COMMON AND PRIVATE PROPERTY LINKAGES FOR SUSTAINABLE LIVELIHOOD

IN

LOW-LAND FOREST-FISHERY-FARMING SYSTEMS OF NORTHWEST CAMBODIA

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COMMON AND PRIVATE PROPERTY LINKAGES FOR SUSTAINABLE LIVELIHOOD IN LOW-LAND FOREST-FISHERY-FARMING SYSTEMS OF CAMBODIA[1]

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ABSTRACT

The majority of the population of north west Cambodia is dependent on subsistence farming-foraging systems Forests, fishery and farming are the main resource-bases The self-sustaining peasant-type households draw their food and livelihood from a combination of activities such as farming and hunting-gathering of fish, wildlife and wood materials This system of utilisation of common and private property has evolved over centuries and has ensured two things First, it enabled an optimum utilisation of labour within households consisting of men, women and children Secondly, as the capacity of private property is limited, natural resources acted as a buffer and the nature of resources distribution was more equitable. In post civil war Cambodia, after several decades of social and political conflicts, the pattern of dependence on the common property resources does not appear to have changed very significantly. Recently, external forces like market, new technologies and development interventions are putting a lot of pressure on the common and private property utilisation systems. These interventions are quite large because of the post war population boom and increased commercial activities. This paper analyses the impact of some of these interventions in terms of how they will affect the balance in gender participation in household economic activities as well as the income distribution and equity Increased pressure for exploitation of fishery and forestry resources has already created an imbalance in the traditionally established ecological economic equilibrium of common and private property resource systems It concludes that technological interventions must maintain a balance in the resource-population relationships. There is a strong need to understand existing linkages between private and common property resources and their use in the context of development interventions in the low-land forest-fishery-farming systems.

INTRODUCTION

Cambodia is a country of forests, rivers and rice fields (Figure- 1). Rice farming, fishing and extraction of forests products have been the major means of producing food,

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materials and energy for subsistence of Cambodians since time immemorial In contemporary Cambodia (in the early sixties) most of the population lived in rural areas and in village settings with clearly defined spatial village boundaries. The village residents had private rights, established by acquisitions, ownership and other tenure arrangements, on most of the arable lands within the village. They also enjoyed free access to adjoining environments such as forests and waters (streams, rivers and lakes) that were regarded as common properties. These common properties often extend beyond village boundaries.

Cultivation was mainly for subsistence, and hence ties with the market were limited (Ebihara 1968) Despite several decades of social and political conflicts, the pattern of dependence on both common and private property resources does not appear to have changed very significantly

Although there is a general lack of information on the use of common property, some recent studies showed that common property is an important source of food for the rural households. Subsistence production of fish comprises nearly 50% of commercial inland production by providing an annual 3 8 kg per capita (FAO 1994) Almost all of this production comes from catches obtained from common property waterbodies such as streams, lakes and flooded rice fields A recent United Nations Children Emergency Fund (UNICEF) study showed that 87% of the rural households were engaged in harvesting fish, crabs, shrimp, snails, frogs and green leaves (e.g , water convovulus *Ipomea aquatica* and ivy gourd *Coccinia grandis)*, while 14% of the households gathered small wild animals such as snakes, birds and beetles (UNICEF 1994) Similar situations exist in many other South and Southeast Asian countries From a study of three villages in West Bengal, Beck (1994) estimated that common property resources accounted for between 19-29% of the household income Jodha (1991) concluded that in general the rural poor obtained bulk of their fuel supplies and fodder from CPRs which, though likely to be underestimated, accounted for 14-23% of their household incomes

After several decades of war and conflicts, Cambodia has become a chronic food deficit country Since the Paris peace agreement in 1991, donor communities as well as the Royal Government of Cambodia have been putting a lot of emphasis on increasing agricultural production as a means of improving the food security of the growing population However, food security is not solely a result of food production and many rural households can not achieve food security just by producing their own food In Cambodia's ecological and socio-economic situations, rational harvesting of forest, fishery and other natural resources in combination with agricultural production, can be a more sustainable strategy for achieving food security than agricultural production alone Integration of agriculture and natural resources is considered by many as a key to food security (Conway, 1995)

The main objective of this paper is to describe the linkages between common and private properties in managing livelihood activities of the people living in the low-land forest-fishery farming systems of Cambodia.

Specifically, the paper seeks to determine the pattern of dependence of the population on supplies from natural resources and analyse the role of gender in existing practices. The potential impacts of single-ecosystem development intervention on the natural resources as well as on income distribution, equity and gender participation are also discussed

The analysis is based on information collected from a commune (sub-district) known as Ansa Chambok in Pursat Province in the northwestern part of Cambodia (Figure- 2) Several methods of rapid rural appraisal such as case studies, key informant surveys and on-site observations were used to collect the information

1. Environment and ecology of the study area

Located between the Great Lake in the north and Cardamom mountains range in the south, Ansa Chambok is typical of most rural communities of northwestern Cambodia The livelihood of this community is based up on exploitation of resources from at least four distinct natural environments: the Great Lake, the inundated forests, the rainfed lowland and the watershed forests (Fig 3 & 4)

Most of the people depend on a combination of rice cultivation, fishing and extraction of forest products. The commune consists of six villages with a total population of 4,350 living in 823 households Nearly 30% of the households are female headed. All but one village is land based. The village of Kompong Thkol is a floating one whose position shifts with the rise and fall of the water level in the Great Lake The residents of this village are predominantly fishing dependent

Most of the arable land within the commune has been redistributed in recent times for private use (e g , homestead and agriculture) Average size of land per household is at present about 3 37 ha, of which 2 67 ha are held as rice-fields. About 31,128 ha of bushlands (38 24 ha per household) are also available to the commune residents as common property.

Residents also access the resources from the watershed forests, inundated forests and the Great Lake:

- **The watershed forest**, which is only few kilometers away from the villages, is a part of the Cardamom mountain ranges that occupies the entire southern part of the province.

- **The nearby inundated forest** offers an important livelihood opportunity to the population, particularly for the residents of the floating village This forest is submerged under 4-6 m deep flood water of the Mekong rivers system during the wet season. The soil is clay loam having good soil fertility.

- **The Great Lake**, the single most important fishing ground of Cambodia, is only 2-3 km from the land-based villages The villagers access a nearby island that emerges during the dry season The soil of the island is heavy clay having good soil fertility

2. Available resources and their exploitation

The people living in the commune practise seasonal agriculture along with extensive harvesting of a wide range of products and benefit from the adjoining natural resources to support their livelihood needs (Table 3 & 4) Most consider themselves as farmers Wet season rice in low-land rainfed and deep water environments is a major food crop for them

2.1. Rainfed Lowland

There are about 1,312 ha rainfed lowland rice area in the commune The soil of rainfed lowland is basically sandy to sandy loam having poor soil fertility except for deepwater areas where the soil quality is slightly better In general, the soil is nutrients leached and acidic, having low cation exchange capacity. The yield is quite low and averages about 1 ton/ha

About 864 ha of deepwater rice areas are used by the households in the commune The soil of deepwater areas is either loamy sand to loamy clay. The soil structure is generally poor Although the fertility of deepwater soil is higher than the shallow flooded rainfed lowland, unpredictable flooding results in low yield However in a normal year the average can reach 1 4 ton/ha

Due to poor soil fertility and low productivity many households are food deficient and, because of extreme land pressure in the village, they do not possess land to cultivate vegetable or fruit trees

During the wet season, rainfed lowland is almost exclusively used for rice cultivation The other minor activities related to lowland is collection of grass for mat making, catching of fish and other aquatic animals Harvesting of Palm-leaves for thatching roofs and Palm-juice for sugar production are dry season activities

2.2. Homestead

The Homestead is also utilised for production and income generation by households. Important use of the homestead include vegetable and fruit tree cultivation (land permitting), animal raising and culture of frogs.

2.3. Watershed Forests

Fishing in the Great Lake requires a lot of wood and bamboo materials from the watershed forest Cutting small trees for sale to the fishing lot owners (leaseholders) is one of the important sources of income to the commune residents It generates cash income (about US$1 per day) in the dry season, when demand for labour is low. Other activities which provide the inhabitants with incomes are collection of wood for charcoal making and for construction as well as collection of the glue and bark of certain trees (e g , Kapul Bay) to make incense The Watershed forest is also a major source of firewood for household use and sale Villagers also collect medicinal plants (e g , Slek bas and Sav rav prey) to treat fevers

The Watershed forest is also an important source of food Villagers collect tuber, edible leaf, wild mushroom and bamboo shoots Fishing in the seasonal streams supplements the nutrition and animal protein requirements of the households Hunting for game animals like dear, rabbit and birds is still common to some villagers In the rainy season farmers graze their cattle in the forest and clear areas at the foot of the mountain to grow rice seedlings

2.4. Inundated Forest

Like the watershed forest, the inundated forest is a major source of firewood, particularly for those living in the floating village. The villagers collect grasses for roof thatching. Catching of fish and gathering of lotus from small ditches inside the forest are also common livelihood activities. Tree branches are used as an attracting device to catch shrimp and fish in the Great Lake. In cleared parts of the forest farmers grow rice seedlings in early rainy season and dry season. It also serves as pasture for cattle during the dry season. The forest is a source of traditional medicinal plants. For example the bark of *Terminalia cambodiana* and *Barringtonia acutangula* is used to treat diarrhoea

2.5. The Great Lake

The lake and its tributaries are the single most important source of fish and molluscs. The island in the lake is used for vegetable and dry season rice cultivation under zero tillage condition. Other activities on the island include catching fish by using bamboo trap and hunting water birds.

3. Gender involvement in resources utilization

Traditionally, the villagers patterned their lifestyle and livelihood around an extensive system of farming and foraging that made use of the multiple resources available Both male and female members (including children) of the households played active roles in production and resource harvesting activities in privately held lands as well as in adjoining forest and fishery environments which are regarded as common property Members of the households belonging to different gender took on jobs that suited their skills, physical strength and other comparative advantages in order to optimise their labour

Resouce utilization also related with the seasons of the year, man, women and children utilized different resources of the ecosystems based on seasonality (Table 3 & 4)

Many jobs are gender specific by tradition, although there are areas of activities where both men and women are involved in greater or smaller degrees (Table 1 &2). Men's involvement is concentrated in activities which require higher physical (muscle) power On the other hand, women are involved in activities that directly relate to food and nutrition supply of the family, including small-scale production and processing activities in the homestead

The location of human settlement and accessibility to adjacent resources also affect the degree and type of gender involvement in livelihood activities For instance, only land-based households have access to the natural resources of the watershed forest It is basically the adult male members of a family who are involved in commercial wood and lumber extraction from the forest

Men and women are equally involved in fire wood collection from both the inundated and the watershed forests The children help the elders to collect wood, but only from the inundated forest Farmers may choose to utilise either the inundated forest or watershed forest, depending on the distance of the forest from the homestead Similarly, whether men or women will go to the forest depends the availability of time and security situation Presently, because of security reasons, it is the male members of the households who mostly go to the forest for firewood collection Men usually go alone whereas women need to go in a group Hunting wild animals from the watershed forest is exclusively a male activity whereas children are mostly involved in hunting water birds, with the occasional help of women

Fishing in seasonal streams in the watershed forest is the major responsibility of men However, women and children take part to the fishing in the inundated forest During the dry season women and children assist the male members to fish in the lake During the wet season, rice fields are one of the rich sources of aquatic animals like fish, frogs, crab and mollusc Women and children are mostly involved in collecting and harvesting them Men and women, sometimes with assistance of children, are involved in

collection of tree branches to establishing fish attracting device in the lake. With the help of women and children, men collect glue, which is an important ingredient of boat making.

Women collect tuber, edible leaves and bamboo shoot from the watershed forest, mostly for family consumption They also collect grass from the inundated forest to thatch roofs Women and children raise small animals in the homestead On the other hand, care and maintenance of big animals (e g , buffalo) in the watershed forest is managed by men

Residents of the floating village have no direct access to the watershed forest Their activities are confined to the lake, inundated forest and the island in the lake But, like in the land-based villages, there is a definite pattern of gender involvement in production and processing activities Women are mainly involved in cutting and transporting firewood from the inundated forest with occasional help from men and children Selling and processing of fish and mollusc is exclusively done by women Women also sew and repair the fishing nets, make bamboo fences and other fishing equipment The children provide extensive assistance to the women in most of these activities.

In post-war Cambodia the gender ratio of the active human population has changed, with more females than males This is affecting the traditional gender based activities significantly In rice cultivation, land preparation is a traditionally male dominated activity However, women in many female headed households have had to learn how to plough. Similarly, transplanting is one area traditionally done by women Now however, to grow a second rice crop during the dry season, men join women to transplant the field Under water receding environments, farmers have to transplant in a comparatively short period of time, when the land is still moist. As the labour and time are critical factors, men, women and children alike are needed to finish the work on time. Similarly, though harvesting is traditionally a female activity, men, women and children are now getting involved in this activity to cope with increased cropping intensity.

Ebihara (1974) and Ledgerwood (1992) reported that the early stages in rice cultivation (e g , land preparation) are male designated, while the latter stages (harvesting, and post-harvest processing) are female designated. However, Ahlers (1995) reported that certain female activities such as transplanting and harvesting have become gender neutral in the farmer's own fields, but remained gender specific when labour is sold or exchanged in other's field. For example, men will transplant their own fields readily but hired or exchanged labours for transplanting are usually women.

4. Linkages between the different environments

There are also important linkages between the environments in the production processes of various commodities Often resources and facilities from more than one environment are used to produce certain outputs (Table 4)

In the rainfed lowland Palm trees are an important resource Palm sugar production is one of the main income and employment generation activity following the wet season rice cultivation The fire wood to boil the palm juice comes from the watershed forests Similarly, to raise cattle, households depend on the degraded watershed and inundated forests, rice fields and the island in the Great Lake for pasture. Although, rainfed lowlands are the main ricefields to the inhabitants of the commune, the use of either inundated or watershed forests for seedbeds is a common practice

The lake supplies irrigation water for dry season rice on the island Moreover, as the island is quite far from the villages, during the dry season rice growing period the main food for the farmer, in addition to rice, is the fish from the lake.

Due to very low use of chemicals in rice cultivation, ricefields are still abundant with aquatic animals such as fish, crabs, snails, molluscs and frogs Farmers catch fish from ricefields and seasonal streams using traps made of bamboo and rattans from watershed forests During the rice planting period farmers hardly have any time to go to the Great Lake or inundated forests to catch fish Small catches of fish and other aquatic animals from the ricefields supplement their animal protein needs with very little effort

Another source of protein during the busy transplanting days of the rainy season are Prahoc (fish paste) These processed products are made from surplus fish catches in the peak fishing period mostly in the lake

The farmers use bamboos and shrubs that grow along seasonal streams, in the homesteads and bushlands to grow the vines of various vegetables in and around the homestead Weeds, such as Tontrian Khait (*Chromolaena odorata*), grown in bushlands and roadsides, improve the soil fertility and act as a repellent for certain types of insects in ricefields

Raising of *Pangasius spp* in pens and cages in the Great Lake is an old practice, dating back from the beginning of this century (Tana 1996) The raw materials for cages and pens are wood, rattan and bamboo supplied from the watershed forest The fish are fed with small trash fish and rice bran Weeds like water convovulus (*Ipomea aqautica*) and duckweeds from the inundated forests are also used to feed the fish A medicinal plant, locally known as Nonum prai is collected from the inundated forest to treat disease infected fish in the cages and pens The wood and bamboo materials for the construction of fishing lots bounderies come from the watershed forest

The watershed forest also supports boat building for fishing and transportation by supplying wood for planks and glue for water proofing.

The roofing materials for a typical household come from leaves of palm trees grown in ricefield environment and grasses from the inundated forest. The trunks and branches of *Hymenocardia wallichi, Uncaria homalla and Vitex holpaclenon* are used to attract shrimps catched with scoop nets in the Great Lake. These are inundated forest species.

Production of smoked fish is an important fish processing activity in the community during the dry season Firewood from the inundated forest is extensively used for this purpose

Evidence suggests that the productivity of the inundated forest is directly related to productivity of fish in the Great Lake The inundated forest serves as feeding and breeding grounds for many of the fish species. Fish species like *Pangasius sutchi*, *Puntius gonionotus*, and *leptobarbus hoeveni* feed on the fruits of *Diospyres bejadii, Xanthophyllum efglaucum, Breynia rhamnoides, Gmelia asiatica*, Santhey (local name), Veartadeut (local name) The fish species *Notopreus notopterus* also feed on leafs and flowers of several inundated forest species locally known as Veartaearn, Veartadeut, Pkasnaw and Pkaagn chagn (FAO, 1995) It has also been observed that some fish species e g , *Notopterus chitala, Notopterus notopterus, Anguilla mauritiana, cyclochei lichthys* spp and *Puntius* spp feed on ratoon rice in the island (Shams, 1995)

5. Development and changes

5.1. Impact on Various Environments

Despite relatively low population pressures compared to the neighbouring countries, adverse impact of conflicting human interventions have been evident in most of Cambodia's natural environment (Table -6).

5.1.1. Watershed forest

- **Mountains:** due to deforestation the density of the forest has considerably decreased. The logging has resulted in increased erosion of soil which is evident from higher quantity of gravel and big stones currently available from the mountain, probably exposed due to the loss of top soil. The number of extractable trees for lumbers has been reduced.

- **Foothills:** with the presence of clay loam soil, the foothill is also used for cultivation of rice seedlings. A bushland is usually cleared for this

purpose To maintain fertility a piece of cleared land is used only once in every three years This system of cultivation is creating pressure in this environment Due to erosion, the depth of natural depression at the foothill have been reduced considerably (Fig-4) The number of extractable trees for construction use in the foothills has reduced.

- **Plainland forests:** only a degraded forest, comprising mostly bushy species remains in this place It is mostly used now as pasture for animal. Deforestation and pressure of pasture has decreased the fertility of the land and increased the erosion

5.1.2. Lowland

- **Area adjacent to the watershed forest:** prior to civil war the villages composed of scattered households were in areas where there was high soil fertility. Many households were located in the lowlands close to the forest At present, due to security and other considerations the villages have moved near the Highway No 5 and households have been established in linear patterns (Figure- 3) Reduced soil fertility and decline of rice yield (up to 30%) have been reported for farmlands around the abandoned villages Changed waterflows have also resulted in pronounced water scarcity in the higher fields Late transplanting have become common Availability of manures in the fields is less due to shifting of villages away from the land As a consequence, yields have become lower

- **Area adjacent to the village (Southern part):** in some places the fertility of the soil have increased due to proximity of the homestead However, due to unplanned construction of dams during the Pol Pot regime, the pattern of water flow has changed considerably resulting into poor soil fertility in the affected area

- **Villages and homestead:** due to high land pressure in the villages, the size of the homestead is smaller and less fruit trees and vegetables are grown on it Before the civil war, most of the rice fields were close to the homestead Also rice land was more compact After the Pol Pot period the land was redistributed on the basis of land type, so that each farmer could have a combination of different type of land This land distribution though fair, fragmented the farms into different parcels scattered in different parts of the village In addition to travel time, it makes management of land more difficult

- **Area Adjacent to the village:** in pre-civil war period this area was used for deepwater rice cultivation However, due to sedimentation the water depth has decreased in the area The land is now utilised for wet season

rice cultivation. The soil is less fertile and the rice yield has declined about one third

- **Deepwater rice area** due to increased erosion and sedimentation land elevations have increased The fertility of the soil is also low due to accumulation of sand on the soil-surface, carried by the seasonal streams from the upland areas. The yield of floating rice is lower compare to pre civil war period

5.1.3. Inundated forests and the Great Lake:

During 1975-79 the Khmer Rouge regime organised an extensive movement and displacement of the population. The population of the floating villages was shifted to the upland to clear forest, dig canals and increase the workforce for the rice cultivation They were replaced by a fishing group comprising mostly young people. The Khmer Rouge forced the population to clear the inundated forest to expand the rice area. The villagers claim that nearly 30% of the inundated forest were cleared during this period. After the fall of the Khmer Rouge regime the inundated forests regained some of the deforested area. However, deforestation still takes place as lands are cleared to grow seedlings and other minor agricultural crops. The density and distribution of plant population have substantially changed Historically, the big trees and bush species underneath existed in natural proportion. Immediately after the Khmer Rouge period there was a high incidence of deforestation of big trees This has changed the big to small tree ratios in the inundated forests. The logging of the big trees has affected the micro-environment of the inundated forests. Big trees provided shade to the small trees and flooded area. The local farmers and fishermen reported a slight increase of water temperature inside the inundated forest in recent years. Cool temperatures are favourable for fish breeding. The removal of big trees has also some effects on small bush plants as it cover the small trees and protect them from the wind.

The people of the commune reported an abundance of *Mimosa pigra*, popularly known as Vietnamese Spine, a thorny submerge-tolerant plant in the inundated forest. The village elders have identified this plant as new and consider it as highly detrimental to fish because of presence of thorns. The spread of this plant occurred after the Khmer Rouge period. This sudden proliferation of a particular species could be due to the change in micro environment, which may favour a particular species for succession. According to the local population, *Mimosa pigra* thrives better under sunlight than in shade. Also, it is possible that the spread of *Mimosa pigra* occurred through its introduction as a part of erosion control close to water bodies. This incidence has also been reported in other studies (Anonymous, 1994).

The local community has also reported a lesser presence of algae, locally known as Prom, in the seasonal streams of the inundated forest during the early rainy season This may be due to a slightly changed nutrient composition of the water

- **Fish species:** according to the local people, overfishing and destruction of breeding grounds in the inundated forests are pushing some of the species to the verge of extinction. The availability of many other species has been greatly reduced (Table. 7). This is in conformity with other report[2].

- **Wild animals in the inundated forests:** civil war, destruction of habitat and illegal catching have produced a profound reduction in the number of wild animals and birds seen in the inundated forests and adjacent areas (Table 7), including animals like turtle, crocodile and snake This is in conformity with the report of Tana (1996)[3].

5.2. Impact on Income Distribution, Equity and Gender:

Degradation of natural environment in both the inundated and watershed forests have affected the income distribution and the gender participation in livelihood activities Household members now need to spend twice as much time than the pre civil war period to collect the same amount of fire-wood As the size of the trees are now smaller and the density of forest is lower, the families need to cut more trees from a bigger area Sometimes they have to travel much farther from their homes than in the past. It is putting the women in a disadvantaged situation as active participants in firewood collection as their time availability and access to transportation is less

As mentioned earlier, the travel time to visit the rice fields has increased considerably due to the relocation of the villages, and the dispersed and fragmented nature of the farm lands operated by the households This has increased pressure on available family labor and their utilisation. Women find it difficult to work in the distant fields

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[2]Tana (1996) reported that small species already dominated in the total catches and the most of the big species are almost disappeared from the system

[3]Tana (1996) reported that crocodile in the Great lake is endangered due to habitat disturbance by the expansion of commercial fisheries

Deforestation of upland watershed forests by commercial logging and other interests have increased land erosion The elevation of many rainfed lowland rice fields has increased due to deposition soil and sand Higher elevation results in less natural flooding and make the soil less fertile This has resulted in lower yields compared to the pre-civil war period. In effect, commercial exploitation of upland watershed forests, which benefits only a few, has reduced the yield and profitability of the rainfed lowland rice cultivated by the majority

Increased exploitation of natural resources by commercial interests is taking away common property resources traditionally utilised for subsistence by the villagers Deforestation caused by commercial logging is also creating problems in the rainfed lowland, making it less productive Less productivity in the rice land and lack of land in the homestead again encourages the farmer to either exploit more from the CPR or to undertake unsustainable activities like clearing the forest for use as seedbeds Clearing of the ground cover for seedbeds is increasing soil erosion

Indiscriminate damming in the upstream during Pol Pot regime has resulted in changes to the water flows in the lowland rice fields Low flooding has a direct relationship with the productivity of rice Where there is now less flow of water a decline in the productivity of rice has been observed.

Furthermore, indiscriminate human activities in the inundated forest have changed the natural composition of different plant species. Clearing of inundated forest, deforestation of watershed forest, use of illegal fishing gear and siltation of the Great Lake[4] have all affected the size and composition of fish catch. This has affected the income of subsistence fishermen and farmers.

Due to security and other reasons the villages are now concentrated along the main highway Although, land is still abundant, the pressure on land within each village is quite high The homestead lands are quite small to raise seedlings and cultivate vegetable and fruit trees.

CONCLUSION AND RECOMMENDATIONS

The preceding analysis suggests that strong linkages amongst various resource systems and environments predominates human activities in rural Cambodia. Production activities in one environment are subsidised by inputs supplied by other environments. The analysis shows a balance in gender participation in the traditional patterns of management of household resources This enables an optimal utilisation of household

[4]Carbonnel and Guiscafre (1963) reported a siltation rate of 0 04 cm /year. However the other authors (Csavas, 1994) disagree this rate. According to him the rate of sedimentation is 20 to 40 mm per year.

labour However, in post-war Cambodia increasing commercial interest and growing population pressures are acting as a major factors bringing about substantial changes in the traditional relationships

On the other hand, development plans which presently focus on production increases from agriculture are geared toward a single ecosystem, such as the rice-field ecology, disregarding the adjoining ecosystems A single ecosystem will not be able to support the needs of the growing population

In many instances the products and benefits obtained by the local people from the natural environment are not recorded, and hence they are undervalued Whereas the output of many commercially oriented interventions tend to be overvalued due to the market demand. This trend needs to be reversed. For this we need to understand the existing linkages between different ecological systems and their relationships for human uses Development interventions in private property resource systems must consider the linkages with the common property resource systems The cost benefit analysis of any development intervention must include the impact of the intervention not only on that particular environment but also on the adjoining environments In the context of Cambodia's agro-ecological and socio-economic conditions the more appropriate method of harnessing agricultural development is the one that can maintain the appropriate flow of supplementary benefits from the natural ecosystem

The current management of common property resources are based on bureaucratic control, which has largely failed to protect the CPR from overexploitation and destruction Increasingly, these resources are being taken over by commercial enterprises (with or without legal licenses) without any protection of the rights of traditional users, and without effective regulatory systems to ensure sustainable use In some instances, community users themselves have introduced unsustainable practices on the common property resources

The productivity of the private properties are declining due to reduction in the flow of positive ecological inputs or due to increase in the flow of negative inputs from degraded common property resources

Development should focus on maintaining the beneficial links between private and common property resources Reforms in user rights principles, such as community-based systems of management of the common property resources, can protect the resources from exploitation by outside commercial interests as well as from depletion from unsustainable uses by individual members of the community Under co-ownership a degraded CPR can be protected and regenerated It can give the community long term economic and ecological benefits

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Figure 1: Map of Cambodia showing forest, lake and rice fields

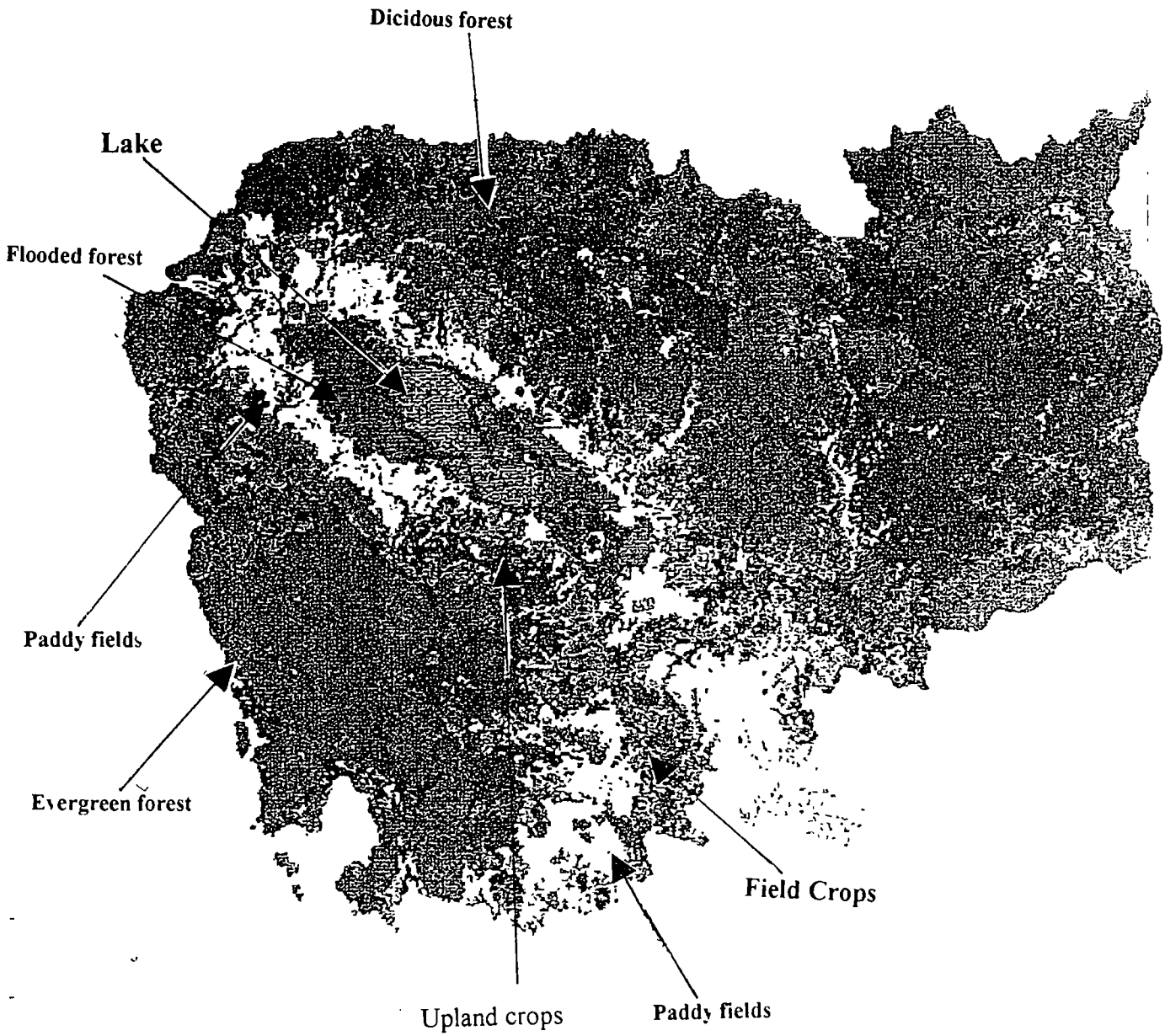


Figure 2: Forest, Fishing and Farming Ecosytems of Northwest Cambodia

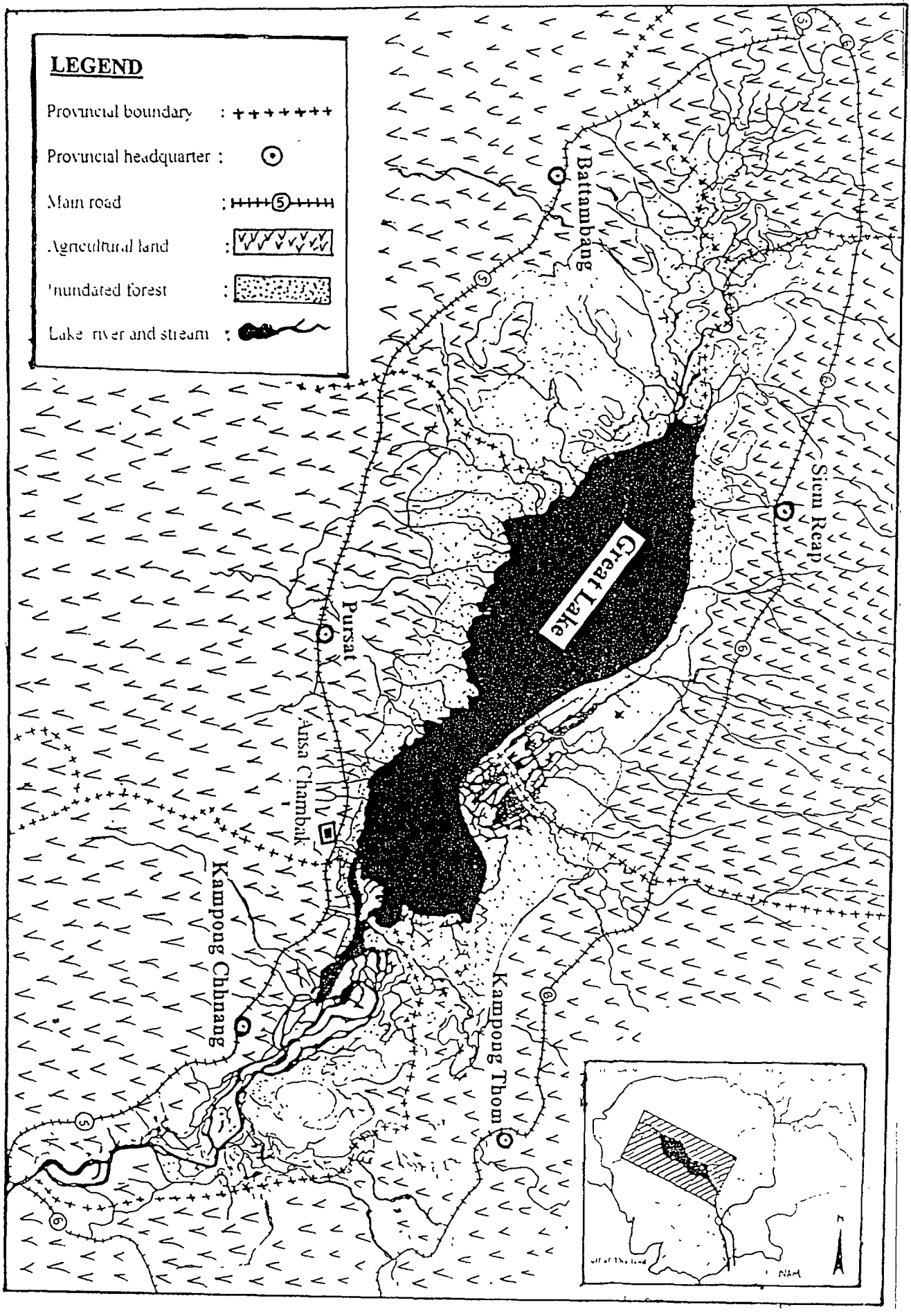
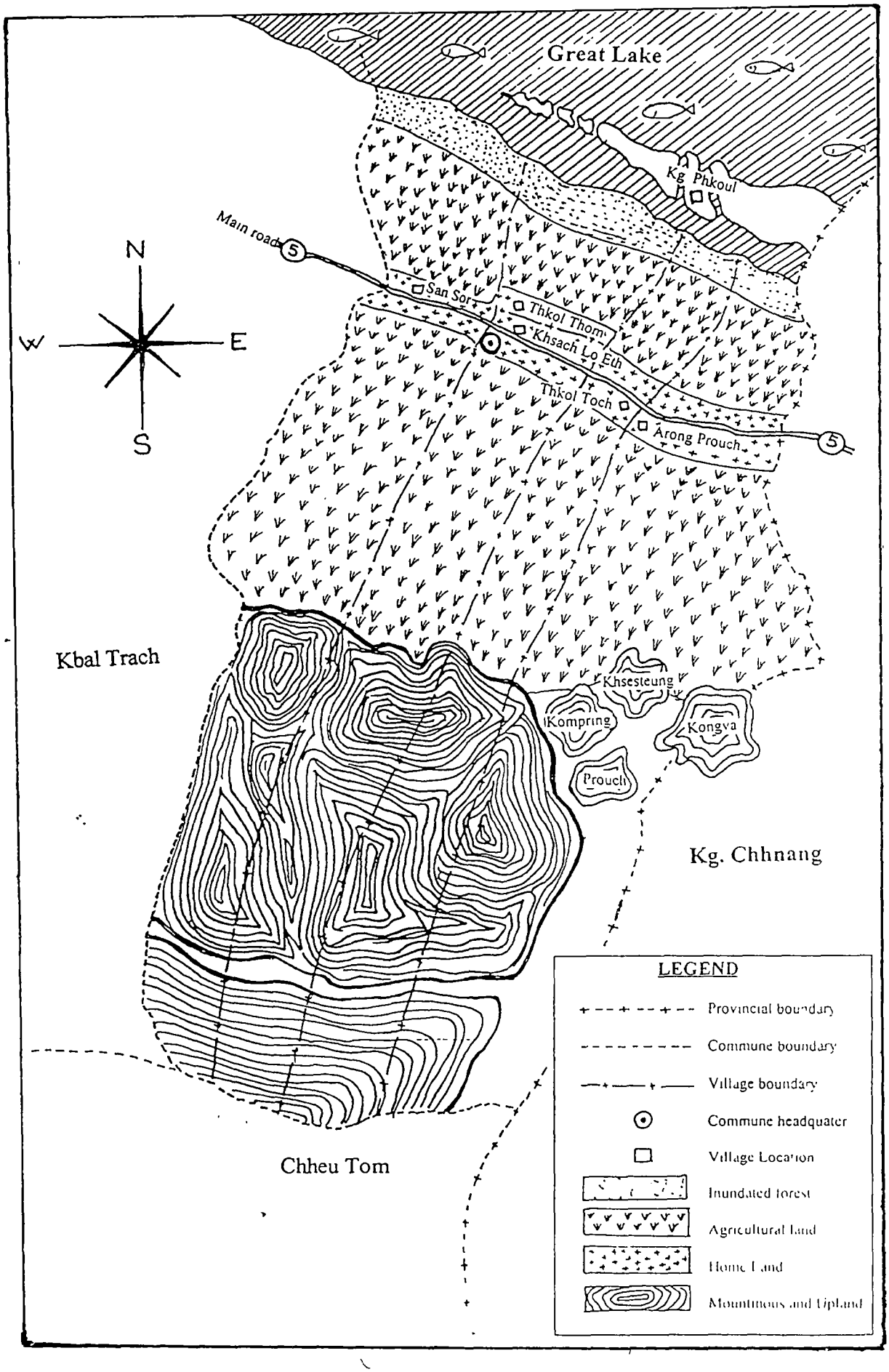
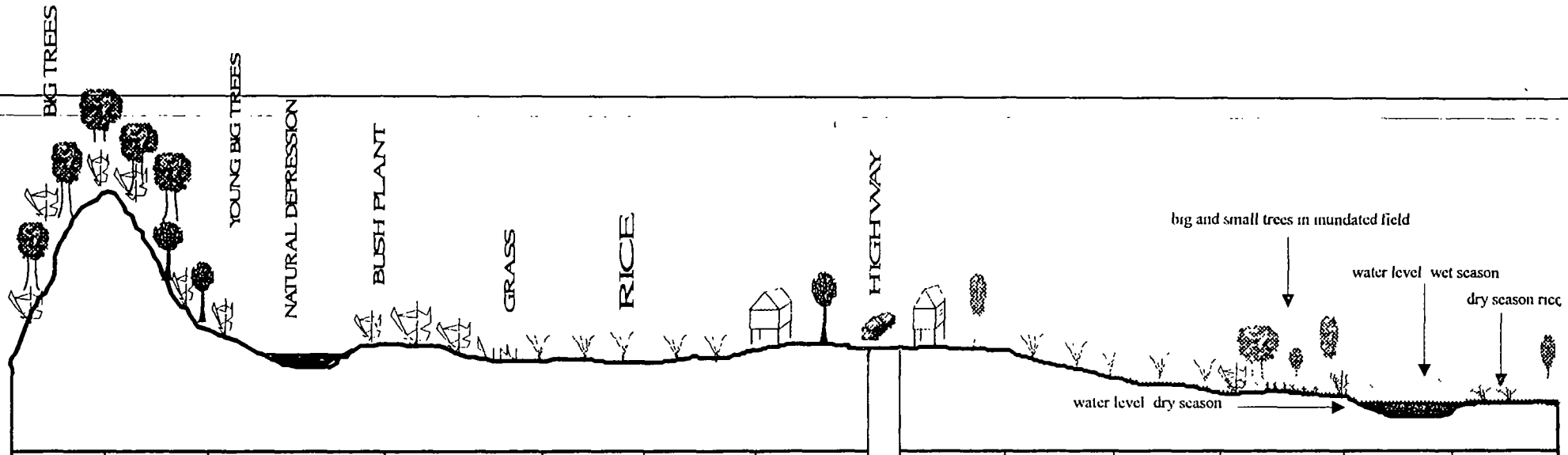


Figure 3: Resource systems Map of Ansa Chambok Commune





Size	2 km	3 km	6 km	2 km	1 km	0 5 km		1 km	5 km	1 km	1 6 km	0 7 km	5 km
Land type	Mountains	Foot hills, natural depression	High land	Low land	Low land	medium land		medium land	low land	very lowland	very low land	lake	V v low land
Eco systems	Watershed	Forest	Degraded forest	Rainfed growing	low land rice area	Homestead		Homestead	Rainfed	rice fields	Inundated forests	Grate lake	Island
Soil type	Sandy with gravel & big stone (1-2m diam.)	Clay loam	very sandy eroded soil of poor fertility	Low Sandy loam High Sandy poor fertility	Sandy loam, poor fertility (more fertile than previous section)	Sandy loam, moderate fertility		Sandy loam moderate fertility	Sandy loam poor fertility	Sandy clay poor-moderate fertility	Clay loam, good fertility	Heavy clay	Heavy clay, good fertility
Flooding	Flood free	At depression Rainy season 6 m at peak flood. During flash flood water flows for 2-3 days before receding of muddy water DS Clear water (2 m depth)	Generally above flood At peak flash flood-low field more than 40 cm At depression 1 m	Lowland 60- 70 cm Med land 30-40 cm	Low land 70-80 cm Medium land 40-50 cm	Flood Free Occasional flash flood of 0 6-0 8 m for 1-2 days		Flood Free Occasional flash flood of 0 6-0 8 m for 1-2 days	Normal flooding 0 5-0 6 m with 0 6 -0 8 m at peak flash flood	Normal flooding 1 5--2 m with high flooding 2-3 5 m (Special year)	Normal flooding 4-5 m with high flooding 5-6 m	Wet season - water depth - 10-15 m Dry season 1-1 2 m	Wet season completely submerged under water of various depth Dry season dry land
Ownership	Common P	Common Property	Common Property	Private	Private	Private		Private	Private	Private	Common P	Common P	Common P
Land Utilisation	Exploitation for lumber Wood for construction	Exploitation of wood for construction Tree for fishing lot	Small tree for lot Pasture for animal	WS. Rice cultivation Dry season Pasture, Palm leaves & juice collec	Wet Season Rice cultiv Dry season Pasture, Palm leaves & juice collec	Homestead	R o a d	Homestead Animal , poultry raising, Veg & fruit tree cultivation Frog raising	Wet season Rainfed rice cultivation Dry season Veg cult (1% land), free grazing of animal	Wet season Deep water rice cultivat Fishing Dry season Free grazing of animal	WS Fishing by trap, Turtle and Snake hunting rice seedling production Fire wood collection DS Dry seedbed Fishing in Pond, lotus cultivation Fire wood collection	WS Fishing DS Fishing, Shell collection	WS Fishing DS, Bird hunting, pasture for animal, rice & vegetable cultivation

S<----------->N

Figure 4: Transact of Ansa Chambok Commune cutting through Thkol Thom, Ksach loeth, Kompong Thkol village

Table 1. Gender involvement in a land-based multi-resource user community, Ansa Chambok, Pursat, Cambodia.

I. Common Property based activities

a. Watershed forest activities	Male	Female	Children
1 Hunting animals (e g dear, rabbit)/ birds	XX		
2 Cutting of small trees for use in fishing lots	XX		
3 Collection of fire woods	XX	XX	
4. Collection of wood and Charcoal making	XX		
3 Lumbering for construction wood	XX		
4 Lumbering for pole	XX		
4 Fishing in seasonal stream	XX		
5 Glue collection	XX	X	X
6 Harvesting of tuber		XX	X
edible leaf		XX	
wild mushroom	XX	XX	
bamboo shoots		XX	
7 Animal grazing	XX		XX
8 Collection of Rattan	XX	XX	0
9 Making Baskets, Mats		XX	
Fishing gear	XX	XX	
Cage for aquaculture	XX		
b. Inundated forest	**Male**	**Female**	**Children**
1 Fishing	XX	X	X
2 Firewood collection	XX	XX	X
3 Fodder collection	XX	XX	X
4 Seedling production for rice	XX	XX	X
5 Growing lotus	XX	X	X
6 Collection of grass for roof thatching	X	XX	X
7 Collection of tree branches for fish shelter in the lake	XX	XX	X

c. Lake, River and river bed	Male	Female	Children
1 Fishing	XX	XX	X
2 Hunting water birds	X		XX
3 Catching mullusc	X	XX	XX
3 Bamboo along stream	XX		
c Paddy field[1]	**Male**	**Female**	**Children**
1. Fishing	X	XX	XX

[1] Fish and aquatic animals found in rice field far from the homestead is considered as common property

II. Private Property based Activities

b. Homestead	Male	Female	Children
1 Vegetable growing	X	XX	X
2 Fruit tree cultivation	X	XX	X
3 Culture of frog/fish	XX	XX	X
4 Animal Raising -Chicken		XX	X
Pig	X	XX	X
Buffalo, Cow	XX	X	X

b. Lowland (paddy fields)	Male	Female	Children
1. Rice cultivation			
a ploughing and harrowing	XX		
b preparation of seedbeds	XX		
c sowing seeds in the seed bed		XX	
d collection of manure		XX	X
e transport of seedling and manure	XX		
f transplanting	X	XX	
g broadcasting natural fertilizer	XX	X	
h broadcasting chemical fertilizer	XX	XX	
I scaring of bird		XX	XX
J Harvesting	X	XX	
K Threshing	XX	X	
l winnowing		XX	
2 Collection of grass for mat making	X	XX	X
3 Fish and mollusc catching		XX	X
4 Palm trees			
a Climbing and tapping	XX		
b cutting leaves	XX		
c roof making from leaves		XX	
d making sugar/wine		XX	
e selling of palm tree based products		XX	

XX= Main responsibility, X= Secondary responsibility, blank = no or very little responsibility

Table 2. Gender involvement in a water-based multi-resource user community, Ansa Chambok, Pursat, Cambodia.

I. Common Property based activities

b. Inundated forest	Male	Female	Children
1 Fishing			
a Catching	XX	X	X
b Selling		X	X
c Repairing boat	XX	X	X
2 Firewood collection			
a Cutting	X	XX	X
b Transportation	X	XX	X
4 Collection of tree branches			
a cutting	XX	X	X
b putting in the lake	XX		X
5 Collection of broad leaf			
a collection	X		XX
b putting in the lake	XX	X	X
c catcing fish in the lake	XX	X	X

c. Lake, River and river bed	Male	Female	Children
1 Fishing			
a Catching	XX	X	X
b Selling		X	
c Processing	X	XX	X
3 Catching mullusc	X	XX	XX
Selling		XX	X

d. Island in lake	M	F	Children
1 Growing vegetable			
a Cultivation	X	XX	
b Irrigation	X	XX	X
c Selling		XX	
2 Rice cultivation			
a Clearing weeds	XX	X	X
b Making dike	XX		X
c Sowing	XX	X	
d Transportation	X	X	XX
e Transplanting	X	XX	X
g Weeding	XX	XX	X
h Irrigation	XX		
i Harvesting	X	XX	XX
j Threshing	XX	X	XX
k Winnowing	X	XX	X
l Milling		XX	XX
3 Fishing by bamboo trap			
a Making trap	XX		X
b Catching fish	XX		X
c selling		XX	X
d processing		X	
4 Hunting of birds	X	XX	XX
a Catcing		XX	X
b Selling			

Table 3. Seasonality nature of activities in a multi-resource user community (land based), Ansa Chambok, Pursat, Cambodia.

I. Common Property based activities

a. Watershed forest activities	Dry season	Wet season
1 Hunting animals (e g dear, rabbit)/ birds		X
2 Cutting of small trees for use in lots	X	
3 Lumbering for construction wood	X	
4 Lumbering for pole[1]	X	X
4 Fishing in seasonal stream		X
5 Glue collection		X
6 Harvesting of tuber / edible leaf, wild mushroom and bamboo shoots		X
7 Animal grazing	X	
8 Rattan, bamboo for basket, mat, fishing gears, cage for aqua culture	X	X

b. Inundated forest	Dry season	Wet season
1 Fishing	X	X
2 Firewood collection	X	X
3 Fodder collection		X
4 Seedling production for rice	X	X
5 Growing lotus	X	
6 Collection of grass for roof thatching		X
7 Collection of tree branches for fish shelter in the lake	X	

c. Lake, River and river bed	Dry season	Wet season
1. Fishing	X	X
2. Hunting water birds	X	
3. Catching mollusc		X

c. Paddy field[2]	Dry season	Wet season
1 Fishing		X

[1]Lumbering for pole can only be done at the beginning and the end of the rainy season
[2]Fish and aquatic animals found in rice field far from the homestead is considered as common property

II. Private Property based Activities

b. Homestead	Dry season	Wet season
1 Vegetable growing	X	X
2 Fruit tree cultivation	X	X
3 Culture of frog/fish		X
4 Animal Raising (e g Chicken, pig, buffalo, cow)	X	X

b. Lowland (paddy fields)	Dry season	Wet season
1 Rice cultivation		X
2 Collection of grass for mat making		X
3 Fish and mollusc catching		X
4 Harvesting of palm leaves and juice	X	

Table 4. Seasonality of income and livelihood activities a multi-resource user community (water based), Ansa Chambok, Pursat, Cambodia.

I. Common Property based activities

a. Inundated forest	Dry season	Wet season
1 Fishing	XX	X
2 Firewood collection	X	X
3 Seedling production for rice	X	
4 Growing vegetable	X	
5 Collection of tree branches for fish shelter in the lake	X	
6 Collection of broad leaf for fish shelter	X	

c. Lake, River and river bed	Dry season	Wet season
1 Fishing	X	X
2 Catching mollusc		X

d. Island in lake	Dry season	Wet season
1 Growing vegetable	X	
2 Rice cultivation	X	
3 Fishing by bamboo trap	X	
4 Hunting of birds	X	

Table 5. Interdependence between environments for livelihood activities in a multi-resource user community, Ansa Chambok, Pursat.

Main activities &	Environment		Supporting Activities	And Environment	
Activities	Environment	Property	Activities	Environment	Property type
Wet season rice cultivation	Rainfed lowland	Private	Seedling production through dry seedbed method Weeds as green manuring and insect repellent	Inundated and watershed forests Bush lands and roadside	Common Common
Dry season rice cultivation	island in the lake	Common	Seedling production through dry seedbed methods, irrigation	Inundated forests for seedbed and water from lake for irrigation	Common
Fishing in rice field by trap	Rainfed lowland	Private	Trap making	Rattan from watershed forest and Bamboo from homestead and along seasonal stream	Common(watershed forest & bank of seasonal stream), Private (Homestead)
Vegetable cultivation	Rainfed lowland, Homestead	Private	Support for vine	Bamboo from homestead or along seasonal stream	Private (Homestead), Common (Bank of seasonal stream)
Large animal raising	Lowland, homestead	Private	Pasture	Island in the lake, inundated and degraded watershed forests	Common
Pig raising	Homestead	Private	Feeding	rice bran from rainfed lowland, water convovuluse from canals,, streams (dry season) and fields (wet season), Water Taro (marshy areas) etc	Private (rainfed lowland), Common (Canals, streams)
Palm Sugar Production	Rainfed lowland, Homeastead	Private	Boiling of the juice	Fire wood from Watershed forests	Common
Aquaculture	Great lake	Common	Cage making, fish feeding, treatment of disease	Feed. Rice bran from rainfed lowland, weeds from inundated forest Treatment botanical medicine from inundated forests	Private (rainfed lowland) Common (inundated forests)
Commercial exploitation of fish	Great lake	Common	Making boundary of fish lot	Small trees for watershed forests	Common
Shrimp catching	Great lake	Common	Catching gear	Bush trees from inundated forests	Common
Fishing	Great lake	Common	Boat making Fish shelters	Plank and glues from trees of watershed forests Trees of inundated forests	Common Common
Fish processing	Great lake	Common	Smoking	Firewood from Inundated forests	Common

Table 6. Changing pattern of resources in a multi-resource user community, Ansa Chambok, Pursat, Cambodia

Environment	Pre civil war	Post civil war	Impact on other environment
Mountains	Dense forest, more animals	Deforestation, erosion of top soil, exposure of gravel and big stones. less extractable trees	Sedimentation at the natural depression at the foothills and plain lands
Foothills	Year round water at the natural depression, always flows in the seasonal stream in WS, dense forest	Sedimentation of natural depression, water flows only during the pick flood, less extractable trees	change of water flows in the stream, impact on rice cultivation
Watershed forest at plain land	Dense forest	Deforested bush land, used as pasture	
Rice land close to watershed forests	Human settlement, rice lands close to homestead	Less fertile soil , yield decline 30%, water flows uneven and in few places	Due to low soil fertility farmers are making dry seedbed in the forests
Rice land close to homestead	Fertility was lower and unhindered water flows (southern part) Fertile soil, floating rice cultivation	More fertile than in precivil war because of proximity to homestead Big effect on fertility and productivity due to change of water flows via Pol pot dam Soil has less fertility and lower yield, shifted to rainfed wet season rice cultivation	Change of fertility increases use of dry seedbed in the watershed or inundated forests which is creating pressure in that environment
Homestead	More human settlement, dispersed village arrangement, rice land close to the homestead, more vegetable and fruit tree cultivation	Villages are along the Highway 5 Small size homesteads, less vegetable and fruit tree cultivation	Higher dependence on CPR for food supplement
Deepwater rice area	Good fertility and productivity of the soil	Irregular flooding, the depth of the field is reduced, lower fertility due to accumulation of sand carried by seasonal stream on soil surface	Higher pressure on CPR to compensate the yield decline
Inundated forest	Dense forest with different species at natural proportion	Less density of inundated forests, more thorny species, less big trees but more grass for cattle Increased use as pasture Higher extraction of inundated forest More dry seedbed Less fish catch Lower population of turtles.	Decline of fish productivity in the Great lake
Lake	Higher water depth, high fish harvest	Water depth decreased, fish productivity has declined, change of composition of the fish species with dominance of small species	Low income and food from the lake, more pressure on other systems to compensate it

Table 7: List of threatened fish and bird species due to intervention

Common name	Scientific name	English name	Ranking
Fish			
Trey thka	*Pristis microdon* Latham	Largetooth sawfish	A
Trey kolreang	*Catlocarpio siamensis*	Giant barb	A
Trey reach	*Pangasianodon gigas*	Mekong giant catfish	B
Trey dangkteng	*Macrochirichthys macrochirus*	--	C
	Belodontichthys dinema		C
Trey Khlar	*Datnioides microlepis*	Finescale tigerfish	C
Trey chhveat	*Pangasius altifrons*		C
Trey kabak	*Clupea kanagurta*		C
Trey krawlang, Trey pruol	*Cirrhinus microlepis*		C
Trey damrey	*Oxyeleotris marmorata*	Marbled sleeper	C
Trey kes	*Cryptopterus apogon*		C
Birds			
Ka aik	*Phalacrocora corba*	Great Cormorant	B
	Phalacrocorax niger	Little cormorant	B
Thmath	*Otozyps calcus*	Red headed vulture	C
		Long Billed vulture	C
Kok Sar	*Bubuleus ibis*	Cattle Egret	C
Khaveik	*Scolopax rusticola*	Eurasion Wood Cock	C
Taum	*Amaurornis phoenicurus*	White Breasted Waterhen	C
Pra vek	*Dandrocygna javanica*	Lesser Tree Duck	C
	Anas creca	Common Teal	C
Moin Tek	*Porphysio edwarsi*	Small waterhen	C
Kok kro	Adeola bacchus	Chinese Pond Heron	C
Animal			
An Deuk	*Testudinidae spp*	Turtle	C
Kra peu	*Crocodilus siamensis*	Crocodile	B
	Ocaelle brevirostris	Dolphin	B

A= All most extinct, B= Greatly reduced C= availability/sighting have been reduced