) encompassing vast tracks of floodplain covered with short-tree/shrubland vegetation (ca.80%) able to withstand long periods of inundation and long dry spells of relentless heat, a gallery forest (<10%) along the lake shore and waterways, as well as aquatic herbaceous - partly floating or emergent - vegetation (McDonald *et al*. 1997). Many of the plant species are endemic to the Mekong River catchment.

**Dai lots.** A dai is a kind of bagnet or stationary trawl positioned in the river to capture fish migrating downstream. The legal set-up is like that for a fishing lot, but instead of a piece of land and water, an anchoring location in the river is auctioned. Dai lots tend to be much cheaper on average than the other lots. Most of the auctionable dai locations are in the Tonle Sap river, where in the present biennium 63 operate from October through March. When the floods recede, fish are leaving the submerged lands toward the river and lake and eventually the Mekong. Particularly in a time window 6 – 1 days before full moon there is a peak in migration activity. More than half of the season's catch is made in January. The bulk of the catch consists of the current year's crop of small "white" fish species (see Table 3), which are used for fish paste (prahoc), fish sauce, oil, salted and dried fish (Lieng *et al.* 1995).

- Middle-scale fishing

In Cambodia, this type of fishing can be done legally under license only. It then will permit the use of quite a variety of gears of certain dimensions, which exceed those allowed under family fishing rights. It is an open access fishery, although excluded from operations in the fishing lots.

Due to practical limitations only about 40 gear types are being monitored regularly in Cambodia, although quite a few more are being used in the country. The top-ten most common gears are shown in Table 1.

Middle- and family-scale fishing and rice field fisheries are very widespread in Lao PDR, Thailand and Viet Nam. Catches, as presented in Table 2, are likely to be under-estimated. The official figure for Thailand's Mekong Basin fresh water catches in 1989 was 51,000 tons compared to the result of a food consumption survey of 303,000 tons in the same year (MRC 1992).

Table 1: Middle-scale fishery. Top 10 gears ranked by share in total catch (weight) in 1995 - 1996. All together data on 28 gears are available. Data from Diep *et al.*,1998.

| Type of gear | Share in % | Khmer name |
|---|---|---|
| 1. Gillnets (all mesh sizes) | 52 | Mong |
| 2. Encircling seine net | 16 | Uon Hum |
| 3. Arrow-shaped trap | 6 | Lop Nor |
| 4. Small river trawl | 3 | Neam |
| 5. Encircling gillnet | 3 | Mong Hum |
| 6. Hooks and lines | 3 | Santouch |
| 7. Single bamboo trap | 3 | Lop |
| 8. Beach seine | 2 | Uon |
| 9. Castnet | 2 | Samnanh |
| 10. Brush park[1] | 2 | Samrah |
| Share of total catch | 92 | |

1 Probably grossly under-reported, as the fishing method is illegal.

- Family-scale fishing and rice field fisheries

Family fishing is estimated to produce at least 100,000 tons annually in Cambodia (Ahmed, *et al.*, 1998), but is likely to be more productive. By law this is an open-access non-licensed fishery with certain restrictions on gear size and use. Access to fishing lots is limited to the closed season (June – September).

Data on rice field fisheries are scarce. Fedoruk and Leelapatra (1992) reported a minimum figure of 25 kg/ha from northeast Thailand, while Gregory (1998) found 62 kg/ha in Svay Rieng, a Cambodian province outside the Mekong Basin. Fish yield per ha. is likely to vary with the elevation of the field and its distance to a permanent water body or wetland.
At the onset of the flooding and rainy season fish is migrating to the lands that are being submerged, from permanent water bodies or wetland refuges. By the time contours re-appear above the waters farmers start fishing and guarding their paddies. Surplus yields are sold and supplement income considerably in some cases according to Gregory and Guttman (1997).

Employment
In Cambodia fishing related employment is significant. The household survey in the fishing dependent communes of eight provinces with a total population of 2.4 million people or 453,000 households (Government figures) found that for 10.5% of the households fishing (9.3%) or a fishing related activity (1.2%) was the primary occupation, while another 34.1% are part-time engaged (Ahmed *et al.* in press).
Only about 4% of households in fishing dependent communes is engaged in one way or another in large-scale fishing, while 9% is involved in middle-scale and 87% in family fishing activities (Ahmed *et al.* in press). Most rice farmers will fish in their fields.

### 2.3 Catch levels and state of exploitation of the fish stocks

Brief history
Since the Great Lake in Cambodia was formed some 5 - 6000 years ago (Carbonnel 1963), it must have abounded with fish. The rise of the Khmer Angkhor Empire may to a large extent have been based on fish judging from the abundance of fish pictured on the reliefs of

the Bayon and Angkhor Wat temples and their proximity to the Great Lake in Siem Reap province. The combination of rice and fish still is the staple food of the great majority of Cambodians.

Until recently Khmer speaking rice farmers in Northeast Thailand (Buriram) used to track to the Great Lake during the fishing season to trade fish for rice. Nowadays, this still happens within the Cambodian national boundaries.

The French colonizers, recognizing the Cambodian richness in fish resources, modeled their taxation system on the traditional royal fund-raising practice of issuing fishery leases, the fishing lots, introducing the first fishery laws of the country (Petillot,1911).

Petillot (1911) reported that in 1910 about 50,000 tons were exported in the form of dried, salted, and live fish, as well as fish oil and paste. In the twenties and thirties the export trade of dried fish for Java was big business. Chevey and Le Poulain (1940) report that in these years annually on average 25,000 tons was shipped from Cambodia mainly via Singapore by Chinese traders. Given a fresh to dried fish ratio of 3 to 1 (Chouk Borin 1996) this corresponds to 75,000 tons of fresh fish. Chevey and Le Poulain (1940) estimated total fish production to be 120,000 tons per year. It is not clear what happened during and after the Second World War, but at present this trade does not exist anymore, although similar quantities are being exported to Thailand and Viet Nam mostly in fresh form or as fish paste or sauce.

Although the richness of the Cambodian fish resources was recognised, it never has been documented well. There have been a number of useful descriptions by Chevey and Le Poulain (1940), Bardach (1959), Fily and d'Aubenton (1966) and Lagler (1976). However, statistics on the fish catch and its value are very poor and time series do not exist, despite their importance for management.

Estimates of present catch levels

The Department of Fisheries in Cambodia generates fishery statistics based on planned figures. The catch range in the period 1981 – 95 was given as 51,000 – 75,000 tons.

The MRC/DoF/Danida Project for the Management of the Freshwater Capture Fisheries of Cambodia has set up a catch assessment study based on stratified random sampling of the catch (by species and gear) and frame survey information on fishing gears (Van Zalinge *et al.* 1996, Diep *et al.* 1998). Their data for the annual inland water catch in the years from 1994 to 1997 are summarized in Table 2.

Table 2: Cambodia. Range of the annual inland water catch in the years from 1994 to 1997 (Diep *et al.,* 1998).

| | Annual catch range (tons) |
|---|---|
| • Large scale fisheries | |
| - Fishing lots[1] | 30,000 - 60,000 |
| - Dais (bagnets)[2] | 15,000 - 20,000 |
| • Middle scale fisheries[3] | 60,000 - 75,000 |
| • Family fisheries[3] | 100,000 - 125,000 |
| • Rice field fisheries[4] | 50,000 - 100,000 |
| • Total | 255,000 - 380,000 |

1 Range reflects uncertainty in actual catch levels

2 Range shows approx. minimum and maximum values since 1994/5 season
3 Based on socio-economic survey data extrapolated to entire country
4 Approx. 2 million ha x likely range of fish yields: 25 - 50 kg/ha

The relative top-ten species composition and relative catch value of the lots, dais and middle-scale fisheries are shown in Table 3.

Table 3: Cambodia. Ranked relative species composition (top-ten species only) and value of the 1995/96 catch by major gear category (Diep *et al.,* 1998). Family and rice field fisheries have not been included due to insufficient data.

| Species name | Lots % | Dai % | Middle % | Total catch % | Total value % | Type of Fish |
|---|---|---|---|---|---|---|
| 1. *Henicorhynchus* spp. | 11 | 40 | 20 | 21 | 9 | Cyprinid |
| 2. *Channa micropeltes* | 16 | - | 8 | 9 | 19 | Snakehead |
| 3. *Cyclocheilichthys enoplos* | 8 | 1 | 13 | 9 | 8 | Cyprinid |
| 4. *Dangila* spp. | 5 | 6 | 7 | 6 | 2 | " |
| 5. *Osteochilus* spp. | 2 | 10 | 2 | 4 | 2 | " |
| 6. *Cirrhinus microlepis* | 5 | 3 | 2 | 3 | 4 | " |
| 7. *Pangasius* spp. | 8 | 0 | 1 | 3 | 3 | Catfish |
| 8. *Barbodes gonionotus* | 3 | 0 | 4 | 3 | 2 | Cyprinid |
| 9. *Paralaubuca typus* | 1 | 11 | 0 | 3 | 1 | " |
| 10.*Channa striata* | 5 | - | 1 | 2 | 6 | Snakehead |
| Weight % of 10 species | 64 | 70 | 59 | 63 | 56 | |
| Share in total catch | 33 | 23 | 44 | 100 | | |
| Share of total value | 41 | 15 | 44 | 100 | | |
| Number of species recorded | 75 | 44 | 62 | | | |

The monetary value of the catch ranges from US$ 130 to 200 million (based on landing site prices) and total value added to fish could increase if quality management and marketing efficiency would improve.

Recognizing that official production data are generally unreliable, MRC (1992) and Jensen (1996) have given estimates for the inland capture fisheries in the Lower Mekong Basin that are presented in Table 4 and to which the above Cambodian estimates have been added. Total fish production already approaches the 1 million tons annually and might increase considerably, when better data in particular for Lao PDR will be available. The contribution from aquaculture, which is thought to be rather insignificant (<10%), especially in Cambodia, is not included.

More than 50 million people living in the Lower Mekong Basin with an average per caput income of US$ 150 – 200 per year, are the main consumers of the produced fish (Jensen 1996).

Table 4: Range of estimated capture fisheries production in the Lower Mekong Basin

| | Annual catch range (tons) |
|---|---|
| • Cambodia[1] | 255,000 – 380,000 |
| • Lao PDR[2] | 27,000 |
| • Thailand[2] | 303,000 |
| • Viet Nam[2] | 190,000 |
| • Total | 775,000 – 900,000 |

1 Diep *et al.*, 1998

2 MRC 1992 and Jensen 1996

Are the stocks over-fished?
Recent findings indicate that compared to the 1960's the middle-scale and family fisheries production has more than tripled, although large-scale fisheries output appears to have been stable (Fily and d'Áubenton 1965, Van Zalinge 1997a and Van Zalinge and Touch 1996). Middle-scale and family fishers complain about decreasing catch-per-unit-of-effort. Large fish species, like *Pangasianodon gigas (*Giant Mekong Catfish*)* and *Catlocarpio siamensis* (Giant Mekong Barb) have practically disappeared, although juveniles of these species are still caught in very small numbers. Also catches of medium sized species, such as *Cirrhinus microlepis, Boesemania microlepis, Probarbus jullieni* and *Tenualosa thibaudeaui,* are reduced. Large species of fish tend to reproduce at a relatively late age and big size. Over-fishing is certain, as most will be caught before having a chance to reproduce.
On the other hand, small species like *Henicorhynchus* spp. (a small cyprinid, Trey Riel) are very abundant and form a large part of the catch (see Table 3). *Channa* spp. (snakeheads, Trey Chhdaur and others) also have become more dominant in the catch, which must partly be due to a fast reproduction rate and the decline of other large species. Small fish species reproduce at an early age, often within the first year of their life. Fast reproduction ensures that they can withstand much more pressure from fishing than large species and are unlikely to be over-fished at present.

Lack of reliable statistics that could show trends, prevent conclusions about sustainable catch levels. However, the steady loss of flood forest may have had a negative effect on the overall sustainability of the fisheries.

## 2.4 Fish consumption and food security

Fish consumption and food security
The above figures indicate a consumption rate of 15.5 – 18 kg of freshwater fish per capita per year, which seems to be on the low side when compared with 21 kg/capita/year in Northeast Thailand and 30 kg/caput/year in the Mekong Delta in Viet Nam (MRC 1992).

Household sample surveys carried out in fishing dependent communes in eight provinces around the Great Lake and the Mekong floodplains and being representative of more than 2.4 million of the 10 million people living in Cambodia, suggest that average consumption of fresh and processed fish exceeds 78 kg/capita/year (Hab Navy 1997, Ahmed *et al*. in press). The national average will necessarily be lower. Yet, this figure suggests that total production as given in Table 1 may still be an under-estimate. MRC (1992) concluded that 48.5 kg of fish/capita/year was the optimal nutritional need of the Cambodians. The low average price of most fish products makes them affordable by the whole population thereby providing 70 – 80% of their animal protein in-take.

Fish together with rice are the main elements in the Cambodian food security equation, although fish has not been recognized as such by the Government and FAO (MAFF 1996). A possible consequence of this lack of awareness is that the Government will neglect the protection and management of the fish resources within the country and additionally will

fail to take the importance of the national fisheries into account on regional platforms dealing with water management issues.

## 3. Discussion

As described above, wild fish production in Cambodia takes place in a wetland ecosystem that is driven by the annual flooding of the Mekong River under influence of the southwest monsoon. Several dangers are perceived threatening the sustainability of the productivity. They stem from sources outside, which are dealt with here, as well as inside the country, which are discussed in the next section.

### 3.1 Effects of water management

External dangers are perceived to lie in the cumulative regulatory effect water management schemes may have on flood levels of the river. Flood control will result in a lesser area of the flood plains being inundated and a shift in peak flooding times, which may cause them to be out of phase with natural occurring cycles of reproduction especially in highly migratory fish species. A reduction of the submerged area and duration of inundation will lower the productivity of the floodplain.

The extent (area and duration) of the flooding is assumed to be positively related to fish productivity (Dennis 1987, Nedeco 1988, Escap 1990). The cumulative effects of water regulatory works, such as hydropower dams, will result in a reduction of the average peak flows and a delay in their occurrence. Based only on a rough model predicting flow changes, a first estimate was given by MRC 1998 showing that the maximum reduction in river flow at Phnom Penh will be 15% in the wet season resulting in approximately 20% less flow towards the Great Lake. This translates into a loss of ca. 240,000 ha in area flooded (ca. 20% of the 1.2 million ha presently on average flooded around the Great Lake).

Considering that the duration of the inundation of the land covered at peak flood levels is shorter, losses in fish production are likely to be proportionally less and are estimated to be about 10%. (Flood cover and duration data are from CNMC 1998). However, the model estimates that losses will be greater for wetlands in Lao PDR and northern Cambodia.

There is an urgent need to address this issue by improved hydrological modeling of the cumulative effects of water management to predict flood levels and extent and duration of the inundation at various river locations. In addition, more research is needed to assess the impact time delays in flood occurrence will have on fish recruitment levels.

### 3.2 Fishery management and related issues

Fishery management is a balancing act between the requirements for biologically sustainable resource use and economically optimal exploitation patterns, while being socially acceptable to the involved parties.

The main internal threats are the “open-access” nature of the middle-scale and family fisheries, their social incompatibility with the fishing lot system and the destruction of flood plain areas for rice production and other uses.

Open access

The large increase in the effort of the open-access middle-scale and family fisheries may have been caused by the improved security and access to the lake, and possibly by an influx of internally displaced persons and refugees (380,000 returned in the early nineties), some of whom have settled in the lake and river areas. It is easy to take up fishing, as the required capital investment is low and access is more or less free, except in the fishing lots.

Open access in fisheries invariably leads to over-fishing, especially in times of economic depression. Traditionally, fishing rights that govern fisheries along the Mekong and its tributaries in Lao PDR and northeast Cambodia (Stung Treng, Ratanakiri) provided some form of protection to local non-migratory stocks. In places where these traditions were reinforced with outside help fish stocks often recovered in a surprisingly short time (Baird, pers.com.). Ideally, such traditional rights should be firmly anchored in an effective fishery law, which strengthens community involvement in fisheries management, if the resources are to be maintained with a growing population for which there is little alternative employment.

The fishing lot system and habitat protection

In Cambodia, the fishing lot system has been in place for at least a 100 years (see Degen and Nao, this conference, who provide a detailed description and analysis of its functioning). Even though, a concession holder will fully exploit the fish resource in his lot, catches seem to have been stable, as suggested by the few records from the past (e.g. Fily and d’Aubenton, 1965). Although the fish stocks are exploited, a degree of protection is provided by keeping poachers out and preventing large-scale destruction of the flood forest. In non-fishing lot areas flood forest coverage is continuously being reduced by cutting, burning and conversion into rice fields and other crop lands. This causes a loss in biodiversity and also a decline in economic value of these for agriculture generally marginal lands.

The open-access situation prevailing in the fishing areas outside the lots has induced increasing numbers of people to take up full- or part-time fishing. This has led to conflicts over resource use between fishing communities existing in the area and fishing lot concessionaires, who need to employ armed guards to keep poachers and woodcutters at bay.

Privatization of fishing

The Government of Cambodia does, at present, not have the capability to control fishing practices and access to the fisheries, except through privatization of these tasks, as is done through the fishing lot system.

Solutions may be found in a combination of increased privatization of the fisheries through expansion of the fishing lot system and the involvement of fishing communities in the management and operation of the lots. There is, however, a long way of learning and experimentation ahead, as there is some doubt about the existence of adequate

social structures for successful implementation of such management arrangements in the targeted communities (see Ovesen *et.al.*1996, Degen and Nao, this conference) and a protracted process of capacity building may be required.

Expansion of the fishing lot system in the Great Lake/Tonle Sap River region may under proper conditions be one of the options to safeguard Cambodia's flood forest and fish resources. However, the effectiveness of the fishing lots in habitat and fish stock conservation needs to be studied and monitored (Van Zalinge, 1997b). Every year the floods reach a level of 8m or more (above the average sea level) submerging an area of more than 700,000 ha of which < 10% is under cultivation in the dry season (CNMC, 1998). Fishing lots presently occupy only 56% or 390,000 ha thereof and could substantially be expanded without causing any serious disruptions.

There is a proposal of UNESCO and the Ministry of Environment to set up a biosphere reserve, which would include the Angkhor temple complex, the Great Lake and surrounding wetlands. Certain core areas are identified that would protect the internationally important bird colonies (Painted Stork, Spot-billed Pelican, Greater and Lesser Adjutant) found in the flood forests of Battambang, Siem Reap and Kampong Thom provinces. As fishing would be llowed outside these core areas, there does not appear to be a major conflict of interests. In fact the protection provided by the lots would be greatly beneficial toward maintaining the reserve. Therefore, fishery management objectives in the Tonle Sap area of Cambodia are not incompatible with conservation objectives as put forward under the Biosphere Reserve proposal (UNESCO 1996). Flood plain conservation through community participation and limiting "open-access" are priorities for both.

## 4. Conclusion

The paper has shown the importance of fisheries for Cambodia and indeed for the entire Lower Mekong Basin, first, in terms of food security and, second, as an industry of major proportions providing employment and income for millions. Safeguarding this requires:

(1) Vision: greater awareness at decision making levels in government and at international organizations of the potential role the Cambodian fisheries may have in the future economic development and integration of the region (*Could Cambodia become the fish "basket" of the region?*).
(2) A functional platform for dialogue and cooperation between the riparian countries in order to be able to timely deal with the upcoming water and fisheries management issues.
(3) An improved and enlarged research capacity and database.

The Mekong River Agreement signed by Cambodia, Lao PDR, Thailand and Viet Nam in April 1995 provides the framework. So far a few steps have been taken toward an overall management concept and relevant actions (MRC 1998), including consideration of a proposal for a sub-committee for fisheries under the MRC Joint Committee of member nations.

It is time to act: As the river dominates the lives of so many, her fate is also shared by them.

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**Figure 1**
**Map of the Lower Mekong Basin**