

**Environment and Society
in the Lower Mekong Basin:
A Landscaping Review**

VOLUME I

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FOREWORD

This review of the literature on the lower Mekong basin peoples and their production systems has been prepared by the Institute for Development Anthropology (IDA) to contribute to Oxfam America's "Mekong River Basin Research and Capacity-Building Initiative." At their meeting at Can Tho University in January 1998, and in Ho Chi Minh City in January 1999, the participating organizations in this initiative, which include Can Tho University, the International Center for Living Aquatic Resource Management, the International Institute of Rural Reconstruction, Oxfam America - Southeast Asia Regional Office, and IDA, agreed to focus initially on environmental and socioeconomic dimensions of rural areas in the Mekong Delta. Hence, the review largely considers the literature of that part of the basin in Vietnam and Cambodia, but it also includes upstream materials from Cambodia beyond the delta and from Lao Peoples Democratic Republic.

The review is presented in two volumes. The first volume is a substantive discussion of the region as drawn from the literature. It is intended only as a guide to the literature and does not pretend to be comprehensive in any of its sections. The second volume is bibliographic. In order that the material remain fresh, we plan on issuing periodic updatings of the review for the duration of the Initiative activity. Therefore, Initiative partner organizations and other readers are warmly encouraged to share corrections, alternative interpretations of the material, and suggestions on improved organization of the document, and to advise us of additional bibliographic materials. Where these materials are "grey" or "fugitive" limited-circulation documents, we should be most grateful to receive hard copies as well as the

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Section One. Introduction

At the outset we need to point out, as this report makes clear, that dam construction for hydropower, navigation, flood control, and irrigation is not the only, nor necessarily the most profound change affecting the lower Mekong region and its peoples. Large-scale investments are planned in all segments of the transportation infrastructure (roads, riverine, air, and rail), facilitating the movement of people and goods to some of the more remote parts of the region. People are migrating from rural to urban and industrial sectors in response to the perception of new economic (and health and educational) opportunities. Tourism is beginning to play an increasingly prominent role in the regional economy, a tourism that includes not only foreigners but also expatriated nationals. These latter, particularly ex-refugees living in western industrial countries, may themselves be important sources of investment. Export of logs from upland areas of the basin is a significant economic activity whose adverse environmental impacts are beginning to be appreciated. A widespread shift from semi-subsistence to commercial agriculture is impacting rural areas, affecting domestic (including gender and age) relations of production in 1998 the absence of a normal rainfall regime brought drought to much of Southeast Asia. Finally, the current economic crisis of the East Asian "tigers" is resonating among smaller Southeast Asian economies, forcing a recalculation of the various economic rates-of-return on which many of the development projects had been appraised. While we emphasize interventions involving river flows because their impacts are never simply local contained within a single province or even country, but extend enormously both upstream and down, this report also consider; some of the other changes affecting the region.

1. DEVELOPMENT ON RIVER BASINS

Oxfam actions in the Laos, Cambodia, and Vietnam must be situated in the unprecedented context of international and national concerns for the continued capacity of the Mekong River region to sustain food-production. Large-scale infrastructural developments on all tropical rivers in Asia, Africa, the Middle East, and Latin America are driven by a curious concatenation of political, economic, and ideological events. The introduction of large dams¹

in the United States in the mid-1930s was enthusiastically welcomed by persons on both ends of the political spectrum. The poet and folk singer, Woody Guthrie, celebrated darn control over "wild and wasted" waters in Oregon and Washington:

*The world has seven wonders, that travelers always tell,
Some gardens and some towers and I guess you know them well.
But now the greatest wonder in Uncle Sam's fair land,
Is the keen Columbia River and the big Grand Coulee Dam.*

And little wonder for rejoicing in the promise of cheap and clean electricity that would support industrialization and job creation in a rural America still reeling from the 1929 collapse of the national economy and the massive population shifts accelerated by the dust bowl. Indeed, who would not celebrate the technological triumph over nature that promised not only power, but also flood control, irrigation, transportation, and, in America, recreation?²

The post-World War II period saw an explosion of dam construction mainly in China and in western industrial countries including the former Soviet Union, with more than 35,000 high darns built within 50 years after the Hoover Dam came on line in 1935. Suddenly, construction in Western Europe, Canada and the United States essentially stopped. On the one hand, they had run out of appropriate, darn sites; on the other hand, strong environmental movements militated against new construction and agitated, with some success, for darn decommissioning. Yet a huge civil engineering capacity continues to operate in these countries, as it does in Japan and Australia, and that capacity seeks work in more receptive locales. A recent study shows how Sweden and Norway, where environmentalists have blocked new domestic darn construction, have become major advocates and funders of hydropower in developing countries.

By the 1970s, public opposition to darns was such that the relevant industries in countries Eke the United States, Norway, Sweden, Canada, Australia, France and Austria found themselves forced to look for new markets. Their building spree in the Third World began at this time, aided in no small measure by the development aid institutions, in particular the World Bank, and the bilateral aid agencies. With their mandate to alleviate poverty, Western donors began to give darns as aid, in the name of bringing development and progress to the South. The bilateral agencies tended to channel this aid through their national darn-building companies, for which aid subsidies created competitive advantage in international bids (Usher 1997:4).

In 1989, India alone counted between 60 and 70 high darns in construction, and Turkey was building forty (Veltrop 1992:22). Across the world, more than 1000 high darns were under construction (ICOLD 1989).³

Most of the world's major river basins are now girdled with darns; many great rivers are now little more than staircases of reservoirs. A meager 70 km of the 2,000 km of the Columbia River flows unimpeded by the slackwater of the 19 darns which cut across it. In the continental US, only the Yellowstone River remains undammed out of rivers longer than 1,000 km. In France, the only remaining free-flowing stretch of the Rhône was impounded by a darn in 1986. Elsewhere in Europe, neither the Volga, the Weser, the Ebro nor the Tagus has a stretch more than a quarter its length which has escaped being turned into reservoir (McCully 1996:6-7).

With the shift of river-basin work from the industrial to the developing world, the controversy over darn construction has broadened. Few would dispute the need for increased electrical

capacity in poor countries, especially to support the industrial and urban sectors of the economy. Advocates of hydropower argue that it is cheaper and cleaner than any currently available alternatives, including nuclear and fossil fuel steam plants. Generating electricity with wind and tide is not yet feasible on the necessary scale, they say. They also point out that electricity is a rare marketable export commodity for many poor countries endowed with little but fast-flowing rivers and falls. Environmentalists and human rights activists, particularly advocates for the rights of indigenous peoples, argue that proponents of dams invariably underestimate their human and natural costs, while exaggerating their anticipated returns. These opponents of large-scale hydropower generation also point out that the cost-benefit analyses never take into account the ultimate necessity for decommissioning and deconstructing the dams, as siltation reduces the live-storage capacities of their reservoirs.

Economic development involving the construction of high dams on tropical rivers has become an increasingly contentious area... The contest is clear and uncompromising (see "The Debate Over Large Dams" *Civil Engineering*, August 1991), reflecting zero-sum thinking on both sides. Despite rhetoric acknowledging a multiplicity of objectives in dam construction whose "purposes include providing clean and adequate water supplies for drinking and irrigation flood control navigation, hydroelectric power, fish and wildlife enhancement, recreation and water quality" (Veltrop 1992:iii), those responsible for power generation resist demands of downstream users for releases of water in excess of power requirements, irrigation engineers see flood-recession agriculture as wasteful, managers of potable water supplies tend to jaundiced views of recreational uses, and so on... My colleagues and I sought a reconciliation of the opposed positions. Is it possible for high dams built for power irrigation, flood control and navigation to be managed in ways that enhance rather than damage the productivity of the downstream [and upstream] ecosystem (Horowitz 1994:IV-73-74).

In the hope of finding an environmentally and socially sustainable river-basin management that might reconcile the opposed positions, we turn to a consideration of the Mekong.

2. THE MEKONG

Compared to other basins, the "Lower Mekong has been a giant asleep—a source of tremendous potentialities for power production, irrigation, navigation, and flood control, but a source virtually unutilized" (Schaaf and Fifield 1963:74). See Figure 1, General Path of the Mekong.

The Mekong River carries 475 cubic kilometres of water a year. It is the tenth-largest river in the world measured in water flow, and by far the largest unexploited river in the world. At low flow it carries 1,600-2,000 cubic metres per second, which makes it the third in size in Asia after the Yangtze in China and the Ganges in India. It stretches 4,200 km from Tibet to the Mekong Delta in Vietnam 2,400 km of which are in the Lower Mekong Basin [south of the juncture of Myanmar, Laos and Thailand]. Its basin covers 795,000 km²... The total basin population is around 50 million, with an estimated GDP per capita of less than US\$200 per year... The birth rate and population growth are high throughout the basin...

The Mekong River originates in Tibet, passes through the Yunnan province in China with its deep, inhospitable, and thinly populated canyons, then strikes the

Burmese border for a short while before it crisscrosses in and out of Thailand and Laos. At the violent and beautiful Khone Waterfalls it enters Cambodia rapidly before it slows up in central Cambodia. Finally, it discharges into the South China Sea through nine arms in the low-lying Mekong delta in the south of Vietnam

The annual rainfall is somewhere between 1,000 and 3,000 mm, locally up to 4,000 mm, falling almost entirely during the rainy season, June to October, when the normally very reliable monsoon comes in over SE Asia. Of the [riparian] countries Laos contributes most of the water to the river, followed by Cambodia, Thailand, China, Vietnam, and Burma in descending order. Of the lower basin, with its total of 607,000 km², 204,000 are covered by Laos (85 percent of the country, 40 percent of the basin), 182,000 by Thailand (23 percent of the country, 20 percent of the basin), 156,000 by Cambodia (86 percent of the country, 26 percent of the basin) and 65,000 by Vietnam (20 percent of the country, 11 percent of the basin). The monsoon is reliable but locally the rainfall is utterly unpredictable, notably so in northeastern Thailand.

The river carries a huge economic potential: the technical hydropower potential is estimated at some 37,000 MW and 150-180,000 GWh/year. This could be compared to Cambodia's total installed capacity of 85 MW (1993). The area suitable for irrigation is estimated at 6 million hectares; three times the total area under paddy cultivation in Cambodia (Öjendal 1995:153-154).

As Joakirn Öjendal explains (1995:149), compared with other tropical river basins, the Mekong has a number of unique features: "first, it is a huge river almost totally unexploited on a large scale; second, a regional master plan on its proposed development was constructed *before* any major projects ... had been initiated." The two features are closely related. The United Nations (through the Economic Commission for Asia and the Far East [ECAFEI]) (Schaaf and Fifield 1963), the United States Interior Department, and the Ford Foundation (Conway and Romm 1973) supported the establishment of a Mekong Committee in the late 1950s. The original membership--Thailand, Laos, Cambodia, and South Vietnam--underscored the Committee's linkages to attempts to provide an obstacle to Communist expansion in the region. By 1961, ten mainstream projects involving hydropower, flood control irrigation, and navigation had been identified.

The Mekong River development was, in retrospect, a hostage of the early reports and studies from the later 1950s and early 1960s. It brought the gigantism and the well-intended but naive reliance on technical solutions commonly bred by overoptimistic development thinking in the 1950s. It was stuck in the paradoxical situation of too large (overambitious single projects) and too little (regional integration) at the same time. It was too much engineering and not enough ecology and socioeconomic studies. This led to a situation where not much was achieved besides institutional strengthening and preparations for grand plans (Öjendal 1995:156-157).

South Vietnam, Thailand, and Laos were closely tied to the United States' assumption of France's colonial hegemony in southeast Asia, as represented by the Southeast Asia Treaty Organization (SEATO). During the 1960s and 1970s, the countries of former French Indochina were racked with warfare, both international and civil, as communist regimes supported by China and the Soviet Union, and anticommunist regimes supported by the United States, were embroiled in massive conflict. The wars ended in communist triumph in Vietnam and Laos, and the retreat of Pol Pot's Khmer Rouge in Cambodia. While the Mekong Committee was not formally disbanded during the years of violence, it clearly could

not then move from design to implementation. It was not until the mid 1980s, with the establishment of the Doi Moi reform liberalization program in Vietnam (Nguyen Thi Song An 1996; Riedel 1997; Sidel 1998; Tonkin 1997), that regional cooperation was able to begin anew. Laos and Cambodia also instituted reforms that challenged their command economics, and "free market" economics seemed finally to characterize all countries of the basin, including even China (which, with Myanmar, was accorded observer status in the Mekong Commission).

Yet the common adoption of a free market philosophy could not disguise the inherent inequalities of the riparian states of the Lower Basin. In regional terms, Laos, Cambodia, and Vietnam are poor; Thailand is affluent. This asymmetry in economic linkages, combined with very different hydrophysical endowments, means that dam construction within a country is not devoted primarily to national development, but is "an export-focused activity, based on complementarities between different countries' energy demands and hydroelectric potential" (Hirsch 1996:1-2). Water control infrastructure in the highlands of Laos and Cambodia are designed to generate electricity for consumption in Thailand; "economic designs set Thailand (and thus Bangkok, with its demand for water and electrical power) at the hub of a regional resource economy that places demands on montane peoples and ecosystems throughout the region" (*ibid.*:2).⁴ The current financial crisis in East and Southeast Asia has resulted in a sharp decline in the exchange value of the Thai baht, and hence is forcing a recalculation of the internal rate of return for hydro project lending in the region. This temporary slowdown in project implementation creates an opportunity for the Oxfam America-sponsored initiative, as well as for the work of other environmental, economic, and social action groups operating in mainland Southeast Asia, to conduct field research that will facilitate the design of more socially and environmentally sustainable development.

3. THE LOWER MEKONG BASIN AND DELTA

The review of the literature that follows focuses on the environment and peoples of the Lower Valley in Vietnam Cambodia, and Laos with an emphasis on the ecology, settlement, and production systems in the Delta. We are looking at the Delta because its well-being is totally dependent on the quantity, quality, and timing of waters entering from upstream and is therefore especially vulnerable to upstream actions that alter river flows. The point is critical, because the vast bulk of attention generated by darn constructions has looked at the adverse impacts in the reservoir areas. These are the regions where flooding forces the relocation of peoples, often vulnerable minority and indigenous peoples. The World Bank's guidelines, for example, require resettlement and compensation uniquely for persons from the reservoir areas, but there are no guidelines for compensating those downstream who may not be physically forced to relocate, but whose abilities to survive are negatively impacted by the changed flow regime (Horowitz 1991).

The Mekong Delta—Cuu Long ("nine dragons") in Vietnamese—is a paradigmatic "fragile ecosystem." A brief but comprehensive ecological description is given by Brocheux (1995:2-10):

Mien Tay [the region the French called Transbassac] resembles all the world's great deltas in that the boundaries between water and land are often indistinct. The osmosis between the two elements is such that the image frequently recalled in descriptions is that of a sponge. The main water course is the Hau Giang, one of the two major tributaries of the Mekong. Though it defines the eastern border of Mien Tay, it periodically leaves its proper limits. Gigantic and

irregular, it regularly submerges most of the plain of Chau-doc under several meters of water for five months of the year. The rainy season, beginning in July, swells its waters so that by October it reaches its maximum level. As a rule the water runs slowly and poses little danger, as it is regulated by the great lake of Tonle Sap in Cambodia.

Mien Tay is drained by a system of *rach*, small water courses without any permanent source. The *rach* are shallow and nearly without slope due to the flatness of the land. Anastomosed to the point that it is almost impossible to distinguish their hydrographic basins, they form a magnificent network of waterways. As the tides wash through them two to four times a day, the flux and reflux imposes a rhythm on the movements of sampans and junks. The only obstacles to navigation are alluvium bars built up by the changing tides. The shifting alluvial deposits also make a mockery of human boundaries.

The demarcation of land and water is just as uncertain along the coast where the sea penetrates by means of arroyos. The dry season favors the influx of brackish water, which in the rainy season is pushed a few kilometers off to sea. The coast is most unstable in the Gulf of [Thailand] where violent northeasterly currents sweep away the alluvium and orient the hook of the point of Ca Mau toward the southwest. The coastline is remade quickly...

The mangrove forest is the precious agent binding the silted land of Mien Tay. On each new accretion of land is found a strip of young mangroves, which gives the beach the appearance of beds of greenery arranged in regular tiers. The Bay of Cuu Long was by 1937 a forest reserve of 20,000 hectares. On the coast south of Rach Gia, the U Minh is a vast flood forest, saturated with water at the end of the rainy season. Everywhere of recent formation, the coast is low, swampy, and often arranged in a straight line....

The climate intervenes on the side of water in the land-water dialectic of Mien Tay. The west is dominated by the repetitive regime of the monsoons. Situated at the southern extremity of the Indochinese peninsula the region is wide open to the southwest monsoon. But, while the violent winds and abundant rain impede maritime activity in the Gulf of [Thailand], they allow for agricultural work. The humidity, between 60 and 90 percent, and the temperature, between 25 and 35^o Celsius... are propitious for rice cultivation, and generally the rains are abundant and relatively regular...

The reversal of the monsoon in October or November is rarely accompanied by typhoons in this part of Vietnam... The wind from the northeast brings a relatively cool, dry period, which grows warmer and dryer towards the month of April when the ground cracks and fresh water begins to run short....

Recently deposited alluvium composed of silt and clay, predominates in the maritime provinces. Apart from stones and gravel their finer elements are up to 50 percent clay and possess such great compactness that they require a preliminary soaking before the soil can be worked. Rich in humus and organic matter, easily recharged with nitrogen thanks to abundant rains and floods, and containing potash in sufficient quantities, the soil is ideal for rice culture... In the swampy zones of Chau-doc and Long-xuyen, on the other hand, the presence of iron sulfate and aluminum imparts acidity to the soil. In dry periods, salts come to the surface in fairly extensive efflorescence. In these areas fresh water is indispensable to wash the salts into the neighboring rivers so that the land can be worked.

The mangrove trees provide a beautiful example of symbiosis between soil water, and vegetation. All three varieties, the *duoc*, the *vet* (two rhizophoraceae), and the *mam*, are adapted to salt water. The *duoc* with its flying-buttress roots exposed at low tide, and the *vet*, with its creeping roots, present curious silhouettes. In binding the alluvial mud these are the

primary agents of the progression of the coast and the consolidation of the delta. Their presence corresponds to the pioneering phase of the fixation. Where the soil is exhausted, remaining wet but no longer very salty, there is a proliferation of the rear-mangrove, or *mam*.

Every type of tree in Mien Tay is used for a variety of purposes. Mangroves are used for making charcoal budding houses (the *duoc* is rot-proof), and fashioning agricultural and fishing implements. They also [provide] tannin, oil, and fruit... This amphibious environment is also the abode of fish, sea tortoises, edible free-water tortoises, reptiles such as the python and lizards, saurian such as crocodiles, birds (including many waters), and insects (the best known of which are the dreaded mosquitoes). Only the *nui*, or hills, shelter animals of the high forest: tigers, deer, and even elephants.

Almost everywhere in Mien Tay the altitude is no greater than two meters above sea level. Sunken landscapes are the most prevalent. The territory is dotted with immense basins, inundated and deserted, in the heart of the West, near Can-tho (in Phung-hiep District) the Xa No River brings together swamps intersected by occasional sandy ridges, the remains of ancient dunes, or *giong*, where a few trees thrust up in isolation. To the east of the U Minh forest, a vast undrained zone of some 80,000 hectares is home to stagnant water, a few scraps of mangroves, and high grasses. Even in the month of March one can hardly move on firm ground there. As early as the end of April the expanse of black and spongy humus, water-logged and encumbered with reeds, is frequented only by the wading birds that give it one of its names, the Plain of the Birds. In Vietnamese it is known as Bien Lang (Tranquil Sea)...

At the approach to the Cambodian frontier the land rises. North of a hypothetical line drawn from Rach-gia to Can-tho the *nui* precede the Kampot Mountains in Cambodia. The *nui* thrust abruptly from the plain and the resulting contrast accentuates the impression of "mountains." Their altitude varies greatly, from Nui Sap (86 meters) and Nui Ba The (210 meters) in the province of Long-xuyen to Nui Sam (230 meters) and Nui Cain (880 meters) in Chau-doc. Although exploitable quarries and sources of fresh water have long encouraged a dense population at the base of each *nui*, the hillsides are cloaked in deep forest....

Apart from the *nui*, the *giong* provide the only notable relief in Mien Tay. Composed of elongated hillocks of sand running parallel to the coastline, their successive alignments are testimony to the retreat of the sea. Sheltered from floods, the *giong* contain at some depth (where they meet the underlying clay) sources of fresh water. This has made them favored sites for human settlement. The landscape of sandy hillocks, wrapped in green groves, is evocative of oases...

A priori, the climate and the natural environment of Mien Tay do not present insurmountable obstacles to human settlement. Or, the contrary, they offer rich agricultural possibilities. The climate and the soil are suited to flooded rice culture. But settlement is only possible if the water is controlled. Cultivation, whether irrigated or dry, can only be undertaken after the alum of the oil has been drained and the brackish water prevented from flooding the fields during the monsoon. The work is tremendous, for many canals and small channels must be dug to extend the natural waterways.

In the domain of rice culture, the regime of the water determines the mode of cultivation: floating rice sown directly or planted rice with one or two transplantings. It also affects the kind of rice cultivated: early rice, half season rice, or full-season rice.

While there is evidence of anthropogenic modification of the delta going back several thousand years during the Funan civilization, when wet rice cultivation is first found (Sluiter

1992:143), major modifications of the landscape began with French colonization in the 19th century, when canals were dug to facilitate military access to settlements. Small attempts at constructing drainage structures to increase the arability of the land were also tried. To mobilize the huge amounts of labor required to build and maintain these structures, the French turned to *corvée* as they did with road construction in their African colonies. By 1930, some 1,425,000 hectares of land were drained. Roads were built on the excavated materials alongside the canals. "The hydrographic configuration requires many bridges and culverts, some of iron, others of concrete, most of wood. Unless these were rebuilt after each wet season, ferries would be the only means of crossing the canals" (ibid.:22).

The lower Mekong basin today represents an extraordinary adaptation in which some 16 million farmers exploit one of the most productive rice-growing areas in the world. Our colleague, Professor Le Quang Minh, of Can Tho University, says: "The delta is the most productive agricultural area of the Mekong. The floods bring billions of tons of nutrient-rich silt to the fields. In some areas farmers can grow two or even three crops a year, using the Mekong to irrigate" (quoted in Sluiter 1992:143). He continues:

But there are limits to the expansion of rice production. First, we have the so-called acid sulphate soils which are not appropriate for rice. Second, we have areas where salt water intrudes from the seas. Parts of the delta have both acidity and salt. Some policy-makers, intent on increasing rice production, want to change these natural conditions. They maintain the old way of thinking that the sea water intruding every dry season should be kept out with dams and dykes. And they want the Mekong dammed upstream to create large reservoirs, from which fresh water could be released in the dry season to flush out the salt and irrigate the fields.

The explosive increase in rice production in the delta is a consequence in large part of the agronomic creativity of the farmers. Deltaic agriculture constitutes a vast laboratory for microecological experimentation, in which the "technicians" are hundreds of thousands of small holders who use the natural and regulated flows of water to adapt to the local specifics of soil chemistry, land morphology, drainage, labor, and markets. Dean Minh gives an example:

Some ten years ago a farmer started experimenting by flooding his land with salt water in the dry season; he wanted to prevent the soil from drying out, because it then turned acidic. Everybody thought he was crazy because salt damages rice crops, but the results were amazing. Acidity was reduced, and the first monsoon rains flushed out the salt into a ditch the farmer had dug around his field. The harvest was fine, and there was another reward: the sea water had carried shrimp on to the field and into the ditch. The farmer raised the shrimp and made good money (ibid.: 144).

The beauty of such microecological experimentation is that if it works, it is readily visible to others and diffuses rapidly. The shrimp-rice combination quickly was adopted by many other farmers in the region. "Ecologically this farming method is more sound than others," says Mr. Minh, "because farmers avoid the use of pesticides and chemical fertilizer as much as possible, to keep the shrimp happy. So you see, salt water is not the enemy" (ibid.).

The other factor implicated in the recent growth of rice production in the delta is *doi moi*, the radical economic reforms introduced by the Vietnamese government in the 1980s and especially since 1988, which transformed rice production "from a predominantly collectivized and centrally planned sector into a privately operated small-farm household agriculture... After having [had a chronic rice deficit], Vietnam has been now exporting rice since 1989, and is now the third largest rice exporter in the world market" (Nguyen Thi Song An 1996:2).

[the] food situation in the whole country has been considerably improved. Total paddy equivalent food output, food per capita and exported rice in 1993-1995 period increased by 17.5 percent, 9 percent and 31 percent respectively over those in 1989-1992 period. The increase is not only in quantity but also in quality. With regard to exported rice, in 1989 exported rice was mainly 35 percent broken but in 1993 it was mainly 5 percent broken. As a result, price of Vietnam's exported rice increased, with only \$US 15-20 less than Thai price per one ton, while this figure in 1989 was \$US 40-40... Together with food production, animal husbandry continues its stable development with better results than previous stage; the living standards of farmers have improved (58 percent of farming households live in their good dwellings, 52 percent is supplied with electricity,⁵ 62 percent has an access to safe water, nearly 2 million households have television, 5 million have radios) (ibid.:30).

Although overall income in the rural areas has increased markedly with the reforms, there has also been increasing inequality: "the gap between the rich and the poor is growing in the countryside in terms of income distribution and land holding, especially in the South" (ibid.:3).

Title to land still rests with the state, but tenure is renewable with 20 year terms for annual croplands and 50 years for perennial croplands. There is a brisk market in use-rights, and some farmers have accumulated the rights to farm large portions of land, requiring tenants and/or salaried labor to work them. Reemerging in the delta, then, is a kind of landlord class reminiscent of the presocialist period.

A recent study in the Mekong Delta indicates clear evidence of a process of land concentration: accumulation of land by successful farm households on the one hand, and an increase in the incidence of landlessness on the other... The reason leading to this concentration is that some rich farmers who have capital and production experience invested to exploit more new land and some poor households transferred their land-use rights because most of them lack capital (ibid.:41).

Associated with this social differentiation is the emergence of specialized occupations—ploughing, threshing, irrigating, pest management—that are sold or rented to landholders.

The area of Dong Thap Muoi, the Plain of Reeds, covers some 8,000 km² of the northern Mekong Delta. While there was always some farming in this region, prior to the war the Plain of Reeds with its acidic soils was primarily an area of fishing. "The war was to change all this, when bombs rained down, forests were razed, and swamps drained to flush out the Viet Cong. Military tactics aside, drainage unleashed the 'acid tiger' that poisoned waterways, killed fish and made water unfit for use in homes or on fields" (Sluiter 1992:148). Government attempts after the war to restore the productivity of the Plain were only partially successful. In some regions, the acid was flushed out and rice sown. But in other areas, the acid has forced an examination of alternative crops (pineapple, cashew, and melaleuca trees⁶) that could better tolerate the soil chemistry. According to a farmer:

We make "raised beds" in the fields ... so that we can grow crops even when the land is acid. We dig rows of ditches in the field and heap up the soil along the ditches to make rows of plant beds. The topsoil is less acidic than the deeper layers, so the beds consist of two less acidic layers of topsoil. We can grow cassava, yams and sugar cane on them. The acid is flushed into the ditches with the rains and flood water. At the same time the water in the ditches keeps the soil from drying out and becoming more acid (ibid.: 149).

The lower Mekong basin is a great and splendid collaboration between nature and people. Brutalized by chemicals and ordnance during the war between communist and anti-communist forces (Davies 1997), and by class and ethnic conflicts (Kiernan 1993), the region sprang back and is today among the most productive rice-growing areas of the world. Yet it is once again under threat, this time not from the violence of war but from the violence of unsustainable economic development. The delta is threatened by global climate change-induced rising sea levels that may cover the lowlands with salt. It is threatened by deforestation⁷ both locally and upstream, where logging leads to accelerated siltation in such critical flow-regulating areas as the Tonle Sap. It is threatened by chemical into xification from fertilizers, herbicides, and pesticides. And it is threatened by dam-induced changes in the quality and quantity of river flows that provide water at key times, flush out salts and acids, renew fertility with silt, and maintain the integrity of the coastal areas against the erosive power of the sea. It is our hope that this review, and the Oxfam America Mekong Basin Initiative of which it is a part, will contribute to the identification of an approach characterized by an appropriate balance among the well-being of local communities, power, agriculture, flood management, transportation and the natural environment: in short, a development that is both socially and environmentally sustainable.

This report will address one aspect of the Mekong river and its productive activities and environment. It will look at the "landscape" of life along the lower reaches of the Mekong, Cambodia, Laos and Vietnam. In doing so, it will review the state of the literature on the lower Mekong, and synthesize research from both the social and natural sciences on the importance of the river system to life on the lower basin. It will point out the current gaps in knowledge of the lower basin, and make recommendations for further research. It is particularly focused on the lower basin because more studies, most conducted by the Committee for Coordination of Investigations of the Lower Mekong Basin, have concentrated on the effects of river development at the higher reaches of the Mekong in Thailand and Laos (White 1962). Furthermore, because many of these studies were conducted in the 1960s and 1970s, they tended to view darn development and river control as leading to only two main social or environmental problems: flooding caused by reservoirs and resettlement of people out of reservoir areas (Challinor 1973). Now, our knowledge of river development is more comprehensive, and many other downstream effects from dam development are now known. In fight of this knowledge, this study will look at the complex social economic, and environmental systems tied to the Mekong river in order to draw conclusions about possible effects of future river development.

The basin can be divided into three main stretches: the Upper Mekong includes the Tibetan plateau where the Mekong begins and the mountainous stretches of China through which the river flows. The middle Mekong is the area of the river between the drop in elevation below China, comprised of most of the area of Laos and northeastern Thailand. Here the river remains several hundred feet above sea level but has a much less elevated slope than the upper basin. The river forms the border between the Lao PDR and Thailand, turning 600 km eastward into Laos and then abruptly changing course to the south for 250 km, then turning east again. About 25 km upstream from the Lao capital, Vientiane, the river cuts a gorge though the Korat Plateau, and from here to the Cambodian border it follows the rim of the plateau. Natural levees are found in this part of the river (Pantulu 1986a). More than half of the plateau is drained by the Nam Mun and Nam Chi river tributary, and several other tributaries such as the Nam Ngum and Nam Lik form part of a broad alluvial plain in this northeast comer of Laos.

Once the Mekong leaves the southeast edge of the Korat Plateau, it drops over the Khone Falls. The lower part of the Mekong begins below these waterfalls of Khone Falls in Laos, where the river has an elevation of only a few feet above sea level. The river here is characterized by high natural levees and a broad flood plain (Pantulu 1986a). It meanders

through the plains of Cambodia before meeting up with the Tonle Sap river - the Mekong's last major tributary. It is the meeting of the Mekong and the Tonle Sap that creates the backflow of water up into the Great Lake of Cambodia, and forms the series of tributaries that eventually flow down into the South China Sea. In the area of Cambodia between Takeo and Prey Veng, the lower Mekong is at its narrowest, only 100 km wide. Then the river divides to form the nine tributaries flowing into Vietnam. These nine tributaries (the major ones being the Hau Giang (Bassac) and Tien Giang (Mekong)) give the Mekong its name in Vietnamese: Cuu Long, or Nine Dragons. (See Figure 2, Map of the Lower Mekong Basin.)

The lower Mekong basin has a population of around 50 million people. Around 20 million people are in the northeast of Thailand and 20 million in the Mekong Delta region of Vietnam. Cambodia has a population of around 9 million, and Laos around 4 million (Jacobs 1995). This report focuses on the provinces of Cambodia and Vietnam that make up the lower Mekong. In Cambodia, ten provinces are the main component of the river basin, and 86 percent of the population of Cambodia resides here. This includes the capital city of Phnom Penh. In Vietnam, the Mekong Delta consists of 11 provinces and around 3.9 million hectares of land. Of this, 3.3 million are agricultural or forestry lands, and 1.9 of that is cultivated with some sort of rice. The coastal areas of the delta provide rich fisheries. (See Figure 3, Map of Districts and Political Subdivisions in the Basin.)

The great difference in the livelihoods of the different areas of the Mekong basin makes generalization about the area difficult. For example, in Thailand rice yields average around 4.5 tons/ha while in Cambodia they are only 2 tons/ha (Jacobs 1995) And in Vietnam, the population density is around 320 people per km², while in Cambodia is it often one-third that. These dramatic differences indicate that generalizations about localized conditions in the Mekong must be considered with several grains of salt.

The importance of the Mekong to local populations is not the only role the river plays in the region. It is also an impressive potential source of hydropower. It is estimated that the Mekong could irrigate 4.3 million hectares of land and produce over 24,000 megawatts of electricity (Jacobs 1995). The Committee for the Coordination of Investigations of the Lower Mekong, a consortium of all six countries in the basin has proposed a number of major hydropower projects on the mainstream and tributaries of the Mekong (Committee for Coordination of Investigations of the Lower Mekong Basin. CCILMB Secretariat 1992). While most dams are usually used for one or more aims of domestic and industrial water supply; energy production; irrigation; or flood control (Dixon, Talbot et al. 1989), the major aim for the Mekong projects appears to be hydropower (Hori 1993; Jacobs 1994). However, objections to these plans have been raised by many parties (Lohmann 1990; International Rivers Network 1995; Rothart 1995; Roberts 1995b).

The possible environmental and social implications of dams on the Mekong has caused re-analysis of the situation by concerned parties in development. For example, the Asian Development Bank has recently said that "the logic of treating the entire Mekong River watershed or any other major watershed as a single planning unit is clear. The construction of major dams on the main stream in Yunnan Province to generate electricity, or the removal of the rapids between Lao PDR and Myanmar to improve river transport, could affect the seasonal flows through all six countries and the hydrology of the major rice-growing region in the delta in Vietnam. Contamination of the Great Lake (Tonle Sap) in Cambodia could seriously impact the breeding grounds of migratory fish species which are harvested from the PRC to Vietnam. In short, the Mekong River is an integrated system such that the impact from development in one area may be felt throughout the entire system and rational economic-cum-environmental development planning must take this into account." (Asian Development Bank 1994).

This report will mainly restrict comments to conditions characterizing the lower Mekong. Where an upstream hydropower project would particularly effect some part of the downstream environment, note has been made. It is important to realize, however, that this river system is extraordinarily complex, and it is difficult to anticipate the results of various actions on other stretches of the river. As Pantulu (1986a) notes:

Basins are complex ecological systems comprising a diversity of uses to man, where the character and disposition of one resource, for example the temporal and spatial distribution of water, will influence the development of others. In addition, the development of a particular resource may conflict with the development of others - for example, modern intensive agriculture, fisheries, and forest exploitation, wildlife and soils. Furthermore, water use for any purposes will have its own characteristic impacts on water quality and, in the case of consumptive uses, also on quantity. This will conflict with the interests of downstream water users and uses. Therefore, to ensure optimum benefits on a sustainable basis to all riparian states, it is essential that the use of this common resource is integrated in a basin-wide manner.

The main object of this report is to review current knowledge of the landscapes of the lower Mekong in general. The report addresses three main topics: the ecological and environmental landscapes of the lower Mekong; the agricultural and productive landscapes; and the human sociocultural landscapes. Because of the difficulty of collecting accurate statistical information in each of these three areas, statistics in this report should be read with a careful eye. In many places, information is missing, inadequate, suspect, or too general. In these cases, note has been made where additional research would be helpful for future knowledge of this rich and diverse environment.

Section Two: Ecology and Environment

This section will explore the ecological and environmental aspects of the landscapes of the lower delta. In many cases, information on these topics is old, either from French colonial sources or US military and development documents from the days of the Republic of Vietnam. More recent research is often in languages such as Japanese or Russian and is inaccessible to the average reviewer. Environmental research conducted by the state in Cambodia and Vietnam, the two main lower Mekong countries, is often inaccurate, imprecise or missing because of the history of conflict and war in those two countries in the last 30 years. As a result, this section must be read with care as much for what it does not say as what it does.

1. TOPOGRAPHY

The topography of the lower Mekong basin can be defined mainly by the fact that it is only a few meters above sea level, and is confined to Cambodia and the southern tip of Vietnam. Almost all of Cambodia (86 percent of the land area of the country) lies within the lower Mekong basin, and 11 percent of the total areas of Vietnam is in the basin. Most of the area of Cambodia is central low lying plains less than 10 meters in elevation, which is ringed by high plateaus and mountain ranges in a horseshoe shape opening toward Vietnam. The central plains of Cambodia are dominated by the Great Lake (Tonle Sap) system which

plays a crucial role in water regulation of the lower Mekong. Once the Mekong reaches the delta, the elevation is usually not more than 1 meter above sea level.

In the upper stretches of the Mekong, however, topography is much more variable. The river undergoes several steep drops before it reaches the flat plains of the lower delta. The dramatic drop in elevation from the upper to lower Mekong is demonstrated by Table 1, Average Slope of Water Surface of Mekong During Dry Season.

Besides the lower flood plain of the Mekong that is the focus of this report, there are several other topographic features of note that influence the flow and path of the Mekong. This include the northern highlands of Laos and Thailand, the Annamite chain of mountains separating Vietnam and Laos, the Southern Uplands, and the Korat Plateau.

The *Northern Highlands* are the strongly folded and mountainous regions of northernmost Thailand and Laos, where these two countries touch against Burma. The area is steep and rugged, with ridges of 1500-2800 in, and with slopes often exceeding 30 percent. This area is interspersed with a few relatively large upland plains. The vegetation is usually evergreen forest on the slopes, with some Imperata cover in former swidden fallows in the hills. The valley floors are usually densely cultivated with wet-rice. The human population of this area ranges from 5-14 persons per km² (Pantulu 1986a). Most residents are members of one of the upland hill tribes, such as the Khmu or Hmong. Forest loss and soil erosion in these areas has been identified as one environmental problem that can affect downstream users of the Mekong.

Table 1. Average Slope of Water Surface of Mekong during Dry Season

River stretch	Length in km	Drop in m	Slope %
River source to Ahyongkou, PRC	106	752	7.10
Ahyongkou, PRC to Badihekou, PRC	969	2520	2.6
Badihekou, PRC to Dazonghekou, PRC	787	1199	1.5
Dazonghekou, PRC to Vientiane, Laos	1374	429	0.31
Vientiane, Laos to Stung Treng, Cambodia	940	123	0.13
Stung Treng to River mouth, Vietnam	703	36	

Source: Darning 1995

The *Annamite Chain* is the mountain range that divides the watershed of the Mekong from the drainage basin of the east South China Sea. The terrain is steep and mountainous in the north and central part of the chain, gradually ending in rolling plateau in the south just north of Ho Chi Minh City. Rainfall is heavy in the cordillera, especially in the southwest part of the chain. Swidden agriculture is the main mode of production for the residents of this area, many of which are ethnic minorities. Population density ranges from less than 4 people per km² to more than 50 (Pantulu 1986a). As with the Northern Highlands, concerns about erosion and forest cover are common in literature on the Annamites.

The *Southern Uplands* are the Elephant and Cardamom Mountains that create a natural buffer between most of Cambodia and the Gulf of Thailand. These uplands consist of rolling plains of 500-1700m altitude (Pantulu 1986a). Rainfall can be very high here and population

density is low. Most residents are Khmer practicing field agriculture and fruit crops.

The *Korat Plateau* is the large plateau that makes up most of the Isan region of eastern Thailand. It is a large "saucer-shaped intermountain basin" that leans toward the SE (Pantulu 1986a). The surrounding mountains can reach 1400m in height, but most of the plateau is around 100-200m. Because of the rainshadow effects of the surrounding mountains, the area is dry. Floods and droughts often affect Isan. The plateau supports a fairly high population density, ranging from 80 to over 200 people per km². Important agricultural crops of the area are rice, kenaf and cassava.

The *Mekong Plain* is the end point for the Mekong river. The plain consists of lowland Cambodia, the Mekong Delta of Vietnam and small sections of Laos below the Khone Falls and Eastern Thailand in the provinces of Chantaburi and Prachinburi. Most of the area is characterized by an altitude of less than 100 m. The plain has been highly affected by erosion and sedimentation. Deposition in the delta continues to create more land, extending the delta at a rate of 150 m annually in some places (Pantulu 1986a). The plain is by far the most densely populated part of the basin, with average densities ranging from 400 to over 500 people per km².

2. CLIMATE

The entire area of the Mekong River basin is monsoonal, and has great seasonal variation in rainfall. The circulation over the Mekong is dominated by two monsoons, the NE and the SW. The SW monsoon is the rainy season, normally from mid-May to early October. This is a time of "heavy and frequent precipitation, high humidity, maximum cloud cover and tropical temperatures" (Pantulu 1986a). The NE monsoon is usually from early November to mid-March, and in contrast, produces little precipitation and lower temperatures and humidity. In parts of the northern range of the Mekong, in highland Laos and Thailand, temperatures can be quite cold when air from Siberia and China passes down through the area.

Temperatures are uniform in the region but are subject to variation because of elevation and season. Mean maximum temperatures range from 30°C in Vietnam to 33.5°C in Thailand. Mean minimum temperatures range from 15°C in Laos to 22.7°C in Cambodia. Relative humidities are 50-98 percent (Pantulu 1986a). Statistics averaged from 8 weather stations in the lower delta (Cambodia and Vietnam) are listed in Table 2, Weather Statistics for Lower Mekong Basin.

The mean rainfall for the lower Mekong basin ranges from less than 1000mm annually in northeast Thailand to over 3500mm annually in the mountains of Laos. In Cambodia the mean is around 1500mm, and in the Delta it is 1,600-2,400 (Volker 1993). Basintopography has a great influence on the rainfall distribution, with locations in the leeward side of mountain ranges receiving much less rain than those on the windward sides. Torrential rains, particularly in the mountains, can cause extensive flooding downstream (Pantulu 1986a). The rainy season can contribute as much as 90 percent of the yearly rainfall (Volker 1993).

Rainfall rates have a dramatic effect on the flow rates of the Mekong. Typically low flows of the river occur in May and the high flows in September. The difference between the flows can be on the order of 15 times. Accurate climatic statistics for the area tend to be old, however, such as the 1968 data of the US Army Corps of Engineers (United States Engineer Agency for Resources Inventories, Tennessee Valley Authority et al. 1968).

River temperatures fluctuate diurnally. The temperature of the Mekong above Khone Falls usually fluctuates between 21.1-27.8°C. Below the falls, the water temperatures are higher, between 25-30°C. In some of the tributaries and flooding zones, water temperatures over 30° have been found (Pantulu 1986b).

Table 2. Weather Statistics for Lower Mekong Basin

Season	Temp (°C)	Relative Humidity %	Wind Velocity (m/s)	Sunshine hrs per day	Rainy days per month
Dry season	26.3	76	2.4	8.2	2
April	28.7	76	2.3	8.2	2
Wet season	27.3	85	2.2	5.8	18
November	25.6	83	2.0	7.1	10
AVERAGE	27.0	81	2.2	6.9	128 total yr.

Source: Volker 1993

Drought:

Drought is an occasional problem in the Mekong Basin. In fact, the Vietnamese highlands that drain into the middle Mekong watershed from Yali Falls to Drayling are currently experiencing their worst drought in 100 years. Over 200,000 people are said to be suffering from famine induced by the drought, and over 231 million dollars worth of crops were desiccated (Agence France Presse 1998). The southern provinces of the delta have also been experiencing the effects of drought. A June 5, 1998, news report from Vietnam reads:

The government has estimated damage from the drought, the worst in a century, at \$385 million and said it affected more than 1 million farmers and family members, with 450,000 suffering from serious hunger. The Vietnam Economic Times said. Friday that 175.5 billion dong (VND) (\$1 =VND 12,985) is needed to fight the drought's affects in the Mekong Delta, the country's main rice-growing area. The Ministry of agriculture estimates the money would be needed to buy fuel and electricity to run water pumps and pay for the labor. The 12 Mekong Delta provinces already have spent VND276 billion on dredging irrigation canals. The Liberated Saigon newspaper, meanwhile, reported that the government has outlined nine measures to overcome the severe consequences of the drought. They include allocating 3,400 tons of rice for badly affected families, VND5.6 billion for farmers and VND250 billion to VND300 billion for crucial irrigation projects. The State Bank of Vietnam also is making loans available to farmers. Commercial banks have been asked to reschedule outstanding debt for badly affected farmers (Associated Press 1998b).

Fires:

In the literature, fires seem to be the biggest problem in the Melaleuca forests of the Plain of Reeds in Vietnam There, the deliberate setting of fires for bee-keeping (to smoke the bees out of hives for honey harvesting) is blamed for uncontrolled burning. There may be other reasons as well, however, as local beekeepers often claim they are extremely careful about

their use of smoke and fire in honey harvesting (Mulder 1992). The extent of areas affected by the burning vary from year to year. In 1987, 2320 ha burned, out of 18,664 ha total forest, and in 1994, 320 ha burned out of 9,294 ha of forest (Nguyen Hoang Tri 1995). A May 14 news report from the area of the Tram Chim Bird Reserve says that fires have been occurring again this year: "A fire broke out in over 2,000ha of tram (cajeput) forest in the Tram Chirn National Park W Thursday. The fire was discovered and put out immediately. However, the next day another fire started and many trees caught fire. Army and police units, and over 300 residents began fighting the fire, which was successfully put out by Sunday. One ha of forest was destroyed" (Vietnam News Service 1998d). Some of these fires may be deliberately set in forested areas to either illegally clear land for rice harvesting or as an act of protest against state land management (Spencer 1996).

Climate Change:

In addition to concerns about current climate patterns, the Committee for Coordination of Investigations of the Lower Mekong Basin has been interested in recent years in predicting the possible effects of global climate change in the Mekong region. Because so much of the lower basin is only a few meters above sea level presumably any world-wide rise in ocean levels would have a dramatic effect on the basin. Other predictions for possible effects of climate change in the Mekong basin include a temperature increase of 0.2°C to 2-4°C. A probable decrease in soil moisture, and an unknown effect on precipitation. A recent report on the subject notes that "Though difficult to precisely forecast future climate change in the Lower Mekong, the region will continue to experience intra- and inter-annual climate variability. Future variability will continue to cause water related problems in the region, and changes resulting from global warming could exacerbate these problems. It is in this setting of future climactic variability and uncertainties that the Mekong River Commission must formulate water development policy." (Jacobs 1996)

The major hydrological patterns in the lower basin are a result of the course of the Mekong river. After traveling about 120 km of rapids from the border of Laos, the Mekong mainstream flows into the central plains of Cambodia where it meets the Tonle Sap river, and continues to flow as the Mekong and Bassac rivers into Vietnam. The French named this confluence of rivers the Quatre Bras. During the monsoon season, the Mekong river feeds into the Tonle Sap, causing the flow of the Tonle Sap river to reverse into the Great Lake of central Cambodia in around July-Oct. every year (Ahmed, Tana, et al. 1996).

This unusual hydrology has created in the Tonle Sap one of the largest and most productive freshwater lakes in the world. Its drainage basin is about 67,000 sq. km It is the flood waters of the Mekong during the monsoon season that supply more than 60 percent of the water to the Tonle Sap, causing the lake to expand more than three times from its dry season area of 2500 sq. km to 11,000 sq. km The magnitude of the Mekong floods has a high correlation with the volume of water entering the Tonle Sap and the expansion of the lake water (Ahmed, Tana, et al. 1996) The Great Lake acts as a "bladder," taking up in reverse flow about 20 percent of the Mekong river flood waters during the wet season (Hirsch and Cheong 1996). [The storage capacity of the lake is estimated at 7.2 km². This process acts as a natural flood stabilizer for the downstream areas of the Mekong Delta.

Additionally, the flood waters provide inundation for the lands surrounding the Great Lake. These flooded forests of the Tonle Sap are the spawning grounds for many of the Mekong Basin's fisheries. In the wet season the floods bring organic material, fish fry, and adult fish to these areas. In the dry season the fish migrate from the lake as far north as Yunnan and down the Mekong into the South China Sea. The annual floods also help irrigate and fertilize Cambodia's poor agricultural soils (World Bank 1994a) The tremendous power of the Tonle Sap in regulating so much of the hydrology of the Cambodian plains has been one reason

why the lake is being considered for World Heritage status, which would result in more measures for its protection (World Bank 1994a).

Hydrographs noting the hydrological patterns for several years in the Delta are noted in figure 5, Hydrographs.

Tributaries:

The Mekong has over 100 tributaries. These tributaries vary widely in the amount of water they contribute to the mainstream and when they contribute this water. For example, in the SW monsoon season, the Annamite cordillera receives high rainfall on the windward slopes, often leading to flooding in tributaries in Laos. The major tributaries of the Mekong and their average catchment areas and flow rates are listed in Table 3, Major Tributaries of the Mekong River.

3. THE GREAT LAKE:

The Great Lake of Cambodia is the largest water body found as part of the Mekong river system. The lake ranges in depths from 8-10m in the flooded season of May to October, and less than one meter in the dry season. During low water, the lake covers approximately 2500 km², while during the floods the lake area can be inundated to almost 11,000 km². The temperature of the lake ranges from 28-29°C on the surface and 26-28°C on the bottom. The water is extremely turbid, which has been attributed to shallowness coupled with wind turbulence. The pH of the lake is usually around 6.6-6.8 (Pantulu 1986b).

Flow:

The flow rates of rivers have an enormous impact on their geologic and biological contents. What the river can carry, from sediment to fish, is dependent on the annual flow rates. As Roberts writes: "Vitality of rivers depends on their natural hydropower. Hydropower performs a great deal of useful work in rivers. It is essential for natural stream flow characteristics, habitat maintenance, downstream transport of nutrients, aeration of water, build up of food chains, disposal of wastes, dispersal of stream organisms, completion of life histories. All riparian organisms in the Mekong basin (including rice farmers in the delta) depend on geomorphic and other service functions performed by naturally occurring hydropower, (Roberts 1995b).

Table 3. Major Tributaries of the Mekong River

Country	Tributary	Catchment Area	Average annual flow
Laos	Nam Tha	8,170	140
	Nam Ou	26,160	430
	Nam Suang	6,290	100
	Nam Khan	7,620	130
	Nam Ngum	17,600	760
	Nam Nhiep	4,690	240

	Nam Theum	14,700	890
	Se Bang Fai	9,470	410
	Se Bang Hieng	19,600	530
	Se Done	7,170	230
Thailand	Nam Mae Kok	10,800	210
	Nam Mae Ing	8,290	110
	Nam Loei	4,100	50
	Nam Songkhram	12,700	300
	Mun Chi	117,000	720
Cambodia/Laos	Se San (+ Sre Pok)	76,700	2,900
Cambodia	Tonle Sap	84,400	960
	Prek Te	4170	85
	Prek Chlong	5,750	90
	Prek Thnot	15,050	160

Source: Pantulu 1986a

Flow rate statistics for the Mekong at various measuring points are often widely divergent. Old statistics taken by the US Army Corps of Engineers do not match those of the Mekong Secretariat. Some of the uncertainty is due to divergence in measuring sites and methods. There is often wide natural variation in flow rates of the Mekong as well: "The wide seasonal variation in river flows and the considerable load of silt carried by rivers also create major design problems in constructing irrigation works" and this is particularly true of monsoon-fed rivers like the Mekong, which often has a very low dry season flow (Hill 1979). See Table 4, Flow Rate Averages for the Mekong River.

The mean annual discharge of the Mekong has been estimated at c. $475 \times 10^9 \text{m}^3$ annually, placing the Mekong sixth in the world among river system discharge rates (Pantulu 1986a). About 20 percent of the annual river flow comes from the Upper Basin (above the Thai-Lao border), around 70 percent of the flow is added by the Thai-Lao section of the river and the remaining 10 percent comes from the catchment areas south of the Khone Falls in Cambodia and Vietnam (Pantulu 1986a). The water from the upper Basin is usually added to the Mekong in the form of snowmelt, which usually produces uniform discharge, while the water added to the middle Mekong section in the Thai-Lao area is from rainfall, which creates pronounced seasonal variations, as shown in the table above. The Great Lake is the main effect on the mainstream flow in the lower delta.

The middle Mekong usually reaches its maximum crest during the monsoon season, around May or June, and the maximum crest hits the lower Mekong in September or October. River levels then fall off rapidly until December, and then slowly reach their lowest levels around April. There are no mainstream storage structures or dams on the Mekong to affect flow, and only a small number of tributary dams. Their effect on flow rates of the mainstream appear to be small so far.

Table. Flow Rate Averages for the Mekong River

Station	Drainage Area (km ²)	Discharge (m ³ each season)			Mean run off 10 ⁹ m ³ yr
		Maximum	Minimum	Average	
Chieng Saen 189,000	23,500 (in 1966)	543 (in 1969)	2,780	88	
Luang Prabang 1966)	268,000	25,200 (in	652 (in 1956)	3,820	120
Vientiane	299,000	26,000 (in 1966)	701 (in 1956)	4,600	240
Nakhon Phan	373,000	32,900 (in 1948)	915 (in 1969)	7,600	240
Mukdahan	391,000	36,500 (in 1978)	958 (in 1933)	8,170	258
Pakse	545,000	57,800 (in 1978)	1060 (in 1932)	10,200	322
Stung Treng	635,000	65,700 (in 1939)	934 (in 1937)	13,800	435
Kratie	646,000	66,700 (in 1939)	1250 (in 1960)	14,000	441
Phnom Penh	663,000	48,700 (in 1961)	1250 (in 1960)	13,100	413

Source: Pantulu 1986a

Chemical Content and Pollution:

The Mekong River tends to be generally soft, with Ca² and Mg² concentrations fairly uniform through the length of the river. The pH of the river hovers around 7.5. The water quality varies along the length. The river starts off fairly "clean," in that it is not influenced much by anthropogenic or natural pollution. This changes as the river flows downstream. Particularly in Northeast Thailand and the Mekong Delta, agricultural runoff and domestic wastes have reduced the quality of surface water for drinking. Industrial development of paper/pulp and sugar mills, particularly in Thailand, have also had impacts on water quality. There are also natural pollutants that rise and fall with rain and flow rates, such as acids from the acid sulfate soils found in the region as well as salinity from coastal inflows. There are also underlying salt deposits in much of the Korat Plateau in Thailand, and "the possible future institution of large-scale irrigated agricultural projects associated with dam construction and pumping may well result in altered water balance, leading to salt mobilization and salinization of soils unless timely and effective measures are implemented" (Pantulu 1986a).

The implications of pollution in the river are varied. While there are direct effects to river-living animals and plants, there are also indirect downstream effects. For example, "While a fast degradation of organic pollutants is possible, heavy metals and pesticides may accumulate in the mud of the estuary because of their cohesive nature" (Wolanski, Huan, et al. 1996). As a result, pollution from the upper Mekong may well be affecting agricultural productivity in the lower areas.

Petrochemical exploration in the South China Sea in particular also has impacts on the Mekong river system, as tidal action can easily wash oil slicks or other pollution upstream into the river. Recently, a decision was pronounced by the state of Vietnam to hold companies responsible for cleanup of pollution: "The Minister of Science, Technology and Environment, Chu Tuan Nha, has moved to protect the environment inside oil and gas industrial zones. Decision 395/1998/QD states that Viet Nam-based oil and gas companies will be held responsible for all cleanup costs and other pollution-related consequences in the event of environmental damage in their operating fields. Offenders will also be subject to heavy punishment." (Vietnam News Service 1998g)

One aspect of the chemical content of the river at the end of the Mekong's run is the question of salinity. When the Mekong hits the South China Sea, there is a mingling of the freshwaters of the river and the salty sea water. In the water plume at the mouths of the tributaries, salinity varies seasonally. From June-September, salinity is around 27-28 percent at the surface and 30-32 percent on the bottom. In November to February, salinities rise to 25-32 percent at the surface (Pantulu 1986b) "Surface salinity varies seasonally, being maximum in the low-flow season-and maximum in the high-flow season. In the low-flow season, the maximum at 21km up coast is 20 and at 45km it is 6. In the high-flow season, the water is fresh nearly up to the mouth of the main channels of the estuary" (Wolanski, Huan, et al. 1996). The Mekong thus differs from the Mississippi river, where the estuary has what is called a "salt wedge" (a layer of heavy saline water underlying fresh water) year round, while in the Mekong the salt wedge is only present in the high flow season (Wolanski, Huan, et al. 1996). Upriver dams would probably affect this saline/freshwater balance: "with decreased high-flows, the salt wedge will be replaced by partially well-mixed estuarine conditions within the estuary". (Wolanski, Huan, et al. 1996). The implication is that organisms living in the estuary that prefer fresh water will be adversely effected.

In addition to the presence of salt wedges in the estuaries, another important aspect of saline intrusion is the degree to which salt water is able to travel up the Mekong River. The extent of saline intrusion in the Mekong from the South China sea varies with the season. During the dry season, the salt water slowly starts to creep up the Mekong river and tributaries, often reaching several 10s of km inland. The sea water also mixed with groundwater in the area. The maximum value recorded during studies in the 60s by the Mekong Committee showed 35.096 grams per liter salt concentration in one stretch of the river not far from the coast, which is practically the salinity of the sea. Other maximum salinity ranges (measured in 1964-65) included 14.6 gms at Can Tho, 31.5 at Phung Hiep, 28.6 at Rach Gia, 12.4 at My Tho, and 3.5 at Ben Luc (Committee for Coordination of Investigations of the Lower Mekong Basin 1967). Changes in the flow rates of the river will have an effect on how far inland salinity intrusion will occur in the future (Wolanski, Nhan, et al. 1998). See Figure 6, Map of Saline Intrusions.

Sediment loads:

Total sediment loads in most areas of the river are not well documented and more precise data is needed. Some estimates by the Mekong Secretariat have run from 90-100 million metric tons of sediment reaching the South China Sea each year (Pantulu 1986a) while others have estimated the figure could be as high as 300 million metric tons (Rothart 1995). The table below gives some rough comparisons for major river systems. See Table 5, Sediment Loads Deposited by Various River Systems.

Table 5. Sediment Loads* posited by Various River Systems

River	Drainage Basin area (km ²)	Sediment load (10 ⁶ tons/year)	Sediment yield (tons per km ² /year)

Yangtze	1,900,000	480	252
Amazon	6,100,000	1200	190
Mississippi	3,300,000	210	120
Ganges	1,480,000	2180	1670
Mekong	790,000	170	2715

*(Sediment load is how much sediment the river carries; sediment yield is the sediment deposited on land each year.)

Source: Wolanski, Huan, et al. 1996

The suspended sediment found in the lower zones of the Mekong river tends to be fine silt, with little clay content, and the composition of the sediment is similar to those found in organic-rich rivers elsewhere in the world (Wolanski, Huan, et al. 1996). One of the few studies to look at sediment flows in the Mekong found that in the high flow season, the bulk of the fine sediments is silty and carried down right through the freshwater region of the estuary. Most of this is deposited within 20 km of the coast. During the high flow season, approximately 5 percent of that sediment is forced back up the river with saline intrusions. And in the low flow season, even more sediment is probably washed backwards up the Mekong. This contrasts with rivers like the Amazon and Mississippi, where sediment load is unidirectional downstream away from the estuary, and the Zaire and Ganges rivers, where sediment sinks immediately into a deep ocean canyon beyond the mouth of the rivers (Wolanski, Huan, et al. 1996).

Additionally, the Tonle Sap lake has been accumulating siltation from mining and forest cover removal in the Northwest of Cambodia. The Fisheries Department estimates that the siltation rates have risen from 20 nun to 40 mm per year since the 1960s, and the northwestern area of the Great Lake has shrunk from 40 to 35 km in width as a result of excess siltation (World Bank 1994a). The result of the increasing shallowness of lake waters is a raising of average water temperatures with unknown effects on the biological content of the lake.

Floods:

There are several different types of floods on the various stretches of the Mekong. Upstream in the upper Mekong, floods are usually caused by excess precipitation and rarely last more than a few hours or days. In the middle Mekong, primarily in Laos, floods are caused by overflows of the river banks due to upstream rain or snow melts, and can last up to a month. Floods in the lower delta are influenced by the Great Lake of Cambodia and the influx of sea water into the river in the delta mouth. Floods in the lower Mekong can last between 2-6 months, with 12-14 million ha. of land in the lower basin inundated each year (Daming 1995).

The immense impact of the floods on the Mekong system is vividly described by Pantulu: "Water levels are lowest in April-May, when many water bodies and inundation zones are isolated. Small tributaries tend to dry out and the countryside presents a dry appearance. From June through October, the monsoons transform the region into a sheet of muddy water. Rivers, tributaries and numerous small ponds, oxbows and ditches are engulfed and current velocities increase rapidly, both in the tributaries and in the mainstream, until about July-August. From then on, while current velocities of the mainstream remain high (until October-November), those of the tributaries decline sharply because of back-water effects from the mainstream As well as these changes, water temperature, turbidity and hardness

increase, while pH decreases sharply with the onset of floods" (Pantulu 1986b).

The effects of these floods on life in the Mekong basin are varied. Although the floods are rarely predictable in the seasons in which they occur, total levels of flooding are difficult to predict. As a result, preparations are made each year to counter the effects of each year's flood on local populations. Current preparations for this year's flood season are under way in Vietnam, according to newspaper reports:

About 1,016 prefabricated houses worth VND 11 billion (US\$845,000) have been set up in six flood-prone Cuu Long (Mekong) Delta provinces in the first six months of this year. The Cuu Long House Trading and Developing Company under the Ministry of Construction has designed five models of these houses, all made from light-weight materials, which are suitable for use in the provinces of Dong Thap, Can Tho, Bac Lieu, Ca Mau, Tra Vinh and Soc Trang. The company plans to produce 4,850 such structures to sell at low prices under contract with nine provinces in the Mekong Delta. Although the Cuu Long is the country's "rice basket" with annual per-capita food production reaching 1,700 kg of paddy, it has only 30-35 per cent of the region's semipermanent and permanent houses. The other 60-65 per cent of the houses remain in poor condition. In addition, local residents living in poorer quality housing have to cope with months of flooding each year. Solving housing problems in the Delta will provide local people with accommodations which are stable, comfortable and appropriate for their customs and environment. It will also contribute to building a civilized lifestyle for everyone in the region. Meanwhile, the province of An Giang has set up a plan to ensure that 34,600 households can live with floods. The province has invested VND 11 billion (US\$845,000) in constructing housing to sell to its citizens. In addition, the provincial Agricultural Bank has loaned VND 395.826 billion (\$30.5 million) to over 88,000 households to upgrade foundations and set up foundations on stilts. As a result, about 100,000 households can expect to overcome the difficulties of this flood season. (Vietnam News Service 1998e)

In addition to helping people cope with the localized effects of flooding, plans have been floated to control the entire Mekong flooding regime through dams and impoundments upstream. However, managing the Mekong floods would be enormously difficult. The Mekong Committee Secretariat described in 1988 the problems encountered by Mekong flooding: "In broad terms, about half the delta is subject to flooding during the rainy season for 4-6 months and only low-yielding floating rice can be cultivated. Floods are relatively regular and gentle, and people have tuned their lives and agricultural practices to them... More productive rice varieties can only be cultivated if and where flooding is sufficiently reduced, but complete regulation of the flood flows by mainstream and tributary reservoirs is not a realistic perspective" (quoted in (Jacobs 1996). At the same time, these floods are a necessary part of the ecological cycle for such communities in the Plain of Reeds and the fisheries of the Great Lake, and changes in flood regimes would affect these significant biological communities.

A flood forecasting system was begun in the Mekong basin in the 1960s on the recommendation of the Mekong Secretariat. A huge flood in 1966 led to further calls for dams on the Mekong to control flooding. The Mekong Committee Annual Report of 1966 says, "The devastating flood of the Mekong River which occurred in September 1966 served to emphasize the need for flood protection and control... while effective flood control cannot be achieved for several years, reliance must be placed on the establishment of an effective flood warning system" (Jacobs 1995). Pa Mong and Stung Treng are the two proposed mainstream dams that would probably have the most serious effect on floods in the lower delta. Both dams could significantly alter flow rates and flooding regimes. For example, upstream storage reservoirs could increase the low flow during the dry season by 1,000 to

2,500 m³/sec, and have similar effects on holding back flow during the rainy season. Some reports have speculated that these sorts of flood control measures " would facilitate an increase in the irrigated area during the dry season and to restrict the salt water intrusion" (Volker 1993) while other reports disagree that flood control will lead to more saline intrusions and environmental damage (Wolanski, Nhan, et al. 1998). However, no mainstream Mekong darn has yet been built for flood control.

Tides:

Tides are important in understanding the hydrology of the delta where the Mekong River meets the South China Sea. The intrusion of salt water into the Mekong is influenced by tidal action from the Sea and from the neighboring Gulf of Thailand: "Both the vertical astronomical tides (variation in the elevation of the water level) and the horizontal tides (variations in the velocity and the direction of the current) penetrate from the sea into the estuaries and river branches. When the water at sea rises, considerable volumes of water flow into the estuaries and inlets to fill the tidal storage area and when the water falls this water returns to sea again together with the upland flow. Therefore the discharge in a river section varies from minute to minute. The direction of the flow usually changes four times a day... In the Mekong delta there is fairly strong influence of the diurnal tide. The tide may be characterized as mixed with a strong diurnal influence" (CCILMB 1967). Tides can influence many estuarine processes, such as the extent of saline intrusion, the influx of sand into river channels, the dispersal of silty sediment, and amount of coastal wear from tide action.

On the South China Sea coast in the east of the Mekong delta, the tide is semi-diurnal with an average amplitude of 3.5-4.5m; on the Gulf of Thailand coast in the west of the delta, the tide is diurnal with a lower amplitude of 0.5-0.8m. "The gradient of the two tidal amplitudes creates a current which moves in one direction from the east to the west, causing erosion on the east coast and sediment deposition on the west coast" (Binh, Phillips, et al. 1997) The Ca Mau peninsula is most affected by this dual tidal action. For example, mangroves, which often prefer semi-diurnal tides, are smaller in area on the northwest coast of Ca Mau than elsewhere in the delta, probably because of the tidal actions (Phan Nguyen Hong and Hoang Thi San 1993)

Water Use in Lower Basin:

The hydrology of the lower basin is influenced not only by the natural factors of flooding and climate, but also by human water uses (Volker 1993). Documentation of this area is scanty. The table below indicates some general water use statistics for Vietnam, but no comparable information is available for Cambodia. Generally all we know is that in Cambodia, extensive and ineffective dams and canals were built under the direction of the Khmer Rouge in order to irrigate rice fields (Sluiter 1992). Many of these wasted water and were abandoned. Current totals of water use in Cambodia are thus difficult come by. See Table 6, Water Use in Vietnam.

Table 6. Water Use in Vietnam by Region 1995, in 10 million m³:

Region	Water use for agriculture	Water use for Industry
Mekong Delta	21,086.7	1,472.1
Red River Delta	7,516.9	2,736.3
Vietnam Total	53,453.0	7,828.3

Source: Pham Xuan Su 1996

More information on water use for agriculture, settlement and urban areas, and for industry in the lower Mekong is very much needed, such as studies like Tingsanchali and Singh (1996),

Groundwater:

The information on groundwater availability and use in the lower Mekong basin is almost non-existent. There are only a handful of studies on this important topic (Michael 1971; Nguyen Kim Cuong 1986; Pham 1987). The use of pumps to bring up groundwater for drinking and irrigation in much of the Vietnamese delta raises questions of accurate monitoring systems for groundwater pollution. Additionally, saline intrusions are a very real problem for groundwater uses in coastal areas. A few monitoring programs have been set up in the Delta (Thanunongkol 1992; Nguyen Kim Cuong 1996) but research in this area is still inconclusive.

4. SOILS

Although the Mekong delta region is one of the most densely populated and agriculturally productive regions of mainland Southeast Asia, it suffers from problem soils. For example, around 1.7-2.1 million ha of soil are affected by salinity intrusion, 1 million are acidic sulfate soils, and waterlogged soils due to poor drainage affect 1 - 1.2 million ha (Mekong Secretariat in (Jacobs 1995)). As a result of these problems, there have been quite a few major studies on soils of the delta (Vietnam 1959; Moormann 1960; Post and Sloane 1971; Kyuma 1976; Fan 1989; Brinkman, Ve, et al. 1993; Nguyen Huu Chiem 1993; Gustafsson and Nguyen Thanh Tin 1994; Lieu 1994; Quang, Dufey, et al 1995; Kashanskii, Bagdasaryan et al. 1996; Shishov, Chizhikova, et al. 1996; Quang, Thal et al. 1996; Minh, Tuong et al. 1997a; Minh, Tuong, et al. 1997b; Minh, Tuong, et al. 1998). Some of the major findings of these studies and their implications for land use in the lower Mekong are discussed in the sections below.

The soils of the lower Mekong have been classified by Pantulu (1986a) as falling into eight categories, four lowland soils and four upland soils. The lowland soils are found in the Korat Plateau of Thailand and the Mekong Delta; the upland soils are found in the ridges ringing Laos and northern Thailand, and the southern fringe of Cambodia. The lowland soils can be classified as:

Coastal complex soils: These are the clayey, low organic matter soils of the delta coast. They are usually acidic, and often saline as well.

Delta soils: These are clayey soils with varying organic matter content. They are often subject to extreme acidity and toxicity when drained. "Although limited paddy development is possibly, water control and irrigation, whereby acid conditions can be minimized or even eliminated, are necessary before they reach their full potential (Pantulu 1986a).

Floodplain soils: These are clayey soils with slight acidity and moderate fertility caused by their origin as alluvial sediments. The higher flood plain soils are well-suited to dry crops (maize and cassava) and the lower soils are suited to paddy development.

Groundwater complex soils: This are silty and loamy soils with low clay content and organic matter, and low pH. They are suited to paddy use but often require draining or fertilizers.

These soils are mostly found on the Korat Plateau.

In the upland areas of the lower Basin, the four soil types are:

Podzols: These are low in both clay and organic matter and have low water retention capacity. They are often good crop soils with added fertilizers.

Red and black soils: These are rich loamy soils well suited to rain-fed agriculture in the uplands.

Lateritic: These are the soils found in the upland of the Korat Plateau and Mekong Plain, and are generally poor field crop soils. They are characterized by laterite at shallow depths.

Mountain soils: These are shallow upland soils derived from sandstones and acid igneous rocks. Agricultural potential is limited.

There have been several in-depth studies of the soils of the Delta, the ones Pantulu describes as coastal complex or delta soils (see (Post and Sloane 1971; Brinkman, Ve, et al. 1993; Gustafsson and Nguyen Thanh Tin 1994; Lieu 1994; Quang, Thai, et al. 1996; Minh, Tuong et al. 1998). Because it is these soils that support the largest populations in the lower Mekong basin, their properties are reviewed in depth in the next few sections.

Mechanical Properties of the Delta Soils:

In a 1976 study of paddy soils in the delta, mean averages of sand, silt and clay contents were taken. The results for the Mekong Delta of Vietnam are compared with soil samples from Cambodia and Thailand taken from other studies. The results are as follows in Table 7.

The table indicates that the soils of the Vietnamese delta contain an above-average percentage of heavy clays for the region. This is confirmed by several other field studies of the Vietnamese delta (Post and Sloane 1971; Shishov, Chizhikova, et al. 1996; Wolanski Huan, et al. 1996). Thailand tends toward the opposite end of spectrum; the northeastern area of Thailand along the Mekong is notoriously sandy. In sandy soils like this, rice can only be transplanted after considerable rain has fallen, and in areas where the sandy layer of soil reaches lower than 50-60 cm, paddies can rarely be found. This is because there is no lower permeable layer that can retain moisture for plants (Moorman and Van Breeman 1978).

Table 7. Mechanical Composition of Soil by Country (numbers given in %)

Country	No. of samples	Sand (mean)	Silt (mean)	Clay (mean)
Vietnam	49	9.4	34.6	56.0
Cambodia	16	33.9	31.4	34.7
Thailand	80	38.2	25.2	36.7
Tropical Asia	410	33.9	27.7	138.4

Source: Kyuma 1976

In terms of organic matter, the soils of the Vietnamese delta have a high average for tropical Asia. In terms of percentage of total organic carbon by percentage in air-dried soil Vietnam's delta soils averaged 2.49 percent. This is quite high compared to other soils, as seen in the

table below. Cambodia and Thailand tend to have lower organic carbon contents because of the drier climate and higher temperatures. See Table 8, Percentage of Total Organic Carbon in Air-dried Soil Samples.

Table 8. Percentage of Total Organic Carbon in Air-dried Soil Samples

Country	No. of Samples	Mean % of TOC	Standard Dev.
Vietnam	49	2.49	1.76
Cambodia	16	1.21	0.50
Thailand	80	11.05	0.67
Tropical Asia	410	11.41	1.28

Source: Kyuma 1976

Despite the high levels of organic carbon, the sods are not particularly fertile in many areas, as evidenced by high acidity and other problems with the chemical properties of the soils, as discussed below.

Chemical Properties:

In the 1976 soil survey by Kyuma, the soil samples taken from 49 sites in the Vietnamese Mekong Delta were analyzed for chemical contents. The results are in Table 9, Chemical Composition of Vietnamese Delta Soils.

The following observations can be made about table 9:

- ε Among the three major elements (SiO_2 , Al_2O_3 and Fe_2O_3), alumina content is high because of the clayey nature of the soils
- ε MgO content is moderate and K_2O content is high, reflecting the brackish and marine origins of many of the soils.
- ε Compared with other soils of mainland southeast Asia, the contents of CaO, MnO_2 and P_2O_5 are low, and indicate depleted mineral contents of the sods.
- ε Standard deviations for the soil samples were low, indicating some homogeneity of the Mekong delta soils (Kyuma 1976)

Table 9. Chemical Composition of Vietnamese Delta Soils

Chemical molecule	Mean of Samples	Standard Deviation
SiO_2	67.27	6.29
Fe_2O_3	5.72	2.22
Al_2O_3	21.79	4.66

CaO	0.26	0.14
MgO	1.01	0.29
MnO ₂	0.05	0.03
TiO ₂	1.15	0.21
K ₂ O	2.70	0.50
P ₂ O ₅	0.06	0.02

Source: Kyuma 1976

pH:

The soil pH of Mekong delta soils is "remarkably low" (Kyuma 1976), ranging from 3.8 to 5.5 for plow layer soils. The overall mean of 4.5 for the delta is among the lowest in mainland southeast Asian countries. The soil pH levels of various countries are measured below in Table 10, pH levels by County in Mekong Basin.

Table 10. pH Levels by County in Mekong Basin

Country	No. Samples	Mean pH	Standard Dev.
Vietnam	49	4.5	0.3
Cambodia	16	5.2	0.8
Thailand	80	5.2	0.6
Tropical Asia	80	5.8	0.3

Source: Kyuma 1976

The implications of this are that the Vietnamese soils are more potentially acidic than in many other areas (Shishov, Chizhikova, et al. 1996). As a result, they are vulnerable to increased acidity, which can result from land clearances or changes in water percolation through the soil (Lieu 1994).

Other chemical properties of the soils of the delta are listed in the Tables 11, 12, and 13.

Table 11. Nitrogen Content of Soil Sample in Mekong Basin

Country	No. of Samples	Mean % of N	Standard Deviat.
Vietnam	49	0.20	0.11
Cambodia	16	0.10	0.07
Thailand	80	0.09	0.06
Tropical Asia	410	0.13	0.11

Source: Kyuma 1976

Table 12. Carbon/Nitrogen Ratios

Country	No. of Samples	Mean % of Ratio	Standard Deviat
Vietnam	49	11.9	2.4
Cambodia	16	10.7	1.8
Thailand	180	11.3	2.9
Tropical Asia	80	11.2	2.7

Source: Kyuma 1976

Table 13. Cation Exchange Capacity

Country	No. of Samples	Mean CEC in me/100g air-dry soil	Standard Deviat
Vietnam	49	18.8	4.2
Cambodia	16	14.6	10.4
Thailand	80	14.4	10.5
Tropical Asia	410	18.6	12.0

Source: Kyuma 1976

The implications of the above tables are as follows. In spite of the high organic matter content discussed earlier, in actuality, the amount of mineralizable nitrogen in these soils is not high, and the mean for the Mekong delta soils is 7.7mg/100g of soil which is below the overall mean for tropical Asian paddy soils of 8.5mg/100g (Kyuma 1976). Within the delta, the high tidal flats have particularly low mean percentages of ammonification, at 2.3 percent (Kyuma 1976). This means the addition of N is necessary in many agricultural practices, from rice production to aquaculture (Kashanskii, Bagdasaryan, et al 1996). The total phosphorus content of Mekong delta soils is 76.4 mg P₂O₅/100g which is lower than the mean for most tropical Asian paddy soils. The soils in the levee areas and flood plains of the delta have higher P₂O₅, while those in the high and low tidal flats are poor in phosphorus (Kyuma 1976). Again, additions of this element are needed for many agricultural crops (Quang, Thai et al 1996).

Acid soils:

Many of the soils in the delta are extremely acidic. Acid sulfate soils form when soils containing iron sulfide are exposed to oxygen. Iron sulfide is found in deltaic areas where rising sea levels have flooded estuaries, but does not usually become a problem so long as the soil remains inundated (Brinkman, Ve, et al. 1993). In the Mekong Delta in particular, the deposition of pyritic sediments from upstream has "led to ... extensive areas with acid sulfate soils underlain by a thick deposit of potentially acid clay in the inland parts of the deltas" (Moormann and Van Breernan 1978) The pyritic substratum in the Mekong delta is often within 1 m of the surface. Some subsoil samples in the Mekong Delta showed pH

levels lower than 3.0 and contained sulfur in amounts exceeding 4000 ppm (Kyuma 1976). Acid soils are particularly notorious in the Plain of Reeds and in parts of the Ca Mau peninsula under the U Minh forest. Draining these soils results in a concentration of acid sulfur in the soil as well as the transfer of acidity to canal waters (Hanhart, Duong Van Ni, et al. 1997). This is a common problem in reclaiming soils from the Plain of Reeds for rice production, for example (Tin and Wilander 1995). Acidic soils can be reclaimed by improved drainage and leaching out of the ac, City, but this does take some time and effort (Gustafsson and Nguyen Thanh Tin 1994; Minh Tuong, et al. 1997b).

High levels of dissolved aluminum are also common in delta soils, including up to 10-70mg/liter in floodwater in the Plain of Reeds. [Aluminum is toxic to rice seedlings if the aluminum concentration exceeds 1 to 2 mg/liter] (Moormam and Van Breeman 1978). Flooding these soils will reduce the aluminum concentrations, so that preflooding and late transplanting can result in suitable sod conditions for rice. However, the water runoff from these areas can also contain high levels of aluminum (Minh, Tuong, et al. 1998).

Salinity:

Salinity in soils in the Mekong Delta results mainly from vegetation clearance and irrigation schemes, especially in areas where evaporation exceeds rainfall for much of the year (Wolanski, Nhan, et al 1998). The underlying bedrock and soil may also contain salt, as may groundwater stores. Current salinity intrusion into the Delta can be as far as 100 km from the coast in areas of Minh Hai district. In other coastal provinces the saline intrusions extend 50 km or more. A more average level is about 10 km from the coast (Wolanski, Huan, et al. 1996).

The implication for sake soil use is that the salinity must be flushed out of the system for many crops to grow adequately. "In all paddy fields affected by salinity, the amount of rainfall and its distribution will alter the salt injury pattern from year to year, or even within a season... In a year with copious, well-distributed rain, injury may be minimal but in other years crops may suffer when there is not enough rainwater or irrigation water to suppress salinity in the root zone during the critical stages of plant growth" (Moormann and Breeman 1978) Any change in flushing or flow of canal and river water will impact the ability of soils to resist this salinization. Salinity also tends to happen with extreme micro-variability, leading to difficulty in predicting region-wide effects; a higher level spot in a field may be adversely sake, or bunds along paddy fields may be sake, while the surrounding areas are not.

Because the major crop of the saline soils of the Mekong delta is rice, it is necessary to understand how salinity affects rice plants. "The major reason that rice is grown on saline land, where virtually no other crop will grow, is the aquatic nature of the crop. Rice will grow on land that is highly saline when dry, provided the soil can be flooded with low-salinity water. Floodwater dissolves and dilutes the salt in the surface soil layers, and drainage and percolation induced by ponding remove part of the salt from the rice plant's shallow root zone," (Moormann and Breeman 1978). This flushing works well in non-tidal areas where salinity is caused by evaporation and interflow, but in tidal areas, salinity returns in the dry season after flushing. This means that in much of Vietnam, "surface salt accumulates in the dry season. Water ponded in the paddies during the early rainy season is commonly drained to evacuate the salt, and rice is transplanted only after later rains fill the paddies" (Moormann and Breeman 1978). Rice tolerance to salinity is usually a factor of when the land is saline (young seedlings are more intolerant), the variety of rice grown, and the water and light regimes accompanying saline soils (rice plants are more saline susceptible at higher light intensity and lower relative humidity) (Moormann and Breeman 1978).

Salinity is also found in many of the soils of Northeast Thailand. This is due to the presence

of saltrock under the soil surface. "Seasonally high rainfall promotes the transfer of salts from the weathering zones to spring levels in valleys and along foot slopes... suppression of salinity by ponding good quality rain and irrigation water in the bottom lands of valleys leads to a distribution of salt-affected lands in rice-growing areas" (Moormann and Breeman 1978). The effects of salinity rising to the surface in Thai fields has been remarkable: "In northeastern Thailand, the higher parts of the landscape are mainly in shifting cultivation while in a score of places, people gather salt from the saline zone above the paddy fields. The transition between salt-affected zones in lower slopes and nonsaline paddy fields below is remarkably sharp. Often, the outside of the paddy bund bordering a saline zone may show salt efflorescence at the surface, while the inside of the bund is not or is only slightly saline... Aggravation of interflow salinity and, indirectly, of groundwater salinity in the depressions is influenced by the land-use pattern on the nonsaline dryland soils bordering the valleys and depressions where such salinity occurs. Where these drylands are under a natural bush or forest vegetation, or under a balanced shifting cultivation pattern in which woody species can regenerate, interflow is limited because tree roots intercept much of the water percolating in the rainy season. When the catchment areas are completely cleared, interflow increases and the water table in depressions may increase concurrently. This can lead to a local worsening of lower-slope salinity" (Moormann and Breenman 1978).

Measures to control salinity include retaining proper seasonal flushing regimes. Reclamation measures such as diking to prevent seawater intrusion are not recommended for much of the Mekong delta, because strongly acid soils often result when the natural flushing actions of water are changed. And in many cases, saline soils may be preferable to the extremely acid soils that may replace them. Additionally, retaining many saline-resistant native plant species, such as *Melaleuca* trees, on saline soils will help curb the spread of salinity (Brinkman and Vo Tung Xuan 1991).

Siltation:

The siltation brought by major river systems is one reason why estuarine systems are often so rich for agriculture. The continual deposition of new topsoil materials is a natural way to add fertility and plasticity to the soil. However, the exact benefit of Mekong siltation on downstream delta farms has not been adequately documented (Kyuma 1976) Assuming that the sediment deposited each year by siltation is 1 mm thick, the nutrient elements supplied by the silt would be small compared with the elements contained in the top 10 cm of soil. However, in one soil sample site, a 60 year old canal appeared to have deposited upper sediment of around 30 cm thickness into a paddy field. "As a result, the surface materials have a relatively high amount of exchangeable CA and available phosphorous and contains no detectable amount of sulfur, whereas the subsoil is more depleted and contains about 100 ppm of total sulfur" (Kyuma 1976). This indicates anecdotally the need for silt from the river systems, but more information is needed on the rates and types of siltation.

The implications of up river development on siltation, based on results from large dams in other areas, are clear. For example, the Hoa Binh dam in northern Vietnam has experienced serious siltation in recent years, leading to less topsoil silt traveling down the Da River for the benefit of Red Rive - Delta rice farmers. As one report has noted, "The regularization of the discharge of the Mekong River following the construction of large, proposed hydroelectric dams further upstream in Cambodia, Laos and Thailand, may have significant effects on the Mekong River estuary. In particular, with decreased peak discharges, less riverine sediment will be exported to the sea during the high-flow season" (although the author goes on to note that old riverine sediment in the coastal zones will probably continue to add silt to the estuary even with the loss of new silt (Wolanski, Huan, et al. 1996)).

In addition to the positive effects of adding nutrients and soil during siltations, there are also negative affects. In addition to upland areas losing topsoil nutrients, excess siltation can

damage fisheries and certain aquatic communities. For example, the depth of the Tonle Sap lake is being reduced because of excessive siltation. Therefore, the same volume of water now covers a larger surface area aggravating flooding.

Discussion:

There are several major points to glean from the literature on soils in the Mekong delta. Less information is known about the soils of the Cambodian plains, so less generalization can be made about them. But in general:

- ε The soils of the delta have fine-textured materials with low base status.
- ε The fertility status of the soils for paddy rice cultivation is characterized by moderate inherent potentiality, high organic matter status, and low available phosphorus.
- ε The moderate potentiality is supported by the fine-textured soils, which compensate for the quality of the clay and organic matter to result in fair nutrient holding capacity. But base status is low, especially exchangeable Ca, which results in a low pH.
- ε High organic matter status does not necessarily guarantee a high nitrogen supplying power, because of poor quality of the organic matter and a low ammonification percentage.
- ε Low available phosphorous is commonplace in the delta soils. Acid sulfate soils are common in the delta.
- ε The potential of the delta soils as a medium for non-rice upland crop cultivation (maize, cassava, etc). is low. The high groundwater levels for part of the year is the greatest limitation. The heavy clays pose difficulty for land preparation and for crop germination. The low pH and low calcium and phosphorous contents would prevent many upland crops from flourishing, as would the slight salinity in some delta soils in the tidal flats (Kyuma 1976).

As a result, there are problems with thinking about expanding agriculture, especially rainfed rice and upland crops, in certain areas of the delta. As Kyuma writes, "In comparison with the paddy soil materials of other countries in tropical Asia, these of the Mekong delta are generally considered moderate in their potential capability as paddy soils, as revealed by the dominance of Class III material. But if they were to be used as a median for upland crop cultivation, the heavy texture and low CaO and P₂O₅ contents would set certain difficulties" (Kyuma 1976)

However, these generalizations should be taken with a caveat. As a Dutch scientist working with Can Tho university on Delta soils was quoted as saying, "Delta soils show great differences over a small distance. High acidity in one spot may have disappeared fifty meters further on, depending on local conditions of water, land elevation, type of vegetation. Dealing with delta soils means looking at details and listening to farmers. They know the land best and have often found clever methods to grow crops where nothing seemed possible." (Sluiter 1992)

5. AQUATIC COMMUNITIES

A recent report on Asian freshwater biodiversity bemoaned the lack of attention to rivine

systems in biodiversity studies. The report noted that "in comparison with terrestrial systems, freshwater systems have been neglected in biodiversity studies but they are affected by a wider range of development projects than probably any other system Dams, flood control supplying water, mining, fisheries management, introduction of exotic species, irrigation, bridges, industrial and domestic water, waterway modification for navigational and other purposes, and forest clearance all have the potential to affect adversely natural freshwater system" (Kottelat and Whitten 1996) However, studies on the Mekong in particular have usually- made note of the extremely biologically diverse species found there: "The waters of the Lower Mekong Basin are among the most biologically productive of all such systems on earth — favored by a tremendous faunal diversity, a warm climate, abundant monsoonal rainfall, extensive seasonally inundated areas that serve as fish spawning and nursery areas, and a fertile brackish-water estuarine area" (1976 study commission by the Mekong Secretariat quoted in Sluiter (1992).

To compare the Mekong with other river systems, a scientist who participated in the above quoted Mekong Commission study said that the Mekong has the richest river fauna of Asia, and in the entire world it is surpassed only by the Amazon and Zaire rivers (Sluiter 1992). Well over 1000 species of fish have been identified in the basin. To people living in the area about 150 fish are well known and caught. "People also collect food other than fish from the rivers and wetlands, such as edible plants and algae, shrimp, crab, snails, clams, mussels, frogs, insects and snakes" (Sluiter 1992)

However, little concrete information is known about the aquatic communities of the three main water areas of the Mekong basin. What is known about these communities is usually confined to knowledge of particular fish species, often those of economic importance (Dudgeon 1992). The Lower Mekong has a wide diversity of habitats for fish, which "confuses any faunal zonation that may be present. In addition, most tropical fish have relatively broad environmental tolerances and range across almost all freshwater habitat-types. Furthermore, annual floods inundate large areas, establishing temporary connections between various water bodies that otherwise remain isolated during the dry season" (Pantulu 1986b). In general, however, the habitats of fish in the Mekong area can be divided into:

- ε rivers, including tributaries
- ε natural lakes and swamps
- ε man made lakes
- ε rice fields, irrigation and draining systems
- ε ponds
- ε the delta estuarine zone
- ε the coastal and inshore areas

(Source: Pantulu 1986b).

Pantulu discusses the fish communities in each of these habitats along the Mekong, and the implications of change in this system on fish numbers. For example, of the 700km stretch of the Middle Mekong through Laos and Thailand, much of it is turbid with suspended lateritic sediment (giving the river its rusty color), but physical and chemical conditions fluctuate seasonally: "Temperatures exhibit wide diurnal fluctuations which are most pronounced in

the tributaries; the waters are always warm with cooling most perceptible after heavy rains and in the early morning. A thermal structure such as this is favorable to biological production" (Pantulu 1986b). The mainstream fish habitats range from sand bars to deep pools to rocky rapids.

The catch of fish in the dry season in the mainstream is usually dominated by carp (Cyprinidae) at 54 percent of fish caught; catfish (*Siluridae*, *Clariidae*, *Shilbedae*, *Begridae*, *Sisoridae*, and *Akysidae*) at 19 percent of the catch, and murrels (*Chanidae* and *Ophicephalidae*) at 8 percent. The remaining 19 percent often includes species such as featherbacks (*Notopteridae*), herring (*Clupeidae*), perch and gouramis (*Anabantidae*) among other groups of fish. Pantulu says, "Although proportions may vary seasonally, they are remarkably similar annually, and all groups exhibit wide tolerances to seasonal fluctuations. Almost every available tropic niche is exploited, including planktivory (mostly Cyprinidae and Clupeidae), detritivory (principally some catfishes and Anabantidae), a wide variety of predators (murrels and some catfish) and a large number of opportunists" (Pantulu 1986b).

One important aspect of fisheries in the Mekong is the long distance movement of many of the fish. This is however poorly understood. There are the diadromous fish who travel from marine to estuarine/freshwater systems and back, such as the threadfins, perch, catfish (*Arius spp.*), and herring. There are also the channel migrants (potamodromous species) who move up and down the river and occasionally enter tributaries; these include the giant catfish *Pangasianodon gigas*, other *Pangasius spp.*, and the freshwater prawn *Macrobrachium rosenbergii* (Pantulu 1986b). For example, the giant catfish has a migration range of several thousand kilometers, and starts up-river migration after the floods have ended. It begins from around the Tonle Sap and reaches up to Luang Prabang in Laos. It then continues to move upriver to spawn in lakes in Yunnan province in China. The freshwater shrimp *Macrobrachium* has an equally impressive migration range. Adults live in the freshwater areas of the Mekong, including paddy fields and irrigation ditches. The shrimps migrate toward the estuary of the delta to spawn in saline (11- 16 percent) water. After 2-6 months in the estuary, the juveniles migrate back to the freshwaters, up to 200 km away (Pantulu 1986b). Roberts has added to this list of potamodromous species of importance several species of long distance migrating fish common in wildcapture fisheries, including the carps *Bangana behri*, *Cirrhinus microlepis*, *Gyrinocheilus spp.*, *Laboo pierrei*, *Probarbus jullienti* and *Scaphognathops bandanensis*; the catfish *Pangasius conchophilus*; and the sciaenid *Boesemania microlepis*. "None of these species is likely to survive in reservoirs or head ponds created by mainstream dam" says (Roberts 1995b). He adds that "Especially hard hit will be the true eel *Anguilla marmorata*. Adults live in high gradient mountain tributaries but must return to the sea to reproduce. Mainstream dams would block the downstream reproductive migration of adults as well as the upstream migration of young eel" (Roberts 1995b).

Another important aspect of Mekong fisheries is the annual flooding regime. Sluiter vividly describes life for fish communities during these floods: "In the life of the Mekong fish a special role is played by 'the pulse of the river' the annual rising and receding floods. Just after the peak of the rainy season in September, the Mekong floods its banks and spreads over thousands of square kilometers of Isan [Thailand]. The river also backs up into the tributaries that by this time are brimming with the rains. They flood their banks as well, adding to the area under water. In the thin sheet of water that covers the land nutrients are released from the soil, vegetation decomposes, aquatic plants and algae multiply. All food, not only for fish but also for the insects and worms that are eaten by carnivorous fish." (Sluiter 1992) The importance of flooding for fisheries along the Mekong cannot be overemphasized. As Pantulu points out, "Annual flooding dominates the fisheries production of the Mekong, inundating soil and vegetation and introducing millions of tonnes of suspended and dissolved solids to the system. These changes stimulate an explosive annual reproductive outburst. In the Mekong Delta, sediments are deposited on brackish

water fields and swamps and the Mekong plume eventually enters the South China Sea. This annual nutrient, sediment and freshwater pulse maintains the brackish and estuarine zones in a vibrant state" (Pantulu 1986b). During the flooding season, detrital fish like catfish and son-w carnivores dominate the fish productions of the flooded areas, The mainstream carp and most catfish also use the flooding regimes inundation zones for spawning and rearing young between July-September, and "considerable lateral migrations (rather than up- or downstream) occur" (Pantulu 1986b). Species with low oxygen requirements may stay in the inundation zones for long periods, while those with higher requirements may spawn and quickly move out. "The timing of the floods and their duration is critical: rapid flood recession (low rainfall) will strand and desiccate large numbers of eggs and hatchlings, while prolonged flooding may also cause large-scale mortality of fry and fingerlings because of deoxygenation and drastic pH changes" (Pantulu 1986b).

Flooding is especially important in the Great Lake of Cambodia, which is one of the most productive freshwater fisheries of the world. The reversal of waters up into the Lake, which occurs usually sometime between May-Oct., requires most fish communities in the Lake to be migratory, with movements between spawning ground in the swamp forests around the lake and then continuing an arduous journey from the Lake to the Tonle Sap river and then to the Mekong and back. Some of the fish that migrate up to the lake annually include carp, clupeids, schillbeid catfish (*Pangasius*), threadfins, and drums. The fish that reside year round in the lake are usually murrels, anabantids, catfish (*Saccobranchus* and *Clarias*) and spiny eels and gobys. These around residents all have in common the ability to utilize atmospheric oxygen to avoid problems in the oxygen deficient lake margins and forests. Other flooded fish habitats along the Mekong system include inundated rice fields, where farmers often introduce new fish species such as Chinese carp, during the rainy season. The fish feed on the matter in the flooded rice fields and contribute extra income and animal protein to households.

In addition to the flooded river zones, the coastal and brackish water fisheries of the Delta are also one of the most productive fishery areas. Over 300 species of fish have been documented in the Mekong estuary, and include herrings (*Clupeidae*), mackerels (*Scombridae*), drums (*Sciaenidae*), ribbon fish (*Tachysauridae*), threadfim (*Polynemidae*), catfish (*Tachysuridae*) and flatfish (*Cynoglossidae*). Most of these fish are diadromous and seasonally ascend the river to spawn in the estuary zones. Other species found in the coastal fisheries include shellfish, mussels and clams, and shrimp such as *Macrobrachium rosenbergii* and *Penaeus monodon*. A comparison with the fish fauna of Cambodia, Thailand, and North Vietnam revealed that while the species found in S. Vietnam are quite similar to those in Thailand and Cambodia, they are quite different than those found in North Vietnam (Yen 1988).

The water regime in the coastal areas is described by Pantulu: "The Mekong plume shifts seasonally and exhibits varying degrees of mixing, depending on states of wind, tide and weather. Thus turbidity and water transparency vary seasonally... Conductivity, dissolved oxygen, and temperature values also fluctuate in unison with current velocities, and upwellings are common. These bring bottom sediment nutrients into the photoic zone, allowing plankton bloom development and attracting fish. As recorded in the South China Sea off the mouths of the Mekong/Bassac complex on the French research vessel Lanasson, the fish concentrate until the floodwaters discharge from the Great Lake in Kampuchea into the Mekong and Bassac ceases completely." (Pantulu 1986b). It appears that most sea fish enter the estuaries at the onset of the wet season and return downstream or back to the sea during the dry season.

The contributions of the various habitats of the Mekong to fisheries are demonstrated in the Table 14, which indicates the standing crop of fish in each habitat estimated by the Mekong Secretariat in 1976.

Table 14. Standing Crop Estimates for Various Fishery Habitats

Habitat	Standing crop (kg hw ⁻¹)
Upstream freshwater fishery	60.0 (lotic) - 198.0 (lentic)
Reservoir fishery	290.5
Downstream freshwater	135.0
Brackish and estuarine	13.9 (demersal marine) to 87.0 (pelagic marine)
Paddies	2.2-13.7
Ditches/ponds	11.2-20.6
Aquaculture ponds	391.7

Source: Pantulu 1986b

Roberts has conducted most of the research on newly discovered and endangered fish species in the Mekong basin (Roberts and Karnasuta 1987; Roberts 1991; Roberts 1993a; Roberts 1993b; Roberts and Warren 1994; Roberts 1994a; Roberts 1994b; Roberts and Baird 1995; Roberts 1995a; Roberts 1995b; Roberts 1997) As a result of his expertise on the Mekong's fish, he is strongly opposed to any dams on either the mainstream or tributaries. He believes the dams would ruin fish habitat and impede migration flows. He says, for example, from Mekong committee data "The diadromous catfish *Pangasius krempfi* deserves special mention. This strongly migratory species occurs in coastal waters of the South China Sea from China's Kwantung Province south to the Mekong delta and in the Mekong river at least as far upstream as Vientiane. It is one of the most important species in commercial catches below Khone Falls and is also caught commercially along the Vietnamese coast. *Pangasius krempfi* evidently reproduces only in freshwater in the Mekong basin, and probably only in the Mekong River and one or more of its largest tributaries" (Roberts 1995b)

Pantulu, another Mekong fish expert, agrees. He argues that "mainstream fisheries obviously will be adversely affected by agricultural industrial and community development activities. The initial effects of impoundments, for instance, can be critical to certain species and beneficial to others, for a wide variety of reasons. However, such effects can be expected to result from general reduction or increase (often drastic) of preferred habitat, diminution of enhancement of natural food supplies, reduction or increase of suitable spawning sites (clear, oxygenated and exposed vs. slow-moving quiet waters) and loss of shelter (exposure to predators)" (Pantulu 1986b) Roberts further believes that mainstream dams would probably also cause the extinction of a number of species that occur only in the Mekong basin and are largely or entirely confined throughout their lives to the mainstream of the Mekong River: "the freshwater herring *Tenualosa thibaudeaui*; carps *Aptosyax grypus* and *Probarbus labeamajor*; and the Mekong giant catfish *Pangasius gigas*. *Pangasius gigas* and *Tenualosa thibaudeaui* already are endangered species, and the magnificent 1.5 m predator *Aptosyax grypus* is a rare species" (Roberts 1995b). Pantulu says that "For species with longitudinal migrations, dams will create obvious problems. However, they are a special case and their problems should not be confused with the general inability of mainstream species to cope with life in or below reservoirs. For example, at least initially, concentrations of upstream migrants at the bases of dams will make them unusually vulnerable to over-exploitation, thereby compounding the negative effects of dams as barriers. Flow regulation may also reduce growth periods for hatchlings in nursery waters,

while water flow velocities may be reduced and, associated with this, average temperatures may rise. Conversely, seasonal low flows can be increased to benefit navigation and salinity control downstream, and these will support higher levels of dry-seasons fish stocks than before, as well as flushing toxic wastes. Impoundment will reduce sediment flow, particularly in the main channels, thereby altering light penetration and photosynthesis as well as changing the nutrient regime downstream (usually increasing loads through entrainment of lacustrine organisms, or through hypolimnetic discharges from nutrient-laden waters of the reservoir). Thus sediment-load reduction will significantly alter existing downstream ecosystems. In addition, increased scouring effects below barrages will tend to eliminate habitats and foraging areas of benthic species, while clearer waters will favor some predatory fish⁷ (Pantulu 1986b).

The evidence from the tributary dams that currently exist on the Mekong system, such as Nam Pong in Thailand and Nam Ngum in Laos, is mixed on the effects of dams on fish populations. The reservoirs created behind dams favor those fish that are best able to spawn and adapt to quiet waters. With regard to Nam Pong, the evidence suggests that "apart from substantial changes in fisheries which extended far downstream, together with expected changes from river-adapted species to lake-adapted species, continuing environmental changes and the selective nature of fishing have considerably altered species composition over the years. Pre-impoundment species numbered 76 in the Nam Pong rivers, while shortly after impoundment only 52 species were observed. The number has subsequently increased to 66, not counting nine species introduced to the reservoir by the Thai Dept. of fisheries. This increase is apparently due to ingress offish from the river above the reservoir... Important losses from the original riverine stock as a result of impoundment area *Labeo bicolor*, *L. erythrurus*, *Oxygaster maculicauda*, *Culirops siamensis*, *Rasbora retrodorsalis*, and *Puntius viehhoeveri*" (Pantulu 1986b). However, despite these negatives, the Nam Pong reservoir was producing an average of 1600 tonnes of fish annually, valued at US\$800,000, while the Nam Ngum reservoir in Laos was producing 1800 tonnes annually, valued at US\$1.4 million (Pantulu 1986b)

In addition to freshwater and coastal fish communities, there are also reports of river dolphins in the lower Mekong. The presence of the Irrawaddy dolphin *Orcaella brevirostris* in the Mekong, Sekong, Sesou, Sekhaman, Senamnoi Sekampoh, and Sepian Rivers in Southern Lao PDR, and the Mekong River in North-eastern Cambodia, was documented between December 1991 and March 1994 by Baird, Mounsouphom et al. (1994). Anecdotal reports from villagers implied that populations have greatly declined in recent years. The report by Baird says that many villagers in Southern Laos and Cambodia believe dolphins are reincarnated humans, and the species is highly respected by local people, who never eat the meat of dolphins and only very rarely harm them intentionally. Nevertheless, several sources of anthropogenic mortality have been identified by Baird and others (Stacey 1996). These include animals being killed in gillnets, by explosives used for fishing by Cambodians in portions of the Mekong and Sekong Rivers shared between Laos and Cambodia, and being shot by soldiers or villagers unfamiliar with what the dolphins are. Overfishing in the Mekong could also be causing a reduction in available prey for the dolphins. The authors of these studies say that large-scale dams proposed for the Mekong and Sekong Rivers threaten the species in Laos and Cambodia. A community-based research project has been set up in Southern Laos by Baird and others to continue to investigate traditional fisheries, fish and dolphin ecology and biology, and other environmental and socioeconomic issues of significance to the fishing villages of Laos and Cambodia.

In addition to these valuable species endemic to the Mekong, there are also some incidences of exotic aquatic species in the river system. The water hyacinth (*Eichhornia crassipes*), which causes deoxygenation in the water systems in which it resides, leading to fish kills, is found in the middle Mekong, but not yet in the lower Mekong in either Vietnam or Cambodia (Hirsch and Cheong 1996). There was an increase in infestation of *Eichhornia* in

the Nam Pong reservoir after impoundment (Pantulu 1986b), so research is needed on the implications of the spread of water hyacinth for lower downstream river users.

6. PLANT COMMUNITIES

There are a number of diverse and unique plant communities around the area of the lower Mekong basin. The importance of understanding these communities is especially important in fight of current river basin development. "Most plant and animal life along the rivers of the Basin are adapted to seasonal inundation. The life cycles of the plants, and vertebrate and invertebrate fauna are synchronized with and adapted to the seasonal flooding. Consequently the cessation or control of flooding will so alter the environment that habitats of the inflexible species may be exterminated" (Talbot 1974).

The major divisions of land and water communities for Cambodia are given in Table 15.

Several plant communities of unusual interest are located in the lower Mekong basin. These communities include the Melaleuca forests of the Plain of Reeds of Vietnam, the flooded forests of the Tonle Sap in Cambodia, and the coastal mangroves of both countries. Some of these communities are mentioned below.

Table 15. Type of Land and Water Resources in Cambodia	Area (ha) 1985/87	Area (ha) 1992/93
Permanent water (river, lake, pond)	567,100	411,100
Flooded forest	795,400	370,700
Flooded secondary forest	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
Swamps	12,200	1,400
TOTAL	1,868,000	1,687,100

Source: Ahmed, Tana, et al. 1996

Plain of Reeds:

The Plain of Reeds (Dong Thap Muoi in Vietnamese) is an area of the Mekong delta with a distinctive plant community structure. The typical feature of this area is heavily acid sulfate soil with a large area of forest dominated by Melaleuca trees and wild reeds. The Plain is located in three districts, Long An, Tien Giang and Dong Thap, and comprises 8,000 sq. km. The area is about 0.5-1.5 meters above sea level, and basically consists of a large hollow at the north of the Tien river, one of the branches of the Mekong. Most of the Plain of Reeds is deep flooded in the rainy season but quite dry in the dry season, which has led to the presence of acid soils. The flooding in the wet season can reach up to 3 m or more in some places and averages around 2 m elsewhere (Nguyen Hoang Tri 1995).

The *Melaleuca* forests are adapted well to the acid soil can tolerate salinity, and they contribute to a peat layer where they are found. This peat layer can retain water in the dry season and regulate water in the wet season and as such can prevent further acidification of the soil (Brinkman and Vo Tung Xuan 1991). The *Melaleuca* dominated forests form a transitional zone between submerged saline mangrove areas and more continental forest vegetation (Crane, Vu Van Luyen, et al. 1993). *Melaleuca* is often found in pure stands, where acidity keeps other plants from thriving (Brinkman and Vo Tung Xuan 1991). Other flora species in the *Melaleuca* forests can include *Leptochloa chinensis*, *Echinochloa crusgalli*, *Marsilea minuta*, *Cyperus elatus*, *C. polystachys*, *Eriochloa procera*, *Heleocharis dulcis*, *Sacciolepis myuros*, *Nelumbium nelumbo*, and *Nymphaea* spp (Nguyen Hoang Tri 1995). The flora of the Plain provides timber and firewood and medicinal oils for local residents. Cajeput oil from a *Melaleuca* species fetches a good price on the market (Le Van Dang 1968) The oil is used as an insect repellent, in soap manufacture, and as a anti-irritant (Crane, Vu Van Luyen et al. 1993). The forests also provide a good habitat for bee keeping and collecting of natural honey (Mulder 1992; Crane, Vu Van Luyen, et al. 1993; Svensson, deBeer, et al. 1995).

The Plain also supports an important bird fauna, including the endangered eastern sarus crane. It also used to be a major fishing area (Le Van Dang 1968).

The Plain suffered from wartime bombings and from being the site of an NLF base. It later suffered more anthropogenic damage when it was designated a New Economic Zone by the state, where new settlers were given state encouragement and financial incentives to settle and drain the area for crop production. The population of the area increased from 1,350,000 in 1986 to 1,486,000 in 1994. The "frontier" nature of this area was apparent in a survey of several communes within the Plain, where three generation households only accounted for 9.5 percent of the households. Everyone else was second generation or younger. As a result of this influx of settlers, in only three years the extent of agricultural land in the Plain has increased by 33,603 ha in Dong Thap province alone. The land is usually claimed by cutting of any trees and by implementing drainage plans. This unfortunately results in highly acid soils, however (Hanhart, Duong Van Ni, et al. 1997; Minh, Tuong, et al. 1997b).

The current extent of remaining *Melaleuca* forests in the Plain is around 60,756 ha, of which 50,696 are in Long An province, 857 in Tien Giang, and 9,023 in Dong Thap province (Nguyen Hoang Tri 1995). According to a household survey conducted by Tri, many families are eager to replant the depleted *Melaleuca* areas but lack capital to do so (Nguyen Hoang Tri 1995).

Currently, the main environmental problems facing the Plain have been identified as:

- ε Decrease in forest area
- ε Deterioration in aquatic resources
- ε Unsustainable utilization of the natural resources
- ε Water source pollution
- ε Rapid population growth in the area
- ε Exhaustion of the soil
- ε Land disputes in the protected bird reserve

ε Lack of research and monitoring

(Nguyen Hoang Tri 1995).

These problems are likely to continue as long as the influx of population into the Plain continues. Currently, the only section of the Plain under any sort of land use restrictions is the small corner of the Plain dedicated to the Train Chim bird sanctuary. And conflicts still exist over the environmental goals of the sanctuary and local residents' desire for agricultural land. An article in a conservation magazine in 1994 said that the International Crane Foundation was working to help "local people plant freshwater mangroves to harvest for turbo and medicinal oils, a less destructive process than planting two crops of rice on the same land every year" (Kuznik 1994)

Swamp Forests of Tonle Sap:

The definition of "swamp" vegetations are those plant communities that "grow in low-lying areas which are permanently or seasonally flooded with fresh water rich in nutrients (eutrophic). The soils are mainly alluvial belonging to the entisol group, and are clayey or loamy (never sandy) in texture" (Hill 1979). The swamp vegetations of the Tonle Sap basin of Cambodia are the best example of this type in mainland Southeast Asia according to Hill. These swamp forests are dominated by *Homalium brevidans* and *Hydrocarpus antheilmintica* (Pantulu 1986a). The vegetation around the Great Lake is often termed "flood forest" instead of swamp forest, though by no means is the whole area forested, since even deep in the forest, there are "grasslands arranged in "rings" lying parallel to the lake shore. Bordering the lake itself are semi-aquatic grasslands with herbs such as *Polygonum spp.*" (Hill 1979) There are around 600,000 ha of flooded forests in Cambodia, 80 percent of which are located around the Tonle Sap (Ahmed, Tana, et al. 1996).

Flooded forests are an important ecological buffer for the communities of freshwater capture fisheries. The forests provided breeding and feeding ground for hundreds of types of fish. However, the flooded forests of Cambodia have been declining in area for some time. Between 1929-38 nearly 250,000 ha were cleared by the French government for maize cultivation (Ahmed, Tana, et al 1996). In 1973, the total area of flooded forest was estimated to be around 937,000 ha. Pol Pot is said to have ordered hundreds of ha of forests around the Great Lake to be cut to expand rice production. Exact figures on the amount of area destroyed are not available, but it is estimated to have been around 100,000 ha of the 800,000 total ha around the lake (Sluiter 1992). By 1992-3, the total had been reduced to 630,000 ha (of which around 40 percent was considered secondary or degraded forest) (Ahmed, Tana, et al. 1996).

Mangroves:

Mangroves ring the coastal areas of Cambodia and Vietnam. Cambodia has an estimated 85,100 total ha of mangroves (Bann 1997), and Vietnam has 191,000 ha in the southern delta alone (Phan Nguyen Hong and Hoang Thi San 1993). In Cambodia, the area surrounding the Tonle Sap and the sides of the Mekong and Bassac rivers are also covered with freshwater mangroves that are seasonally flooded.

Mangroves are quite common in many coastal systems: "One can thus safely say that, wherever one has a continental tropical sea coast sheltered from wave action, a mangal ecosystem may evolve" (Por and Dor 1984). Mangroves need certain environments in which to thrive, however. These conditions usually include air temperatures above 20°C, ocean currents that can convey seeds, protection from excessive wave action, the presence of shallow shores, access to salt water, the degree of tidal penetration and the type of

substrate (usually mud is preferred). (Por and Dor 1984.)

However, it takes particular environmental conditions to sustain mangrove forests. Mangrove muds must have a high capacity to absorb nutrients from the incoming tidal waters (Por and Dor 1984). "If the upland runoff is cut or artificially reduced, the mangal responds by reduced levels of production and turns into a scrub mangrove. This scrub mangrove may be of a second class quality for considerations of forestry, but it is still a mangal ecosystem, which maintains itself In fact it is an artificially produced high-salinity mangal" (Por and Dor 1984). Mangroves in Vietnam prefer the silt-clay soils strata of the delta coast and prefer moderate salinity, with mangrove mortality influenced by too low or too high a salt content (Phan Nguyen Hong and Hoang Thi San 1993)

The following species of mangrove are the main ones that can be found in Vietnam:

<i>Rhizophora apiculata</i>	<i>Rhizophora mucronata</i>
<i>Bruguiera cyclindrica</i>	<i>Bruguiera gymnorhiza</i>
<i>Bruguiera parviflora</i>	<i>Bruguiera sexangula</i>
<i>Sonneratia alba</i>	<i>Sonneratia caseolaris</i>
<i>Sonneratia griffithii</i>	<i>Sonneratia ovata</i>
<i>Xylocarpus granatum</i>	<i>Xylocarpus moluccensis</i>
<i>Lumnitzera littorea</i>	<i>Avicennia marina</i>
<i>Scyphiphora hydrophyllacea</i>	<i>Acrostichum aureum</i>
<i>Acanthus illicifolius</i>	

Source: Por and Dor 1984

In total, 32 species of true mangroves are found in Vietnam. Cambodia appears to have a lower count, at only 19 species. (Phan Nguyen Hong and Hoang Thi San 1993).

Mangrove systems are highly productive. The rate of leaf fall of mangroves is among the highest of all tree species (Por and Dor 1984), with only about 5 percent of leaves consumed on the tree and the rest recycled by the detritic food chain. This results in a

breakdown of angiosperm plant material in the sea and brackish waters [which] goes through a complicated and often repetitive sequence of bacterial + fungal decomposers --> meiobenthic bacteria and fungus grazers -> macrobenthic detritivores and predators... The essential difference of the mangal as compared with other aquatic detritic ecosystems is a high efficiency of "within ecosystem" recycling. Although sizable amounts of the detritic food are lost to the open sea... the majority of the detritic mass is retained by the intricate sediment trap of the countless aerial roots and rootlets of the mangrove bottom and decompose in situ (Por and Dor 1984)

The result of this detrital cycling within the system is that mangrove waters are highly productive fisheries. Seasonal migration by fish into the mangal water, and the following seaward migration of fish and shrimp, are an important phenomenon in the mangrove

waters. "The mangal waters do not serve as a nursery — as sometimes stated — but as a feeding ground for fish in their earlier stages of development after having spent their larval life in the open sea. The same seems to be true of the rich fauna of tropical *Penaeidae* shrimps. Only a minority of the fish species encountered in the mangal waters are nonmigratory mangrove breeders" (Por and Dor 1984). A total of 258 species of fish are found in the mangroves of Vietnam. A study of the fish fauna of the Ca Mau cape found the majority to be true estuarine species (spending their entire life cycle in the estuary) while others were sea fish from the shallow continental shelf that entered the mangrove areas for feeding (Phan Nguyen Hong and Hoang Thi San 1993).

Because of the importance of mangrove areas for fish breeding and hatching, many fishermen rely on them for fishing grounds. In one province in Cambodia lined with mangroves, 87 percent of households depended on fishing for their livelihood (Bann 1997). Respondents to a survey indicated that they believed it was harder to fish now compared with 5 year ago, and over 30 percent of respondents said they thought it was because of decreased mangrove area (Bann 1997). In Vietnam, some traditional Khmer villages are found in mangrove areas. These communities, particularly in Soc Trang and Tra Vinh provinces, have built houses on stilts with the roofs and walls made of Nipa palm leaves. They earn a livelihood through catching crabs and other gastropods (Phan Nguyen Hong and Hoang Thi San 1993). In heavy mangrove areas like Ca Mau, Vietnamese resident also traditionally build stilt houses and engaged in forestry and fishing activities.

In addition to fisheries habitat, mangrove also provide shoreline protection from coastal erosion. They can also help reduce effects of flooding and storm surges. Studies indicate that the value of mangroves as serving as a natural sea dike can be expressed as a function of: the width of the stand, the age of the stand, and the average wave-length of the incident ocean waves (Adger 1997). Mangroves anchor silty mud against the effects of coastal waves and can reduce saline intrusion into surrounding areas. By accumulating soil affluviates around their root systems, mangroves start the process of turning deposited sediment into solid land (Pantulu 1986a).

Mangroves are also home to diverse faunal life. This includes crab-eating macaques, clawless otters, fruit bats, fishing cats, monitor lizards, salt-water crocodiles, pythons, and various birds like the white bellied sea eagle, mangrove whistler, and pied imperial pigeon (Pantulu 1986a). Sixty-seven species of bird were found in one mangrove area of Minh Hai province alone (Phan Nguyen Hong and Hoang Thi San 1993). The number of mollusks in mangrove waters reach almost 2,000 species in the northern mangroves of the Vietnam coast. (Phan Nguyen Hong and Hoang Thi San 1993). The number of shrimp species found in the mangroves is around 100.

Mangroves also provide traditional medicines for many in the Delta. Some of the medicinal uses of mangrove trees are listed in Table 16.

Table 16. Uses for Mangrove Species in Traditional Medicine in the Mekong Delta

Species	Treatment	Part of mangrove used
<i>Acanthus ilicifolius</i>	Rheumatic joints	Leaf
<i>Acrostichum aureum</i>	Wounds and boils	Pounded rhizome
<i>Ceriops tagal</i>	Malaria	Decoction
<i>Clerodendron inerme</i>	Jaundice	Leaf

Heritiera littoralis	Diarrhea	Seeds
Hibiscus tiliaceus	Emollient, diuretic, laxative	Root
Ipomoea pescaprae	Astringent, tonic, diuretic	Plant
Pluchea pteropoda	Headaches	Leaf
Thespesia populnea	Stomach aches	Leaf
Xylocarpus gramtum	Dystentary	Bark
Wedelia biflora	Wounds and cuts	Leaf

Source: Phan Nguyen Hong and Hoang Thi San 1993

Despite these benefits, mangroves are now under threat in much of the Mekong basin. One main reason is intensive shrimp farming, where mangroves are cut to make way for shrimp ponds in the mud. Ninety-seven percent of respondents in a Cambodia survey of households in mangrove areas said that they were unhappy with the expansion of shrimp farming into their mangrove areas. The shrimp farmers had constructed dikes to divert water to shrimp ponds, which has resulted in water pollution and shortages of fresh water for fishermen (Bann 1997). As Por explains: "Much as it is done, there is little justification to turn mangal areas into areas of ponds and sea-farming facilities. Invariably, such basins will turn their surrounding into ugly and useless degraded areas and themselves become completely dependent on artificial feeding. In the mangal impoundments the delicate balance of the tidal influx and of the runoff is disturbed and as a consequence the intricate detritic foodchain is disrupted. The result of mangrove deforestation is probably as disappointing from the point of view of food production as the clearing of the rain forest" (Por and Dor 1984). Damage to mangroves from grazing of buffalo and some goats is also a problem in some areas of Vietnam (Phan Nguyen Hong and Hoang Thi San 1993)

Charcoal production is another threat to mangrove areas. Mangrove species are well suited to charcoal because the wood is dense and hard with a high calorific value and little smoke. In one coastal mangrove province in Cambodia in 1992, there were more than 300 charcoal kilns producing over 24,000 tons of charcoal. 94 percent of this charcoal was being exported to Thailand. An estimated 100,000 tons of mangrove wood would be needed to produce this amount of charcoal (Bann 1997). Cambodian charcoal exports were banned in 1994 but the number of kilns is said to have increased in spite of this. Many charcoal producers in coastal Cambodia claimed that they had turned to charcoal production because fish catches were no longer sufficient for survival (Bann 1997). Similarly, mangroves are still used for fuelwood in much of coastal Vietnam (Phan Nguyen Hong and Hoang Thi San 1993). The state forestry enterprises located in mangrove areas of the delta controlled the creation and trade in charcoal for many years after independence, selling charcoal on behalf of the state at fixed prices. However, the state is believed to have dropped out of the charcoal business in the last few years (Phan Nguyen Hong and Hoang Thi San 1993). Mangroves are also exploited for timber because the wood is hard and heavy and good for houseposts. In the past, mangroves were also used for tannin production; the tannin was used for leather and the preservation of fishing nets. There used to be a tannin factory in Ca Mau town, but it closed in 1987 because of competition from synthetic tannin and synthetic fishing nets (Phan Nguyen Hong and Hoang Thi San 1993). Exploitation of mangroves in Vietnam's Minh Hai province is indicated in Table 17.

Table 17. Exploitation Mangrove Areas in Minh Hai, Vietnam, 1975-1983

Year	Timber (m ³)	Firewood (stere)	Charcoal (ton)
1975	25,787	35,011	669
1983	10,826	51,909	2,641
Total 1975-83	207,798	686,961	23,030

Source: Phan Nguyen Hong and Hoang Thi San 1993

There are possibilities for coexistence of humans and mangroves. For example, "A network of channels and lagoons maintained and even dug through the mangrove forests will increase the food availability for the shoals of commercial fish and provide better access for the fishermen. In this way, more of the mangrove detritus will find its way into the food chain and ultimately turn up in the fishing nets. Instead of being lost to the mangrove peat" (Por and Dor 1984). These shrimp/mangrove integrated systems can be found in several areas of the delta (Binh, Phillips, et al. 1997). The mangrove mud crab (*Scylla serrata*) is also a popular and nutritious food in the Mekong Delta and can be used as an incentive to retain mangrove areas. Bee-keeping can also benefit from mangrove areas (Crane, Vu Van Luyen et al. 1993).

The reforestation of many areas of mangroves in Vietnam is being undertaken with overseas development assistance funding (Action for Mangrove Reforestation 1994; Witter 1994). In a study of mangrove restoration on the northern coast of Vietnam, the authors weighted the costs and benefits of a mangrove afforestation project. Their results showed a benefit to cost ratio in the range of 4 to 5 for a range of discount rates, "which means mangrove rehabilitation can be justified on economic grounds for all the discount rates analyzed" (Adger 1997). All these benefits listed in Table 18 were compared with the cost of VND 522,000 for planting one hectare of mangroves.

Protected areas:

Of the provinces of Cambodia and Vietnam in the Mekong basin, several are home to state-designated wildlife and nature preserves to protect their plant and animal communities. The Cambodian government pledged in 1993 to designate a system of seven national parks, nine wildlife sanctuaries, three protected landscapes, and three multiple-use management areas (World Bank 1994a). And Vietnam has an even more impressive record. Vietnam has 7 national parks, 29 "Cultural Historical and Environmental Reserves" (CHERs) and 50 Nature Reserves, almost all of which were created by the state in two administrative orders in 1977 and 1986 (Cao Van Sung 1995). National parks in Vietnam are graded according to use-criteria; all consist of a strictly protected inner core in which most anthropogenic activities are banned. Outer cores allow for such activities as regenerating and replanting schemes, and recreational activities. Buffer zones which allow for regulated production activities are managed by park officials, but are outside most parks' official boundaries. The second designation of biodiversity zones in Vietnam is in nature reserves. Nature reserves are protected areas primarily designed for conservation; tourism is not encouraged. The administration of these zones falls to the Ministry of Forestry, but boundaries are to be developed with local people's committees of local provinces. Finally, culture, historical and environmental reserves (CHERs) contain historical relics and scenes with aesthetic interest. Tourism is encouraged, and these CHERs are administrated by the Ministry of Forestry, although most are considered to contain little of scientific or ecological value (Cao Van Sung 1995). Currently almost 1 million hectares of land are in these three protected categories, and Vietnam has indicated it plans to double that amount to 2 million hectares by the year 2000 (Vietnam, Socialist Republic of, and GEF 1995).

Table 18. Benefits from Mangrove Restoration in Northern Vietnam

Impact or asset valued	Method for valuation	Timing of Cost/Benefits
Timber benefits	Thinning trees: VND 180/tree Extract mature: VND 5000	Thinning and extraction from year 6 with 3 year rotation
Fish	Mean price per kg: VND 12,500; yield 50 kg/ha	benefits from year 2 after planting
Honey	Potential yield of 0.21 kg/ha	Honey collected from year 5 after planting
Sea dike maintenance	Costs avoided in sea dike maintenance due to mangroves	Benefits arising from year one.

Source: Adger 1997

In Cambodia, the following protected areas fall within the confines of the Mekong basin and would be sensitive to changes in Mekong landscapes:

Kirirom National Park. 35,000 ha. In Koh Kong and Kampong Speu provinces.
Aural Wildlife Sanctuary. 253,750 ha. In Koh Konh, Pursat, Kampong Channang and Kampong Speu provinces. (From Bann 1997)

In Vietnam, the following protected areas fall within the basin:

U Minh Nature Reserve. 2,000 ha of Melaleuca forest. In Minh Hai province.
Cac San Chim Nature Reserve. 500 ha of bird breeding grounds. In Minh Hai Province.
Ca Mau Nature Reserve. 4,000 ha of mangrove forest. In Minh Hai province.
Hon Chong Cultural Reserve. 3,000 ha of karst landscape. In Ha Tien province.
Nui Cam Nature Reserve. 1,500 ha of forest. In An Giang Province.
Tram Chim bird sanctuary of the Plain of Reeds. 7,000 ha. In Dong Thap province.
Phu Quoc Nature Reserve. 5,000 ha of island forest. In Kien Giang province.
From: (Cao Van Sung 1995)

7. ANIMAL COMMUNITIES

There are many animal species at home in the lower Mekong basin. Cambodia alone is believed to be home to as many as 900 bird species, 265 mammals, 300 reptiles, and 600 marine species (Desai and Vuthy 1996). Many of these communities may not be directly dependent on the Mekong river system for habitat or food, but they may be affected by agricultural or development changes in the region.

Mammals:

Despite the devastation during the Khmer Rouge years and continued fighting since then, Cambodia has a range of mammal species, particularly in the forested northeast provinces along the Mekong river. However, "a number of these species are believed to be rare and threatened, including the following: kouprey, Eld's deer, Doue langur, pileated gibbon, marbled cat, clouded leopard, tiger, leopard, elephant, Javan rhino, gaur, goral, serow, land monitor, and Siamese crocodile." (World Bank 1994a)

There are also several economically important mammal species residing in the lower Mekong basin. The most well known and potentially important is the extremely rare kouprey, a dewlapped cattle species. "The kouprey, the oldest existing bovine species, is of particular interest, not only because it is considered a natural symbol, but also because it is believed to have a natural immunity to rinderpest" (World Bank 1994a). However, few animals have been seen in recent years, leading some to wonder if the kouprey is extinct in the area. Another possibly new bovine species has also been described from the same area by a recent German expedition to Cambodia (Dioli 1997)

In Vietnam, mammal species of note include swamp cats in the Plain of Reeds and various species of bats and rodents (Cao Van Sung 1995). In general, the mammal fauna of the delta is not diverse, especially when compared with its fish fauna (Yen 1988; Zakaria 1994). Mammals known to have lived or currently living in the mangrove and forested areas of coastal Vietnam include the following:

<i>Lutra lutra</i>	<i>Hylobates spp.</i>
<i>Viverricula indica</i>	<i>Panthera tigris</i>
<i>Viverra zibetha</i>	<i>Cervus unicolor</i>
<i>Herpestes javanicus</i>	<i>Neofelis nabulosa</i>
<i>Felis verrina</i>	<i>Megacrops ecaudatus</i>
<i>Bandicota indica</i>	<i>Sus crofa</i>
<i>Callosciurus erythraeus</i>	<i>Macacamulatta sp.</i>
<i>Callosciurus pygeythrus</i>	<i>Macamulatta fasciularis</i>
<i>Callosciurus finlaysoni</i>	

Source: Phan Nguyen Hong and Hoang Thi San 1993

Birds:

Over 386 species of birds have been recorded in the Mekong Delta, 73 of which are migratory (Phan Nguyen Hong and Hoang Thi San 1993). Main areas for bird habitat and nesting in southern Vietnam include the U Minh forest swamp on the Ca Mau peninsula, and the coastal mangrove areas (Robson, Eames, et al. 1989).

One of the most significant bird sanctuaries in Vietnam is in the Mekong Delta's Plain of Reeds. Tram Chim (Bird Swamp) is the permanent habitat, migrating site, or nesting place of more than 187 bird species of which 13 are rare or endangered (Nguyen Hoang Tri 1995). Tram Chim was administratively created in 1986 and now covers 9,000 ha of protected areas. A system of inland dikes was built around the reserve to hold water during the dry season (Kemf 1988). One main impetus to creating the reserve is the presence of the endangered eastern sarus crane (*Grus antigone*) which disappeared from the area during the war and has since returned in small numbers in the last ten years. In 1988, around 1,000 individuals were counted in the reserve (Nguyen Hoang Tri 1995). However, the reserve is regularly encroached upon by local people to catch fish, collect honey, or cut wood. The director of the reserve has estimated that 100 or so people in the reserve each day is average, and it can reach as high as 600 (Spencer 1996). The effects of these excursions on bird breeding and nesting is not known.

There are also significant pressures on bird communities along the upper stretches of the Mekong. A recent report says that the Mekong river with its tributaries is the "most threatened bird habitat in Laos" (Duckworth, Timmins, et al. 1998). The bird communities are threatened by human use and encroachment on habitats along the river, as well as by potential dams. For example, the river lapwing disappeared from the Bhumipol Dam after construction in Thailand, and other similar effects on birds may be noted downstream from more dams, as "rivers downstream of dams and the receiving streams of water diversion projects could also become unsuitable because of loss of sandbars through the impoundment of sediment in reservoirs" (Duckworth, Timmins, et al. 1998)

8. WAR DAMAGE

There are a few studies that have looked at the environmental damage of the Vietnam War in the Mekong Delta (Egler 1968; Westing 1971). An estimated 22,000 sq. km of forests and farmland were destroyed by herbicides and napalm bombings in all of Indochina. During the war, the main agents of chemical defoliation were Agents Orange, White and Blue. Herbicide applications began in the early 60s; in 1962 about 17,000 acres of vegetation were sprayed. In 1967 that number had jumped to 844,000 acres (Tschirley 1968). Some of the most heavily sprayed areas were the mangrove forests along the coast the U Minh forest on the Ca Mau peninsula, and the Plain of Reeds area of the upper delta (Thomas 1974). From 1966 to 1970 the tip of Ca Mau peninsula received 1,027 kg of Agent Orange through 55 missions and 285kgs of Agent White. Other areas also received similar sprayings.

It is estimated that half of the 2500 sq. km of *Melaleuca* swamp forests and 27,000 ha of mangroves were defoliated in the delta during the war. This is approximately 30 percent of the total mangrove areas of the South. Severe soil erosion resulted from the dead mangrove areas immediately following the war. Furthermore, the studies of defoliation by the US that are available were short term studies; longer term studies of the lingering effects of Agent Orange and other chemicals in the natural and human environment have not been completed in Vietnam. Studies indicate that birth defects, cancers, and genetic malformations are causally linked to dioxin exposure.

Most of the studies of war damage have looked primarily at the effects of defoliants and herbicides on the natural fauna and agricultural systems of the delta (House, Goodson, et al. 1967). Other impacts, such as bomb craters or landmines, have not been studied. In Cambodia, an estimated 40 percent of the arable farm land has been sown with land mines (Sluiter 1992). This will no doubt have great effects on future agricultural development in that country.

Notes

¹The International Commission on Large Dams (ICOLD) defines "large" (or "hiah") as an impoundment that raises the upstream water level a minimum of 15 meters.

²Even in the pre-World War II period there were some contrary voices. McCully (1996:23) quotes Ed Averill President of the Oregon Wild Life Federation saying in 1937: "I hope future generations will not look back upon their ancestors with scornful contempt, as they ask, why in the name of all the fishes that swim the seas, did they permit the engineers to utterly destroy our streams?"

³By 1989, China, with almost 19,000 high dams, had half the world's inventory, followed by the United States, the former Soviet Union, Japan, India, Spain, South Korea, Canada, Great Britain and Brazil.

⁴In Yunnan Province, China, the Manwan Dam has been completed. Its 1500 MW will be consumed primarily by Chinese mining and manufacturing industries.

⁵The author later states that in the delta 75.6% of rural households lack electricity and 73% of the housing is poor (Nguyen Thi Song An 1996:33).

⁶An aromatic oil, cajeput, is distilled from the leaves of a variety of melaleuca.

⁷In their first report the International Environmental and Social Panel of Experts advising Lao PDR on the likely impacts of the Nam Theun 2 Hydro Project discuss the timber industry in the project-affect region. The estimated annual lumber harvest from the area to be inundated is 400,000 m³... The timber is partly sold as logs to Thailand and Vietnam and partly processed. The processing industry is an important source of employment in Thakhet where it directly supplies 2,000 jobs and a further 600 people are employed in felling. "High-value logs of *Foekienia*, which bring as much as \$1,000/m³, were exported through Vietnam to Hong Kong and Japan. In 1996, further cutting of these "cypress" was suspended" (Scudder. Talbot and Whitmore 1997:13).

Section Three. Agriculture and Other Production Systems

This section explores the agriculture and other systems of production in the Delta, such as aquaculture and fishing. In doing so it attempts to explain the various systems, their historical development in the Mekong Basin, the trends in production in the last 30 years, and possible future directions of production. It also explores the social, economic, and environmental results of various production systems. Finally, this section concludes with an in-depth look at one aspect of agricultural production that has been particularly important in this part of Southeast Asia: changing land tenure systems.

General Overview:

Agriculture predominates the economics of Cambodia and the Mekong Delta. Agriculture comprises half of Cambodia's GDP and employs 80-85 percent of the work force. Livestock farming contributes to 15 percent of the GDP, fishing to 5 percent of GDP, and forestry activities comprise 3 percent GDP (World Bank 1994a). Industry is negligible in Cambodia.

In Vietnam, agriculture contributes 30 percent to the GDP. The Mekong Delta consists of 25 percent of the agricultural lands (11 percent of the total land area) of Vietnam, but produces almost 50 percent of the nation's rice output. General statistics for the Mekong are provided in Table 19.

Table 19. General Statistics for the Mekong Delta, 1993

Terms	Unit	1993 level	% of nation
Total Area	million ha	3.9	12
Population	million person	16,2	22
Farming HH	million HH	2.3	22.6
Agricultural lands	million ha	3.3	25
GDP	billion USD	3.3	28
Rice lands	million ha	1.9	46
Rice outputs	million tons	10.7	48
Sugarcane output	million tons	26.67	41
Coconut	thousand tons	881.59	77

Source: Nguyen Thi Song An 1996

Historically, agriculture in these two countries has always been dominated by rice production. Archeological evidence of the delta reveals ancient strains of rice and abandoned canal works (Anon. 1980; vanLiere 1980). Thus despite the fact that the Vietnamese settlement of the southern Delta is relatively recent (17th century), there is evidence for extensive rice production in the area far preceding that.

In this century, the state has highly encouraged agriculture in the Mekong Delta. The French

colonial state implemented extensive dredging works, creating the system of irrigation canals and waterways currently crisscrossing much of the southern tip of the country (Brocheux 1995). The Republic of Vietnam also relied on the Mekong Delta to produce food for the war-torn country, especially when American foreign aid began to wane in the early 70s, and implemented a number of waterwork programs.

With the reunification of Vietnam in 1976, the agricultural production systems of the south underwent a collectivization campaign. Although the collectivization was never implemented to the same degree it had been in the North (in the years 1955-1970), it did disrupt the agricultural productivity of the delta for several years. The same was true of the war years and disarray in Cambodia during the Pol Pot regime, when agricultural production declined dramatically.

In the last ten years that Vietnam has opened its economy to market influences and allowed private property land use rights, agricultural productivity of the delta has been rising dramatically. Rice output grew by 3.14 percent per year in 1981-1988, then jumped to 5.02 percent per year in 1988-92 before stabilizing at 3.14 percent in 1992-1994 (Nguyen Tri Khiem 1996).

Although Cambodia also implemented economic reforms in the years 1988-1993, the continuing political instability there has prevented the same sort of dramatic improvements in agricultural productivity. "In Cambodia at present, new problems have emerged. In the rainfed lowlands, many households cannot produce enough food to support their families because of the low productivity of traditional farming system, smaller landholdings per family, and increasing demand, as well as the degradation of communal lands and forests. In the area that is flooded by the Mekong River and its tributaries, flooding is more frequent and irregular. As a result there is less production stability and not enough food for the people. Some people have given up floating rice production and changed to flood-recession rice in the dry season" (Yang Saing Koma 1998)

The following pages will discuss the various cropping systems and agricultural outputs historically and currently in place in the Mekong delta and Cambodian plains. Following that will be a closer discussion of the economic, environmental and social issues involved in agricultural production that are not told by statistical data.

Accurate total agricultural production statistics by province or by agricultural sector are not currently available for Cambodia in the published literature.

1. RICE FARMING

Rice cultivation is the most important agricultural activity in the Mekong basin, and it has been for hundreds of years. Hickey says that rice cultivation not only follows long traditions, but "also reflects the alterations that have taken place in it as the Vietnamese peasants in their southward migration adjusted to new physical environments, sometimes devising new techniques and sometimes borrowing from the indigenous Cham and Khmer farmers. Drawing on this experience, the settlers in Khanh Hau learned to maintain the necessary balance among soil seeds, water, sun and available fertilizer. In time they selected artifacts they considered functional - a harrow, waterwheels, a Khmer plow, water scoops, knives, sickles, threshing sledges, baskets, winnowing machines, granaries, and rice mills. The result is a well-defined pattern of planting" (Hickey 1964)

Table 20. Total Agricultural Production in Rice Equivalent in thousand tons 1976-1990,

for Vietnam

Area or Province	1976	1980	1985	1990
Long An	426,900	433,300	560,900	841,600
Tien Giang	454,000	476,100	796,800	1,010,400
Ben Tre	293,100	278,500	429,600	314,500
Dong Thap	443,900	532,200	656,900	1,258,100
Vinh Long/Tra Vinh	665,700	646,100	845,900	1,157,600
Can Tho/Soc Trang	1,034,000	1,061,900	1,504,000	1,741,600
An Giang	507,200	778,900	858,100	1,498,400
Kien Giang	448,900	603,700	683,200	879,100
Minh Hai	578,300	688,700	650,600	906,500
Mekong Delta	4,852,000	5,402,600	6,986,000	9,607,800

Source: Vietnam, Socialist Republic of, 1992

Rice cultivation in the delta must be considered thus not only as an economic and production system, but a way of life that permeates all of society. Both the Vietnamese and Khmer languages use the words "to eat rice" to mean to eat any meal at all. A Khmer proverb says "It is rice that gives strength even to the King; one must not have contempt for rice" (Sluiter 1992). There are roles for many people in this rice system - farmers, tenants, laborers, rice millers, rice merchants, and gleaners. There are also roles for religion and deities: "There are also things sacred. Specific deities associated with successful rice cultivation are venerated in individual and collective rituals, and should there be a catastrophe such as a drought, tradition provides the proper ritual to cope with it" (Hickey 1964).

Only a few years after having suffered chronic deficiencies of rice during collectivization, the liberalization of the Vietnamese economy has allowed the Mekong Delta to become not only self sufficient in rice, but for Vietnam to become the third largest rice exporter in the world, after the US and Thailand (Nguyen Thi Song An 1996). And in Cambodia, over the last few years there has been an increase in paddy production there as well - from 0.8 million tons in 1979 to 2.4 million tons in 1993 (World Bank 1994a). Over 90 percent of the currently cropped area in Cambodia is planted in rice, and the number is only slightly lower for Vietnam. Clearly, for both areas, rice is key to understanding agriculture.

Tables 21 through 26 present a statistical picture of rice planting in the provinces of the Mekong Delta.

The steadily increasing land available for agriculture in Vietnam has come from draining and preparing many of the swampy marshes and forests of the western part of the Mekong Delta (Hill 1984). The state has encouraged this land expansion in several ways. One way has been the creation of new Economic Zones (NEZ), "regions in receipt of new settlers who are privileged in terms of tax and various other benefits, organized into cooperatives and state farms, the former often partly sponsored and supported by the cooperatives and the municipalities in the 'donor' areas" (Hill 1984). There were at least three NEZ regions in the Mekong delta during the 1980s: Kiem Binh NEZ and My Lam NEZ in Kien Giang province of

the far western Delta, and Hau Giang NEZ of An Giang province bordering Cambodia (Hill 1984). A number of other NEZs were scattered throughout Vietnam, including quite a few in the Central Highlands of Vietnam where they were used to encourage ethnic minorities to sedentarize and abandon shifting cultivation.

These NEZs involved significant migrations of people, although they were never the regional growth engines the state expected them to be. In the first Five Year Plan of 1976-1980, in which the NEZs were implemented, some 252,000 families in total moved to an NEZ. Within the Delta, there are sketchy statistics on how many people moved to one of the three NEZs to set up farms and clear land. In Minh Hai it appears that in 1976-1980, 86,000 ha of land was cleared for agriculture, of which 60,000 was planted in rice. That brought the 1980 total of area in rice for Minh Hai to 300,000 ha. The total number of immigrants to the province in 1976-1980 was 30,000 people. In the NEZ in An Giang, 30,700 ha of land was cleared, and 40,000 people were immigrants in 1981. And in one district of the Kien Giang NEZ alone, 101,000 ha of land was developed or rehabilitated from war time disuse, which tripled the productive area of land in the province, up to 150,000 ha. Much of this land in Kien Giang was converted to state rice farms, instead of being allocated as collectives or cooperatives. This required laborers to harvest and thresh the rice and around 3,600 people moved to Kien Giang to be rice laborers during this time. In Minh Hai, seven state farms, seven cooperatives, and three army-run farms (possibly re-education camps for former South Vietnamese soldiers) were set up in the NEZ (Figures from Hill (1984)).

The steadily increasing number of farmer households in the delta provinces are shown in Table 22, which reflects not only NEZ immigration, but spontaneous migration and repatriation to lands abandoned by the war.

However successful the state projects may have been in encouraging some land expansion for agriculture in the difficult post-war years, there were problems with trying to expand agricultural land and increase the number of farmers in the Delta. These NEZ areas, "especially in the Mekong delta, have been started in environmentally difficult areas of poor, sandy soils or even in areas of saline and acid soils where successful colonization is likely to be difficult to achieve" (Hill 1984). And it is not clear to what degree these immigrants were received in the new areas, or how reliant they were on money and rice from both the state and relatives in their original home villages. And particularly in the Delta, the NEZs were plagued with unforeseen problems such as "lack of farming experience, malaria, destruction of marketing systems without adequate substitutes being provided, confusion in the application of policies, and shortage of such spare parts and basic technical staff as tractor drivers and mechanics" (Hill 1984).

Table 21. Total Sown Area of Rice per Year, 1976-1990 in Mekong Delta, in ha.

Area or Province	1976	1980	1985	1990
Long An	186,200	197,200	204,100	290,700
Tien Giang	171,900	190,800	201,300	248,300
Ben Tre	129,700	138,300	125,100	93,500
Dong Thap	201,600	231,000	212,700	274,500
Vinh Long/Tra Vinh	259,700	261,900	267,200	302,400
Can Tho/Soc Trang	423,300	431,600	480,200	493,900

An Giang	220,700	288,100	263,200	324,900
Kien Giang	222,100	260,200	250,100	270,800
Minh Hai	247,400	297,000	246,900	281,000
Mekong Delta	2,062,600	2,296,100	2,250,800	2,791,400

Source: Vietnam Socialist Republic of 1992

Table 22. Farmer Households in the Mekong Delta 1980-1991

Area or Province	HH in 1980	HH in 1985	HH in 1990
Long An	146,600	174,900	192,200
Tien Giang	171,900	192,600	205,700
Ben Tre	167,500	189,600	223,700
Dong Thap	178,300	189,200	210,100
Vinh Long/Tra Vinh	229,000	255,300	257,500
Can Tho/Soc Trang	317,800	361,600	384,400
An Giang	201,300	232,800	251,200
Kien Giang	139,000	187,300	187,400
Minh Hai	64,500	190,000	226,000
Mekong Delta	1,715,900	1,973,000	2,201,900

Source: Vietnam Socialist Republic of 1992

Additionally, as the NEZs often organized work under the auspices of a collectivized farm situation, the NEZs faced the same hurdles of management and productivity that had beset collectivization all over the country. Particularly from the time collectivization was begun in 1976 in the south, to the early 1980s, the Mekong Delta had poor agricultural production per unit of land and per capita. Some of this stagnant productivity was certainly attributable to war-time damage and disarray, but much of it was also attributable to poor management of farms and lack of incentives to work. Under the collectivized system of agriculture, the Mekong delta of Vietnam had declining or even levels of rice production until 1981. When the liberalized "product contract" system was implemented in 1981, the rice production gradually began to rise, and since 1988, the year of privatization of land use rights, the rise in rice production has been rapid (Nguyen Thi Song An 1996). See Table 23 for comparison with 1976 and 1990.

Table 23. Rice Production Equivalent per Capita 1976 and 1990, in kg

Area or Province	1976	1990	1994
Long An	454.8	658.2	-

Tien Giang	385.9	663.2	-
Ben Tre	302.6	253.3	-
Dong Thap	427.8	916.4	-
Vinh Long/Tra Vinh	486.3	621.2	-
Can Tho/Soc Trang	531.0	631.5	-
An Giang	358.1	811.1	-
Kien Giang	518.7	712.0	-
Minh Hai	565.1	564.8	-
Mekong Delta Total	454.8	658.2	775
Red River Delta Total	273.3	324	361

Sources: Vietnam, Socialist Republic of 1992, and Nguyen Thi Song An 1996

The situation is quite different in Cambodia. The area of cultivated land in Cambodia has dropped dramatically since the 1960s. According to the Ministry of Agriculture, the area of land used for rice cultivation decreased from 2.5m ha in 1967 to 1.8m ha in 1992, a decrease of 28 percent (Economic 1998a). Given the lack of irrigation in most of Cambodia, rice farmers depend on rains and floods for successful crops, which leads to often dramatic productivity differences from year to year. Rises in per ha productivity have been seen in Cambodia since the liberalization of the economy in the years 1988- 1993, but the increase has not been as dramatic as that in Vietnam. The estimated average yield of paddy rice in Cambodia — only 1.3 tons/ha — is very low compared with the rest of Southeast Asia (and Cambodia's per ha level has always been among the lowest in the world, as in 1961 it was documented at only 1 ton per ha (Walker 1961)). For comparison, Vietnam's production in 1996 was 3.76 tons/ha, Indonesia's was 4.4 tons/ha, and China's was 6 tons/ha (Economist 1998b). Much of this difference can be attributed to environmental and labor factors, such as Cambodia's acidic soils; a relative shortage of labor to land; a shortage of draft power for land preparations, low percentage of irrigated rice fields; few high-yielding rice varieties; and low uses of chemicals and fertilizers (World Bank 1994a).

Table 24. Rice Produce in Cambodia, 1960-1992

	1960	1983	1992
Rice yields (tons/ha)	~ 0.98	~ 0.96	~ 1.3
Per capital rice (tons/capita)	~ 0.43	~ 0.24	~ 0.25

Source: Raymond 1996

Variation in Rice Crops:

Rainfed lowland rice is most common in the Mekong delta, although there are areas of irrigated paddy as well as non-irrigated dry upland rice areas. Rainfed lowland rice is grown in non-irrigated bunded fields that are flooded at least part of the cropping seasons. Some higher areas of the Delta can be double and even triple cropped, while some areas can take

only a single crop of the so-called "floating" rice of the delta, which is rice that is able to grow in extensively deep flooded fields.

Oryza sativa predominates in both Cambodia and Vietnam, although *O. glutinosa* is also cultivated (but contributes less than 5 percent of the total rice crop (Dao The Tuan 1985a). There are many divisions and varieties within each of these species, such as early rice varieties and late rice varieties. Can Tho University has collected at least 1,000 local rice varieties in the Delta (Nguyen Huu Chiem 1994). Hickey gives the most commonly used rice varieties in one village in the delta: 14 Vietnamese names for different varieties of *O. sativa*, and seven names for *O. glutinosa* varieties (Hickey 1964). In Cambodia, a 1967 survey found more than 400 different varieties of rice being grown (Sluiter 1992).

Table 25. Main Group of Local Rice Varieties in the Mekong Delta

Rice Variety	Duration in seed bed (days)	Growing period (incl. seed bed) in days	Time of harvest
Early varieties	30-40	130-160	Variable, Oct or Nov
Medium varieties	40-50	160-200	Dec. -Jan
Late varieties	50-60	200-250	Jan-Feb
Floating	none	200-240	Dec. -Jan

Source: Nguyen Huu Chiem 1994

Traditionally (before 1967 when HYV was introduced to the delta), early maturing rice was usually planted in coastal areas and broad depressions, where it could be harvested before saline intrusions in November. Medium varieties were often planted on relatively high areas of tide-affected flood plain where it is difficult to control water. Late varieties were cultivated in low lying areas with plentiful fresh water, and floating rice was cultivated in the high flood plains (Nguyen Huu Chiem 1994). Now more diverse patterns are found throughout the delta because of availability of new HYV varieties, fertilizers, pesticides, and water control facilities.

Currently, four main styles of single crop rice planting are found in the delta. These include (Volker 1993):

- ε **Single transplanted main season rice.** This variety is found in areas where flooding depths usually do not exceed 0.4 to 0.5m. Early, medium, and late varieties of rice are used, depending on the location. Most single transplanted rice is grown in the rainy season and not irrigated. Yields range from 2,500-3,500 kg of paddy per ha.
- ε **Double transplanted rice.** This is used in areas where flooding depths range from 0.4 to 1.0 m. Late varieties of rice are usually used. Rice is transplanted a second time to control weed competition and water availability. Because part of the root system of rice is cut off when it is transplanted a second time, the vegetative period is longer. This is a very labor consuming method, however.
- ε **Broadcast main season rice.** This method includes floating rice and non-floating varieties. Floating rice is grown in areas where floods usually exceed 1m up to 34m in depth. However, the slow rate of rise of water (less than 10cm a day) is essential for success. Yields are generally below 1,000 kg per ha.

- ε **Dry season rice.** This variety is planted in receding flood waters, and is found mainly in Cambodia along the main rivers and around lakes, which provide the needed water.

The decision about which rice to plant varies from year to year. The farmers with high fields often must cultivate only early rice because water drains easily from their fields, leaving their crops vulnerable to drought. Other varieties of rice are planted because they are said to be resistant to drought or flooding, and if bad omens indicate such a disaster may fall during the year, farmers may change to these varieties. "Be amount of working capital a farmer has at the beginning of the planting season and the cost of fertilizer also are essential considerations in selecting types of rice" (Hickey 1964). Anticipated rice prices for the year will also influence farmers' decisions about what, how much, and when to plant. Statistical data on the areas planted to each variety of rice over time would be helpful for future agricultural planning.

Rainfed Rice:

The planting of rice in the Mekong Delta both follows age old patterns of agriculture as well as incorporates modern techniques and varieties. "When the first rains have sufficiently softened the soil the seedbeds are plowed, preferably to a depth of only 5 cm, so the soil will be finely tilled.... Before sowing, most farmers perform a simple ritual to the Spirit of Agriculture, asking him for an abundant crop. This consists of offering some tea and cooked rice, but the usual joss sticks are absent because, as the farmers pointed out, burning joss closely resembles wilting rice plants - a bad omen" (Hickey 1964). Rice seeds are soaked in water for a few days and kept damp so that they germinate; they are then scattered on the soil of the seedbed and allowed to sprout. While the seeds are growing, the farmers begin to prepare their fields for the transplanting. This all must be done in the proper rhythm at the proper time, as the seedlings must not, be too high before being transplanted. Plowing fields took around 5-6 days per ha. in the 1960s with manual labor and wooden plows (Hickey 1964); most areas of the delta are still farmed in this way as mechanization is not suitable to many of the soils of the delta.

Once the fields are ready and the seedlings the proper height, the farmer consults the lunar calendar for a proper day to plant. Many farmers will hire manual labor to assist with the transplanting, and all family members are expected to help as well. It was estimated that it took a team of twelve one eight-hour day to transplant one hectare. Transplanting is accomplished by uprooting seedlings, collecting bunches of thirty or so, tying these into bundles, collecting the bundles, and carrying them out to the fields; and then planting a few seedlings at a time, each group around 20 cm apart, and covering the seedling roots carefully with mud (Hickey 1964).

In the Khmer plains, rice seedlings are also prepared in seedbeds, some of which may be under trees that have been flooded and where rotting leaves provide manure for the seedlings. Fields are ploughed during this time, and Khmers describe these plowed fields as "having been awakened" (Sluiter 1992). Whether the farmer will broadcast or transplant these seeds depends on the amount of labor he can gather for the task, and on the supplies of water anticipated. In Cambodia, "wet rice is normally planted in May and June, for the most part as a family enterprise, each group planting 10-15 acres. In all areas except Battambang and Pursat seed beds are planted first and transplanted after one month. The broadcast method of planting is used in Battambang and Pursat" (Walker 1961) Plows and buffalo are still used in much of the delta for preparing fields.

After transplanting, changes in water resources can have disastrous effects. Delays in the monsoonal rains will leave the seedling vulnerable to drought. Farmer may sometimes resort to irrigation with brackish canal water in desperate situations, although they know it will affect the rice crop and the soil. Once plants take root, the major chores are to maintain the

bunds, weed, and prevent crop damage. Regulating water during the rainy season is usually a matter of letting off excess water, given steady rains. Relying on rain does not preclude the use of irrigation techniques, however, such as manual basket lifts, foot powered water wheels, and sometimes gas powered pumps to move water to different heights in different fields (Hickey 1964). Irrigating fields next to water sources is easy with these methods; when the fields are further away, temporary channels may need to be dug, or fields overflowed to allow water to run off to lower, farther away fields. When the plants reach maturity, farmers drain their fields by breaching the bunds.

During the growing season a farmer may tend to other farm tasks. In Cambodia, gathering sap from sugar palms was a common growing season activity in the 1960s (Walker 1961) and tending to gardens or fish ponds is common in the rest of the delta as well.

Once the plants have matured and harvest begins, all family members and hired labor hit the fields to gather the grains. Gleaners will often comb the fields after the work teams have gone through. Hand knives and sickles are still often used for harvesting. Threshing is done either with machines, animals, or hand labor. The collected paddy is spread in front of houses for drying, and from there it is winnowed for the market. Most farmers separate a certain amount of rice to be used by the family throughout the year, and paddy to be used to pay rents or labor costs. The rest is sacked and taken to nearby markets for selling to rice mills or rice exporters. In Cambodia, "in the regions near large rice mills, paddy is collected by truck and transported in large volume to the mill. In more remote areas, hand husking, shifting and winnowing is not uncommon. In addition to trucks almost every known method of transportation is used to deliver paddy to local mills, including oxcarts, canoes, boats and even in hand carried baskets" (Walker 1961).

After the first yearly harvest, farmers with plentiful waters and good soils win double crop. There are some places where triple cropping is also possible. In Cambodia, a second crop of dry rice is often planted in December and harvested in April before the new wet rice crop. However, dry rice accounted for only 5 percent of the total rice crop in Cambodia in the 60s (Walker 1961)

Floating Rice:

The unusual floating rice region of the Mekong delta is the area that is subjected to extensive high waters every year. Floating rice is a variety that grows so quickly it is able to keep the panicle above the high flood waters of the rainy season. When the floods recede, the rice dries in a tangled flat mass of stems on the bottom of the paddy field (Cummings 1978). While the rice is highly adaptive to the hydrological balance of the area, it is not highly productive. Yields are often very low, around 1.5 tons per ha. Before the war it was estimated that 15 percent of the total rice area in Cambodia was floating rice (Sluiter 1992), and similar acreage was found in Vietnam (Cummings 1978). Current statistics are unavailable on the total amount of land under floating rice, but it has been declining in recent years (Dao The Tuan 1985b).

Table 26. The Average Labor Input into Different Rice Regimes in the Delta

Type of Rice Cultivated	Working Yield (ton/ha)	Days/ha
Single crop, transplanted	70	2.1
Double crop, transplanted	75	12.2
Floating crop, direct seeded	40	11.5

Source: Dao The Tuan 1985b

The raising of this rice with low per unit productivity seems to have universally drawn the wrath of the state and agronomists. During the American presence in South Vietnam, the USAID mission included introducing high-yield varieties of rice to the delta to gradually eliminate the unproductive strains of floating rice (Cummings 1978). And after the unification of north and south, northern agricultural cadres from Hanoi and the Red River Delta were set down to the delta to administer new policies. They were unfamiliar with floating rice, as it is not grown in the North, and they were firm that this rice needed to be replaced by more productive ones: "With the help of agronomists and cadres from the North and learning from the experiences of old peasants, the responsible party cadres of Phu Tan had worked out a bold project: to totally replace the crop of slow-growing, low-yield floating rice by more profitable crops" (Nguyen Khac Vien 1985). The plan was to replace the floating rice with faster growth varieties, to speed up irrigation at the end of the dry season to plant a spring crop, immediately after the spring crop plant a fall crop while waters are still high, and then let the waters overflow the dikes after the harvest of the autumn rice (Nguyen Khac Vien 1985). This of course required that irrigation canals be built in the floating rice region, as well as a system of protective dikes. A number of pumping stations were built by the government, and some areas of the floating rice region were converted to double cropped rice (Nguyen Khac Vien 1985). However, still other areas remain floating rice to this day.

Rice Improvement Facilities:

In 1971, a USAID-funded report predicted that increased rice production in the Mekong delta would come from three improvements: extension of the cultivated area; improved practices applicable to traditional rice varieties; and double cropping of new high-yielding varieties. But in order to achieve these goals, the report said that major infrastructure programs would be needed to improve water management: irrigation, flood control drainage and protection against salinity intrusion, in addition to implementing agricultural extension work to pass on HYV techniques and seeds (Resources for the Future 1971). Some of these projects were implemented by the US and Republic of Vietnam during 1960s, like building water works and introducing some varieties of HYV rice (Development and Resources Corporation 1969).

During the Vietnam War, the National Liberation Front also engaged in agricultural improvements in the areas that it controlled in the Delta. Such acts included building wells and installing hand pumps, digging canals, and redistributing rice lands (Wiegiersma 1985). In the years after collectivization, the emphasis was immediately on resettling war-disrupted agriculturalists on their land, and expanding the areas for rice production through reclamation and irrigation projects. A recent report says that it was estimated by the Vietnamese state after reunification that with the help of more irrigation and high yield varieties and more inputs, the Mekong delta could contribute a further 4-5 million tons of paddy annually (Nguyen Thi Song An 1996)

The emphasis in improving agriculture in recent years has returned to the improvement of rice varieties themselves (Tai Duong Thanh and Pham Van Bien 1993; Chau 1994). On-farm research on farmer adoption of HYV rice in Cambodia has revealed that farmers generally look for high yield in all rice cultivars, and riskier new cultivars are grown in more drought-prone upper terraces of rice fields. Farmers looked for drought and water tolerance according to where the rice to be planted. Other less important preferences include production of rice straw, lodging resistance, eating quality, fertilizer responsiveness, aroma, expansion when cooked, whiteness, heavy grain more grain per panicle, high milling recovery, and higher market prices (Fujisaka 1990). This research indicates that the main factor influencing farmer strategies seems to be minimization of environmental risk to the

rice crop.

Additionally, the new varieties of rice with shorter cultivation cycles (less than 100 days) have seen the explosion of double and even triple cropping cycles in much of the Delta. The changes in cropping are indicated in Table 27.

Table 27. Percentage of Rice Land under Cropping Systems, Mekong Delta

	1980	1990
Triple Cropped	1%	4%
Double Cropped	29%	54%
Single Cropped	70%	43%

Source: World Bank 1994a

Furthermore, there has not been as much research on HYV of rice for Cambodia as there has been for the Vietnamese rice producing areas. Therefore, Cambodia is likely to continue to lag behind Vietnam in rice production for some time to come.

Integration with Other Agricultural Products:

There is not much evidence in the literature that rice is integrated with other crops, like sugar cane, in delta farming systems. There is some integration of winter rice and jute in swampy areas with acid soils that are not amenable to water control measures. The jute is highly resistant to drought and can also stand in deep water, as well as adapt to acid soil (Nguyen Huu Chiem 1994). Yarns are also planted with rice in raised bunds in areas around the Vam Co Dong river (Nguyen Huu Chiem 1994).

There is also some integration of rice with fish crops, but only about 2 percent of the total rice area of the delta is used for this rice-fish culture (Rothuis, Nhan et al. 1998a). This system is usually practiced to provide supplementary fish protein to households with little extra labor or input costs, as the fish have water and nutrients provided in the rice paddies. Added benefits to rice-fish culture include reduced weed competition (as paddies with fish are usually subject to higher water levels) and an increase in paddy production per ha, which may be because of both suppressed weeds and fertilization of soil through fish excrement. However, rice-fish culture is made difficult in the delta because of farmers' tendency to favor high plant densities, leaving little room for fish in the rice field; by higher irrigation costs to create high water levels; and by high pesticide use, resulting in fish mortality (Rothuis, Nhan, et al. 1998b). Furthermore, the gross return from rice grown in a fish-rice culture was about 20 percent less than rice monoculture, because of the cost involved in creating better trenches and dikes for retaining water. This lower return was compensated for by the addition of fish income to the household, leading researchers to assert that "as a result, total farm profitability was not affected by the introduction of rice-fish culture" (Rothuis, Nhan, et al. 1998b). Farmers who were experimenting with rice fish culture were also found to be using significantly less pesticides on their fields, in order to prevent mortality of the purchased fingerlings. This has led some researchers to wonder if rice-fish culture could be an appropriate addition to Integrated Pest Management strategies. The report on rice-fish culture concludes that "The main beneficial effects of the integration of rice and fish, in the semi-deep water area of the Vietnamese Mekong Delta, are probably in the field of environmental sustainability and system biodiversity. Despite the low fish yields, and their rather insignificant contribution to the total farm profit, the inclusion of fish in the farm is

important in terms of a decreased use of pesticides. Moreover, a higher degree of farm diversification safeguards the household income against the risks associated with fluctuations in rice market prices and crop failures" (Rothuis, Nhan, et al 1998b)

Flooding:

The flooding season of most of the Mekong delta follows the pattern found across monsoonal Asia, where shallow, irregular, and pronged flooding is characteristic. Rainwater is ponded and stays on the land for long periods of time, although droughts may occur in some years. Fields also receive overflow water from higher fields during and after rainfall. "Hence, lower paddy fields in a toposequence usually have a better provision of water than the higher ones... Flooding of large areas may occur incidentally during exceptionally high rainfall or high river discharge, but the surplus water is rapidly carried off through natural drainageways and canals to the lower courses of the rivers or to the sea" (Moormann and Breenian 1978). In Cambodia, flooding is often common in rice fields. If a late first rainfall combines with early flooding, the paddy yield declines by as much as 30 percent. "To counter this unpredictable rainfall and irregular flooding, the farmer relies on a contingency approach to planting schedules and methods of cultivation and uses a broad spectrum of rice varieties, each with special characteristics such as higher drought resistance, better tolerance of submersion time, better adaptability to the acid-sulfate sandy soils, or the ability to grow with the floods (floating rice). Such complex systems are not conducive to steady performances (World Bank 1994a). Should the farmers be locked into agricultural schemes that do not allow for this last-minute flexibility (such as HYV that waterlog easily; or inflexible irrigation schedules), they will probably suffer badly in flooding years.

The flooding of rice lands around the Tonle Sap lake follow a slightly different pattern. There, shallow flooding after deep seasonal flooding is found. The land around the lake inundates after the monsoonal reverse flow of the Mekong. Rice is generally planted when the level of the lake begins to recede and planting follows the floodwaters toward the center of the lake. The rice lands gradually dry out and if they are not irrigated, they rely on the residual soil moisture from the earlier floods to grow (Moormann and Breeman 1978).

Irrigation:

The extensive canal system bat by the French in Vietnam provides numerous ways of access to water diverted from the Mekong and tributaries. The amount of dredging undertaken in the delta started from practically nothing in 1885 to around 2,000,000 m³ dredged in 1900, 7,000,000m³ in 1912 and almost 12,000,000m³ in 1924 (Brocheux 1995). From 1886 to 1930, these dredging operations "permitted the drainage of 1,425,000 ha of land, at the cost of around 52 million piasters. The expenses were offset by the sale of land at public auction and the revenue derived from the export of rice" (Brocheux 1995). In recent years, more and more drainage ditches and canals have been added to this system. There are now over 4,500 km of canals and tributaries in the Delta (Economist 1998b).

However, the situation is different in Cambodia. Of the 2,500,000 ha planted to rice in Cambodia in 1967 less than 90,000 were irrigated (Resources for the Future 1971). While the Khmer Rouge regime oversaw the digging of thousands of km of canals in Cambodia during 1975-1979, poor planning meant that most of them were unusable (Cambodia, Ministry of Agriculture, Forestry, and Fisheries 1996). The canals did not reach the intended agricultural lands and often provided only stagnant water and breeding grounds for malarial mosquitoes (Sluiter 1992). Thus, the land under irrigation in Cambodia has not risen by much in recent years, and remains at approximately the same level as in 1967. Additionally, future digging of irrigation canals in Cambodia may be hindered by land mines and poor quality soils.

Irrigation is practiced in the upriver streams of the Mekong as well. Called "muang faai" in Thai, streams are dammed with a lattice-work of materials such as rocks, wood, bamboo and earth. The dams raise the stream level just enough to allow diversion into an irrigation channel that flows by gravity down to the fields. "The muang faai has always been accompanied by a strict set of rules maintained by muang faai leaders, to ensure that the surrounding forest is safeguarded and the water distributed to all members of the irrigation group. Since many of the forests have been logged over the past decades, construction materials needed for annual repair are no longer readily available and free of charge. In the rainy seasons mountain streams become wilder and damage structures more frequently, while soil washed from bare slopes ends up clogging the channels. To eliminate the need for repairs, many farmers have replaced the traditional structures with steel and concrete dams. They have the disadvantage that they are not as adjustable as the traditional dams, a problem especially where the forests have been cut down. Eroding sod and faster run-off can cause erratic changes in streams and channels, demanding adjustments in darn height and channel maintenance. But whatever the materials used, both modern and traditional dams require the forests" (Sluiter 1992). Table 28 indicates patterns of irrigation expansion in the Mekong Basin in recent years.

The possibilities for future irrigation expansion in the lower Mekong basin are somewhat limited. With irrigation, two key issues with water delivery are the rate and duration of flow. Both are key to understanding the water use systems of the Mekong basin. The flooding of the Mekong and monsoon rains in the lower basin provide opportunities for naturally flooded fields without irrigation works. But other areas, such as in the Cambodian plains, also lend themselves to some irrigation expansion, because the flow rate of the Mekong and the topography of the land are commensurate with irrigation possibilities. The problem lies however in balancing the economic costs of building canals and banded fields with the returns to farmers (Rice 1997).

Table 28. Irrigation Expansion in Mekong Basin Countries 1980-1990, in ha of irrigated crop land

Country	1980	1987	1990	Annual growth rate %
Vietnam	1,542,000	1,800,000	1,840,000	1.5
Cambodia	89,000	90,000	92,000	0.4
Thailand	3,015,000	3,996,000	4,300,000	3.6

Source: Murty and Takeuchi 1996

Additionally, the adverse environmental effects associated with irrigation should be weighted in any decision to expand irrigated agriculture in the region. These environmental effects include:

- ε soil degradation (salinity and alkalinity)
- ε land degradation due to water logging deterioration of groundwater quality
- ε deterioration of surface water quality in irrigation return flows
- ε public health impacts of schistosomiasis/mosquito vectors (Murty and Takeuchi 1996)

The Mekong delta has various environmental problems with irrigation in agricultural practices. In the dry season in the lower Delta, canals fill with saline water coming up from the South China Sea. Any change in the flow of the Mekong in flushing out this salinity (such as would be caused by the drawing off of more irrigation water upstream), or any change in the monsoon climate towards more drought years, would tend to worsen the salinity intrusion problems. That is why the World Bank argued as far back as 1972 that if dams were ever built upstream from the Delta, "upstream storage on the mainstream to provide low-flow augmentation will become an important factor in Delta development" (World Bank and International Development Association 1972). The augmentation of water flow to flush out salinity is extremely important in keeping the soils of the delta productive. Some advocates of expanding rice production in the Vietnamese delta have argued for sea dams and dikes to keep out the saline water in the dry season and upstream dams on the Mekong to reserve fresh water in reservoirs for use in the dry season as well. However, experiments in the eastern delta with building sea dikes and drainage canals have not been successful. One sea dike was reportedly blown up by Mekong farmers in 1990 because it was preventing saline water from washing the acidity out of the soil in the dry season (Sluiter 1992). Additionally, saline intrusion during the dry season is sometimes used to farmers' advantage. Shrimp can be raised in fields with saline water, and when the dry season is over, the rains can flush the salinity out of the fields with careful use of drainage ditches. The salt water keeps acidity in the soil down as well.

In Cambodia, the dry season brings a different problem for irrigation. The topography does not offer good sites for dry season water storage, which means that areas that can be irrigated in the dry season are limited; supplementary irrigation of dry season crops has to involve diversion or water-retention structures. 'Unfortunately, many of such structures that were built during an earlier period and that had functioned well such as the "comatage" canals, have become non-functional as a result of the misconceived network of irrigation/drainage canals built during the 1975-1979 period. These latter structures mostly ignore or impede the natural drainage flows, and often lead to uncontrolled flooding and crop damage" (World Bank 1994a). Therefore any expansion of irrigation in Cambodia almost has to start from ground zero to building both new canals and water retention structures and reservoirs.

The economic costs of such projects would be enormous, however. In fact, prospects for irrigation expansion in the lower Mekong are generally not good on either economic or environment grounds. Even the World Bank has agreed that large-scale irrigation schemes were simply not feasible in much of the area of Cambodia in which they could be built. The Bank noted: "The low returns derive from the character of the command areas of projected irrigation schemes, which are predominantly rice lands generally unsuited on account of soil types and poor drainage for other crops, and from the low unit value of rice. Even an increase of four tons of paddy per hectare - far above levels yet attained in the region - would yield only about \$200 per hectare gross income." (World Bank 1994a)

Because of these inherent natural difficulties in irrigation in the lower Basin, large scale irrigation projects have generally not been on the drawing board for any of the political regimes in the two countries. As a result, alternatives to improving water use has been suggested. The World Bank noted 25 years ago that:

It is against this background that the Bank's review has considered the possibilities for raising the agricultural productivity apart from conventional storage irrigation. The first finding is that much greater attention should be paid to lower cost ways of providing improved water control. Above the delta, variations in the timing of the monsoon and the frequent occurrence of dry spells during the growing season present serious hazards resulting in wide variations in rice production from year to year. Some modest run of the river schemes for

supplying additional water at the crucial early growing stages could well prove viable. Based on the limited information, the area which could be so serviced is, however, likely to be quite small. More important could be expansion in use of low-lift pumps along rivers and the existing network of canals in the delta. The rate of expansion in the use of pumps in the delta indicates considerable possibilities and should permit some diversification into higher value dry season crops on stretches of alluvial soils. Improved drainage and better control of flood runoff can provide additional possibilities in some other areas (World Bank and International Development Association 1972).

Groundwater use:

Many small low-lift water pumps are used in the delta for fresh water for drinking and for agriculture. The extensive use of low-lift water pumps may be leading to depleted groundwater levels in the delta, although there is little information available about it. If the groundwater tables are altered, the chances for saline intrusion into groundwater supplied are increased. As a result, research on current levels of ground water use and its possible effects is needed for the Mekong Delta area.

Water Users:

The rights of access to water and water user's rights are unclear in much of the literature on the delta. Mutual-aid societies have often stepped in to support the construction of water works around members' fields, and canals have often been dug with members of an aid society each contributing an equal amount of labor (Hickey 1964). However, there are also reports of much conflict over how water is allocated in each village in the area (Nicholson 1996). How and when users have *de facto* or *de jure* water use rights is an important question for water management in the lower Mekong. Do these water rights vary according to farm size and type of crop? Who undertakes the maintenance and repair work on canals and diversion structures? Since canal areas are not coterminous with village areas, how is intra-village irrigation management planned in the Delta? These are questions that need to be explored in the delta in order to understand local water use systems (Coward 1976). A report on irrigation management associations in Southeast Asia indicated that for Vietnam, water user's groups tended not to exist or to be subsumed under the authority of local provincial officials. In an irrigation scheme south of Saigon, "Farmers at Dau Tieng showed little interest in or experience with taking collective action to secure mutual benefits, except for clearing the watercourses. The fact that many of the farmers in this scheme are relatively recent arrivals, come from different parts of the country, and speak different dialects helps explain the lack of cohesion" (Rice 1997).

For fresh water use, many villagers in the Delta sometimes must resort to stream or canal water put in a large earthen jar with some rock alum which is reputed to purify the water (Hickey 1964). Rainwater is also collected for drinking in those areas without wells.

Pesticides:

Although there is anecdotal evidence that pesticide use is rising dramatically in the delta areas, there are few firm figures or studies on pesticide use on rice growing areas of Vietnam and Cambodia (Heong, Escalada, et al. 1994). A survey in 1992 of 685 farmers in the Mekong Delta concerning pesticide use revealed that the mean number of sprays per farmer per season was 6.9 sprays (this can be compared to Leyte, Philippines, where the average was 2.8 sprays). 89 percent of the total treatments were insecticides, 2.7 percent were fungicides and 8.3 percent were herbicides (Heong, Escalada, et al. 1994). The main target pests of farmers in this study were rice leaffolders and other lepidopterous leaf

feeders, and brown planthoppers.

A recent study found that even though pesticide use in the Delta is high, insect attacks are still common. The report noted: This analysis indicates no apparent effect of pesticide use - fungicides, insecticides, and herbicides - on the pattern of distribution of injuries. In other words, pesticides do not appear to have any significant effect on the overall occurrence of pests" (Du, Savary, et al. 1997). This could very well be because spraying broad spectrum insecticides against rice leaffolders may cause brown planthopper infestations later in the season. "Farmers protect their crops from leaf damage in the early stages because they perceive that this damage can lead to yield loss. Encouraged to achieve high yields, farmers tend to pay more attention to these "cosmetic" effects. Such a misuse of insecticides has clearly led to disruptions of natural control mechanisms which then require additional sprays against the secondary pest, the brown planthopper" (Heong, Escalada, et al. 1994)

Evidence also suggests that pesticide use is reaching dangerous levels in the delta. A recent newspaper account notes that "Farmers in Viet Nam have been using too many strong agri-chemicals, according to recent research Some 200 agri-chemicals are in wide use, including those already banned from use for vegetables and fruit. Banned chemicals include Methyl Parathion Monitor and Thiodan. The research said that 70 per cent of farmers who use chemicals on their crops feel very tired, 19 per cent report headaches while 10 per cent report vertigo (fear of heights). The research also revealed that nearly 25 per cent of farmers remain oblivious of the harmful effects of overusing chemicals, with some farmers saying there is no harm in using agri-chemicals "for a long time... (Vietnam News Service 1998h). However, the misapplication and overuse of pesticides has had disastrous results. Recently 81 Vietnamese in the delta were hospitalized and one man died after eating pesticide-contaminated vegetables in Tra Vinh. A newspaper report about the incident noted that

The farmers know little or nothing about insecticides, except that the chemicals help make their vegetables grow faster," said Dr. Tran Cong Tao, a senior health official in the Tuu Can district where the latest rash of food-poisoning occurred.... Powerful insecticides, which are widely banned elsewhere as dangerous to people and the environment, are still widely available in Vietnam Even pesticides banned by Vietnamese officials are still readily available through the country's pervasive underground economy, Tao said. The 70-year-old man died just hours after eating the contaminated vegetables, one of a series of food poisoning incidents over the last two weeks in the Mekong Delta district. (Deutsche Presse-Agentur 1998)

To counter these problems, there is some indication that Integrated Pest Management is being encouraged by the state in Vietnam in recent years, but more information needs to be collected on this topic (Chau Luong Minh 1995).

Cambodia appears to have less of a history of using pesticides. This is perhaps because the country was so politically isolated in the 1970s when pesticide use around the world skyrocketed. As a result, farmers in Cambodia have adopted a number of alternative strategies of pest management. Farmers are known to lay down ash for army worm infestations and to flood fields when seedling maggots (*Atherigona spp.*) are present (Fujisaka 1990). Sometimes more urea fertilizer is applied to areas infested with unidentified diseases. [Weeds were not identified as a major problem in this particular study]. Other pest control measures for paddy crabs and rats included traps and draining fields (Fujisaka 1990). But there is also some indication that pesticide use, especially methyl parathion, is rising in Cambodia (Arida, Heong, et al. 1997).

Fertilizers:

Because so many of the soils of the lower Mekong basin are marginally adequate in chemical content (see Section One), additions of nutrients through fertilizer use is quite widespread. Even 30 years ago, Vietnam was using large quantities of fertilizer on its agricultural lands, as shown in Table 29.

Table 29. Fertilizers Consumed in 1965-6 (kilos per ha. of cultivated land)

Country	N	P ₂ O ₅	K ₂ O
Vietnam	9.0	18.9	3.8
Thailand	1.6	0.9	0.4

Source: Resources for the Future 1971

Even in the 1960s, all farmers in the village studied by Hickey used chemical fertilizers on their rice fields. Before chemicals, farmers would use a mixture of animal manure, ashes, and a compost of straw and dead leaves (Hickey 1964). Others have documented the use of duckweed composted into fertilizer in years past (Hill and Cheung Man Bui 1986). Purchasing new chemical inputs is often a financial burden for families, but they can often buy on credit, to be repaid when the crop comes in. When to apply the fertilizer depends on the farmer's own preferences, and it varies from directly after transplanting to late in the harvest.

With the liberalization of agriculture in 1981, fertilizer use per ha increased 211 percent in the south. The decollectivization in 1989 caused another increase of 361 percent in fertilizer use (Nguyen Tri Khiem 1996). One author believes that "economic reform has led to greater investment in such inputs as chemical fertilizers, which now account for 65 percent of variable costs of rice farmers. The use of fertilizers almost doubled between 1985 and 1993" (Nguyen Tri Khiem 1996). Current fertilizer rates have risen dramatically, from 40kg/ha in 1982 to 135 kg/ha in 1992. This rate is higher than Indonesia but below China (Economist 1998b). Current research by Can Tho university and the International Rice Research Institute is addressing the question of what amounts of long-term fertilizer use are necessary for productive rice crops in the Mekong Delta (Tan, Anh, et al. 1995).

It is estimated that in 1993, Cambodia was using only 10 kg of nutrient fertilizer per ha, a low figure. Recent FAO on-farm studies in Cambodia have indicated that 1 kg of fertilizer applied in a field trial resulted in a 13kg paddy yield increase, with average yield levels of around 2.5 tons/ha in the dry season and 1.3 tons/ha in wet season (World Bank 1994a). As a result, more fertilizer use is probably going to be encouraged by the FAO and the state in Cambodia.

The negative effects of fertilizers in the Delta have not been documented in any reports. Possible water contamination of fishing areas because of excess N or other chemicals have not been reported for the Delta although this is an area that probably needs further research.

Mechanization:

Mechanization of agriculture has always been low in the lower Mekong basin compared with other neighboring countries like Thailand. For example, in 1973, there was one tractor for every 2,500 people in Thailand, while there was one for every 9,200 people in southern Vietnam.

The lack of mechanization of agriculture in the Delta is probably due to two reasons. In

Vietnam, the clayey soils make tractors difficult if not impossible to use in the sticky mud. And in Cambodia, the lack of foreign exchange currency and extreme political upheavals of the last 30 years have probably prevented many tractors or other mechanical inputs from being purchased. The future benefits of increased mechanization of agriculture in either area have not been explored in the literature.

Table 30. Tractors in Service and Ratio to People in 1973

Country	# of tractors Ratio	# people per tractor
S. Vietnam	1,600	9,200
N. Vietnam	2,400	7,700
Cambodia	1,400	4,800
Thailand	13,273	2,500

Source: Hill 1979

Credit and Markets:

Improvements to rice production can be made when farmers have access to credit to buy fertilizers and use tractors and other inputs. But many rural areas in the lower Mekong have traditionally been "poorly served by banks or other credit institutions, and the main source of credit is through friends, family or traders, in which case the rates charged can be very high and the supply of funds low. Suppliers of many agricultural inputs are often small to medium sized Chinese family firms in the Delta" (Resources for the Future 1971). Access to credit has improved in recent years with several state loan programs for farmers: "The Vietnam Bank of Agriculture has been providing short and medium term credit to farmers since 1991. In 1992, it was able to provide (mainly short term) credit support to only 10 percent of potential rural borrowers. Given the banks' restrictions on deposit and lending rates, as well as its lack of qualified staff, it remains to be seen whether the VBA will ever be able to operate on a commercial basis, mobilizing rural savings to finance the investment needs of farmers" (Nguyen Tri Khiem 1996). Recently, the Vietnamese state has also provided loans to extremely poor farmers and women-headed households for agricultural diversification through the Bank for the Poor; loan sizes tend to be less than \$ 100, however. This usually can only buy a pig or some seedlings for pineapple or other crops, and cannot be used for the significant land improvements that many marginal farmers need.

There is some indication that more credit has been forthcoming recently. A May 1998 news report notes that

Ten million farming households nation-wide will benefit from five major projects covering flood-mitigation, disaster-relief, purchase of rice, sugarcane production, and hunger eradication and poverty alleviation. The Government has directed the Bank for Agriculture and Rural Development (BARD) to fund these projects. The Living with floods project involves raising the ground floors of houses and building houses on stilts in the flood-prone Cuu Long (Mekong) Delta. So far, about 256,472 households have been allocated loans totaling VND 1,051 billion for the purpose. The project on rehabilitation in the aftermath of tropical storm Linda in the southern provinces will improve irrigation systems, repair and build fishing boats and other relief work. BARD's local branch has provided loans to nearly 30,000 households, while VND 1.2 trillion has been earmarked for

providing loans by the end of this year to promote fisheries and build offshore fishing vessels. However, the implementation of this project has been slow, and some farmers and fishermen have been waiting for a long time to receive loans. For purchasing the 97-98 winter-spring subsidiary crop, also in the Cuu Long, a capital of VND 4 trillion is required. BARD provided capital to farmers at the beginning of the harvest in January, as part of this project. The bank will ensure that businesses have sufficient capital to purchase the crop (Vietnam News Service 1998b).

In addition to state banks and government agencies, "Perhaps the most important commercial institutions providing marketing services to Basin farmers is the rice mill located in or near almost every town.... The rice millers, who, like input suppliers, are predominantly Chinese, have come to perform a multitude of functions for the farmers. Rice millers extend credit during the rice season, buy the crop at harvest, transport the crop to their mills, provide some short term regional storage of rice, and sell it locally or to the national and international markets" (Resources for the Future 1971). Research on the social institutions currently guiding access to credit for Delta farmers is almost nonexistent and tends to be dated (Than Van Cao 1992). There also appears to be no literature on access to credit for Cambodian farmers.

Markets for rice products are still managed by the state. For example, "the Prime Minister's office normally approves export targets based on recommendations made by the Ministry of Agriculture and Food Industry, the former State Planning Commission, and the Ministry of Trade. MAFI is responsible for maintaining the country's "food balance" and recommending when to export and to which countries. The MOT supervises all import and export activities. It also sets the minimum rice export price, adjusting it periodically according to the world price. In 1988, some 40 organizations were participating in rice exporting. At the end of 1993, the government decided to limit the number of rice exporting organizations by granting export licenses to only 15 state owned enterprises" (Nguyen Tri Khiem 1996). This situation has led to considerable variation in rice prices at the farmgate and at retail as "there are so few SOEs involved in the export of rice, as each is expected to make an annual contribution to state revenue through export taxes, farmgate prices could be driven down significantly in periods when trading companies failed to meet their targets" (Nguyen Tri Khiem 1996). Recent accounts suggest that this year's drought has strengthened the state's resolve to control rice markets and exports: "Vietnam, the world's second largest rice exporter, which had imposed a temporary freeze on new rice export contracts since mid-April, has started to approve limited new rice export sales, Ho Chi Minh City rice traders told Dow Jones Newswires Tuesday. The traders said the Vietnamese government is seen gradually releasing its grip on control of rice export sales. While some new export quotas were recently granted to a few exporters, there hasn't been an official lifting of the temporary ban" (Dow Jones 1998).

2. OTHER FARM CROPS

Although rice is by far the predominant crop of the lower Mekong basin, other crops are grown as well, although in much smaller numbers and on much smaller areas. [This has not always been the case. In a travelogue of 1872, a French administrator living in Ha Tien described the area as entirely dependent on pepper production and fishing. Rice was not to be found (Morice 1875).] The predominance of rice over other crops in the Vietnamese delta is shown in Table 31.

Even in the early 1970s when these statistics were published, there was a push by the state to diversify farm holdings in the delta, and create more opportunities for farmers to make a

living. A US report of the times states that: "The performance of Mekong Basin farmers shows a similar responsiveness to economic opportunity. Lao farmers have responded to vegetable market opportunities; Thai farmers to kenaf and corn opportunities; Cambodian farmers to new opportunities with cash crops; and Vietnamese to various opportunities for fresh foods and fibers. Moreover, basin farmers have demonstrated a uniformly positive reaction to the prospect of irrigation water" (Resources for the Future 1971).

Table 31. Land Use in Southern Vietnamese Agriculture in 1970

Crop Type	Area in ha	Percentage of Land area
Rice	3,900,000	95%
Maize and other cereals	34,000	1%
Beverages, spices, tobacco	18,000	>1%
Sugar-cane	17,000	>1%
Rubber	107,000	3%
Perennial oil crops	141,000	1%
Totals	4,118,000	100%

Source: Hill 1979

Diversification of crops in the lower Mekong is highly dependent on the agronomic conditions found in different parts of the area; different crops have widely divergent nutrient, water and weeding needs. For example, along the high natural levees of the Tien and Hau rivers of the upper Mekong in Vietnam, where the soil is drier and has little saline intrusion, "one can find houses on stilts with house gardens of coconut, mango, jackfruit and others. In An Giang province, soybean, mungbean, and cucumber are planted along the high natural levees" (Nguyen Huu Chiem 1994). Hendry found that in one village in the upper Delta in the 1960s, approximately half of all households in the village raised both fruits and vegetables in addition to rice (Hendry 1964).

Many alternative crops need raised beds to grow in the lower Delta. The raised beds not only keep the crops dry and flood-free, they also help drain the soil of acidity. Raised beds can be permanent for long-term crops, or just seasonal use of the rice fields during the dry season. For the 4000 ha of most acid soils in the Plain, alternative crops such as pineapple and cashew have been proposed, because they are more tolerant of acidity than rice is. "To plant pineapple or cashew trees, farmers have to construct polders of different sizes depending on the field. Then raised beds are constructed, 5 to 6 m wide and about 60 to 70 cm higher than the original land surface. The space between two raised beds varies according to the amount of soil that has to be taken for the beds. Care must be taken during excavation not to bring pyritic and jarosite layers to the top of the beds. First the topsoil should be set aside, then jarosite or pyritic layers are deposited on the beds, and finally the original top soil is spread over the beds. It takes much time to prepare the beds, but they can be used to cultivate through one rainy season, because toxic substances are washed away" (Nguyen Huu Chiem 1994) The yield of pineapple in these sorts of beds is usually 10-15 tons/ha.

Fruit trees are also often planted on raised beds or dikes to prevent the submergence of roots in floods and rainy seasons. The ditches dug between these dikes can be used for

raising fish or shrimp as well. For example, coconut gardens with fish ponds are often found in the delta, particularly in Ben Tre province. "To plant coconut, farmers construct polder dikes around their gardens to prevent intrusion of saltwater and also to keep freshwater for raising fish and freshwater shrimp... Within the polders, farmers have constructed parallel raised dikes of 5 to 6 m width, 50 to 60 higher separated by ditches of 1 to 1.2 m depth and 2 to 2.5 m width. . . . Coconut trees are planted in one row on the middle of dikes or two rows on the sides of dikes.... To raise good coconut trees, experienced farmers often choose fruits of parent trees with desirable characters, such as many fruits, thick copra and thin fiber.... Each coconut tree can bear fruit in 5 to 6 years after planting" (Nguyen Huu Chiem 1994).

The dominant commercial crops grown in the Delta are soybeans, sugar cane, vegetables, tobacco, pineapples, jute, coconut, citrus fruits, and pepper. In Cambodia, non-rice crops include sugar cane, vegetables, cotton, peanuts, soybeans, tobacco, sesame, and corn (Sluiter 1992). State encouragement of alternative crops, particularly sugar cane and groundnuts, is increasing in Vietnam in particular.

Towards meeting the government's target of producing one million tonnes of sugarcane by the year 2000, BARD will invest VND 8 trillion in sugarcane cultivation and processing. At present, about 15 sugarcane factories with average capacity of 1,000 tonnes per day have been provided with VND 3.7 trillion to import and install new production lines. Seven sugarcane factories came into operation during the West cropping season. A sum of VND 5 trillion has been provided by the bank to 12 other factories with capacities between 2,000 and 6,000 tonnes per day. These are expected to begin operations by the end of this year. BARD expects to provide VND 3 trillion this year to farming households who have been allocated thousands of ha to cultivate sugarcane to feed the factories (Vietnam News Service 1998b).

Tables 32 through 35 present figures for the various areas of land under these alternative crops in the delta (all figures from Vietnam Socialist Republic of 1992)

Most research on alternative crops in the lower Mekong has focused on agronomic requirements for growth. There has been almost no research on the social or economic factors that influence farmers to adopt alternatives or additions to their rice crops (Duong and Cho 1994; Dreyfus 1996). Further research on this issue is badly needed.

Table 32. Total Area under Soybean Production in Mekong Delta 1976 and 1990 in thousand ha

Area or Province	1976	1990
Dong Thap	100	10,100
Can Tho/Soc Trang	600	1,800
An Giang	200	2,800
Long An	604	8,000
Tien Giang	600	3,400
Ben Tre	5,700	9,100
Dong Thap	1,100	3,500

Vinh Long/Tra Vinh	1,200	4,300
Can Tho/Soc Trang	4,300	13,600
An Giang	2,300	2,400
Kien Giang	2,000	4,500
Minh Hai	1,200	4,000
Mekong Delta Total	23,500	52,800

Source: Vietnam Socialist Republic of, 1992

Table 33. Sown Area of Jute in Mekong

Area or Province	1976	1990
Long An	-	415
An Giang	-	93
Minh Hai	148	462
Mekong Delta	244	845

Source: Vietnam, Socialist Republic of 1992

Table 34. Sown Area of Coconut Palms in Mekong Delta, in ha

Area or Province	1976	1990
Long An	500	2,811
Tien Giang	4,895	6,070
Ben Tre	10,030	24,592
Dong Thap	0	2,181
Vinh Long/Tra Vinh	1,754	15,924
Can Tho/Soc Trang	3,000	16,631
An Giang	-	2,620
Kien Giang	2,266	7,800
Minh Hai	2,932	19,847
Mekong Delta Total		98,206

Source: Vietnam, Socialist Republic of 1992

Table 35. Sown Area of Pineapple in Mekong Delta in ha

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Area or Province	1976	1990
Long An	2,761	1,256
Tien Giang	50	3,568
Ben Tre	-	-
Dong Thap	-	-
Vinh Long/Tra Vinh	2,410	1,398
Can Tho/Soc Trang	1,287	3,400
An Giang	-	-
Kien Giang	1,341	13,000
Minh Hai	841	3863
Mekong Delta Total	8,690	26,485

Source: Vietnam, Socialist Republic of 1992

3. FISHING AND AQUACULTURE

Fishing and aquaculture supplement production systems in the lower Mekong. The annual fish harvest from the Mekong river alone was an estimated 500,000 tons worth \$US 225 million in 1986. Fishing contributed 4.5 percent of the GNP to the lower Basin in 1986, and directly or indirectly involved up to 25 percent of the rural population of the area (Pantulu 1986a). Furthermore, fish and fishery products supplied about 40-60 percent of the animal protein intake of lower Basin residents in 1986. And in much of Cambodia, fishing provides the only source of income and food. Exploitation of the fishery resources of the lower Mekong has expanded at a modest pace in recent years, with output of fish and shifting from Vietnam expanding at 3.5 percent annually (Economist 1998b). See Table 36.

Fishing is highly productive in the lower Mekong. This is particularly true of the fishery resources of Cambodia and the Great Lake. In Cambodia, the inland fisheries of the Great Lake provide 60 percent of the total recorded fish catches for the country and probably an equal amount of subsistence fishing (World Bank 1994a). In 1994, the FAO estimated that the total annual catch from Cambodia's inland capture fisheries is approx. 100,000 tonnes. The true figure is probably much higher, as it is difficult to include subsistence fishermen in these figures.

Table 36. Estimated Total Fisheries Production and Consumption of Fish Products per Person per Year (1974) (includes Mekong and coastal fishing)

Country	Tons Fish	Kg. consumed/pp
S. Vietnam	713,596	36
N. Vietnam	300,000	13
Cambodia	184,700	11

Thailand	1,678,000	41
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Source: Hill 1979

Subsistence Fishing:

In Cambodia, nearly "every Cambodian farmer fishes to a limited extent in his paddies or nearby potholes or streams for subsistence. Those who live along Lake Tonle Sap, rivers, or along the coast may be exclusively fishermen" (Ebihara quoted in Ahmed, Tana, et al. 1996). While rice is the staple diet for most Cambodians, as it is for Vietnamese, fish is "part of the staple diet" in many Cambodian homes (Ahmed, Tana, et al. 1996). The predominance of fish as part of a subsistence diet is perhaps due to the fact that many Cambodian peasants grow only one crop a year (because of small land holding size, lack of irrigation and fertilizers, etc.) so the fish that can be caught to supplement these often meager rice diets become especially important: "Fishing and foraging in the lakes, rivers, flooded rice fields and forests continue to provide the necessary buffers to the rural majority's food and income security." (Ahmed, Tana, et al. 1996)

Table 37. Fish Catches from Mekong System in 1973

	Annual catch estimated (tonnes)
Upstream freshwater (Lao-Thailand)	95,000
Reservoir fishery	13,000
Downstream freshwater (Cambodia-Vietnam)	195,000-245,000
Brackish and estuarine	156,000
Total Annual Catch	459,000-509,000

Source: Pantulu 1986b

Subsistence fishermen intimately know the ways to catch certain kinds of fish in certain kinds of environments. "The fishing gear and methods used in Cambodia are extremely diverse, each adapted to the environmental conditions and to the species being sought according to the stages of the annual flooding cycle. In the current fisheries regulations, about 70 different techniques and gear being used in the waters have been defined" (Ahmed, Tana, et al. 1996). These methods include seine nets in the Great Lake, anchored or drifting gill nets, drag nets, hook and lines, and traps. Floating cages in the Great Lake also allow fishermen to keep caught fish alive until they are ready to be used (Sluiter 1992). The best time for fishing is said to be December and January when the Great Lake water begins to recede and filter back into the Tonle Sap river and other tributaries.

While the Cambodian state holds the property rights to inland water resources such as the Great Lake, it manages the fisheries through an extensive regulatory regime that uses control and enforcement as the major mechanisms of regulation. Subsistence fishermen usually fall through the cracks of this system and generally appear to be allowed to fish how, when, and where they please. The only literature mentioning restrictions on subsistence fishing in Cambodia is in regard to the use of dynamite or poison to catch fish, which is opposed by the state.

Subsistence fishing in the Mekong delta takes place in many areas along the coast, and

involves everything from hook and line, baited fish traps, casting nets, gill nets, and gape nets (Phan Nguyen Hong and Hoang Thi San 1993). Restrictions on subsistence fishing in Vietnam seem to be limited to bans on the use of dynamite or poison. There are no documented "fish reserves" for Vietnam in the literature.

Commercial Fishing:

Commercial fishing is a lucrative venture in both Vietnam and Cambodia. Commercial fishermen ply the waters of fund and coastal regions as well as engaging in managed aquaculture. The commercial fish catch is an export exchange earner for both countries. The commercial catch off the coasts of Cambodia and Vietnam is so valuable that disputes have arisen in recent years between the countries bordering the Gulf of Thailand and the South China Sea. More than 400 Thai fishing vessels had been arrested for illegal fishing by Malaysia, Cambodia and Vietnam in 1990 (McDorman 1990).

Commercial fishing in Vietnam is booming. Output of farm-raising shrimp and fish has helped fuel an increase in fishery exports, which rose in value from \$239 million in 1990 to \$651 million in 1996. Fishery products are now the fourth most valuable export from Vietnam (Economist 1998b). However, the limited range of much of Vietnam's commercial fishing fleet means that coastal waters are becoming over fished, and many of the mangrove areas of coastal Vietnam are being cut down for shrimp farming. Furthermore, dynamite fishing has been popular in increasing marine catches, leading to great damage to coral reefs and fish populations. Recently, the government of Vietnam issued an ordinance banning all fishing methods that harm the marine environment and has taken to arresting fishermen found with dynamite on their boats (Vietnam News Service 1998a). See Table 38, Composition of the Commercial Fish Catch in Vietnam.

In Cambodia, commercial fishing is only allowed in one open season (October/November to May/June). Subsistence fishers may fish year round, but the state does impose restrictions on the fishermen, such as gear and mesh size restrictions. Commercial fishing, however, requires a license (Ahmed, Tana, et al. 1996). Large-scale commercial fishing takes place in around 300 fishing grounds (called lots) located along the periphery of the Great Lake and along the banks of the Mekong-Bassac and Tonle Sap rivers. The grounds range in size from 15-25 km long and 5-10 km wide in the Great Lake, to smaller ones in the riverine areas. The government collects around US\$2 million a year in fishing fees and licenses. "Catching fish from the fishing lots involves large capital investment and organized labor-force, and is therefore monopolized by the rich and their agents. Although the bidding for fishing lots takes place among a limited set of people, their fishing lots, either in parts or as a whole, are subleased to other individuals" (Ahmed, Tana, et al. 1996).

Table 38. Composition of the Commercial Fish Catch in Vietnam (in metric tons)

Year	1992	1993	1994	1995
Marine	627,400	660,000	712,500	722,000
Farmed fish	135,500	139,700	178,400	222,700
Farmed shrimp	37,400	394,000	44,700	155,300
Total	1,622,200	1,780,000	2,224,200	2,475,000

Source: Economists 1998b

These commercial operators in Cambodia often illegally extend their lot areas into areas

used by middle-scale and subsistence fishermen and this, as well as reports about the use of poisons and explosives used illegally by the commercial operations, is a source of complaint with subsistence fishers (Ahmed, Tana, et al. 1996). As Ahmed notes: "A large proportion of community fishing benefits are being reaped by large-scale fishing lot operators and their agents and patrons who are mostly non-residents.... Subsistence and artisanal fishers have limited access to good fishing grounds which places them in a competitive, and in many cases hostile, relationship with the government and fishing lot operators, prompting them to violate fish reserves and lot boundaries in order to obtain a bigger catch for their efforts."

Table 39. Composition of the Commercial Fish Catch in Cambodia (in metric tons)

Year	1981-1983	1984-86	1987-89	1992-94
Inland	58,399	58,558	57,951	67,267
Marine	4,424	8,714	21,499	32,367
Aquaculture		2,270	4,312	8,217
Total	62,823	69,543	83,653	107,750

Source: Cambodia, Ministry of Agriculture Forestry and Fisheries 1996

As a result, fishing may be taking a toll on the stocks of fish in the Great Lake and its tributaries. "Although intensive fishing in the Great Lake was identified as a major cause of decline in fish production as early as the 1940s, there is still not enough catch data and knowledge of environmental factors and riverine ecology to indicate whether intensive fishing should be considered a major factor in the decline of freshwater capture fisheries." (Ahmed, Tana, et al. 1996) But the mechanized boats used since the 1960s, the increased use of nylon nets, the doubling of the registered fishing boats between 1982 and 1992, and the fact that some large fish species such as *Pangasionodon gigas* (giant catfish) and *Catlocarpio siamensis* are now infrequently caught, may all indicate there is some danger for fish stocks in Cambodia. More monitoring of fish declines in Cambodia is needed. As a result, the state has marked out a series of reserves in the Lake where fish spawn, and no fishing is to take place here. Approximately 10 percent of the lake is protected in this manner (Sluiter 1992).

Another reason for declining fish stocks may be the deforestation around the lake. There were 8000 sq. km of forests around the lake in the 1960s, and there were only 3000 remaining in 1992. Deforestation of upland forests in northwest Cambodia is also blamed for increased siltation of the Great Lake. As a result, the dry-season water level has been reduced from 2 meters in the 1900s to only 40 cm now. Shallower water usually means an increase in water temperature, which can have adverse effects on fish stocks (Sluiter 1992).

There is some indication from the literature on Cambodian fisheries that fishermen may be quite amenable to state efforts to improve fish stocks. For example, forest protection to provide breeding grounds for fish in the Great Lake is an option the state has been considering. "Access to flooded forest resources, though prohibited by law, is equally open to the members of both the farming and fishing communities. The upland farming communities are more interested in agricultural practices than in harvesting the forest products. In contrast, fishing communities have a vested interest in keeping the forest intact, as it supports their livelihood"(Ahmed, Tana, et al. 1996).

Other examples of local communities working to protect fisheries include river conservation

zones in several areas of Cambodia, Thailand, and Laos. One such zone on the Mekong in the Lao province of Champasak was set up by local people with the help of the Lao Community Fisheries and Dolphin Protection Project. Villagers decided on the location of the conservation areas and the rules were to be used to manage them. The zones range in size from 1 to 36 ha, scattered around the down to the Khone Falls area. "The zones, some including pools up to 30 meters deep during the dry season, are essential for conservation of many large, sedentary (non-migratory) species which are vulnerable to fishing during the dry season" (Hogan 1997). As of 1997, 44 villages had established conservation zones, and all reported satisfaction with the program, as fish stocks had increased. Ecological studies of fish populations support the evidence that local conservation works (Baird and Roberts 1995). "Local aquatic conservation zones offer a plausible solution to the problem of declining freshwater fish stocks. Local action can have a dramatic impact on riverine fisheries, especially when such fisheries have been heavily overfished at all life stages of the fishes. Conservation zones also may increase fishers' yields and sustain breeding populations of some previously depleted species" (Hogan 1997).

Effects of Dam Development on Fisheries:

As first mentioned in Section One, fisheries biologists of the lower Mekong have been sounding warnings about the possible damage to fish stocks caused by upstream dams. As Ahmed writes, "Migration activities of the fish, the timing and level of waterflows, and flooding and recession are central to the sustainability of the fish stocks of the Mekong river system in Cambodia. The hydrological regime, especially the annual floods, will definitely be altered because of water diversion projects and hydropower development on the Mekong river" (Ahmed, Tana, et al 1996). Roberts adds that fisheries would be affected by changes in flow speed and temperature, as well as the ability of fish to move upstream and down past dam projects (Roberts 1995b).

We can look to the effect of current tributary dams on fish stocks as possible examples of what may happen with the extension of dam development. The fisheries survey conducted by the Electrical Generating Authority of Thailand (EGAT) prior to the construction of the Pak Moon tributary dam in northeast Thailand was widely criticized. The environmental assessment proposed to build a "fish ladder," a bypass to the side of the dam, to allow fish to swim up and down the Moon river as the sole source of fishery damage mitigation. However, as was pointed out, "most fish ladders that exist have been built for specific kinds of fish like salmon, a powerful fish that will fight its way up against strong currents to spawn. Fish experts say it is unlikely that a fish ladder could ever accommodate all the different fish in the Moon, especially the migrants from the Mekong that like slow currents" (Sluiter 1992). Local residents around the Moon were heard to say, "We'll have to train our fish to jump like the salmon Or maybe EGAT = pay us to scoop fish over the dam" (Sluiter 1992).

One proposed dam is at the mouth of the Great Lake in Cambodia, where it meets the Tonle Sap river. The dam was proposed in the 1960s by the Mekong Secretariat to regulate the flow of the Mekong if upstream dams were built. The Tonle Sap dam would supposedly reduce uncontrolled flooding around the Great Lake in the rainy season, and increase the dry season flow downstream to the Mekong Delta. However, many in Cambodia are opposed to the dam, especially those involved in fishery management. The director of Cambodia's Fishery Department has been quoted as saying "The dam would stop migration of fish. Every fish has its own place and time to enter the lake, no gates or fish ladder could accommodate them all. And the forest around the lake depend on the annual flooding, the trees can't live without it. The dam would mean the end of fisheries in the Great Lake. And with the fish gone the people will not be happy with the Fishery Department, because the Khmer are a fish- eating people" (Sluiter 1992).

Aquaculture:

Aquaculture is the raising of fish in ponds with managed inputs of food and resources, and it has historically been quite widespread in the lower Mekong region. Many varieties of fish and crustaceans can be raised in this manner. In the 1960s, a survey of a village in the upper Delta found that 20 percent of all households had a pond in which they raised fish (Hickey 1964).

Table 40. Water Surface Used for Aquaculture in 1987 and 1991 in Mekong Delta in ha

Area or Province	1987	1991
Long An	2,325	958
Tien Giang	1966	1009
Ben Tre	6417	11,712
Dong Thap	2551	2739
Vinh Long/Tra Vinh	3314	4155
Minh Hai	108,787	113,765
An Giang	414	370

Source: Vietnam Socialist Republic of 1992

In order to show the importance of managed aquaculture to the economy of the lower basin, the following tables compare the amount of fish caught by coastal sea fishing versus the amount of fish raised in ponds. In almost every province of southern Vietnam, aquaculture provides a substantial catch of fish. Much of this fish is used locally; the rest is often frozen and exported.

Aquaculture is something that can be practiced by both the small-scale farmer and by large commercial enterprises. Because it is manure and waste that often provide the organic nutrient inputs into fishponds, small farmers need not put excessive capital into ponds once they are constructed. Ponds can be dug anywhere that a channel to fresh water can be added (and some ponds in the Mekong Delta were not dug at all, as they are bomb craters left over from the war). Ponds can be fertilized if desired by other purchased inputs, such as N and P fertilizers (N and P are the most often needed inputs for fish production). The breakdown of fertilizer inputs versus natural ones in the typical Delta fishponds is not mentioned in the literature on aquaculture.

Table 41. Production of Aquaculture Products by Tons, 1991

Area or Province	1991
Can Tho/Soc Trang	36,800
Tien Giang	22,200
Ben Tre	52,900
Vinh Long/Tra Vinh	30,600
Minh Hai	104,000

An Giang	38,600
Kien Giang	109,800

Source: Vietnam, Socialist Republic of, 1992

Table 42. Production of Sea Fish in Tons, 1991

Area or Province	1991
Can Tho/Soc Trang	16,000
Tien Giang	15,000
Ben Tre	40,000
Vinh Long/Tra Vinh	10,500
Minh Hai	57,600
An Giang	2,800
Kien Giang	94,000

Source: Vietnam Socialist Republic of 1992

The literature does mention quite a few adverse environmental effects of aquaculture. "Intensive aquaculture is often associated with concentrated areas of fish mortality and, consequently, water pollution. In Cambodia, where the annual flood waters effectively flush aquaculture sites, water pollution has not proved a problem" (World Bank 1994a). Better research on the environmental effects of aquaculture is needed for much of the area of the Mekong, particularly on how small-scale farmers can mitigate environmental effects.

Shrimp/Mangrove Farming:

A booming trend in the lower Mekong is the raising of exotic tiger shrimp in ponds and canals along the coast. Shrimp ponds are usually dug in mangrove areas to take advantage of daily tides. Ditches and ponds hold water and shrimp during low tides, and higher flat areas with mangroves are usually part of the system. A mangrove flat area is normally flooded during high tides and exposed to air during low tides. Shrimp are stocked by the farmer, and wild shrimp enter the ponds during tidal action as well (Binh, Phillips, et al. 1997).

At high tide, the gates are opened in order to fill the pond and closed again when the water level stops increasing. A net with small meshes in the opening of the gate prevents shrimps from escaping and predators from entering the pond. Post larvae of shrimp and fish fry depend on the natural supply, and feeding and fertilization is not done. Water exchange is entirely dependent on the tidal water supply. Because of the favorable environmental factors in the Mekong coastal delta, the harvesting is done once or twice a month, while in the north it is done every 2-3 months. The products are harvested at the sluice gates using nets during ebb tides. In the middle of the dry season in February-March, water in the ponds is drained. The bottom of the ponds are then cleaned and the silt in the gullies is dredged. Dikes are also repaired at this time. The productivity is generally low because of the storage of larvae, food and the presence of many

predators in the ponds (Phan Nguyen Hong and Hoang Thi San 1993).

In the Ca Mau peninsula, the average shrimp pond area (which includes mangroves, ditches and bare land as well as the water pond) ranged from 1-3 ha on the east coast, and larger ponds over 3 ha were common on the west coast (Binh, Phillips, et al. 1997). The government has recently tried to limit the amount of pond area that can be dug out for water canals and ditches to 30 percent (mainly to reduce mangrove deforestation for ditches). However, a study of 161 shrimp-mangrove farms in Ca Mau revealed farmers to be exceeding the ditch requirements in 30-40 percent of the farms. The area of mangroves in these farms, which were supposed to be around 70 percent as required by the state, in fact varied widely from 1 percent mangrove to over 80 percent of the total area. "The wide variation of mangrove area was due to the farmers illegally occupying mangrove land and not following the government rule and to different modifications of the policy by State Forest Fishery Enterprises and local governments." (Binh, Phillips, et al. 1997)

These shrimp ponds have been highly productive in recent years. The Delta exported an estimated 31,000 tons of frozen shrimp in 1993, which is 75 percent of the shrimp produced in the whole country (Nguyen Thi Song An 1996) The average net profit of shrimp-mangrove culture in the Mekong delta was US \$362 ha in 1993. Further economic analysis of integrated mangrove shrimp systems reveals that net profits to farmers are greatest when the pond area contains 31-50 percent cover in mangroves, and net profit is lowest where there is 0 percent mangrove coverage (Binh, Phillips, et al. 1997). Mangroves probably contribute to shrimp harvests because they temper the acidity found in many soils of the delta; over-cleared shrimp ponds have high acid water levels which may kill off the shrimp. However, a too-dense stocking of mangroves may limit sunlight penetration into ponds and cause shrimp kids through excesses of decaying leaves.

Table 43. Suggestions for Improving Shrimp Yields in Shrimp-Mangrove Systems

Recommendation	Main Benefit
Proper pond design	
Keep land with a mangrove cover	Reduce acid sulfate soil problem
Keep the "flat" flooded	" "
Liming	" "
Increase flooding levels by not digging so many canals and not dumping dug sod on flats	Increases water area
" "	More natural flood from mangroves
" "	Reduced acid sulfate soil oxidation
Increase gate width or number of gates	Flushes decayed leaves from ponds
" "	Takes in more shrimp seeds
Separate inlet and outlet	Discharges decayed leaves
" "	Better water management
Management	
Mangrove planting density	Reduce problems of decayed leaves

Proper thinning of mangroves	More space for shrimp habitat
" "	Improves quality of mangrove wood
Good water exchange	Better water quality
Better quality shrimps and proper feeding	Increase in yields if carried out with proper pond design

Source: Binh, Phillips, et al. 1997

Recent declines in shrimp production and Large-scale shrimp kills have raised questions about the practice of shrimp farming in the Delta. Whether the shrimp kills are due to mangrove clearance and consequent water pollution or a disease is not yet apparently known (Lazard and Cacot 1997). It is most likely to be a combination of the result of acid water that is not properly drained, unsuitable pond locations not influenced by the tides, poor quality shrimp larvae, and poorly constructed ponds with easily broken embankments (Phan Nguyen Hong and Hoang Thi San 1993). More research on this topic is needed. Recommendations for improving shrimp yields in shrimp mangrove systems in the Delta, based on a survey of 161 farms in 1994, was made by Binh, Phillips, et al (1997) and is reproduced in Table 43.

One significant environmental problem with the shrimp farming that needs more research is that large numbers of mangrove trees have been cut in recent years to make the ponds (Action for Mangrove Reforestation 1994). Many coastal provinces reported dramatic drops in hectares of land under mangrove in the 80s and 90s and a great increase in land under shrimp farming. In one year alone, Ngoc Hien district of Minh Hai province lost 5,503 ha of mangrove because 914 migrant families and 9 provincial bodies cleared forests to make shrimp ponds (Phan Nguyen Hong and Hoang Thi San 1993). This is why several development agencies and NGOs have been supporting research on integrated shrimp/mangrove farming. When creating shrimp ponds, farmers are encouraged to plant mangroves along the banks. There is some indication that this program has been successful in encouraging tree planting, but the long-term benefits of tree planting and shrimp farming will have to be assessed in the future.

4. FORESTRY

A recent study attributes the rapid and massive deforestation and loss of biodiversity in Southeast Asian countries during the past half century to "conversion, consumption and corruption."

Southeast Asia is experiencing an unprecedented appetite for wood, wildlife, and other natural resource products and services. Local communities are caught in the conundrum of depending on natural resources while being largely marginalized from the politics and practices, often illegal and predatory, of governments and extractive industries that profoundly impact the local resources bases (Talbot and Brown 1998:53).

Forests covered 73 percent of Cambodia's land territory in 1964. In 1993 the number was estimated to be around 60 percent. During 1989-1993, the deforestation rate was estimated at 3 percent annually. Vietnam's forest cover declined from 14.3 million hectares to 9.3 million in the past 50 years. "At just 0. 12 ha per person, Vietnam now has Southeast Asia's

smallest rate of forestry coverage per capita" (Dao Nguyen Cat 1999:3). Some estimates range from 25 percent to 40 percent former forest cover in the delta area. Current forest cover in the delta is indicated in Table 44. [Production forests are those used for timber, protected forests are those in nature reserves or parks, and special forests are such things as rubber plantations or bee-keeping areas.]

Profits from deforestation have, in general been captured neither by Southeast Asian governments, where they might be redirected toward social and economic development, nor by local communities whose very well-being depended on close adaptation of productive activities with the environment. "The private wealth [from lumber sales] amassed by political and economic elites breeds corruption and undermines both long-term regional development and the prospects for stable, civil societies" (Talbot and Brown, 1998:54). The environmental impacts are entirely adverse:

Table 44. Area of Forests by Type and Thousand ha in Mekong Delta in 1989

Area or Province	Total forest	Production Forests	Protected Forests	Special Forests
Long An	4,700	4,700	-	-
Tien Giang	10,700	8,500	2,200	-
Ben Tre	8,300	7,800	100	400
Dong Thap	11,800	8,100	-	3,700
Vinh Long/Tra Vinh	4,300	4,300	-	-
Can Tho/Soc Trang	7,000	3,600	3,400	-
An Giang	10,200	10,100	-	100
Kien Giang	57,500	25,500	7,400	24,600
Minh Hai	118,500	108,200	4,000	6,300
Mekong Delta Total	233,000	180,800	17,100	35,100

Source: Vietnam, Socialist Republic of 1992

Deforestation in the Philippines, Thailand, and Vietnam has led to massive erosion and flooding in several large watersheds. Thousands have died as a direct result of these floods; this number is increased by the spread of disease that results from the rising waters. In addition, deforestation negatively impacts agriculture productivity and fisheries as well as the ecological integrity of watersheds across the region (Ibid.).

Having largely depleted their own woodlands, more affluent countries both within the region--Malaysia, Indonesia, Thailand, and China--and beyond, such as Japan, are active consumers of Mekong Basin woods. It is difficult to get firm figures on the volume and pace of deforestation as much of it is carried out by military units that do not report on their activities:

The rate of logging throughout Cambodian history belies the conflict of the times. In the late 1980s, a series of agreements was reached between Hun Sen's

communist regime, the Khmer Rouge (KR), the Thai military, and private entrepreneurs that led to a dramatic increase in the rate of deforestation. These adversaries have cooperated for years in virtual battle zones on logging, gem mining, and trade in spite of ongoing warfare. Political convictions and ideological differences have been muted by a joint effort to pillage the forests for wealth. Illegal logging, in conjunction with prostitution and heroin trafficking, is the basis for shadow economies throughout Cambodia. The derived revenues are used not only as financial backing for political causes, but also for building the private wealth of the elite, assuring the cooperation of officials, and maintaining personal armies (Ibid.:55).

Talbott and Brown (1998:59) conclude that "Cambodia stands a good chance of becoming a 'beggar state' as a result of ecological deterioration in the form of drought and flooding, siltation and fish dieoffs, and other consequences of large scale deforestation" There are also transboundary effects. Logging has accelerated erosion in areas surrounding the Tonle Sap, reducing its water storage capacity, and potentially adversely affecting the volume of its dry season flow into the Mekong River downstream which will strongly, and negatively, change the productive ecology of the Delta in both Cambodia and Vietnam.

Within Vietnam forest coverage has declined from 45 percent of the total land area, to 28.2 percent since 1950:

Each year another 60,000 ha or so of natural forest is reportedly lost because of poor management, internal migration, over-exploitation and harmful agricultural techniques. Erosion caused by deforestation is worsening. In 20 years, the water level of the Da River in Hoa Binh province has fallen by 11.5 percent. Last year's prolonged drought almost shut down the country largest power plan, built on the Da River, with water level dropping to critical levels (Vietnam Economic Times, January 1999, Issue 59:13).

In response, Vietnam is beginning a reforestation program which hopes to add five million hectares of woodlands by 2010, 40 percent of which is to be devoted to forest protection while the remainder will be harvested for paper, wood chips, and furniture.

There are a number of different production activities related to forestry in the lower Mekong. These include use for timber, fuelwood and charcoal, fruits and nuts, and as homes for bees or animals for hunting.

Timber:

Timber cutting has been most common in Cambodia with its more extensive forests. Companies from Thailand, Vietnam, Malaysia, Singapore, Taiwan, Japan, and France have logging concessions in Cambodia and exported between 0.6 to 1.2 million cubic meters in 1992. In addition to the logging companies, the warring political factions in Cambodia were also engaged in logging operations.

In fact, deforestation from timber was perceived as such a problem that in 1993 the government of Cambodia enacted a moratorium on the export of logs and set a quota on the export of sawlogs (World Bank 1994a). The government also issued a protected areas decree designating, 3,300,000 ha of land for forest protection and afforestation. Illegal timber cutting is However still continuing today in Cambodia: a Chinese state-owned logging company was recently given approval to collect 20,000 m³ of timber without going through a permit process required by the state. "In addition, the 'anarchic situation' caused by the coup has led to indiscriminate logging in a number of areas controlled by military officials loyal to

prime minister Hun Sen" (Anon. 1998).

In addition to timber trees, other tree species are used for housing needs. For example, the latania water palm provides most of the thatch for building materials in the delta, and bamboos are also extensively used in construction (Hickey 1964). Reeds are also collected for construction as well.

Fuelwood and Charcoal:

As mentioned in Section Two, charcoal production is common in mangrove areas of Vietnam and Cambodia. In one coastal mangrove province alone in Cambodia in 1992, there were more than 300 charcoal kilns producing over 24,000 tons of charcoal. An estimated 100,000 tons of mangrove wood would be needed to produce this amount of charcoal (Bann 1997). In Vietnam, fuelwood accounts for a great deal of energy use. It is estimated that 90 percent of household energy comes from vegetable matter, and of this, 80 percent is fuelwood (Economist 1998b). Charcoal kilns to convert mangrove wood to fuel are commonly found in mangrove-dominant provinces of Vietnam like Minh Hai (Phan Nguyen Hong and Hoang Thi San 1993).

Other Forestry Products:

There are a number of rubber estates in both Cambodia and Vietnam. The state in both countries is interested in revitalizing and expanding this sector of the rural economy. "Cambodia's rubber plantations, though old, are still a valuable economic asset; they are second only to timber as a source of export earnings and are the major employer of labor in the populous southeastern provinces of Kompong Cham and Prey Veng. Future development could lead to the growth of a substantial smallholder rubber industry in association with the existing estates" (World Bank 1994a). The rubber estates now, however, are run down and have few funds for operations such as on-site processing. Improvements will need to be made before this is a viable production activity again. Furthermore, with rubber estates, the direct benefits to local people are likely to be through wages for tapping, not through direct ownership or investment in rubber trees. Smallholder rubber gardens are more likely to produce localized benefits.

Smallholder forestry products that do contribute to local incomes are fruit and nut trees in the area. Two major tree crops in Vietnam are orange trees and cashew trees, although the holdings for both are not extensive. The holdings are also difficult to count because they are usually small household stands of a few trees or less, rather than extensive plantation areas. See Table 45.

Sugar palms are also an important Household tree in Cambodia. People rise the leaves and trunks to build houses and thatch, and the fruit is eaten or use to make candy. Pulp from the seeds is used to make a cure for eye-diseases. Juice tapped from the tree's flowers is boiled into sugar: "The palms are tapped twice a day for the juice, and climbing them is hard work. Traditionally it has been done by landless people who would tap other people's trees in exchange for part of the juice" (Sluiter 1992).

Table 45. Cashews in Mekong De in 1990 by ha

Area or Province	Ha cashews
Long An	500
Tien Giang	320

Vinh Long/Tra Vinh	300
Kien Giang	2,874
Minh Hai	45
An Giang	350

Source: Vietnam, Socialist Republic of 1992

5. LIVESTOCK

Livestock raising in the lower Mekong tends to be on a small scale, with animals owned in small numbers by family households; there is little indication of large areas of pasture for ranching in any of the region. The animals are fed in various ways; they can range from rice fields or road and ditch-side weeds; rice straw; and bushes and trees in forest areas (Resources for the Future 1971). In Cambodia, an average size livestock holding might be 2 cattle or buffalo, 1.5 pigs and 5 poultry. A similar proportion might be expected in Vietnam. Older statistics are available to give a general comparative picture:

Table 46. Livestock in Several Countries in 1973

Country	Cattle and Buffalo Total	Ratio of persons per animal	Pigs Total	Sheep and Goats total	Livestock Total	Total livestock Ratio pp/animal
S. Vietnam	1,417,000	13.7	4,275,000	10,000	5,702,000	3.4
N. Vietnam	8,580,000	2.6	7,500,000	-	16,080,000	1.4
Cambodia	12,900,000	3.5	1,150,000	-	14,050,000	1.9
Thailand	15,350,000	2.6	6,250,000	-	21,600,000	1.8

Source: Hill 1979

The recent World Food Programme-UNICEF survey in Cambodia (Kenefick 1998:18) found that 15 percent of households owned buffalo, 55 percent owned cattle, 57 percent owned pigs, and 74 percent owned poultry. The survey did not include households in the northeast of the country, where livestock ownership, except for buffaloes, is reported to be significantly lower.

In Cambodia, oxen are used to till on light soils, and buffaloes are used on heavy, clay soils. If a family does not own a pair of oxen or buffaloes, labor is exchanged for the use of a neighbor's animals (Sluiter 1992). A similar situation in Vietnam was noted by Hickey (1964). Current figures on the average number of livestock per household are not available in the literature.

NGOs working in the lower Mekong have indicated some problems with livestock raising in the area. It has been estimated that each year 20-30 percent of the pig population and up to 90 percent of the poultry are lost to diseases (World Bank 1994a). More research is needed on how systems of agricultural extension might be extended to livestock rearing to cut down

this number of casualties. Furthermore, the extent to which livestock fits into the rural household economy is not well explored in the literature. Anecdotal evidence suggests that women play a large role in raising the family livestock, but it is not clear how much income they usually receive or how that income is used.

6. GARDENING

Gardening is not mentioned much in the literature on agriculture in the lower basin, which is dominated by discussion of rice cultivation, but there is evidence that many homes have small gardens near the homestead where fruit and tree crops are often grown with vegetables. A typical delta fruit tree garden might include coconut, jackfruit, mango, cashew, and oranges interspersed with bamboo or timber trees (Nguyen Huu Chiem 1994). These fruit tree gardens are mostly found around household compounds or on dikes around fields. "Generally, the fruit tree gardens on the ridges are not cultivated as a major source of income for farmers but only for family consumption. Yield of fruit trees are often very low since the soil is poor and extremely dry in the dry season" (Nguyen Huu Chiem 1994).

In addition to fruit trees, vegetable plots are common in delta households. These can include cucumber, pumpkin, soybean, onion, water melon, etc. In Cambodia, Kalab mentions villagers growing vegetable crops in garden plots along river banks that were called chamkar (Kalab 1968). Hickey lists a wide variety of vegetables that were being grown in one village in the upper delta in the 1960s. These are listed in Table 47.

Table 47. Vegetables Cultivated in Gardens in the Upper Delta, 1964.

Vietnamese Name	Latin Name	Common Name
<i>Ngo</i>		Maize
<i>Bau dai</i>	<i>Aegle marmelos</i>	long gour
<i>Bau ngan</i>	<i>Aegle marmelos</i>	short gourd
<i>Bi dao</i>	<i>Benincasa hispida</i>	Varieties of squash
<i>Bi do</i>	<i>Cucurbita maxima</i>	Variety of squash
<i>Bi xanh</i>	<i>Benicase hispida</i>	Variety of squash
<i>Ca nau</i>	<i>Solanum mesa</i>	Eggplant
<i>Ca chua</i>	<i>Solanum lycopersicum</i>	Tomato
<i>Cai bap</i>	<i>Brassica oleracea</i>	Cabbage
<i>Cai be trang</i>	<i>Brassica oleracea</i>	Chinese white cabbage
<i>Ca cu</i>	<i>Brassica oleracea</i>	Another cabbage
<i>Cai salat</i>	<i>Lactuca saliva</i>	lettuce
<i>Dau bap</i>	<i>Hibiscus esculentus</i>	Okra

<i>Dau haricot trang</i>	<i>Dolichos catjang</i>	White French bean
<i>Dau mong chim</i>	<i>Phaseolus lunatus</i>	Sieve bean
<i>Dau haricot ve</i>	<i>Phaseolus vulgaris</i>	Green bean
<i>Dau phung</i>	<i>Arachis hypogea</i>	Peanut
<i>Dua gang</i>	<i>Cucumis melo</i>	melon
<i>Dua hau</i>	<i>Citrullus vulgaris</i>	Watermelon
<i>Dua leo xanh</i>	<i>Cucumis sativus</i>	Cucumber
<i>Hanh</i>	?	Onion
<i>He</i>	<i>Allium angulosum</i>	Welsh onion
<i>Khoai lang</i>	<i>Ipomoea batatas</i>	Sweet potato
<i>Khoai mi</i>	<i>Manihot utilissima</i>	Manioc (cassava)
<i>Khoai mo</i>	<i>Dioscorea alata</i>	Red yam
<i>Khoai mon</i>	<i>Colocasi esculentum</i>	Taro
<i>Khoai tay</i>	<i>Solanum tuberosum</i>	Irish potato
<i>Khoai tu</i>	<i>Dioscorea esculentia</i>	Yam
<i>Muop dang</i>	<i>Momordica charantia</i>	Bitter melon
<i>Muop khia</i>	<i>Luffa acutangula</i>	Zucchini
<i>Muop ngot</i>	<i>Luffa cylindrica</i>	Zucchini
<i>Ot</i>	<i>Piper spp.</i>	Chili pepper
<i>Rau can</i>	<i>Oenanthe stolonifera</i>	Celery
<i>Ran can nuoc</i>	<i>Oenanthe stolonifera</i>	Water celery
<i>Rau den</i>	<i>Amarantus gangeticus</i>	Brede de Malabar
<i>Rau hung</i>	<i>Mentha aquatica</i>	Mint
<i>Rau huong</i>	<i>Polygonum odoratum</i>	Thyme
<i>Rau rung toi</i>	<i>Basella rubra</i>	Basella
<i>Rau muong</i>	<i>Ipomoea aquatica</i>	Spinach
<i>Rau que</i>	<i>Ocimum basilicum</i>	Thyme
<i>Rau rap</i>	<i>Houttynia cordata</i>	none

	<i>Neptunia oleracea</i>	none
<i>Thom dua</i>	<i>Ananassa saliva</i>	Pineapple
<i>Xu hao</i>	<i>Bassica oleracea</i>	Turnip
<i>Xu xu</i>	<i>Sechium edule</i>	Chayote

Source: Hickey 1964

Hickey also found a wide variety of fruits to be grown in gardens, in larger groves on old paddy fields, and as individual trees on bunds and pathways. The species he documented are listed in Table 48.

Currently, the state encourages diversification in gardens through the promotion of the VAC system. VAC stands for Vuon Ao Chuong, meaning Garden, Pond, Livestock, and it integrated agroforestry system is a popular development strategy, particularly in marginal areas not suited for rice cultivation (like the northern mountains and central highlands). The literature does not indicate to what degree VAC is being adopted in the rice growing areas of the delta. More research on the type of gardens, the use of gardens, and their economic implications is needed.

Table 48. Fruits Cultivated in Gardens

Vietnamese name	Latin name	Common name
Buoi	<i>Citrus grandis</i>	Grapefruit
Cam	<i>Atalantia monophylla</i>	Orange
Cau	<i>Areca catechu</i>	Areca nut
Chanh	<i>Citrus medica</i>	Lime
Chuoi	<i>Musa spp.</i>	Banana
Dao	<i>Eugenia jambos</i>	Peach
Dau	<i>Baccaurea sapida</i>	Mulberry
Du du	<i>Carica papaya</i>	Papaya
Dua	<i>Cocos nucifera</i>	Coconut
Khe	<i>Averrhoa carambola</i>	Carambole
Long nhan	<i>Euphoria longana</i>	Longan
Man	<i>Prunus triflora</i>	Jambose
Mia	<i>Saccharum officinarum</i>	Sugarcane
Mit	<i>Artocarpus integrifolia</i>	Jackfruit

Oi	<i>Psidium guajava</i>	Guava
Quyt	<i>Citrus nobilis</i>	Tangerine
Tam duoc	<i>Phyllanthus distichus</i>	Gooseberry
Trau	<i>Piper belle</i>	Betel
Vu sua	<i>Chrysophyllum cainito</i>	Milk app
Xoai	<i>Mangifera spp.</i>	Mango

Source: Hickey 1964

7. OTHER AGRICULTURAL SYSTEMS

There are other small productive systems worth mentioning in the delta, including beekeeping, hunting, and silkworm raising.

Beekeeping:

Beekeeping has been practiced for almost 200 years in the forests of the Mekong delta. French surveys made between 1805 and 1836 indicate that 68 villages in the U Minh forest region made their main living from cultivating *Apis dorsata* nests, and paid their taxes in wax. In 1898 14.75 tons of honey and 2.8 tonnes of wax were exported from Vietnam (Crane, Vu Van Luyen, et al. 1993).

Bees are naturally found in the delta, and they often move between the mangrove forest of the coast and the Melaleuca forests further inland, such as in the U Minh forest (Crane, Vu Van Luyen, et al. 1993). They arrive in the Melaleuca forests after the rainy season ends in December, and they usually remain until August, nesting in tree branches. "When *Kandelia candel* and *Aegiceras corniculatum* are in bloom the hives are placed in the holes along the dikes to avoid sunlight and heat and to enable the bees to feed on the blossoms. When the blossoms are finished, the bees are brought inland where there are a lot of trees, such as longans and litchies, which have flowers" (Phan Nguyen Hong and Hoang Thi San 1993). Local farmers are able to manage *Apis dorsata* bee colonies by building artificial nesting sites in the form of rafters, to which the bees attach their honey combs. Farmers have a great deal of knowledge about which direction to turn the rafters, what sort of wood they should be made of, etc., in order to attract bee colonies (Crane, Vu Van Luyen, et al. 1993). After the bees migrate in the rainy season, farmers can cut down the honeycomb for the wax and honey. A large comb night yield 20 liters or more of honey and 1 kg of wax. Harvests can also be taken periodically during the year. Smoking out the bees is a common practice to eliminate bee stings during these types of harvests. A bundle of Melaleuca leaves is lit on fire and the smoke either dulls the bees' senses or sends them temporarily away so honey can be harvested. Harvesting can be done 3 to 5 times each season, at 10-20 day intervals. Other wild bee species like *Apis florea* also nest in Melaleuca forests, as in the Plain of reeds, but they are not actively managed. Rather, honey is collected more sporadically from the wild nests. (Crane, Vu Van Luyen, et al. 1993).

In the Song Trem state forest farm (10,200 ha in the U Minh forest), foresters employed by the state are allotted plots in the forest for bee keeping. Tax is paid to the state on collected honey (around 30 percent of its value). It is estimated that this farm produces more than

150 tonnes of honey a year, most of which is consumed domestically rather than exported (Crane, Vu Van Luyen, et al. 1993). Suggestions have been made that the rafter keeping technique might be introduced to the northern and eastern provinces of the Mekong Delta, as these areas have *Melaleuca* forests but no active beekeeping management systems like those in Minh Hai and Tien Giang.

Hunting:

Many formerly populous animal species in the Mekong delta are now rare, mainly because of hunting pressure and habitat loss. The mangrove areas of Vietnam used to support tigers, crocodiles, snakes, wild pigs, and monkeys, many of which are rarely found today. Crocodiles and snakes were hunted for their skins, while other animals were hunted for meat or medicinal purposes. Hunting of birds for selling feathers was also widespread in the Delta until bird numbers declined. One estimate was that 30,000 birds were killed each season in the delta (Phan Nguyen Hong and Hoang Thi San 1993).

Sericulture:

Silk weaving has attracted the attention of bilateral donor and nongovernmental organizations who see it as an important income-generating activity for the rural poor, especially for women. The Lao Women's Union, with support from the Swedish International Development Agency and UNICEF, sponsors an "Art of Silk" program to promote and revive the tradition of silkworm raising and weaving. The U.S. Agency for International Development sponsors the Laos Economic Acceleration Program for the Silk Sector, as a cash sector alternative for opium for farmers in the northeastern Lao province of Houaphanh. USAID claims that as a result of the project "and other interventions, opium production has almost disappeared" (USAID 1999) in the region. Silk cotton cloth, and other traditional crafts have been identified throughout SE Asia as providing small enterprise opportunities for minority and handicapped peoples.

Coffee:

Coffee grown in the northern areas of Vietnam has become an important export. In 1997, 404,000 metric tonnes of coffee beans were exported at an average FOB Vietnamese port price of US\$ 1,445 per tonne for Robusta grade 2 (Vietnam Economic Times, January 1999, p. 28). Because of its high value-to-weight, and perhaps because it is raised in areas close to the porous frontier with China, coffee is also a target of praedial larceny. According to the Vietnam Economic Times (January 1999, p. 10, emphasis added):

Hundreds of coffee growers in Lam Dong province are living with the fear that their produce is likely to be stolen any time, anywhere, on the road, at home, or even in the very field where they are harvesting. *The average household loses between five and ten tonnes every season.* Nothing deters the ruthless thieves, who are armed and not afraid to use violence. "You can even hear them singing as they harvest our coffee," one local said. The robbers seem to have no fear of the police either. It is a cruel blow for the farmers, who are just recovering from the prolonged drought.

8. MARKETS AND TRADING

The recent opening of both Vietnam's and Cambodia's economies to new market influences is part of a long pattern of the lower Mekong being highly involved in commercial activities

(Brocheux 1995). The Mekong's local rice production has been tied to larger world market forces since the arrival of the French, and it has continued throughout the time since. This dependence on the world market forces promoted important rural-urban linkages. For example, until 1950, most of the rice mills serving the Delta were located in Cholon, Saigon. Paddy has to be transported there by boat and truck from the rural areas of the delta. Gradually hand mills became popular in villages, and eventually local milling was greatly expanded by machine-powered rice mills in each village (Hickey 1964). This paddy can now be taken to more local rice-buying centers, but Cholon remains an important part of the rice exporting business.

After reunification of Vietnam in 1976, markets were officially controlled by the state. Farmers had to buy and sell according to state dictates on price and quantity. This changed in 1981 when new policies of liberalization began. While cooperatives moved closer to recognition of household farming, at the same time, the government's purchasing price of rice was adjusted close to the market price. Most of other market oriented reforms began more toward the late 1980s. "Since then agriculture, especially rice production, went through dramatic changes, transforming it from a predominantly collectivized and centrally planned sector into a privately operated small-farm household agriculture. The land distribution, reform of cooperatives and trade liberalization, along with other macroeconomic reforms gave strong incentives to farmers, especially rice producers, to work harder on their land and undertake investments. Despite a reduction of the public expenditure on agriculture, the sector has been growing rapidly, at an average of 4.5 percent during 1981-1994" (Nguyen Thi Song An 1996).

Price liberalization was a major aspect of the opening of the Vietnamese economy. Prior to reform, all cooperatives had to sell output to the state at fixed prices. After reforms, rice producers now have greater choice of when, where, and to whom to sell their products, although the export totals that will be allowed are still determined by the state from year to year. A recent news article suggests that farmer complaints about this system are serious enough that the issue was taken up at this spring's National Assembly: "The Standing Committee says at this session of the assembly voters have continued to ask the Government to adjust the distribution of rice export quotas and prevent disputes about buying and selling prices which are causing a loss to farmers and exporters" (Vietnam News Service 1998f).

Similar constraints on the market for agricultural products were loosened in Cambodia in recent years. A two-tier price system for rice in Cambodia had been introduced in 1984, and it indirectly taxed farmers because they were compelled to sell a portion of their rice output to the state at below-market price. This policy was abolished in 1989 (World Bank 1994a). Currently farmers are allowed to market their rice and buy input in a competitive market similar to the situation in Vietnam.

Additionally, as part of the decollectivization and reform processes in both countries, farmers now have ownership over the means of production (machines, livestock, etc.). They have been granted the right to purchase, sell and transfer these means of production in the market. As a result, "farming households purchased more production means for expanding production and conducting intensive farming on contracted fields" (Nguyen Thi Song An 1996). The farmers also have the ability to buy agricultural inputs on the free market and can hire labor during rice harvests.

However, there are down-sides to the liberalization of the market system. For example, because the state has reduced the number of state-owned firms that have the right to export rice, the remaining firms then exercise a monopoly and can pay lower prices to farmers (Economist 1998b). And landless laborers are on the rise in the delta. The problem of land stratification will be addressed more fully in a following section.

9. OTHER RURAL ENTERPRISES

There is some degree of industry in the lower Mekong, although by far the bulk of the land remains rural and agricultural. Two systems are worth mentioning.

Mining:

There are some mining operations in the lower Mekong basin. Thailand is a major tin producer, and there are copper deposits in Laos and Thailand. Other industrial minerals include rock salt, limestone, and gypsum (Pantulu 1986a).

Mining takes place in some areas of Cambodia, mainly for gems like rubies. Additionally, the sluice mining operations for gemstones in the northwest are believed to be contributing to siltation levels in the north of the Great Lake.

Salt is also produced in much of the Delta. In Thailand, it is rock salt that is mined, and in along the Vietnamese coast, salt is panned from evaporation of salt water. One hectare of salt pan can produce 25 tons of salt a year. In Minh Hai province alone, there are 9,067 ha of salt pans that stretch for 59 km.

Industry:

There are industrial parks in several areas of the delta, including Can Tho Industrial Park. It is unclear how much industry contributes to the GDP of the delta. Additionally, there are in the middle Mekong river stretch several industries that have contributed to pollution of the water for downstream users. For example, in 1992, a spill of molasses from a sugar mill into the Chi-Moon river basin killed a number of fish (Sluiter 1992). Further industrialization along the river is likely to result in more of these types of problems.

10. LAND TENURE AND PROPERTY RIGHTS

Two extremely important aspects of agriculture and rural life in the Mekong area are land tenure and resource use rights. The stratification of land rights under the French colonial regime is well documented (Ngo Vinh Long 1984). This stratification began when large areas of canals, more than 1300 km, were dug by the French in Cochinchina (Robequain 1944). The process relied on French mechanization and indigenous corvée labor (Brocheux 1995). Because of the need to establish agriculture quickly in the delta, the French dug these large drainage canals and then sold large landed estates in the drained areas in order to recoup their investments. Prior to 1880 the total cultivated area of Cochinchina was 552,000 ha, and between 1880 and 1937 irrigation increased this to 2,200,000 ha (Hickey 1964). The concessions that the French created were put up for bid, and in order to keep title, land owners would have to clear the land and bring it under cultivation quickly. The owners of these concessions would recruit labor to help in the land development, and these laborers often became tenants, taking as much land for themselves as they could cultivate. The owners of the concessions would then take as much as 70 percent of the crop of tenants as payment of rent. As a result of these policies, large estates were prone to being owned by absentee landowners, both French and Vietnamese, in far-off places like Saigon. The canal network, which was designed not only to drain land but to facilitate the export of rice from remote areas, thus made practical the easy accumulation of land by absentee owners (Bassford 1984).

Additionally, any other "unused" land was granted free of charge to any Frenchman in return for a promise to put the land in cultivation and pay land taxes (this "unused" land often included village common lands). These concessions were limited to 100 ha at first, then to 300 ha in 1896, then 500 ha in 1899, then 200 ha again in 1928 (Ngo Vinh Long 1991). As a result, there were also fewer communal lands belonging to the village in the South than the North, where they were an important part of the lives of the poor (Ngo Vinh Long 1984). What communal lands there were in these villages were often sold off by the French, in 1939, communal land was 20 percent of the cultivated land in the North but only 3 percent in the South (Gourou 1940). By 1930, there were 606,500 ha of total French concessions in Cochinchina. These policies have led some to speculate that in the 1930s, 75 percent of the farming families in the Delta were landless (Ngo Vinh Long 1991).

There were a number of other factors that contributed to land stratification in the Delta. Because most of the rice grown there was for export, farmers were more susceptible to fluctuating rice prices, and during world-wide recessions (such as in the 1930s), rice farmers were particularly hard-hit. There were also heavier taxes in the Cochinchina area, because of the amount of French investment in land preparation, and additionally, taxes in Cochinchina had to be paid in cash (Rambo 1973).

Table 49. Land Distribution under the French

No. of People	Cochinchina			Tonkin		
	% of Pop.	% of ha held	No. of People	% of Pop.	% of ha held	No. of People
Small holders (> 5 ha)	183,000	71.7%	15.0%	946,000	98.2%	40%
Medium holders (5-50 ha)	65,750	25.8%	37%	17,500	1.8%	20%
Large holders (< 50 ha)	6,300	2.5%	45%	180	0.02%	20%

Source: Cummings 1976

The stratification of land rights in the delta that had begun under the French continued under the regimes of the Republic of Vietnam. In 1969, about 70 percent of farm families in the Mekong Delta farmed land for absentee landlords for which they paid the landlord the equivalent of about 1/3 of their crop (Burr 1976). Starting in 1969, the South Vietnamese government began a series of measures, the Land-to-the-Tiller program, to give land to landless and small farmers with fair compensation to the landlords (Callison 1983). The political motives behind this move were clear; the state of South Vietnam believed it needed to reduce the amount of rural unrest caused by wealth stratification. The state believed that without measures like land reform and allocation, the NLF would continue to benefit from rural discontent.

The Land-To-The-Tiller program was called by the New York Times as "probably the most ambitious and progressive non-communist land reform of the 20th century" (quoted in Cummings 1976). The objective of the program was to reduce tenancy and landed absentee landlord estates. By establishing small farmer-landowners, the goal was also to reduce communist influence in the delta. Land was granted free of charge to tenant-farmers, and ownership caps of 15 ha were put in place. The new owners were told not to transfer ownership or fail to cultivate the land for 15 years. The land for the program was bought from large landowners by the state with 20 percent cash down and the balance in interest bonds over an 8 year period. More than one million ha of rice land were distributed among 800,000

farmer tenants in the LTTT program, according to the Republic of Vietnam in 1970 (Cummings 1976).

However, many of the people who lost their land were not large landowners but smaller ones, and many former tenants on landowners' estates did not receive the same parcel of land they had been farming (which was a main goal of the program). Also, many new landowners under LTTT were related to the former large landowners, indicating that sons, daughters, in-laws, nieces, nephews, etc, signed up for the land so that it actually remained in the family of the larger landowners (Cummings 1976). Thus, the results of the LTTT program were mixed at best.

In North Vietnam a cooperative-managed collective farming system was established in the 1960s and 1970s. Following reunification of north and south after the American withdrawal collectivization was the official policy for agriculture throughout the state. There is an argument in the literature about the extent of collectivization accomplished in the South as compared with the North (see White 1985; Wiegiersma 1985; Ngo Vinh Long 1988). There is some indication that collectivization was much less firmly established in the south in the years after reunification, and thus it was easier for the south to undergo decollectivization under the liberalizing regime begun in 1981.

According to an FAO report, "the pre-1981 land tenure system did not motivate farmers to improve soil fertility or land-use efficiency as they did not feel attached to the land. Each farm household received a share of outputs according to the recorded labour hours of its member" (Haque and Montesi 1996:68). The shift away from a cooperative-managed land system to a household managed system began in 1981, with the introduction of the production contract system (Kerkvliet 1995). Termed "Resolution 100," this plan authorized the cooperatives to fix production contracts directly with households, to whom plots were allocated on a yearly basis. Most inputs were supplied by the cooperatives, and households were obligated to submit output quotas to the cooperatives. Still, it was the first step toward a more privatized agriculture. The next major reform came in December 1987: "a new Land Law was enacted, which recognized the land-use rights of individual households. It abolished the old contract system and allocated lands to individual households for a period of 3 to 15 years on the basis of the number of family members or the labour capacity of the household. The land-users could keep the entire output after fulfilling their tax and other obligations" (Haque and Montesi 1996:68; Nguyen Thi Song An 1996). These changes were "after affirmed with Resolution 5 in 1993, which confirms the long-term rights to agricultural lands under production. The 1993 Land law also allows farmers the right of transfer, exchange, lease, inheritance, and use for collateral of their land use rights. The types of policy changes from reunification to the current day are demonstrated in Table 50.

[The 1993] law provides for the allocation of land to organizations, individuals and households for long-term and stable use. The period of land allocation is 20 years for annual crops and 50 years for other perennial crops and forestry... The tenure can be renewed on expiry, if the land-users need to do so and if they have used the land properly according to law. All land-users will be given land-use right certificates ... All these measures are intended to create a land tenure system that will be conducive for sustainable agricultural and rural development (Haque and Montesi 1996:69).

There are several major implications for these land use and ownership changes. One is the increased productivity mentioned earlier. A less positive result however, has been the increased stratification of rich and poor households and the consolidations of land holdings of the rich. The transfer of exchange rights for land may be causing the current rise in the consolidation of land holdings, particularly in the delta's booming rice production areas. According to 1996 data, there are now 76,000 households in the delta with over 3 ha of

agricultural land. These rich farmers make up 3.6 percent of the total farmers. Of these farmers, there are about 12,250 households with over 5 ha of land and 916 households with over 10 ha per household. At the same time, there are about 12,250 households without any land (0.7 percent of households in the delta) and 6 percent of farm households have less than 0.3 ha per homestead (Nguyen Thi Song An 1996).

The reasons for land consolidation are varied. Some households sell their land to move into other occupations, such as trading. Others are forced to sell their land to pay off household debts racked up by gambling or family obligations like weddings. Still others lack capital to improve their lands, and so use them as collateral when they borrow from private moneylenders at high interest rates (and then lose the land if they are unable to pay it back). The situation appears to be worse in the Delta than in other areas of Vietnam. The difference between the Mekong Delta and the Red River delta in terms of land access between the richest and poorest is 3.3 times higher in the Mekong delta (Nguyen Thi Song An 1996).

The land consolidations are also contributing to the rise of new divisions of labor and the creation of a laboring agricultural class. The high yields of large farms and increased productivity of many farmers has risen to the point where they can afford to hire laborers for planting, irrigation, threshing, and pest control. And now peasants have the rights to sell these services in the new reform economy (Kerkvliet 1995). As a result, a permanent landless laboring class is on the rise in the delta.

Land consolidation is discouraged by the state, which office puts caps on the amount of land each household is allowed to hold lease-rights to. In the Delta, the official cap is at 5 ha per household [In the Red River Delta the cap is 2 ha]. Other measures to limit land holdings in Vietnam include land taxes. Still, there remain significant regional differences in land holdings. Farm areas of the poorest 1/5 of farms in the Mekong delta were still a third larger than the richest 1/5 of farm sizes in the Red River delta (Dapice and Biles 1995). This is due to the historical patterns of settlement in each region and policies on inheritance and property rights that have diverged in each area.

There is much less information on land tenure issues in Cambodia. In Cambodia from 1975-1979, private property was abolished and all sectors of the country were controlled by the state (Kiernan and Boua 1982). In 1979, the Vietnamese-backed government slowly tried to implement collective organization of agriculture organized into cooperatives called "krom samaki," or solidarity units. The approach to collectivization was similar to that in Vietnam, but as the Vietnamese system was soon reforming toward private use rights, so did the Cambodian system. This culminated in 1985 with recognition of private enterprise of the household. In 1989, the Cambodian government adopted a restoration of private property ownership (World Bank 1994a). Furthermore, the land ownership law of 1989 did not allow individuals to have more than 2 hectares of land for a household and a total of 5 hectares of farming land. Villages got around 6 ha of communal land. "As a result of this, small farms dominate the structure of the Cambodian agriculture. Based on data available from a demographic survey by the Ministry of Planning in 1996, the number of farming households is estimated to be about 1.7 million, most of which are rice producers, their production systems generally subsistence-oriented." (Yang Saing Konia 1997). However, there are often still disputes over land ownership, such as among returnees and those who remained in Cambodia and were allocated holdings after the breakup of collective farms.

Despite the land distribution program, recent evidence indicates an increasing concentration of landownership in rural Cambodia.

There is significant land market activity in Cambodia. At one end of the scale there are large institutional and quasi-institutional land owners that include the

army (more accurately, individual generals) and international (usually regional) agribusiness interests. Vast tracts of both agricultural and forest lands have been taken over by these groups, taking advantage of a weak regulatory framework, poor enforcement of property rights and widespread corruption. This is leading to widespread land-grabbing by powerful vested interests, pointing to an emerging dual ownership pattern in the rural areas: a peasant subsistence sector... and a nascent commercial sector. Little has been forthcoming by way of investment in the latter, so that the principal motivation here seems to be timber extraction and land speculation (Murshid 1998:39).

Even on peasant holdings, there is a movement toward expansion of holdings by affluent farm households and contraction of holdings by poorer farmers. The need to pay for (often ineffective) medical expenses is cited as a recurrent cause of land sales by the poor:

A widow with tuberculosis who had sold two plots of rice land also sold four small cows. She likewise sold seven chis of gold that her daughters had saved from her work as a farm labourer.

A woman with a gaseous illness... spent 10 chis of gold on treatment. She spent five chis from her savings and borrowed another five without interest from her aunt.

Table 50. Major Features of Agricultural Policy Regimes, 1976-1995

	1976-1981	1981-1988	1988-now
Type of system	Work-based contract system	Product-based contract system	Household responsibility
Agricultural production	Collectivized	Partly collectivized	Fully decollectivized
Land	Controlled by cooperative	Allotted to individual farm households, but insecure tenure	Long-term leases to individual farm households
Farm decisions	Made by planning department; centralized	Made by local planning authorities	Made by individual farm households
Farm operations	Carried out by cooperative	Carried out jointly by coop and HH	Carried out by individual farm HH
Farm income	Based on hours of work in coop	Based on hours of work and output above quota	Based on total output after taxes
Inputs and outputs	Controlled by govt; low output price	Partly controlled by govt: fully controlled inputs, partly controlled output markets	Fully liberalized, but still govt involvement in export markets and pricing
Growth rate of rice output	0.46%	3.14%	5.02%
Level of rice self-sufficiency	Food shortages; rice imported	Food shortage in 1987-1988	Self-sufficient; rice exported

Source: Nguyen Tri Khiem 1996

Another woman with tuberculosis had spent from 300,000 to 400,000 riels a year in medical payments over the past four years. In 1996, she sold a portion of her house lot and one cow. She also sold a large portion of her rice yield to repay loans bearing 10 percent monthly interest. In late 1996, she spent a total of 135,000 riels to treat the illnesses of two daughters.

After the 1995/96 crop season, a man with a stroke spent 30 sacks of his total paddy yield of 65 sacks to repay loans bearing more than 100 percent interest for the treatment of his illness

One woman spent 12 sacks of paddy rice... to repay loans she had borrowed the previous year to treat the illness of her now deceased 16-year old daughter (McAndrew 1998: 8).

Illness therefore has a ratcheting effect on poorer households. This emergence of a rural class structure based on widely different access to land, labor, and capital is only beginning to be recognized and is an area that calls for considerably more field examination. The implications for development are staggering, because of the recurrent likelihood that the benefits of aid will be captured by the already affluent leading to further disadvantaging of the poor. It is crystal clear that one of the major tasks of the Oxfam partners' initiative will be to challenge the myth of the homogeneous peasantry in the countries of the lower Mekong basin.

Several other areas of interest in regard to land use rights are not addressed by the literature. Land use rights literature tends to stress the economic and political aspects of land ownership and decollectivization without focusing on the social aspects. For example, how have informal de facto systems of land use in non-agricultural areas in the Delta (such as the Plain of reeds) been established? There are indications that complicated systems of use rights govern land seen as "unused" or "state" land in these areas (Spencer 1996). The role of communal village or common property lands in southern regions has also not been explored as much as it has in the north of Vietnam. The literature on common property tends to be mainly historical in nature (Ngo Vinh Long 1990; Nguyen Dinh Dau 1992). Further research on the current extent of and uses for common property in the lower Mekong is certainly needed.

Regional and ethnic differences in patterns of land tenure are also not well explored in the literature; one commentator noted the intense difference in landlordism in the Delta and the more informal land holdings of farmers in the upriver areas, where many farmers do not hold official leasehold over their land, but informal use rights (Resources for the Future 1971); however, further research on upriver and downriver differences has not been pursued since then.

Conclusion:

The productive systems of the delta region are highly diverse, and quite regionally varied. Thus it is difficult to draw many generalizations about a typical "life in the Delta." Perhaps the best way to sum up the opportunities and difficulties in the areas is to quote at length from a recent newspaper account that described the situation found in just one province alone:

An Giang is striving to further develop its economy, but rice production has stagnated over the past two years. The province has concentrated on increasing rice production since the beginning of *doi moi* (renovation), in order to feed its population and contribute to the country's rice exports. Current reforms are centered on developing rural infrastructure. The province completed the task of

building roads and hydroelectricity networks to every commune by the end of 1996. Nearly all villages now have electricity, while health care and cultural facilities are also being improved. Land-use has not been well-managed, however, causing disputes between residents and authorities. Some farmers have so little land to cultivate that they are forced to give up the land and look for other work. To deal with the problem An Giang authorities have encouraged farmers to develop industrial and handicraft production. By focusing on traditional crafts, authorities hope to help people produce goods they can sell on the market, to improve family incomes. Private industry is also being promoted, with the hope being that workshops and co-operatives will attract redundant agricultural labor. Many of these laborers are not very qualified, however. Training courses in line with the national employment programme are helping laborers improve their skills. As a result, handicraft workshops created employment for over 46,600 people last year, contributing VND 646 billion to the provincial economy. The province has made substantial achievements in the 12 years since agricultural reforms started. Unfortunately, rice output over the past two years has been lower than the figure from 1985, when reforms began. Dozens of ha of rice-land have been taken out of production or are being wasted. Agricultural machinery, although available, is either worn out or obsolete. This has hurt both rice production and secondary crops. Low output has also been due to farmers ignoring productive land for other economic activities. The decline of agricultural production has forced authorities to return land and machinery to each household, to prevent any disputes between farmers who had acquired large plots and those who had none. The land redistribution focused on wealthy families with large plots of land. In addition, An Giang authorities have asked State-run enterprises to provide materials and sell products to farmers at market rates. The province has also tried to bring more land into cultivation. The canal system has been expanded, and farmers have been given tax breaks and loans to help boost production. Many farmers have brought former waste land into production in the past two years, resulting in substantial profits (Vietnam News Service 1998i).

Section Four. Sociocultural Issues

This section explores general sociocultural issues surrounding life in the lower Mekong.

1. HISTORY OF SETTLEMENT

We will not in this report rehearse the rich prehistory of the lower Mekong basin. Two relatively recent comprehensive accounts have been written by the Australian archaeologist Charles Higham (1989, 1996), and the authoritative Cambridge History of Southeast Asia (Tarling 1992; see also Marr and Milner 1986) includes important bibliographies. It is clear that people have been living in the valley for millennia. There is evidence of preagricultural settlements from about 12000 BP. Most of these are inland as changing sea levels obliterated the early coastal sites. Deposits of copper and tin supported complex Bronze Age cultures and the Mekong clearly served as the major artery of contact between peoples as smelted ores along with other produce were transported by boat. Most of the excavated sites are in Thailand and Cambodia, with some important archaeology done in Vietnam and a more modest amount in Laos. Years of warfare suspended historical field work in Laos, Cambodia, and Vietnam and unexploded ordnance in certain areas today renders excavation problematic (Davies 1997).

There are a number of sites that should be considered social, cultural, or historical sites of importance in the lower Mekong. See Table 51. These sites include tombs, monasteries, temples, and ruins in the plains of Cambodia. The same cultural survey of Vietnam interestingly revealed next to no sites of historical interest in the Mekong, however (U.S. EARITVA 1968). But in fact, there are several sites of archaeological note in the delta, according to French archaeologists (Malleret 1959a; Malleret 195 9b). Additionally, the architecture in several delta towns has been mentioned as particularly of historical interest (i.e. Sa Dec).

The magnificent archaeology of the Mekong Region constitutes an incredible human treasure and, through tourism a potential economic resource. It is a wonder that so much has survived the devastations of warfare, especially in Cambodia but also throughout mainland Southeast Asia (Zéphir 1998, Groslier 1966, Groslier and Arthaud 1966, Mannikaa 1996, Higham 1996 and 1989). The cessation of military actions in Laos, Cambodia, and Vietnam has not, unfortunately, ended the violence to which historical sites fall victim Reservoirs created upstream from hydropower dams inundate areas many of which have not been adequately surveyed. A very brief anthropological reconnaissance of the region to be flooded by the Nam Theun 1/2 Dam in central Laos mentions the loss of "sacred eaves" (Ovesen 1993:52-53). While assessments of adverse impacts, both upstream and down (Horowitz 1991), human population and on the environment and natural resources must take precedence, along with the elaboration of mitigative measures, it is also important that cultural and historical! sites be surveyed and protected.

Table 51. Sites of Historical Interest in Lower Mekong Basin

Site Name	Province	Description
Angkor Borei	Takeo	Remains of 7 th c. capital
Ba Phnom	Prey	Ruins of 8 th c. capital
Bati	Kandal	Khmer temple of 10 th c.
Battambang	Battambang	Pagoda of White Elephant

Chambak	Takeo	9 th c. brick tower; 11 th c. temple
Kompong Thom	Kompong Thom	Temple of Dang-nek at 700m elevation; Ruins of capital from 6 th c. Oldest complex in Cambodia
Oudong	Kompong Chhnang	Tombs of kings, 11 th c. temple
Phnom Penh	Capital city	Numerous palaces, pagodas
Preah Khan	Preah Vihear	11 - 12 c. temple with moat
Takeo	Takeo	Brick sanctuary 8 th c.
Rolous	Siam Reap	Monuments, 9 th c.
Taing Krasang	Kompong Thom	Buddhist monastery on hill
Angkor Wat	Siem Riep	12 th c. ancient city, considered biggest ancient buildings ever discovered

There are indications that the area may at one point have supported a higher population density than currently exists (Ingersoll 1968). Vietnamese movement into the Mekong delta began in the 15th century, and accelerated rapidly in the 17th and 18th centuries. As people moved into these swampy and insect-ridden lands, they settled first on river banks and flat alluvial plains (Brocheux 1995), later spreading out to the less welcoming swamps which they drained for rice production (van Liere 1980). Nguyen Khac Vien (1985) quotes a popular song about that period that is still sung today:

*Here the sky and the land are so strange
We're frightened on hearing the birds,
We're scared by the sight of fish in the water
While on the boat, one is afraid of crocodiles
In the marshes, one is attacked by leeches
The forests are haunted by ghosts and demons*

Of course, rice consumption long pre-dated the Vietnamese migration to the delta, though it is not known precisely when rice was cultivated rather than gathered from wild plants, nor when its cultivation diffused outward from the Yangzi Valley (Higham 1996:337). In fact, wild swamp rice continues to be collected: "in historic times, the inhabitants of the margins of the Tonle Sap have harvested wild floating rice by tapping the seed heads into their boats" (Higham 1989:82).

The Nguyen dynasty of the royal family supervised the settlement of the Delta. The Nguyens had severed relations with the rest of the imperial court in the 17th century, and essentially governed the southern delta as their own fiefdom (Brocheux 1995). This has resulted in a modern-day dichotomy between northern and southern settlement patterns and administrative structures in Vietnam. For example, military colonies were an important part of the expansion scheme of the south. In these colonies, soldiers, prisoners, and other vagabonds were granted plots of land which they were to develop in return for tax exemptions for 7 years (Cummings 1976). This type of settlement history has led historians to argue that villages in the Mekong Delta are thus less traditional and kin-bound than in other areas of Vietnam. One historian says that "Unlike villages in the more traditional areas, which were virtually self-contained economic, social and political units, villages in the South were more open to outside forces, and social, economic and religious activities did not become as village-centered" (Cotter 1968). There has supposedly been less emphasis on traditional ancestral duties in the south,

and a weakening of family hierarchy rules such as a decline in primogeniture and an increase in bilateral inheritance (Cummings 1976).

There was also a historical difference in village administration between North and South. Because so much of the south was settled by military and other figures, there was not as much emphasis on scholarship and mandarin exams as a means to upward mobility. Land holdings and military offices became the ways to advance oneself politically (Cummings 1976).

Unlike the post-colonial states of Africa and the Americas, those of the lower Mekong basin were well developed political entities long prior to French colonization. Although a consideration of the precolonial period is beyond the scope of this review, political competition between Laos, Vietnam and Thailand during the first quarter of the 18th century and the first quarter of the 19th continue to inform interstate relationships: "the 1827 conflagration left lasting, vivid scars on the soul and spirit of the people in the region. When tensions flare up today, people from both shores of the Mekong River still tend to refer back to it... Politics in Laos and Thailand today are still spoiled by miscues, misrepresentations, and conflicting assertions regarding the 1827 conflict, and these lapses continue to mar relations between our two neighboring countries, just as they also influence Thailand's relationship with Vietnam (Mayoury Ngaosyvathn and Pheuiphanh Ngaosyvathn 1998:13). A critical consequence of the 1827-29 defeat of the Lao by the reigning Chakkri dynasty of Bangkok was the destruction of the Lao aristocracy in Vientiane and in the south of the country. The loss of the elite resulted in a much more modest emergence of a land-owning class before and during the colonial period to facilitate development of capitalist relations of agrarian production. Unlike the delta region itself with its enormous productive potential there was relatively little in Laos to motivate such relations. "There were few opportunity for Lao aristocrats to transform themselves into commercially oriented landlords wish to swallow large tracts of land, or indeed for a commercially oriented peasantry to form... Under French colonial protection the petty principalities in Laos were slightly transformed but essentially were preserved intact. There was no real growth of a landed gentry or of a class of commercially oriented landlords" (Evans 1990:29-30)⁸.

The patterns of French colonial rule in Vietnam also differed from North to South. The French were concentrated in the South, the site of their first military achievements, and they continued to administer much of the South in a direct fashion for 80 years, while preferring more indirect rule in the North. As Cummings says, "Politically, the French broke the isolation, self-sufficiency and autonomy of the Vietnamese villages, reformed the legal and judicial system, dissolved the mandarin state, and devitalized the monarchy. Economically, they transformed the countryside from swampland to productive rice paddies and plantations, established industry, transportation routes and an import-export market economy, and in general changed subsistence-oriented peasants into market-oriented farmers. Socially, the French introduced Western civilization while destroying the Confucian-based, traditional, cultural system; reformed the education system; altered the traditional class structure and undermined the sanctity of the traditional Confucian family pattern" (Cummings 1976).

The upheavals of the colonial period were surpassed by the turmoil of the Vietnam War. The Mekong Delta was the site of heavy skirmishes during the Vietnam War. Most coastal mangrove areas were defoliated to eliminate military hideaways for the communists, and other areas believed to be harboring the NLF, such as the U Minh forest and the Plain of Reeds, were subject to herbicides and bombs (Vidal 1984). Waves of villagers from the area often fled to Saigon to avoid the military clashes of both sides (Trullinger 1980). After the reunification of Vietnam, the state implemented several policies to encourage the de-urbanization of Saigon. These policies ranged from incentives to move back to one's home village, such as free seeds or money for moving, to forced repatriation of refugees (Halls-French 1979; Desbarats 1987). More recently, New Economic Zones have been established in several Mekong provinces to

encourage outsiders to come in and settle, and to increase the population densities and agricultural productivity of the area (Hill 1984).

In Cambodia, the social upheaval caused by the Vietnam War was made worse by the genocidal policies of the Khmer Rouge in the late 1970s (Kiernan 1993). As part of their goal of a self-sufficient Cambodia, Phnom Penh was emptied of its urban population, and all citizens were put to work on forced labor agricultural cooperatives (Ebihara, Mortland, et al. 1994). Estimates of the number of people who died during the Khmer Rouge reign vary from one to three million people, which approaches 30 percent of Cambodia's total population (Heuveline 1998). Continued political instability has frustrated much development, both rural and urban, in recent years.

2. ETHNICITY

The political states of the lower Mekong basin, despite their antiquity, have not fully resolved the issue of how to create modern national identities within geographical boundaries comprised of diverse peoples who embrace distinct, and often discrepant histories, who speak different languages, who may be physically definable, and be characterized by different religions and customs. The problem of creating nonxenophobic national identities is made more complex because not only do each of the states contain a number of peoples, whose recent as well as ancient histories are replete with violent intergroup conflict, but many of these groups have transboundary locations rendering them politically suspect to the dominant community. Finally, the communitarian as opposed to individual-rights ethics which the states have embraced tend to impose a need to determine who is within the community, and therefore can be relied on to share the dominant ethic, and who is outside the community, and by definition therefore unreliable, untrustworthy. Thus, tensions exist among ethnic groups within and between states. In times of economic prosperity, these tend to be muted if not entirely submerged; but they can resurface with a vengeance with economic decline. The current economic downturn in East and Southeast Asia risks generating a new wave of xenophobia.

A recurrent fact of the region is that minority groups within a lower Mekong basin state may well be the dominant ethnicity within another or nearby state. Thus, Khmer and Vietnamese, minorities within Vietnam and Cambodia respectively, are obviously the principal ethnic group within their own states. Chinese are a minority population everywhere except in the world's most populous country that controls the headwaters of the Mekong. In this landscaping review of the literature, we outline an ethnic inventory of the region, to provide background reference for subsequent research and analysis. The issue is everywhere sensitive, but ethnic boundaries, however permeable they might be, and ethnic confrontations must be faced if we are effectively to participate in socially and environmentally sustainable economic development in the region.

As with all statistical information presented in this review, the figures in Tables 52-54 should be considered suggestive rather than definitive.

Ethnic tensions are on the rise in the Mekong basin, although they have always been high between Khmers and Vietnamese, because of the feeling that the Vietnamese have encroached on traditional Khmer lands in the Delta (Comte 1976). The Khmer Rouge, for example, were virulently anti-Vietnamese in their rhetoric and action and many Vietnamese were killed in the Cambodian genocide (Abuza 1995). Since the defeat of the Khmer Rouge, with thin assistance of Vietnam anti-Vietnamese sentiment has continued in Cambodia. The King of Cambodia this spring was quoted as making several racial slurs towards Vietnamese, and telling Cambodians that Vietnamese were no good and should go back to their own country. Anti-Vietnamese sentiment has also extended to violence against many Vietnamese

in Cambodia (Amer 1994). In March 1998, a number of ethnic Vietnamese fishermen were ambushed by Khmer Rouge rebels around the Great Lake. At least 20 people were killed. Aside from problems of violence, Vietnamese living in Cambodia are not granted Cambodian citizenship, and are routinely denigrated as outsiders living within the country (Bermen 1996).

Table 52. Ethnicity in Vietnam, 1993

Ethnicity	Total no. of persons
Vietnamese	55,900,200
Khmer	895,300
Chinese	900,200

Source: Vietnam, Socialist Republic of 1991

Table 53. Ethnicity in Ratanakiri Province, NE Cambodia, in 1996

Ethnicity	Total no. of persons
Brou	5,500
Kreung	14,000
Kavet	2,000
Lun	150
Tampuen	18,000
Kachok	2,200
Pnong	very few
Jarai	14,000
Lao	6,500
Chinese	200
Vietnamese	750
Khmer	18,000

Source: Colm 1997

The situation appears to be better for Cambodians in Vietnam. The state in Vietnam recognizes people of Khmer ethnicity as Vietnamese citizens, and not as Cambodian. As such, they are supposed to be accorded the same rights as any other citizen of Vietnam, including access to all public services and supports. There may be instances of discrimination in reality. For example, Khmer children are required to attend school in Vietnamese; therefore many children may not go to school, and literacy among Khmer in Vietnam is lower than the average of the population.

However, more blatant in.-qualities between the Khmer in Vietnam and the majority population do exist, especially in terms of access to land and resources. As a Vietnamese social scientist

has written, "The well known fertility of the Mekong Delta makes it favorable for agriculture to develop, yet the local inhabitants, who should have received the nature's favor, are unequally fortunate. Endowed with favorable geographical features of their living areas, the majority of Vietnamese peasants prosper very fast. On the contrary, the Khmer, who inhabit on and saline land where there is a chronic shortage of fresh water, have lived on nothing but rice culture from generation to generation" (Mac Duong 1991).

The disparity in living standards may be a result of the general pattern of Khmers in the Delta tending to inhabit more marginal lands. "Their chosen environment is usually ideal for industrial plants as coconuts, pineapple, pepper, sugar canes, etc., or plants of the soya family as groundnuts, green and black peas, soya beans, sesames, and so on. But for a long time they have lived solely by a single-crop cultivating system with the maximum yield of 3 tons per year on a hectare" (Mac Duong 1991).

According to Duong, the Khmer primarily engage in rice production (90 percent of the population) with some crafts production, like basketry or pottery (5 percent), some fishing (2 percent) and some trading (3 percent). Duong also compares this to the two other minority groups in the delta, the Chinese and the Cham. The livelihood distribution for Chinese residents of the Delta is 28 percent small trade, 70 percent industrial plants and gardening, and 2 percent rice cultivation. For Cham, 80 percent of the population is in small trade, 15 percent in sericulture, 2 percent in rice cultivation, and 3 percent in fishing (Mac Duong 1991).

Anti-Sinicism exists in both countries. According to one author, Chinese businessmen are often seen as exploitative and too wealthy and hence become a scapegoat for Vietnamese and Cambodians to blame for economic problems (Amer 1996; see also Chirot and Reid 1997). Ethnic Chinese were massacred in Cambodia by both the Lon Not and the Pot Pot regimes in the 1970s. Chinese were deported from Vietnam in 1975 and again in 1978-1979 when a number of Chinese, including large numbers of people from Cholon, Saigon's predominantly Chinese neighborhood, were expelled. The claim was that Chinese capitalist business practices were harming attempts to socialize the economy. In 1979, the Chinese population was around 960,000, and a large proportion of this population fled. Other reasons may inform on the deportations, including the fact that the State took much of the property left behind by the Chinese exiles, and in December 1979, Vietnam went to war with China over a border dispute. Currently, the number of Chinese living in Vietnam is around 950,000 people, almost reaching pre-war levels. Chinese residents represent 1 out of every 7 urban dwellers in Vietnam (Economist 1998b).⁹

Table 54. Income Distribution of Ethnicities in Mekong Delt 1988

	Well off income of over 600,000 VND/yr	Good income over 400,000 VND/yr	Average income 200,000 - 300,000	Substandard income under 200,000	Poor income about 100,000 VND
Vietnamese	8%	0%	50%	36%	6%
Chinese	25%	60%	15%	0%	0%
Khmer	3%	0%	25%	20%	52%
Cham	0%	7%	23%	52%	18%

Source: Mac Duong 1991

The conventional classification of ethnic groups in Lao PDR parallels that in Cambodia: the lowland peoples (Lao Loum); the midland people (Lao Theung); and the highland peoples

(Lao Soung). None of these groups constitutes a majority by itself, though the Lao Loum are socially and politically dominant, while the Lao Theung and Lao Soung are "minorities" (Ireson and Ireson 1991:921). Unlike Cambodia, however, the highland Lao are not considered to be indigenous, since they are relatively recent migrants:

Originating from somewhere near Kweichow, China, [the Hmong (sometimes called Meo) and the Yao] came to Laos only a century and a half ago and settled on lands above 3,000 feet. They, like the Mon-Khmer tribes, practice swidden¹⁰ agriculture, growing upland rice and maize as well as opium as a cash crop. Family and clan have traditionally been the only important groupings among the Yao and Hmong. Like the Mon-Khmer, they are animist and their shamans play important roles in village life and in clan decision-making.

Other smaller Tibeto-Burman-speaking groups from Yunnan, Re the Yi Akha and Lahu, now live in Laos near the Burmese and Chinese borders (Batson 1991:134-135).

Sensible and soundly based ethnic minority policies are especially important in Laos because the dominant Tai-Lao are themselves not a majority population and the minority groups, settled in border areas themselves constitute transboundary populations. Minority groups also played significant roles in the revolution, and for 30 years the Lao communists drew on, and received, considerable minority support. In 1968, the Lao Patriotic Front, as part of its 12-point program, announced a policy:

To actively assist all nationalities, especially the minorities, in developing [their] economy, in study, in improving their material and cultural life, in preserving their own customs and traditional culture. (Stuart-Fox 1986:130).

Prior to 1975, 60% of LPRP membership and most of the Pathet Lao military were recruited from minority groups, and minority areas were the principal targets of American bombing.¹¹ Nonetheless, the revolutionary elite in Laos remains overwhelmingly Lao Loum. Government attempts to force upland peoples to abandon shifting cultivation in favor of terrace-based rice farming and/or relocation to the lowlands, generated a good deal of resentment. "This took various forms, from sullen non-cooperation to migration to Thailand or China. Tribespeople objected to working in collective labour gangs, disliked living at lower altitudes where they were susceptible to malaria and other diseases and resented close government supervision and control. Discontent among tribal minorities was one of the factors which led the government to change tactics and ushered in the liberalization of 1980" (Stuart-Fox 1986:133).

The fact that many Hmong embraced the communist cause does not mean that the Hmong in general supported Pathet Lao. On the contrary, thousands of highlanders became refugees in Thailand, "a ready source of recruits for either political agitation or military action against the new regime. The threat this presented to the nation's internal security was greatly increased, in the estimation of the Pathet Lao, by Thai collusion with rightist exiles and hostility towards the new regime" (Stuart-Fox 1986:137).

Relations between Tai-Lao and the ethnic minority populations are made even more contentious by the farmer's tendency to despise the latter as "uncivilized" and to refer to them by the opprobrious epithet *kha*, meaning slave.

The Lao Theung groups resented the lowland Lao as the people who had forced them into the mountain slopes in the first place. The Hmong, late arrivals, immediately challenged the Lao Theung for both territory and economic control of certain northern areas such as Xieng Khouang. The lowland Lao looked down on

both groups as savages, barbarians, people who were to be distrusted (Batson 1991:137).

The government has tried to overcome negative stereotypes and to stress the multi-ethnic composition of the state. But despite the improved rhetoric, a great deal remains to be accomplished in creating a national Laotian identity. According to two close observers, "Two central issues inform ethnic relations in Laos: who makes political and economic decisions, and who controls economic resources." The answer to both remains the lowland Lao. (Ireson and Ireson 1991:925).

The extensive damage from the Vietnam War and the lingering effects of the Khmer Rouge regime and Cambodian-Vietnamese conflicts have resulted in large numbers of refugees and displaced persons, as well as war damage to land and settlements. In rural Cambodia, nearly 2/3 of the household heads are women, and there are large numbers of disabled people unable to work full time in agriculture (World Bank 1994a). As one author writes, "War and conflicts have shocked the ecological, economic and social fabric of the country. People continue to be displaced, and many displaced families without food or shelter are forced to beg. Maintaining the balance between human needs, technology, development, and environment is a big challenge for Cambodia. Any major disruption of communities or destruction of livelihoods will only make things worse for the rural majority in Cambodia" (Ahmed, Tana, et al. 1996).

Repatriation of refugees from camps in Thailand is still an ongoing process in Cambodia. In 1993, it was estimated that there were 600,000 displaced persons in Thailand and other neighboring countries who were to be repatriated to Cambodia at some point (World Bank 1994a). "Though many, if they have not already done so, will seek their living in the towns, a large number will either rejoin their rural families (if they are still to be found and if there is farm land to spare) or will seek to open new farms in some of the more remote parts of the country, such as the Ratanakiri Plateau. The capacity of existing rural communities to absorb displaced persons is clearly limited" (World Bank 1994a).

3. POPULATION

The population structures and densities of the countries of the lower Mekong show dramatic differences. In all of Cambodia there are 9.8 million people. In the Mekong Delta of Vietnam alone, there are 16 million. (See Figure 7. Population Density Map.)

Tables 55-59 lay out the statistical information on population size in the region.

More detailed statistics for the provinces in the lower Mekong basin are indicated in the tables below. The first indicates the increase in population between the end of the war and the early 90s, and the second indicates current population levels and urban/rural distributions.

Table 55. Population Structure in Cambodia, 1990

Age group	Total	% of Total population	% Female
All ages	8,567,582	100	53.7
Over 15	4,547,673	53.1	57.3
Under 15	4,019,909	47.9	49.7

Source: World Bank 1994a

Table 56. Population Structure in Vietnam, 1989

Age group	Total	% of Total population	% Female
All ages	64,375,800	100	51.5
Over 15	39,153,200	60.8	53.3
Under 15	25,222,600	39.2	48.8

Source: Vietnam Socialist Republic of, 1991

With approximately 4.5 million people in 1995, Lao PDR is the least populated and least dense (17 persons/km²) of the lower Mekong countries. Land-locked, it is also the poorest. Yet unlike its neighbors, income and access to productive resources are relatively equitably distributed:

Table 57. Vietnam Population by Province in 1976 and 1991

Area or Province	Population in 1976	Population in 1991
Long An	865,000	1,177,000
Tien Giang	1,181,000	1,557,000
Ben Tre	968,000	1,264,000
Dong Thap	1,037,000	1,402,000
Vinh Long/Tra Vinh	1,367,000	1,905,000
Can Tho/Soc Trang	1,947,000	2,819,000
An Giang	1,416,000	1,850,000
Kien Giang	865,000	1,266,000
Minh Hai	1,017,000	1,643,000
Mekong Delta Total	10,663,000	14,883,000

Source: Vietnam, Socialist Republic of, 1992

Table 58. Vietnam Population by Province in 1995 and Urban/Rural Distribution

Area or Province	Population in 1995	Urban %	Rural %
Long An	1,255,290	20	80
Tien Giang	1,655,765	12	88
Ben Tre	1,369,400	7	93
Soc Trang	1,172,616	16	84
Vinh Long	1,072,652	14	86

Dong Thap	1,485,995	16	84
An Giang	1,970,318	18	82
Kien Giang	1,368,000	20	80
Minh Hai	1,117,562	20	80
Tra Vinh	957,700	5	95
Can Tho	1,818,700	20	80
Total	15,901,998	15	85

Source: Tran Phuoc Duong 1995

The agriculture sector can be characterized as an extensive but low productivity system. Over 90% of income earning adults make livelihoods in agriculture, and this is consistent in rural areas in all three regions of the country. Admirably, landholding in Lao PDR is nearly universal with each family claiming ownership to 1.4 hectares of cultivable land on average. The range of land ownership is also modest, with the lowest quintile (20%) owning 1.29 hectares on average and the richest quintile only 1.72 hectares. Rice is the most important crop... Irrigation is rare, double cropping equally scarce... (World Bank 1995:iv).

Given its low productivity, commercial farming in Laos is much less common than in the other lower Mekong countries. According to the World Bank (1995:v), "Over 80% of villages report that the most important crop is eaten, not sold."

The best population data for Cambodia come from the World Bank in 1994.

Table 59. Population in Cambodia by Province, 1981 and 1993

Province	1981	1993
Kandal	720,000	893,000
Kompong Cham	1,066,000	1,417,000
Svay Rieng	292,000	442,000
Prey Veng	672,000	900,000
Takeo	531,000	675,000
Kompong Thom	379,000	498,000
Pursat	175,000	270,000
Kompong Chhnang	221,000	323,000
Kampot	354,000	482,000
Kratie	157,000	204,000
Cambodia Total	6,682,000	9,308,000

Source: World Bank 1994a

4. INCOME AND POVERTY

The political economy of the lower Mekong basin is informed by major differences in national income levels among the four riparian countries. Until the current East Asian financial crisis, Thailand was the wealthy economic powerhouse of the region while Lao PDR, Cambodia, and Vietnam were, and remain, poor. Because of their poverty and their lack of readily available commercial alternatives, Laos and Cambodia responded positively to suggestions that they exploit the two resources they seemed to have in abundance: timber¹² and water, the former through the export of logs and the latter through the export of hydropower. Thailand was to be the transit country for lumber and the principal consuming country for power. The Mekong River Commission, composed of the four countries (with China and Myanmar having observer status), is the collective instrument for planning and attracting support for what is euphemistically called "river-basin development." The various cost-benefit projections on which the World Bank, the Asian Development Bank, and several bilateral funders (notably Japan and Australia) appraised the dams, power-generating stations, and transmission lines, have been rendered dubious by the precipitous decline in the value of the Thai baht, thereby providing a breathing space during which construction and operating plans might be reassessed. It is important to underscore, however, that Cambodia and especially Lao PDR see themselves as having few if any alternative resources that might bankroll their entry into the world economy. Ironically, the exportable rice surpluses produced in the Mekong delta of Vietnam are vulnerable to upstream developments that will adversely affect the quantity, flows, and quality of water. Dam construction also engenders human and environmental costs in the upstream countries. While there is pressure on Laos and Cambodia, and on the funding organizations, to be more environmentally and socially responsible in their planning, it is also important to acknowledge that alternative income-generating activities are, because of their overall poverty, rare.

Vietnamese household incomes vary widely both within and across regions. The figures in Table 60 on average household incomes do not indicate the disparity between rich and poor in each region. According to the Vietnamese Living Standards Survey of 1993-1994, the gap between the rich and poor is growing in the countryside, especially in the south. The gap is often related to the size of land holdings, and as holdings tend to be bigger in the south (both because it is allowed by the government in the south and because of historical land patterns), there are more affluent land owners there. In general though incomes have risen in Vietnam since liberalization, so too have income disparities, as shown in Table 60.

According to a recent analysis by economists from the Harvard Institute for International Development (Dapice and Sarah 1995), poverty in Vietnam is attributable to:

Table 60. Household Incomes Compared across Regions in Vietnam

Region	Year	Income per capita/mo in 1000 VND at 1992 levels	Gini coefficient	Households under poverty line %
Red River	1989	63.3	0.202	25.4
	1992	89.7	0.307	13.1
Mekong	1989	90.0	0.267	12.1
	1992	113	0.291	8.6

Vietnam Total	1989	66.0	0.263	25.3
	1992	89.3	0.298	12.1

Source: Kerkvliet 1995

1. isolation, both geographic and social-intellectual
2. excessive risk from poor crops, disease, unwanted births, or livestock deaths
3. inadequate productive resources due to lack of labor, land, or capital.
4. lack of sustainability from declining resources
5. inadequate participation in government programs

There is no universal agreement on a quantitative measure of poverty; its incidence varies according to the specific survey administered. Using Vietnam's official definition of poverty as an annual income of less than 1,090 thousand Vietnamese Dong per person (Prescott and Litvack 1995:ii), the regional index of poverty is shown in the following table:

Table 61. Incidence of Poverty by Region in Vietnam, 1993, in percentages of people living below the government poverty line

Region	% Rural residents	% Urban	Total % impoverished
Mekong Delta	52	28	48
Red River Delta	55	15	49
Total of Vietnam	57	26	51

Source: Nguyen Cong Dinh, Le Xuan Diem, et al. 1990

Table 62. Rural Income Distribution by Region 1989-1992

	Per capita monthly income ('000 VND)	Gini Index	Households below poverty line
Red River Delta			
1989	63.3	0.202	25.4
1992	89.7	0.307	13.1
Mekong Delta			
1989	90.0	0.267	12.1
1992	113.0	0.291	6.6
Average all Vietnam			
1989	66.0	0.263	25.3

1992	89.3	0.298	12.1
Commune Name	Province	Land conditions	Income (VND per HH)
Thanh Phuoc	Ben Tre	Saline soil, low rain	120,000
Hoa Dien	Kien Giang	Salty alum soil, shallow	234,035
Long Toan	Tra Vinh	Saline soil	405,150
Phong Thanh Nam	Minh Hai	Alum soil with shallow	505,862
Khanh Hoa	Minh Hai	Alum soil, saline in	905,769
Dai Tam	Hau Giang	Alum soil, saline in dry	984,150
Viet Kieu	Minh Hai	Saline in season, ample	1,010,000
Hoi Cu	Tien Giang	Good soil	1,175,400
Vinh Xuan	Tra Vinh	Good soil	1,569,300
Long Thanh	Kien Giang	Slight alum soil	1,579,926
Phu Cuong	Dong Thap	Slight alum soil, deep	1,637,500
Tan Phu	Ben Tre	Good soils	1,836,000
Tan Cuong	An Giang	Poor fertility, little rain	2,160,000
Doc Binh Kieu	Dong Thap	Slight alum, deep flood	3,506,062
Tan Hoa	Long An	Slight alum, deep flood	3,629,130
Tan Hao	An Giang	Good soil, deep flood	3,809,900

Source: Mac Duong 1991

As was discussed in the Section on Health and Nutrition, the World Bank emphasizes ability to purchase food as its principal measure of poverty:

The starting point for developing an appropriate poverty line is the basic notion that food is the most fundamental need of human beings. Extreme lack of food leads to death, while chronic insufficiency of food leads to physical weakness, greater susceptibility to disease and, among children, impaired cognitive development. This suggests that any method for calculating a poverty fine should be closely tied to sufficient food intake (Prescott and Pradhan 1997: 15).

In Cambodia, Laos, and Vietnam the poverty line is defined as the ability to purchase 2,100 calories of food per person per day (while acknowledging that calories are not the only measure of nutritional adequacy, and that persons of different ages, weights, and activity regimens have different caloric requirements).

Setting the poverty line requires specification of a basket of food items yielding exactly 2,100 calories. The relative composition of the basket is obtained from observed dietary patterns. To determine a typical consumption pattern, a reference household has been constructed... derived from observations in the middle (third) quintile in the per capita consumption distribution (appropriately weighted). The reference food bundle is constructed by taking average values of the reported

quintiles for every food item. Next, the calorie content of this basket is determined. The food basket for the poverty line is obtained by scaling all quantities by the same factors such that the basket has a calorie content of 2100. In the Cambodian case, the reference food bundle has a calorie content of 2298 calories. As a result all quantities were scaled down by a factor $(2100/2298) = 0.9138$ (Prescott and Pradham 1997:16).

By these measures, the incidence of rural poverty in the lower Mekong basin countries is much higher than elsewhere in East and Southeast Asia:

Cambodia	43 percent
Vietnam	47 percent
Laos	53 percent

Urban poverty in the three countries, while less than half that of rural poverty, is also comparatively high:

Cambodia	24 percent
Vietnam	20 percent
Laos	24 percent

Ability to consume food is a useful, but not the only indicator of poverty. The Socioeconomic Survey of Cambodia carried out in 1993/1994 by the National Institute of Statistics under the joint sponsorship of the Asian Development Bank and the UN Development Programme, showed that the poor live in larger households (average 6.6 for the poorest quintile and 4.9 for the richest); they have significantly less schooling (persons aged 15 years and older averaged 3.1 years for the bottom quintile and 5.3 years for the top); and they have much less access to potable water and sanitary facilities: "Only 4 percent of the poor quintile have access to piped water, while more than 17% of the richest quintile do... Few of the poor - 9% - have access to a toilet in the home, while around half of the richest 20 percent do.... Access to electricity from a generator or line connection... rises sharply with income, from a mere 1% among people in the bottom quintile to 37% of Cambodians in the richest quintile" (Prescott and Pradham 1997:39-40).

There are no longitudinal data on household-level income in Laos, as the first official survey by the National Statistical Center was carried out only in 1992-1993, and focused on expenditures and consumption.

In keeping with the literature on poverty, consumption (instead of income) per capita is used as the indicator of individual welfare. Although this is necessitated by data considerations (the Lao Expenditure and Consumption Survey [LECS] did not collect data on household income), there are a number of conceptual reasons why consumption provides a more reliable measure of poverty than does income, especially in a developing country where agricultural incomes can be highly variable over time. Indeed, households engaged in self-employment activities often routinely report zero business income in any given year; it would be incorrect to define 0 of these households as poor (World Bank 1995:1-2).

As in Vietnam and Cambodia, the LECS showed both regional and rural/urban variations in household economic status. The central area around Vientiane reveals a greater consumptive profile than either the North or South, with the South showing the most acute poverty.

... roughly one-third of all poor individuals in Lao PDR live in the rural areas of the Center and slightly less than a third live in the rural areas of the North. Slightly less than one-quarter of the poor live in the rural areas of the South. Thus, although the incidence of poverty is greatest in the rural South there are more [poor] people in the rural Center because of this region's larger population (World Bank 1995: 10).

A bit more than half of all farmers are poor farmers. Salaried workers, in both the public and private sector, also show high rates of poverty (24.5% and 40.7%) because of their low wages.

An unexpected finding from the LECS is that the incidence of poverty declines with the age of the household head. "The incidence of poverty is 52.5%, 49.4%, 41.5%, and 33.1% for households with heads aged 15-30 years, 31-45 years, 46-60 years, and 61-89 years respectively" (World Bank 1995:11). One hypothesis to be explored in explaining these data is that the older heads are most likely located in larger extended households with multiple earners. The relationships among poverty, household size, and occupation have not been explored. It would be important to determine if high fertility rates in Laos responded to rational economic decision-making.

Despite the small size of Laotian farmlands, "overall land distribution is relatively skewed at the bottom and top end of the income distribution. Compared to neighboring Vietnam, for example, the poorest 20% of the rural population in Lao PDR have access to a significantly lower share of all land [average 1.3 ha.], while the wealthiest 20% control significantly more land [average 1.7 ha.] in Lao PDR than in Vietnam" (World Bank 1995:46). Nonetheless, neither an agrarian proletariat nor a rentier class has emerged in Laos.

The World Bank (1995:47) points out that traditional land access rights do not protect small Laotian farmers from land alienation by logging companies and by the extension of commercial agriculture. Formal titling of holdings has been rare although the Lao PDR has recently adopted land use decrees.¹³ It is not clear the extent to which these are being implemented and whether they protect smallholders.

5. HEALTH AND NUTRITION

Some generalized data for indicators of social development were collected by state agencies for most of the lower Mekong as of 1993.

Statistics, questionable everywhere in the region, are even less reliable for Cambodia. The country's first and only population survey was undertaken in 1962. Subsequent estimations have been based on assumptions about birth and death rates.

Currently, the total fertility rate, a measure of the number of children a woman would have in her lifetime at current reproductive rates, has halved and now stands at 3. Demand for child labor on farms and in family enterprises, school attendance, and mother's educational level are estimated to have a large effect on family size in Vietnam (Gallup 1998). Reduction in birth rates in recent years appears to have been partially due to the efforts of the state, which runs an extensive family planning policy modeled on China's. However, the Vietnamese policy allows more flexibility in number of children than

Table 63. Infant Mortality and Literacy Rates for Vietnam, 1993

Region	Per Capita	Density of	Illiteracy	Infant	Maternal	Paddy
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	GDP 000 (in VND)	Pop. Per km ²	Rate per 100,000 live births	Mortality per 1000 births	Mortality	equiv. in tons/ha
Red River Delta	448.4	1085	7.2	44.2	1.7	2.74
Mekong Delta	472	325	15.3	51.7	2	3.95
All Regions	478.2	209	13.1	49.5	2	3.06

Source: Bird, Litvack, et al. 1995

Table 64. Infant Mortality and Literacy Rates for Cambodia, 1993

Region	Per Capita GDP 000 (in VND)	Density of Pop. Per km ²	Illiteracy Rate per 100,000 live births	Infant Mortality per 1000 births	Maternal Mortality	Paddy equiv. in tons/ha
Cambodia	?	159	35%	97	4.9	1.3

Source: Economist 1998b

China's one-child policy. In Vietnam, the state allows up to two children for everyone and additional children with official approval or payment of fines (Goodkind 1995). As a result of this one-or-two child policy, contraceptive use and abortion are widespread in Vietnam (Haughton 1997). The fertility rate is expected to fall to the replacement level (2.1 percent) within a decade (Economist 1998b). In Cambodia, the population growth rate has been around 4 percent in recent years (World Bank 1994a).

Fertility rates in Lao PDR are among the highest in the world: 6.7 overall (and 6.9) in rural areas, and the net growth rate is 2.9%, doubling the population every 25 years. Infant mortality is estimated at 125 per 1,000 live births, a rate substantially higher than the average for subSaharan Africa. Maternal death rates are also high, about 660 per 100,000 births (World Bank 1995:30), and almost 40% of women report that they deliver at home and without assistance. "About 30% report being assisted by a friend or relative, and 23% receive assistance from traditional healers or midwives also at home. Only 7% attend a hospital or clinic. . ." (World Bank 1995:37). Most Laotians, especially in rural areas, seek medical care primarily from pharmacies (60%), while only 12% visit modern health facilities. According to a UNICEF/Ministry of Health survey in 1994, "51% of the surveyed population reporting sickness purchased medicinal products as the first-stop care without any consultation to health personnel; and only 14% of those ill reported visits to hospitals" (World Bank 1995:34). In urban areas, however, where modern health facilities are concentrated, they are used much more frequently.

There are disparities between Cambodia and Vietnam also. Cambodians have much poorer health than do Vietnamese, with a significantly shorter life expectancy and higher infant mortality.

Table 65. Cambodia Health Indicators, 1990 Indicator

Indicator	

Life Expectancy	49 years
Infant mortality rate per 1000 live births	97
Access to safe water, % of population	12%

Source: World Bank 1994a

Table 66. Vietnam Health Indicators, 1993 Indicator

Indicator	
Life Expectancy	68 years
Infant mortality rate per 1000 live births	51
Access to safe water, % of population	?

Source: Economist 1998b

One reason for the discrepancy in health is that around 6.4 million rural people in Cambodia have no access to clean water and only 500,000 have access to sanitation facilities (Cambodia, Ministry of Agriculture Forestry and Fisheries 1996). Furthermore, Vietnam's medical services and medical administration are more developed than in Cambodia because of state intervention. After 1954, North Vietnam set up a public health infrastructure down to the hamlet level, and this system was extended to the south after reunification. However, since the reform years of 1988-91, public spending on health care has decreased and there has been a decline in availability of some services in rural areas. For example, the Want mortality rate is no longer falling as of 1997 (Economist 1998b).

In Cambodia, many rural areas rely on traditional healers (Lemoine and Eisenbruch 1997), and this is also the case in areas of Vietnam. In Vietnam traditional healers usually combine some Chinese medicine with Vietnamese rituals. Additionally, there are many traditional rituals performed to prevent ill health in the first place by requesting protection from deities or appeasing evil spirits. Families also sometimes keep medicinal plants grown in gardens for health problems; chili is considered good for a preventative against worms, and several other species known as *cay muon*, *voi voi*, and *day mong toi* are used for skin disorders, backaches and eye problems respectively (Hickey 1964).

A number of diseases are quite prevalent in the lower Mekong, many of which are directly tied to the presence of standing water in the area (Harinasuta, Grossman, et al 1973). These include malaria, dengue, schistosomiasis, cholera, and bacterial dysentery (Midorikawa, Nakamura, et al 1996; Voelker 1996; Hien, Vinhchau, et al. 1997; Yoshida, Li et al. 1997). AIDS is also on the rise in southern Vietnam and Cambodia (Thuy, Nhung, et al. 1998).

Table 67. Vietnam Medical Care Indicators 1991-1996

	1991	1994	1996
No. of hospital beds	206,000	191,000	197,000
No. of physicians	20,000	30,000	32,000
No. of nurses	68,000	51,000	46,000

% GDP spent on health	0.8%	1.3%	1.0%
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Source: Economist 1998b

Table 68. Cambodia Medical Care Indicators, 1993

	Total	Phnom Penh	Elsewhere
No. of hospital beds	?	?	?
No. of physicians	986	626	360
No. of nurses	9,452	2,260	7,192
Total USD spent on health care	7 million	NA	NA

Source: Economist 1998a

While more than 8,500 AIDS patients have been found in Vietnam, the number of those infected with the AIDS virus is estimated six to ten times higher. A latest Vietnam News report said 90 percent of the people tested positive against the AIDS virus are under 30; five percent are adolescents. Freelancers, jobless people, street kids, prostitutes and drug users are defined as high risk groups.

In a related development of Friday, the Vietnamese government launched a nationwide year-long campaign to promote public awareness about the deadly disease. The campaign aims to involve young people in HIV prevention programs, inform them about HIV's devastating impact and mobilize their support in the fight against AIDS (Indochina Interchange 8(2):26, 1998, citing Xinhua, May 23, 1998).

In 1991 USAID provided \$525,000 to help Vietnam's National AIDS Committee fight the spread of the disease.

Tuberculosis and dysentery continue to kill hundreds of people in Cambodia, and leprosy and polio are still common there as well.

Tuberculosis is a major health threat in Cambodia, with an estimated prevalence rate of 500 per 100,000, the highest in the Southeast Asia region. Recognizing this, in 1994 the Government launched a nationwide tuberculosis control programme. The National Tuberculosis Programme (NTP) aims to decrease tuberculosis transmission by improving the cure rate and case detection. With the assistance of WFP and WHO, a directly observed treatment with short-term chemotherapy (DOTS) is provided to more than 90 percent of the tuberculosis patients attending consultations in 120 anti-tuberculosis units throughout the country. Tuberculosis patients from rural and urban areas tend to represent the poorest groups within their communities. Should patients not complete their six-month course of treatment, it is possible that drug-resistant strains of tuberculosis will develop in Cambodia and spread globally, with catastrophic consequences for public health (World Food Programme 1998:6).

In terms of schistosomiasis, the parasite and snails are already present in several of the Mekong tributaries. Schistosomiasis (of the kind *S. mekongi*) has been recorded in several areas of the upper Mekong where dams have been built in the last 20 years (Attwood 1995). It appears that the vector is the *Tricula aperta* snail (Harinasuta 1984). Malaria remains the most common infectious cause of morbidity in Vietnam, however, and malaria is often drug-resistant

in the Delta areas (Hien, Vinhchau, et al. 1997). Twenty-eight species of mosquito have been documented from the middle Mekong, including the malaria-transmitting *Anopheles* variety (Rattanaarithiku, Mongkolpanya, et al. 1994). Dengue fever, also transmitted by mosquitoes, has killed tens to hundreds of people each year in the delta in the last few years (Voelker 1996). Fifty Vietnamese died from dengue fever during the first quarter of 1998, and during this period, dengue-infected people numbered 13,528, or 238.8 percent higher than in the same period big year. "In 1997, dengue fever was the fourth major disease and the largest killer in the country, with a total of 77,370 people infected and 222 killed" (Vietnam News Service 1998c). In early July alone, 17 children died of dengue in the province of Dong Nai outside HCM city (Associated Press 1998a).

Rice is clearly the mainstay of diets in the region, constituting up to 75 percent of caloric consumption. Even among rice-producing households, shortfalls occur, and rice may be borrowed from neighbors and relatives without interest and from merchants at interest rates of 40 to 100 percent. "Of the 19 households considered that produced rice in Babaong, only six (less than one-third) were able to subsist for the entire year from the 1995 to the 1996 crop season without borrowing rice for consumption needs" (McAndrew 1998:5). Borrowed rice may also be repaid in labor:

the teenage daughter of a blind father worked for five days in the rice fields of other villagers to repay two baskets of paddy rice that the household had received. The cost of two 15-kg baskets of paddy rice at 300 riels per kg amount to 9,000 riels, while wages for five days of farm labour in Babaong amounted to 12,500 riels. In this case, borrowing rice against labour translated into a 28 percent reduction in the wages earned. In We 1996, [she] owed a total of 90 days of farm labour to 10 villages lenders. If she did not complete the work in the forthcoming crop season, she could extend it into the following season (McAndrew 1998).

It should be pointed out, however, that households within a village often lend labor to each other without strict accounting. McAndrew (1998:23) suggests that these incidences of mutual assistance "do not necessarily mean that social cohesion and solidarity prevailed in the villages. Relationships of reciprocity were circumscribed by a household's capacity to make exchanges, and poorer households with limited resources were decidedly disadvantaged."

Although other crops are important and fish provide about 76 percent of animal protein consumed in Cambodia (Ahmed, Tana et al. 1996), the key element in the national diet is rice. According to Murshid (1998:5), "food security equals rice security equals production of rice equals consumption of rice." Yet despite common production shortfalls at the level of the household and the high incidence of borrowing, Murshid concludes that "there does seem to be a case against the widespread view among donors and policy-makers that large numbers of rural Cambodians are unable to address their basic calorie needs" (Murshid 1998:6). He acknowledges, however, that the quality of the data supporting this conclusion are "uneven."

Ecological changes accompanying lumbering and anticipated dam construction will adversely affect the Cambodian riparian fisheries which are the principal source of animal protein in the country. The most recent available examination of children's nutritional status in the country (Kenefick 1998) finds alarmingly high rates of nutrition in the below five-year group: forty-nine percent of the children are stunted and 20 percent suffer from acute malnutrition. These figures reflect some improvement over earlier assessments, which the author attributes to food and other forms of foreign assistance. The study found moderately high rates of night blindness, *kwak moin*, among both children and women, which it attributes to very low Vitamin A intake. Women and children also exhibit high rates of anemia.

The World Bank's basic indication of poverty is a level of income insufficient to buy 2100 calories of food per person per day. In Laos, this "food poverty line" is 8,558 kip per person per month.

... since poverty lines for at least three low-income countries in Asia--China, Indonesia and Vietnam--are based on a food bundle providing an average daily energy intake of 2,100 calories per capita, one can compare the incidence of poverty obtained in Lao PDR against that reported for these three countries. In 1990, the incidence of poverty was estimated to be 14% in the rural and 17% in the urban areas of Indonesia. The corresponding figures for China are 13% and 1%, respectively... However, the incidence of poverty reported for Vietnam--a country that is most similar to Lao PDR in terms of per capita income and its socialist background--is remarkably close to that obtained for Lao PDR. Based on data from the Vietnam Living Standards and Measurement Study, the incidence of poverty has been estimated at 57% for rural areas and 26% for urban areas in 1992-93 (World Bank 1995:8).

If these figures are reliable, then approximately half the populations of the two countries are not only poor, but also malnourished and unhealthy.

The health status of Lao PDR is well below Asian standards, and comparable to the least developed countries of South Asia and Africa. From the recent Lao PDR Social Indicator Survey (LSIS) infant mortality has been computed to be 125 infant deaths per 1000 live births, compared to an average of 99 for Sub-Saharan Africa. Maternal mortality was found to be approximately 600 deaths per 100,000 births, and total fertility is approximately 6.7 children per mother... These health outcomes suggest a health system characterized by low access to services and poor service efficiency (World Bank 1995:30).

Within the country, ethnic Lao are least likely to suffer from poor nutrition. Only 1% of Lao children from 0-14 years of age who were tested demonstrated a severe level of malnutrition, while the comparable figures for Khmu and Hmong are 8% and 14% respectively. The total percentage of malnourished children among the three groups is 28, 39, and 51 % respectively (Ireson 1996:142).

Despite "marked overall improvements between 1995 and 1997 in both national production and reporting of national rice crop statistics," the World Food Programme states that in Cambodia, food distribution continues to be problematic. "Neither the country as a whole nor many individual households can yet be regarded as enjoying food security" (World Food Programme 1998:4). The recent devaluation of the riel has resulted in a marked increase in food prices, especially for the poor who do not have access to U.S. dollars, which circulate widely and legally throughout the country.

While there is a network of modern -- though perhaps ill-equipped -- health facilities in Laos, especially in the urban areas, many Laotians either self-medicate, using pharmacies, or see traditional practitioners.

6. EDUCATION

In Vietnam, access to near universal primary education has produced high literacy levels. In 1989, it was estimated by the state that 88 percent of the population over 15 years was literate; the rate was 92 percent for men and 84 percent for women. In Cambodia, the rate of literacy is far lower; the World Bank estimates it is 65 percent or below.

Illiteracy is endemic throughout rural Cambodia... Survey work by the UNFPA and the Ministry of Planning has been able to establish national estimates of adult literacy rates by gender, finding that the illiteracy rate for rural females is 43 percent compared to 25 percent for males. In rural areas, illiteracy correlates

significantly with the use of contraceptives which in 1995 was as low as 13 percent...

Relationships among gender, literacy, and religion are suggested in this reports sections on Gender and Religion.

Lao PDR again displays a very different picture in regards to literacy. While schools and teachers are present in the rural areas, illiteracy remains high. 1993 data reveal an adult illiteracy of 36%, with the highest rates, 76%, among rural women aged 36-55. Illiteracy correlates not only with age, gender, and rural/urban location, but also with poverty (World Bank 1995:15-16). Thus, the least educated segment of the population is female, rural, adult, and poor; the best educated is male, urban, young, and relatively affluent. Finally, geographic location within the country influences rates of scolarisation. "Northern rural males have a 31% gross enrollment rate compared with a 12% for females. In the South these figures are 27% and 15% respectively" (World Bank 1995:18).

Traditionally, ethnic Lao boys in Buddhist villages and in towns were educated by monks in the temple. Ethnic Lao girls and children of other ethnic groups learned life skills from their parents, siblings, and relatives. With the development of secular education in urban areas during the French colonial period, some girls began attending school. Education became availability to the majority of children only with the more recent growth of schools in rural areas. Most villages have own to three grades of school whereas 30 percent of villages have full primary schools. Secondary schools are located with 10 km of more than one-half of all villages, usually in provincial capitals or district centers (Ireson 1996:33).

Some of this expansion of primary schooling in rural areas is not very solid. Teachers are often left unpaid by the state, and for them to remain in a small village they may insist on payment from the villagers and their own rice field. Most children who begin schooling drop out before completing it. "Less than one-half who enter first grade complete the five grades of primary school" (Ireson 1996:33).

Beyond the formal school program, Laos initiated an adult literacy campaign in the late 1970s. Yet more than a third of women ages 15 and older remain illiterate, and the general drop out rate is higher for girls than for boys. "The number of illiterate women over 35 years of age is at least three times greater than the number of illiterate men over 35" (Ireson 1996:34).

The defeat of the Khmer Rouge regime in Cambodia, which had destroyed the earlier French-influenced educational system was accompanied by a resurgent interest in primary and secondary schooling "... despite the lack of the most basic materials, the schools started to reopen almost spontaneously in the first weeks after the overthrow of the Pol Pot regime in early 1979. "

From the beginning there was a spirit of seeking a fresh start in education with the aim of building a new school system more attended to Cambodia needs. At the same time the government has proclaimed the goal of expanding education into a democratic and comprehensive system embracing all people, including children, the elderly, ethnic minorities and the inhabitants of remote areas previously unprovided with schools... Another problem, general in character but affecting girls most acutely, is the legacy of the widespread disruption of schooling during the war years and Pol Pot period. There are now ten- or even twelve-year old children in Cambodia who have never been in school. The remedial problem is a major challenge to the new system, but it is likely that older sisters will give way to younger brothers once again (Boua 1982:54-55).

One aspect of education is extension training for farmers. Farmers in the Mekong Delta

appear to strike a balance between traditional ways of farming and openness to innovations. For example, "while many farmers continue to observe astrologically auspicious times for farming and plowing, they are also likely to be keen to adopt new varieties (every third agricultural season in the South)" (Dreyfus 1996). Farmers have adopted many new agricultural techniques in recent years, diversifying into shrimp/mangrove ponds (Binh, Phillips, et al. 1997), and turtle raising (Dreyfus 1996). One researcher has attributed the openness of Delta farmers to new techniques to the Vietnamese concepts of fate and chance (Dreyfus 1996), leading to "what do I have to lose?" sorts of attitudes toward innovation. Similarly, this researcher believes the high population densities in the delta lead to facilitated communication and the spread of information about new techniques. Indeed, in just the last 10 years, the rise of shrimp farming among the mangroves of the Delta can be attributed in part to the spread of word-of-mouth advice (Action for Mangrove Reforestation 1994).

Further research along these lines is needed for the region. Research on farmers' indigenous knowledge in the Delta has been hindered by several factors. One is the heterogeneity in the Delta and the small size of farmers plots, leading agricultural researchers to focus on larger farms. Furthermore, on-farm research is often made more difficult by the rapid pace of changes in agricultural diversification (new and trendy strategies like deer raising my spread widely in short amounts of time). Lack of trained staff in on-farm extension has also contributed to the problem (Lazard and Cacot 1997).

7. SETTLEMENT PATTERNS

Currently, in rice growing areas, farming villages tend toward one of two settlement patterns. In upland areas of the Mekong basin they tend to be mostly compact clusters of households on slightly higher wooded land in the midst of rice fields. In the Cambodian and Vietnamese delta the pattern tends more towards a linear village strung out along the sides of canals and rivers (Hickey 1964; Kalab 1968). Villages can be composed of more than a thousand households, and in Vietnam are usually divided administratively into several hamlets, each of which may have a hamlet head (Resources for the Future 1971). Footpaths and canals that connect different hamlets are "in effect minute lines of communication for clusters of farmsteads which usually contain families of the same kin grouping and, in some instances, members of the same religious sect" (Hickey 1964). There are also regional differences in settlement patterns between the upper Delta, which was settled first, and the lower Delta, south of the Bassac river, which was settled later (Cummings 1976).

In Cambodia, the pattern in settlement in the plains is toward "self-sustaining villages formed along rivers, extending into the inter-riverine intersections. Abundant fish in the mainstream and its tributaries have made fishing a prime occupation for many people and the main source of protein for most. Traditionally, village communities have patterned their livelihood around rice cultivation, fish catching and gathering wood" (Ahmed, Tana, et al. 1996).

There are also numbers of households who are not traditional village-dwelling agriculturalists, but full-time fishermen who spend more time in boats than on land. These are both coastal fishermen as well as petty traders who ply goods along the canals of the lower Mekong. There are a number of people who live on boats in and around the Tonle Sap lake in Cambodia as well. The literature of the area does not give any indication of the percentages of people who live full time on the water.

There are also those families that balance between fishing and agriculture. In one study of a fishing community of the middle Mekong, Fraser found that most fishermen also relied on agriculture for their families' support. Therefore any dam projects that might benefit them as a fisherman (such as the creation of reservoirs for fishing) would be offset by the loss of land for agriculture (Fraser 1974).

According to some observers, highland villages are far less corporate than are villages in the lowlands. Rather than the village being the basic unit of social organization, as it appears to be for lowland Lao, for example, to "the Hmong, the primacy foci of social identification are the household, the group of close relatives (*kwv tij*), and the clan, irrespective of any temporary or even permanent settlement" (Ovesen 1995:24). The French imposed a village structure on the highlanders, and these villages had to provide corvée labor for the colonial administration.

Highland villages contain a number of small shops attached to family houses, "which sell such items as cigarettes, sweets, soft drinks, batteries, razor blades, soap, and the odd tin of Russian sardines in tomato sauce; one shop even advertised cassette tapes of Hmong music. (Ovesen 1995:43).

Housing:

In rural Vietnam one of the clearest signs of wealth or poverty is simply the kind of house a family lives in. A house constructed of more durable materials is not only more comfortable, healthier and a source of family pride, dignity, and social status, but it is also highly valued as a religious shrine of family worship.... If a farmer could save enough money to build a house of the and masonry he was considered to have "arrived" in the local community. When asking his way around a hamlet, a stranger was always directed by and to particular houses according to the type of roofs they had--very visible symbols of wealth (Callison 1983:111-112).

Rural houses in Vietnam traditionally had a variety of structures: the main house, a granary, a stable for livestock if needed, possibly a chicken coop or pigsty, and a hedge or fence around the whole homestead. The area in front of the house was used for drying paddy, reeds for weaving, and coconut husks and rice stalks for fuel. Many homes had ponds fed by nearby channels. Ponds were used for fish raising, bathing, and sometime as an outhouse (Hickey 1964). There are a variety of different housing styles and construction material, depending on the home site and the wealth status of its owner; these include thatch houses with wooden frames, wooden houses with thatched roofs, wooden houses with the roofs, houses with masonry walls and the roofs, etc. (Hickey 1964). Geomancers are often consulted before house construction begins as to the most auspicious places for rooms to be placed. Bad luck is likely to be encountered if the house is placed in a way that does not favor the spirits, according to Vietnamese tradition.

Traditionally houses were often build on stilts in the flooded areas of Cambodia. Now that timber is more scarce or controlled by the state, houses are built with bamboo and sugar palm leaves for thatch. Near urban towns houses might be built of brick or cement with tile or corrugated iron roofs (Kalab 1968). An early description of rural Khmer housing notes that their "thatched (sometimes tin-roofed) dwellings are similar to those of the Chinese and Vietnamese but stand 3 to 6 feet above the earth on pilling" (Steinberg 1959:39).

A Cambodian peasant's house is raised on mangrove piles, sometimes as much as 10 feet. There may be several rooms, separated by partitions of dried palms, but poorer homes often have but a single room. Beside the house and joined to it by a ramp is a kitchen shed, also on stilts. Crowding is general and privacy at a premium ... The houses of wealthier families, especially in urban centers, are capacious villas, affording privacy. Such a house may contain three or four rooms and have a large veranda (Steinberg 1959:78).

Stilted houses were also common among the lowland Lao,¹⁴ but in the higher lands houses were not raised on poles:

[the Hmong house is] built directly on the ground, the floor being made of levelled,

packed earth. The roof is supported by a number of pillars, as many as 15 for a large house--one of which is the central house-post, the abode of one of the most important spirits of the house. The walls are usually made of split bamboo, but occasionally of timber. The roof is thatched with woven mats of large leaves, but sometimes with split bamboo or wooden slates... The main door is placed in the long front wall the outside length of which forms a kind of porch overhung by a continuation of the roof. A side door is set in one of the gable walls.

The inside lay-out of the house shows individual variations, but common features are the altar or altars on the wall opposite the main door, a cooking hearth in the middle of the main room one or more walled bedrooms for the married couple(s) of the household, one or more open sleeping platforms along the walls for visitors, and a ceremonial hearth to the one side of the altar(s). This hearth is constructed of dried mud and is the foundation of a large pot in which pig food is cooking and into which eventual left-overs are scraped. The space under the roof serves partly as storage loft, and over the cooking fire ears of maize and chunks of smoke-dried meat are hung. In some houses the granaries are built along one of the gable walls, while others have erected separate rice-barns close to the house.

The selection of a site to build a house is determined both by practical and geomantic considerations. Among the former are the proximity to the fields, to sources of water, and to kinsmen and other neighbors (Ovesen 1995:40-41).

Urbanization:

Many of the larger Mekong delta cities, like My Tho, Can Tho, and Vinh Long, are large marketing and agroprocessing centers for the surrounding areas. The state has encouraged the urbanization of these smaller cities to accommodate the influx of migrants usually bound for HCM City (Pham Van Trinh and Parenteau 1991). Urbanization accelerated during the Vietnam War, when many villagers fled for Saigon and other cities to escape the fighting and herbicide spraying in the countryside (Thomas 1974). Current migration to HCM City from the Mekong provinces was 77,000 in 1991, 96,000 in 1992, and 84,000 in 1993 (Nguyen Tri Khiem 1996).

In Cambodia, the patterns of urbanization were the reverse, with people forced to leave the cities during the Khmer Rouge years. Currently, the only major urban areas are Phnom Penh, Battambang City, and Siem Reap. Phnom Penh is 16 times bigger than the next largest town and continues to receive the bulk of urban migrants in Cambodia.

Lao PDR is the least urbanized of the lower Mekong basin countries.

Throughout the region, urban centers are again growing in response to economic liberalization and the encouragement of small enterprises. The major problems of the cities is how to provide adequate potable water and sanitation to their residents, and how to provide adequate and affordable housing without developing squatter settlements. A more subtle but perhaps pervasive problem is how to overcome the widespread suspicion of urban middle classes, who are often ethnic strangers, among some senior levels of the Communist parties.

Transportation:

The canals and waterways of the Mekong Delta provide passage for many types of vehicles and cargo. There are over 4,500 km of canals and tributaries in the Delta (Economist 1998b). In 1994, 257,389 tons of cargo were transported per km of canal in the Plain of Reeds alone (Nguyen Hoang Tri 1995). With the opening of the economy and the increased market availability for products, the cargo loads are likely to increase on the Delta waterways. This increase in traffic can lead to more water pollution and riverbank erosion. At the same time,

every year only 40 percent of the canals are dredged, which means many of the canal waterways are silting up quickly and may hamper transportation in the future (Economist 1998b).¹⁵

The Asian Development Bank (1994) organized a conference at Chiang Mai, Thailand on "Subregional Economic Cooperation" in 1994, at which a series of programs for improving transportation in the region were considered. Riverine transportation projects discussed at that conference included:

- ε Upstream Lancang-Mekong River Navigation Improvement Project;
- ε Mekong Delta Navigation Improvement Studies;
- ε Red River Navigation Improvement Project; and
- ε Southern Lao PDR-Cambodia River Navigation Improvement Project.

In addition, the ADB considered port development projects for Phnom Penh, Sihanoukville, Central Viet Nam, northern and southern Viet Nam, and Yangon-Thilawa in Myanmar.

Roads are another source of needed transport in the area, and the Asian Development Bank says that these should have the highest priority in the sector. Currently, there is the main paved highway No. 1 between the Delta and Saigon as well as a number of unpaved provincial roads. One major new transportation project in the area is the building of a bridge over the Tien Giang at My Tho. Currently, the river is served by ferries. The cost of the bridge, an estimated US \$66 million, is being borne by Australian aid dollars.

For the six countries of the basin, the ADB is studying the following projects:

- ε Bangkok-Phnom Penh-Ho Chi Minh City-Vung Tau;
- ε Thailand-Lao PDR-Vietnam East-West Corridor;
- ε Chiang Rai-Kunming Road Improvement Project via Myanmar and Lao PDR;
- ε Kunming-Lashio Road System Improvement Project;
- ε Kunming-Hanoi Road Improvement Project;
- ε Southern Lao PDR-Sihanoukville Road Improvement Project;
- ε Lashio-Loilem-Kengtung Road Improvement Project;
- ε Southern Yunnan Province-Northern Thailand-Northern LAO PDR-Northern Viet Nam Road Improvement Project;
- ε Northeastern Thailand-Southern Lao PDR-Northeastern Cambodia-Northern Viet Nam Road Improvement Project.

Internal rates of return for most of these projects seem to be satisfactory for ADB financing.

In Cambodia, there are 3,200 km of national roads and 3,100 km of provincial roads, of which only 600 km total are paved. Many of the country's bridges and ferries are in similar states of disrepair. Inland waterways provide an important means of import during the rainy season. There are some 1,800 km of navigable waterways in the rainy season in Cambodia (Economist 1998a). Lao PDR has the least satisfactory internal transportation network.

Subregional railroad projects are being considered, but they are generally seen as costly with uncertain internal economic rates of return: comparatively high traffic levels would be necessary if the benefits resulting from the investments are to be sufficiently high to generate acceptable rates of return. Projects or project components involving improvement of existing facilities rather than new construction face lesser, although still formidable, hurdles" (ADB 1994:5 1).

Air transport projects being considered involve improving existing facilities. Justification for these depends largely on increased tourism.

8. HOUSEHOLD AND VILLAGE STRUCTURES

Family Structure:

In Vietnam the individual family household is the prime kin unit. A household may contain several generations of family, but is predominantly nuclear in the Mekong Delta. The average household size in the Mekong Delta is 5.6 persons. The paternal lineage is an important unit of identity in much of Vietnam, but the household family unit remains the most strong in the Delta (Hickey 1964). The traditional Vietnamese pattern of inheritance is through sons, although this has changed toward bilateral inheritance in recent years. Cambodian inheritances have always tended to be distributed to both sons and daughters (Kalab 1968). Resources in land are important determinants of residency and household composition. Patrilocal residence appears to be norm in most of the Delta, although there are exceptions of daughters remaining with the family to take care of parents, etc.

Within the family, there is some division of labor, although everyone is expected to contribute to family survival in some manner. Men usually work the fields, while women work in the fields as well as take care of the household compounds. Women's work in the paddy fields often includes weeding, harvesting, winnowing, weighing paddy, and storing it. However, Hickey says that the "primary role of the women remains that of housewife and mother" (Hickey 1964). Household tasks include preparing meals for the family and any hired labor, cleaning the house daily, carrying water, collecting fuelwood, and caring for infants and children (Hickey 1964).

Kin relations are strong in Vietnam There is much specific kin terminology in Vietnamese, with precise terms for relatives depending upon their age, the paternal or maternal side, and gender. Most families trace their ancestors back several generations and engage in ancestor worship. Kin relations in Vietnam are closely linked to religious practices through this system: "For the villager, immortality lies in his undying lineage, but bliss in the afterlife can be attained only by proper cult veneration, without which the deceased becomes a malevolent errant spirit" (Hickey 1964). As a result, filial piety is to be extended to deceased ancestors, and parents and grandparents are often careful to establish who in the family will continue the care of their tombs and spirits in the afterlife. Rituals surrounding deaths in Vietnam are widespread. There is a saying that "When alive, one must have a home; when dead, one must have a tomb" (Hickey 1964). Members of a patrilineage make regular rituals to the dead ancestor on death anniversaries.

In Cambodia, households are also usually occupied by nuclear families, possibly with one other relative attached to them The average number of persons in a household in a 1968 survey in a southeast province was 5 persons. There appeared to be a trend in this survey toward uxorilocal residence, not the patrilocal residence found in most of Vietnam (Kalab 1968). The author of this survey noted that kinship was important in Cambodia, but that it was imprecise, as there are not many specific kin terms in Khmer. Any distant cousins were termed "elder siblings" or "younger siblings" (Kalab 1968).

Extra-family Structures:

There can be a number of extra-family groupings in an average village in the Mekong delta of Vietnam. There are the mandarin's association, elderly men's associations, trade associations, women's associations, cult committees, mutual aid associations, agricultural labor's associations, youth associations, and school associations. Mutual aid societies, known as *hui* in Vietnamese, were an unusual feature of Delta villages, and usually consisted of groups of women who gathered to loan money to one another on the basis of need (Hickey 1964). [The system also has an air of gambling about it, as participants would bid on how much money they would receive]. During the time of Hickey (1964) and Cummings (1976), both indicated that such associations tended to be less frequent than would be found in the North of Vietnam, and that these associations tended to wax and wane in members over time. Cummings also added that many associations were actually extra-local in that they were branches of a regional or national group, such as the Hoa Hao religious cult. In contemporary Vietnam, many local committees are also extensions of state administrative structures, such as the Women's Union, which is a national organization with local administration in each hamlet.

Other links within any village are much less formal. Laborers might aid one another in finding work in paddy fields, traders might lend peasants credit to buy this season's fertilizers, etc. Distant kin might make no-interest loans to relatives. Neighbors are often called on for assistance as well; there is a Vietnamese saying that one ought to "sell distant kin, buy close neighbors." Hickey says that "close neighbors are treated as kin, and in this respect proximity of residence might be considered a more universal determinant of strong social bonds in the village than kinship" (Hickey 1964).

Village Structures:

Administratively, village structure has been dictated by the state since 1904 (Hickey 1964), although it has been changed under reunification toward a more state centralized policy of provinces and districts. Every village in Vietnam has a headman. Traditionally, most also had a Village council. It was the duty of the council to maintain order in the village, including arbitrating disputes and punishing crimes. Village problems rarely made it to a higher level of administrative justice, such as the district level. Complaints often included land disputes, thefts, arguments over loans, domestic disturbances, etc. Now, village councils have largely been replaced with People's Committees, composed of local villagers (often those most active in Communist Party affairs) who also take duties as head of the Peasant's Association in the hamlet, head of the Women's Union in the district, etc. District People's Committees rely on village headmen to pass state administrative dictates to each villager, allowing state policy to filter down to the lowest levels. However, the old Vietnamese saying of "*Phep vua thua le lang*" — the laws of the emperor yield to the customs of the village — is still applicable to most villages, which retain some degree of autonomy in local affairs (Shultz and Khai Le 1993).

In addition to the village council many male villagers traditionally were involved in the village cult committee, which venerated the spirits of the village. The committee was responsible for the rituals at the temple (*dinh*) in the village, and for managing any income resulting from disowned lands. However, during the last 20 years, religious practices were discouraged by the state, and many cult committees disbanded or went underground. Lately, religious freedoms have been on the increase in Vietnam and cult committees may expand in the future.

In Cambodia, the administrative head of villages is an elected headman who represents villagers to higher up levels of government. Traditionally, village structures also revolved around local pagodas and monasteries; 'Though in theory any person may support any pagoda, the houses giving support to particular monasteries form distinct contiguous areas... Though the monastery is the social center of all its supporters, the frequency of contact and attendance depends much on age, sex, and personal inclination and to a lesser degree on

geographical distance" (Kalab 1968). Young children would attend schools run by the monasteries, and monks performed rituals, including funerals, weddings, and house buildings. In return, villagers presented the monasteries with charitable donations to keep the monastery mining (Kalab 1968). However, many monasteries suffered terribly under the Khmer Rouge, and it is not clear to what degree these have been rebuilt in rural areas.

Currently, local administration is stronger than centralized control in Cambodia. Most areas have elected village heads who report to *sangkat* heads at the sub-district level who report to district administrators, who then report to one of the 19 provincial governments of the country. Most levels of administration in Cambodia below the province are unpaid positions. Thus those who get involved in administration and government often seek ways to economize on their power, (such as by leasing timber concession in the area); this situation has led one writer to speak of the "provincial warlords" who control the districts of administration in Cambodia today (Devas 1996).

9. GENDER

The highly patriarchal nature of the traditional Vietnamese family is well known (Hoskins 1976). Men were considered by the state to be the heads of households, land is traditionally given to sons, women rarely have title to family land or estates, and most inheritance passes through the male line. Gender relationships are never static, however, and the current situation is not captured by simplistic claims of patriarchy. While there are historical trends toward patriarchy because of traditions of male inheritance and patrilocal residence, in Vietnam these are under challenge. Thanh-Dam Truong (1996:2) insists that a shift in gender relations occurred with the adoption of the reform process (*Doi-Moi*). She asks: "How does Doi-Moi redefine major social institutions such as the family, the private sector, the collective, and the state? In which area does this redefinition affect gender relations and the position of women as producers and reproducers?"

Her somewhat surprising conclusion is that the socialist paradigm initially favored women but in 1979, with the shift from a state-sponsored to a household-based reproductive strategy the position of women began to erode.

Accompanying this shift of policy was first and foremost a qualitative change in gender relations at the household and commune level, stimulated further by the increasing disintegration of social infrastructure that has supported women in their reproductive responsibilities to be on an equal footing with men at the work place. This shift of policy transfers the burdens of social reproduction onto families. Women are the main bearers of such burdens. Their work has become more intensified and invisible and old patterns of patriarchal control over women's labour and sexuality have re-emerged.... [Under the reform process] this decline may render the formal protection of gender equality enshrined in the Constitution, the Family Codes and the Labour Codes, more of a suspended dream than a reality (Truong 1996:2).

Truong argues that evidence for the deterioration in women's status is seen in the reemergence of older oppressive actions such as prostitution and cross-border trafficking in women, early and forced marriage, concubinage, all of which, along with polygyny had been legally banned by the socialist state.

The Communist Party of Viet-Nam adopted the marxist paradigm on the Women's Question in the late 1920s as an instrument to mobilize women to participate in the struggle against French colonialism. After independence in the North in 1945, the struggle against the American- supported 'bourgeois' rule in the South continued

until 1975. From the start, the Women's Question was directly linked with the question of national independence. Emphasis on the family as the origin of women's subordination was pronounced in 1930s and 1940s. Here, patriarchal features of feudal family forms and affiliated cultural practices abusive to women were denounced as the primary oppressor of the female sex. The control over women by patriarchal families were seen as a social force which prevented women's participation in the national struggle... [However, once unification was achieved], it became apparent from state-party discourse on the family, which stressed stability, functional cooperation and female obedience, that women's vanguarding role was in essence a temporary and objective-specific assignment rather than something that was meant to induce further change (Truong 1996:4-5).

Truong does not deny that genuine improvements have been made and many of them may prove durable. The sensitization of Vietnamese, both men and women, to issues of gender inequality, continues to inform thinking in the country. She sees the crucial current issues as how the Vietnamese Women's Union will focus on gender inequality and the oppression of women.

Current research on gender in Vietnam might explore the role women play in small scale businesses. In the Ben Thanh market in Saigon, for instance, the vast majority of vendors are women. A current anthropological research project among the Ben Thanh women reveals that they use their gender to present their business to the state as "small scale" and "insignificant trading." This allows the women to escape regulations and taxes, but in reality the women are running major business holdings and trading in large amounts of capital (Leshkovich 1998). There are other examples of women's predominant role in urban businesses and employment, such as recycling (Mehra, Thai-Thi-Ngoc-Du, et al. 1996). Studies are also indicating that much female outmigration is now taking place from the Delta to HCM City, whereas previously most outmigration was male. Many daughters of families are now finding employment in cities and remitting a certain amount of money back to the family in rural areas (Summerfield 1997). Thus rural women are allowed a certain degree of autonomy and independence in choosing to live in the city.

Many rural households in Vietnam are also female-headed, because of war casualties and labor outmigration (UNDP 1995). The same is true for Cambodia, where at older cohorts, women make up a disproportionate percentage of the population. According to a UNICEF report in 1990, "women now constitute 64% of the adult population and head 35% of the households (up to 50% in some villages)" (cited in Lipsky and Nimol 1993:384).

The way women are allowed or not allowed free measure to pursue their activities should be one fruitful future area of research in the Delta. An American sociologist (Phinney 1998) considers out-of-wedlock births in Vietnam as a way for women to assert cultural autonomy over the patriarchal state and family. The role of Women's Unions is another area of interest. The Women's Unions are the main state organ in Vietnam assigned to assisting with women lives, and each province has a local section of the WU. How these Unions help women in the Delta could be explored in further research.¹⁶

Excellent field research on Cambodian villagers was carried out in 1959-1960 by May Ebihara (1968), who was able to return to the field after the fall of Pol Pot (Ebihara 1993). Changes between those periods have been extraordinary. Relationships of gender in Cambodia today have to take into account the demographic effects of state-sanctioned violence during the Khmer Rouge period. The first examination of the impacts of the Pol Pot regime on women was made by Chanthou Boua (1982), who was studying in Australia when the Lon Not government was overthrown in 1975, and who remained in exile until 1980. By the time of her return, women constituted the vast majority of the labor force, due to the murders/executions of the late 1970s that targeted men primarily, though hardly exclusively. Although women were

always prominent in agriculture and commerce, they were underrepresented in more prestigious activities:

From birth a girl was often looked down upon as a burden to the family. A Khmer girl was proverbially compared to a piece of cotton wool; a boy, to a diamond. If a diamond is dropped in the mud, it can be picked up and washed as clear as before, but cotton wool once it has fallen into mud, can never be restored to its original purity, no matter how much cleaning is done... From infancy a Cambodian girl is trained to be different from a boy. She is supposed to be more gentle in every action: sitting, standing, speaking--a nice girl is one who makes no sound when walking on a wooden floor (Boua 1982:46).

Girls rarely were educated beyond the primary level and in rural areas, where education was assigned to the pagoda, girls did not go at all in order that their close presence not defile the monks. Thus, there were very few women employed in positions that required literacy.

But in the post-Pol Pot era, Cambodia had to confront a sharp shortage of men. This not only provided a "pull" for women, but a "push" as well, since the demographic imbalance meant that many young women would be unable to marry. Older women often widowed, found themselves to be the sole source of support for their families.¹⁷ Commercial sexual work thus became an expanding area of women's employment. On the farm, the gender division of labor, in which women sowed, transplanted, harvested, threshed, and stored, and men ploughed and harrowed, broke down. Survival for the many rural households without able-bodied men required that women assume all agricultural tasks. To enhance household access to male labor, solidarity groups (*krom samaki*) have been formed comprised of between 5 and 20 households. "Efforts are made to ensure that each group has a comparable number of men, working animals and agricultural instruments" (Boua 1982:48).

What is the life of peasant women like in the solidarity groups? Consider the example of Mrs. Mean, a 36-year old widow... struggling to raise three children.... Her husband, together with many other men of the village, was murdered in mid-1977 by a group of Pol Pot cadre who replaced an earlier Khmer Rouge detachment (who themselves also disappeared). Mrs. Mean now belongs to a *krom samaki* of 16 families. In the rice growing season she sets off for the field with her children (there is not yet a school in the village) at 4 or 5 a.m. If the fields in which she is working that day are far from home, she must take food for the family with her. Usually she returns home only at sunset, then she has to fetch water, cook dinner, see that the two pigs are fed, perhaps patch the children's clothes; she does not go to bed until 8 or 9 p.m. Besides her work in the *krom samaki*, Mrs. Mean also spends some time tending her private plot where, with the help of relatives, she grows fruit and vegetables to sell privately at the market. Market income provides clothing for the children and other household needs (Boua 1982:48).

The harvest that year was poor, which Mrs. Mean attributed to the shortage both of male labor and traction animals.

Major psychological problems for both men and women characterized the immediate post-Pol Pot period. "Suicide attempts by women have become much more frequent than by men, especially amongst those who have lost husbands, children or other family members. The brutalities many underwent and witnessed during the Pol Pot period have demoralized them" (Boua 1982:50).

On the positive side, the new government was receptive to women, and positions were opened to them that had previously been closed. About 20 percent of the members of the

Central Committee of the United Front for National Salvation were women, as was the Vice Minister of Health. Positions in the government bureaucracy have been opened to women, but official salaries were exceptionally low. And women have also entered the industrial work force, "working at every level of factory production, except in management where they are still conspicuously absent" (Boua 1982:57). Gender-finking continues to discriminate against women in the health professions, where they are employed mainly at the lower and less prestigious levels (Lipsky and Nimol 1993).

Despite the specific inclusion of gender equality in the Lao People's Revolutionary Party (LPRP) 1975 agenda, which also promised respect for d religions and protection of all national minorities, Ng Shui Meng concluded that "considering the conservatism of Lao society, women's liberation is not likely to emerge in the near future" (1991:180). Ng notes that the positions of women, however subordinate they might be in Southeast Asia, are in general higher than they are in either East Asia or South Asia. In Laos, there

was no overt discrimination against females, no evidence of female infanticide or predominant son preference. Lao women also often had similar inheritance rights as men, largely because of the prevalence of matrilineal residence among lowland rural Lao,¹⁸ where a newly married couple resided with the girl's family.¹⁹ This practice ensured some protection of the bride's interest vis-à-vis the husband. Land was therefore commonly (but not always) passed down through the females.... [Nonetheless] there were other social practices which negated "apparent benefit" and continue to perpetuate inequality between the sexes. Sex role differentiation is very clear-cut in Lao society, and women are trained from early childhood to accept a subordinate position in relation to men.... Female docility is viewed as a virtue and assertiveness is definitely discouraged. In the past, girls seldom had the benefit of education, as the village 'wat' schools were open only to boys... While women were expected to shoulder almost the entire household and child care burden and work in the fields as well female labour was seldom credited much social or economic value (Ng Shui Meng 1991:173-174).

Educational opportunities for women have clearly improved under the LPRP, especially at primary levels, and positions for women in civil service, educational, and factories have markedly expanded. Women continue to provide most of the agricultural labor. But the senior levels of the Party it continue to reflect traditional androcentric biases. The official Union of Lao Women does not see principle as an instrument for women's liberation, but rather as a means "to promote the political goal of the party to mobilise women in building socialism" (Ng Shui Meng 1991:176). According to Ng Shui Meng (191:177), the Women's Union did not challenge the LPRP's pronatalist policy: "a few privately express concern on how uncontrolled fertility is detrimental to women's health, but none dare openly push for any policy changes."²⁰

Ireson is more optimistic, and sees a more feminist agenda emerging in the Union, which has recently embraced a birth-spacing project.

As rural women's situation changed after 1975 with socialism and economic liberalization, so too did the Lao Women's Union [LWU]. It began as almost a "women's auxiliary" of the Lao Communist Party and reflected women's traditional nurturing and family roles. In wartime, however, it became more active, moving into some nontraditional activities, much as rural women did, either as revolutionaries or as their households' primary farmers. With the end of the war 1975, active and qualified women's union members were appointed to a variety of responsible governmental positions, while the women's union itself was given a share in the job of consolidating a new nation. The limited focus of women's unions on child-care centers for governmental workers and on creating a nominal network of local women's unions was replaced in less than a decade by more active women's

unions oriented toward local development controlled by village women in cooperation with village administrative committees and supported by the socialist ideology of gender equality. With economic liberalization local women's union projects freed women's time and energy for a return to entrepreneurial activities, enabling a number of women to develop their own economic sources of power. As local projects succeeded, the LWU prospered as an organization. The LWU too increased its access to economic resources during this process as it became increasingly able to channel funds from foreign donors to local development projects (Ireson 1996:256-257).

Laotian women traditionally dominated the informal marketing sector of the economy and saw themselves as targets of government programs to nationalize private enterprise in the late 1970s. In place of the small scale informal trading locations, the government established 'a network of state stores and village marketing cooperatives... [whose] managers are nearly always men' (Ireson 1992:14). Economic liberalization that began in the 1980s has allowed women to resume their prominence in retailing. An area that remains to be explored in the lower Mekong countries is the ways in which remittances from expatriated kin are being invested in small- and medium-scale businesses and how these are affecting the gender division of labor.

Prostitution is widespread in southeast Asia. Although most of the reporting has been on the commercial sex trade in Thailand and the Philippines, it is found in all the countries of the region. Some have attributed it to the presence of foreign military personnel: "Forced urbanization campaigns, carried out [in Vietnam] for military reasons in the 1960s, uprooted millions of peasants in an effort to destroy the rural bases of communist guerrillas. Many rural women were drawn into the cities and to areas surrounding US military bases, where a service industry instantly sprung up and revolved around personal services provided to US military personnel" (Truong 1990:x). It has also been associated with the development of an international tourist industry and with the huge gender imbalance in rural areas as a consequence of wars. As the countries of the lower Mekong basin increasingly look to tourism as growth areas of their economies, it is important that the conditions generating the commercial sex trade and its impacts on society also be carefully and comprehensively examined.

10. RELIGION

Every major historical transformation in Southeast Asia has been attended by changes in religion, and some have been especially facilitated by the emissaries of new faiths. In the late 20th century pragmatic utilitarianism may be the most powerful missionary force and the communities of that faith are expanding. But focus on the urban surfaces of local life can obscure the persistence of patterns which are rooted in the animistic and rice-growing village substratum of the region. Beneath surface transitions the structures of popular perception and belief remain remarkably cohesive. Changes have generally had their greatest impact on the élites linked to trading ports and temple cities. Even in those contexts whenever local people domesticated imported tool of thought and organization, including religious systems, they gave local flavour to patterns which were used otherwise elsewhere. The idioms of imported religions accommodated local meanings. Indian deities came as universal terms for spirit forces known already by different names; Confucianism shaped Vietnamese courts²¹ while villagers self-consciously retained ancestral culture (Tarling 1992:II-529-530).

In the Mekong Delta of Vietnam religious expression draws mainly on Mahayana Buddhism, Confucianism, and ancestor worship. Buddhism came to Jiaozhou [Vietnam] as early as the second century of the common era, but it became officially established only after

independence from China in the 10th century.

During the four centuries after Vietnam established its independence from China, the Vietnamese ruling dynasties constantly enlisted eminent monks to assist them in religious, political and literary affairs. During this period Buddhism was able to establish itself as a significant political and cultural force. Some eminent monks served at court, and others ... were involved in state affairs in indirect ways. Certain eminent monks who spurned the court's invitations and chose to shun court politics were nevertheless celebrated as paragons of religious purity and embodiments of national values and powers (Nguyen 1997:9-10).

Today, the social roles of temples (*dinh*) and pagodas (*chua*) are of note in understanding village structures and responsibilities. For example, each village often has one or more cult committees, which are responsible for rites honoring various village deities and protective spirits. Examples might include a *dinh* to the spirit of the water in a village close to a river. Almost every village is likely to have one cult of the Guardian Spirit of the village, with other deities such as land and water spirits more regionally distributed (Hickey 1964). Buddhist pagodas are also common in most villages, and lay monks will often live off income from paddy owned by the pagoda committee. In a 1991 survey in the delta, 621 households were interviewed about religion and other household matters. 57 percent responded they had no particular faith, 23 percent identified as Buddhists, 6 percent as Catholic, 11 percent as Hoa Hao, and 2 percent as Cao Dai (Mac Duong 1991).

The syncretic religious beliefs in spirits and fate have several practical applications in Vietnam. For example, to violate a taboo or to anger a spirit is to invite disharmony and trouble. "Floods, droughts, and other catastrophes are indicative of disharmony and the disapproval of heaven" (Hickey 1964). Hickey says that "while this generates a certain conservatism in villagers, it does not commit them to fatalism. Innovation may be viewed with some skepticism although... villagers do accept technological change when there are patent economic advantages. Also there will be examples to show that villagers, rather than fatalistically accept manifest bad fortune, do everything possible to deter further deleterious consequences. In a drought, they do all they can to save the wilting crops, and in illness, all available means for a possible cure are employed" (Hickey 1964).

In addition to the traditional Vietnamese Confucianism and Buddhism the Mekong Delta has two home grown varieties of religion that have played a large role in the development of the region this century. The Cao Dai and Hoa Hao groups of the delta have at various times this century been not only religious sects, but during the Vietnam War both groups commanded considerable numbers of armed members. The two sects between them claimed more than half of the Delta's inhabitants as adherents in the early 1970s (Cummings 1976).

The Cao Dai religion is an amalgam of Taoist, Buddhist, Confucian, and Christian elements. There are seven major groups of Cao Daists, each with its own Holy See as the main seat of the religion. The best known Holy See is in Tay Ninh, in the upper Mekong Delta. The other major centers of Cao Dai in the delta are in Rach Gia, Can Tho, Ben Tre, My Tho, and Tan An (Oliver 1976). Most Cao Dai adherents are to be found in the upper Delta.

The origins of Caodaism can be traced to several factors. Changes in the social structure of Cochinchina after 60 years of French rule transformed the traditional upper strata from an agrarian-bound elite to an urban-oriented, increasingly bourgeois landholding class tied to the world economy. There was an attendant cultural alienation among members of this class (or two classes, if we include the petty bourgeoisie) from the secular French regime. Among the peasantry, there was social unrest brought about by a decline in the standard of living... increased taxation, landlessness, lawlessness, and increased dependence on traditional exploiters such as moneylenders and landlords. Village autonomy and local social

regulatory mechanism had been destroyed by the imposition of French legal and political structures. There had been a decline of Buddhism and Confucianism leaving a cultural vacuum propitious to the creation of new doctrines and aimed at the renewal of Vietnamese culture. Further, in the 1920s, there was a prerevolutionary political climate caused by the repeated repression of anti-colonial uprisings and the growth of intellectual radicalization. Finally, the rapid but unequal development of the southern economy had produced marginal areas such as Tay Ninh province which provided a favorable base for a movement such as the Cao Dai (Werner 1981:56).

The political role that Cao Dai might have played--and might still play--in modern Vietnam is muted somewhat by its recurrent tendency to segment internally, so that different temples often find it difficult to coalesce around unifying political concerns.

The Hoa Hao, founded in 1939 by Huynh Pho So, are found primarily in the area between the Mekong and Bassac rivers (*Hau Giang* and *Tien Giang* in Vietnamese). The Hoa Hao is a reformed Buddhist sect that aims at simplifying Buddhism by eliminating ostentatious displays in temples and pagodas, and eliminating the performance of expensive rituals and rites (Cummings 1976). "The movement spread rapidly in the 1940s and 1950s among the rural population in Chau Doc, Bac Lieu, Rach Gia, and Long Xuyen provinces, for whom it served not only as a religion but a means of political and social organization" (Duiker 1999:69). Relations between the Hoa Hao and all authorities in Vietnam--French Japanese, Vietminh--has been problematic. All have accused the Hoa Hao of activities hostile to the regime.

Membership in both of the sects was strong during the Vietnam War, as both groups provided not only spiritual guidance, but also material benefits and military security. Each group had its own military, its own administration, social welfare, and legal and educational system. Some authors have argued that both the Cao Dai (with an estimated membership of between one and two million in 1965) and Hoa Hao (with a 1964 estimated membership of about half-million in An Giang Province and perhaps two million overall) are messianic movements typical of Southeast Asia, and that their genesis during the colonial upheavals of the 1920s (when nationalist sentiment was on the rise in Indochina) was a result of economic and political factors. In other words, beyond their religious significance, both groups also were recreating social and economic links among peasants in the Mekong Delta through apocalyptic rhetoric and action (Nguyen Xuan Nghia 1995).

There were Buddhist activists, particularly in the postwar period, who opposed both communism and Western models, arguing that Buddhism itself constitutes the basis for a tolerant and just society. Specifically Buddhist political activity became prominent in the south. In the early 1950s, "Buddhists took issue with the Diem government because it so often appeared unwilling to recognize a role for them. Diem's policies appeared to be based on patronage models of government."

Tensions mounted around the ceremony of Waisak, the celebration of the Buddha's birth, enlightenment and passing, in early May 1963; crowds in Hué were met with tanks and nine died, precipitating lengthy petitioning and a series of demonstrations in Saigon... The self-immolation of Thich Quang Duc on 11 June followed a lengthy period of unsuccessful petitioning to Diem on behalf of the Buddhists that year. In August 1964 Buddhist antagonism to the Saigon government led as far as rioting in Danang, where Buddhist-led mobs burned down the huts of Catholic refugees... Throughout 1966 tense negotiations continued between Catholic, Hoa Hao, Cao Dai and Buddhist groups and the Ky government over the holding of elections and prospective representation in the constitutional assembly... The appeal to Buddhism as a basis for national unity was undermined by Cao Dai dominance of Tay Ninh Province, Hoa Hao power in the western Mekong delta and the semi-autonomy of the Montagnard animists, Khmer border people,

and Muslim Cham remnants (Tarling 1992:II-545- 546).

The Buddhist opposition to the South Vietnamese regime did not necessarily endear them to the subsequent communist administration, and several prominent monks who exiled themselves during the former regime, like Thich Nhat Hanh (King 1996), have not returned. On the other hand, Buddhism is allowed to operate, and the government supported the establishment of a High Level School of Vietnamese Buddhist studies. "The government is nonetheless actively hostile to anything representing popular millenarianism, which it sees as representing a throwback to definitely outdated superstitions" (Tarling 1992:11-564). Religious participation in Vietnam today is active, and temples and churches appear to be in good repair.

There is also a great deal of the practice of geomancy and astrology in Vietnam. The state has tried to wipe out any practices conducted according to astrological signs (such as the timing of weddings or farming activities according to auspicious days on the lunar calendar), claiming that they are superstitious" practices that should not be industry practiced in a modernizing country (Malarney 1996). In fact, the state has gone so far as to eliminate use of lunar calendars, and has put into place regulations on the conduct of weddings and funerals to make them less "ritualistic" (Goodkind 1994; Goodkind 1996). However, these practices do persist in most rural areas (Nguyen Minh Thang and Swenson 1996).

The implications of all these religious sentiments mentioned above, according to one report, is that "Veneration of ancestors and honoring of elders is probably strongest in Vietnam but peoples throughout the Mekong Basin place a strong value on recognizing their obligations and debts... Reciprocal help is essential at peak seasons of rice cultivation - the times of transplanting, harvesting and threshing. A strong ethic of reciprocal help - far beyond agriculture - exists throughout Southeast Asia" (Resources for the Future 1971).

Cambodia and Laos are also Buddhist countries, but the predominant form of Buddhism there, as in neighboring Thailand, is Theravada.

From the 11th through the 15th centuries, Buddhist monks gained the patronage of most rulers of principalities and kingdoms in what are today Burma (Myanmar), Thailand, and Laos as well as Cambodia. These monks derived their understanding of buddhism from interpretations of Pali texts that had become authoritative in the 4th century A.D. in Sri Lanka. These interpretations constituted what became known as Theravada Buddhism, or the 'way of the elders.'" The sangha, or Buddhist order of monks, is seen as the exemplar, teacher, and embodiment of the dhamma, the message of the Buddha (Keyes 1994:44).

Temple-monasteries, called *wat* or *vat*, were built in both urban centers and rural villages.

From monks' teachings and even more through participation in rituals led by monks, followers of Buddhism came to conceive of the social orders in which they lived as manifestations of a cosmological system based on the principle of *kamma*... [which] refers to the moral consequences of human acts.... [The] status at birth of all beings--both human and nonhuman--was deemed to reflect the relative amounts of merit (Pali *punna*; Khmer *bon*), or positive *kamma*, and demerit (*papa*, *bap*), or negative *kamma*, inherited from previous existences (Keyes 1994:44).

Merit is obtained through controlling one's natural desires and eschewing murder, adultery, theft, dishonesty, and drunkenness, and by supporting the temple and its monks (and, indeed, for men, becoming a monk. at least for a short time). Ovesen et al. (1996:38) note that, in Cambodia, Buddhism was embraced by royalty because its tenets seemed to constitute no

challenge to their rule. "The monkhood was non-priestly in the sense that the monks did not claim to command supernatural powers and did not invoke supernatural sanctions. Thus they did not compete with the semi-divine status of the king." Somboon (1993:107) adds: "it is possible that these two interests [of the *sangha* and the king, respectively] more or less coincided: an ideology which needed a supportive political power met a political ruler looking for a legitimizing ideology." The king revealed his own merit through ostentatious support of the temples and the monks. And, by receiving alms from the common people, the monks provided them with a means of obtaining merit themselves.

During the period of French colonization, traditional Buddhism also prospered. "The maintenance of a traditional social order... with a monarch at its apex, made it easier for the French to administer the country and extract indirect taxes from it. The French also moved very slowly in introducing modern secular education in Cambodia. Whatever education villagers received throughout the colonial period was provided by traditional monks in local monastic schools" (Keyes 1994:48). French support for the traditional order did not completely stifle protests, especially over tax collection, and there was popular receptivity for reforms in the religion. Some Cambodians adopted Vietnamese Cao Dai. Writing became an instrument of nationalist protest against French (and Japanese, allied with the Vichy government during the Second World War) colonization. Many monks were literate in Khmer, written in a Thai-derived script that the French could not read. French efforts to supplant Khmer a latinized script, as had been done in Vietnam, were not successful.

It is beyond the scope of this landscaping survey to review recent political history of the lower Mekong riparian states. Certainly from the 15th to the middle of the 20th century Cambodian rulers, domestic and foreign wrapped themselves in the mantle of Theravada Buddhism. Both Prince Norodom Sihanouk, who assumed control of the government in 1952 and General Lon Nol who overthrew him in 1970, identified themselves with the religion. Lon Nol tried to legitimize his regime with the people as a "religious crusade against communism" (Keyes 1994:53). His support, however, came primarily from the American and South Vietnamese governments.

The war, together with the bombing [by Americans], took a brutal toll on the population of Cambodia. It is estimated that at least 600,000 people were killed in the war between 1970 and 1975. The victims were often civilians and included Vietnamese who resided in Cambodia, who became the object of racially motivated attacks encouraged by the Lon Nol government.... It is also estimated that more than a third of the population of the country, which in 1974 was said to contain 7.89 ... million people, became refugees ... (Keyes 1994:54).

In April 1975, the Khmer Rouge became the government of "Democratic Kampuchea (DK)." In addition to pursuing a Vietnamese ethnic cleansing of unprecedented scale in the region, the DK regime declared war on the urban and intellectual segments of the population and on Buddhism. Monks were forced to disrobe, thousands were murdered, *wats* were destroyed. Keyes says that in "no other Communist state, including even Tibet, was a materialist ideology so radically imposed at the expense of a spiritual tradition" (1994:58).

There is a tragic irony in that many monks, disillusioned with the corruption of both Sihanouk and Lon Nol, supported the Khmer Rouge, which hid its anticlerical agenda until it actually assumed power.

Many rural people were naturally attracted to the Khmer Rouge propaganda of national liberation; of freeing the people from the yoke of the imperialists; of setting up a new society where equality would prevail. Hence, monks often supported the Khmer Rouge before their victory in 1975, "because they believed in independence, revolution to free the country from colonization and feudalism,

where equality can be restored--no poor, no rich" (Boua 1991:229).

But once victory was achieved, the DK turned on the monasteries. Every sip of Buddhist practice was declared illegal subject to punishment. Monks were imprisoned and forced to labor in the fields with little food. "Having been in the monkhood for so long, many ex-monks died on the job because they were not accustomed to such heavy labor . . ." (Boua 1991:237). Boua estimates that by 1979, only 2,000 monks were alive in the entire country of a 1975 population of 65,000.

The Vietnamese invasion in 1979 led to the establishment of a new government, one that initially encouraged reopening of the *wats* and reordination of the surviving monks. But it soon began to impose new restrictions, for example, forbidding the monkhood to men younger than 50. "Within ten years after the PRK/Heng Samrin government came to power, the *sangha* did not exceed 10 percent of their pre-Khmer Rouge membership. The Hun Sen government lifted restrictions, and young men were once again allowed to become monks. In April 1989, Buddhism was reestablished as the official religion of Cambodia (Keyes 1994:63).

The remembrance of the Buddhist past made Cambodia in 1979 a haunted landscape, one filled with the ghosts of the hundreds of thousands who were killed or died during the Pol Pot period. The PRK government had to attend not only to the needs of the living, but also to those of the dead. It is noteworthy that the most significant monuments built by the PRK were those honoring the dead at the sites of mass executions. It is even more noteworthy that the forms of these monuments were unequivocally Buddhist. The restored *wats* of Cambodia have also been used to effect a relinking between the living and the dead through communal sponsorship of rituals to make merit for the dead (Keyes 1994:68).

Khmer Buddhists were not, of course, the only targets of the Pol Pot regime. "Previously targeted victims of DK had been partly distinguishable from the masses of the people by their uniforms (defeated Lon Nol regime military personnel), their social behavior (urban dwellers), their relatively light skin color (Vietnamese residents, Chinese and other urban dwellers), or their vocabulary, accent, or language (intellectuals, Phnom Penh residents, Cham Muslims)" (Kiernan 1991:207). In 1970, some 200,000 Chams lived in Cambodia and about 60,000 in Vietnam. Descendants of a Hindu-Buddhist kingdom that adopted Islam in the 10th century (SarDesai 1997:5 8), the Chams were conquered by the Vietnamese in the 18th century. As Kiernan points out (1991:218), their history of having been victims of Vietnamese did not protect them from the Khmer Rouge. In 1979, half the Chams population in Cambodia was murdered and Islam and even the Chams language was banned; praying or speaking Chams were executable offenses. Chams were forced to eat foods forbidden by the Holy Quran.

Local Muslim leaders began to be killed from 1974 onwards.... In mid or late 1976, children were separated from their parents. After their first year of life, babies were placed in jungle centers and fed on gruel and milk. At three years of age, they were taken "to study," learning to plant crops, raise dykes, and "not much reading or writing." Sos Men recalls: "After many days, children would miss their parents and family, and run back to play with them. The Khmer Rouge would catch them and beat them. There was no pity at all (Kiernan 1991:223).

Georges Condominas says that in addition to the canonic forms of Theravada Buddhism in Laos and Cambodia, spirit cults, phi in Lao, were strong during the period of his field research in the 1950s and 60s. Periodically banned by Laotian royalty and disparaged by monastic monks, spirit cults were widely embraced: "the majority of the Lao devote considerable attention and effort to the phi, whether asking them for favors or simply for their protection, escaping their pranks, or repairing the damage and curing the ills they have

caused" (Condominas 1975:254). From the villagers' point of view, there is no contradiction between Buddhism and the cult of spirits.

The master of the cult of the village's guardian spirit is designated the *chaocham phiban*. One might think that, because of his responsibilities to the village guardian spirit, the chaocham might sometimes set himself up as a rival to the head of the village pagoda. This does not occur, however, for actually the chaocham is usually a good Buddhist who would never believe that the rites he performs in honor of the village spirits run counter to his worship of the Buddha (Condominas 1975:258).

Some students of comparative religion suggest that such entities provide villagers with a sense of empowerment, as they are less inaccessible than the High God--or the Buddha--that is supposed to be venerated.

In its early period, the Pathet Lao government of Laos manifested a conflicted relationship to religion. On the one hand, it asserted that there was no incompatibility between Buddhism and socialism: "both taught the equality of all men and women; both renounced individual but accepted communal ownership of property; both sought to alleviate human suffering" (Stuart-Fox 1986: 162). On the other hand, Pathet Lao criticized many Buddhist practices and beliefs:

Cadres ridiculed the Buddhist cosmology of tiered heavens and hells, the existence of nature spirits (*phi*) and the notions of transference of merit. More importantly, they criticized the non-materialism of Buddhism, and urged instead the crucial importance of material accumulation for social progress and the alleviation of want. The surplus wealth that peasants directed to the *Sangha* in order to obtain religious merit should instead be directed to the state, where it could be put to better use (Stuart-Fox 1986:162).

Monks who resisted the required inclusion of socialist ideology and party doctrines in their sermons had either to exile themselves, fleeing to Thailand, or to leave the monkhood altogether.

After a decade of socialism in Laos and acceptable *modus vivendi* has been arrived at between the Party and the *Sangha*. The earlier repressive phase has been replaced by a more liberal recognition of the continuing importance of Buddhism in defining the Lao national cultural identity. The annual cycle of 12 major Buddhist festivals is regularly performed with Party representatives in attendance. All major Party functions are attended by senior Monks. In addition, several monks were members of the Lao Front for National Construction at various levels, with five serving on the LFNC Central Committee in 1985. Buddhism it would appear, seems assured of a continuing place in the life of the LPDR (Stuart-Fox 1986:167).

Finally, mention must be made of Christianity. In Vietnam, Roman Catholicism was a major component of the identity of its adherents, since its tenets, its emphasis on individual conscience, was contrary to the Confucian communitarian ideal. Missionaries were admitted with other Europeans, particularly during the 18th century and then during the French colonial period. According to Wiegiersma (1988:41), conversions to Christianity "were generally made among the lower ranks of the rural population and not among the mandarinates. It is significant that most conversions were made in groups, that is, villages or hamlets rather than individual persons were converted. This reflects the collective character of the Vietnamese village."

In the confrontation between North and South Vietnam, Catholics were prominent among senior military and government echelons in the South. Indeed, the "Christian character" of Vietnam was invoked regularly by American supporters of the Ngo Dinh Diem regime, who saw him as a bulwark against the "atheist communists" of the Viet Minh. Diem himself was a

devout Catholic, and emphasized that identity when in the United States by residing in a Catholic seminary (Wiegersma 1988:174). Approximately 10% of the Vietnamese population today identifies itself as Roman Catholic, which, after the Philippines, is the largest Catholic group in Asia. Relations between the Church and state have improved, and while the state continues to limit the number of priests that may be ordained, in general Vietnamese Catholic churches and cathedrals seem to operate without much government interference. In 1998, however, the Vietnamese government denied a request that the Pope be invited to a major assemblage of Catholics which was held in August.

Evangelical Protestantism has found some receptivity in the region, particularly among upland peoples such as the Laotian Hmong. Protestant missionary activity seems to have begun in the 1940s, and expanded rapidly after World War II leading to a significant number of converts. The Laotian government does not encourage missionary activity, but Christians number about 20 percent of the Hmong population in the country: "Christian Hmong families in Laos are in contact with Christian Hmong congregations overseas who supply them with religious propaganda in the form of magazines and cassette tapes" (Ovesen 1995:13).

Section Five: Conclusion

Rising in a "river knot" in southeastern Tibet, in the same general region as the Yangtze Kiang, Songka, Salween, and Irrawaddi rivers, the Mekong flows over 4,000 km through six countries to empty into the South China Sea. The upper basin, nearly 200,000 km² in extent, lies within China and Myanmar, while the lower basin, occupying some 600,000 km², is contained within Cambodia, Laos, Thailand and Vietnam. After decades of the most violent conflict in which the environment, peoples, and their production systems were devastated, the region is largely at peace, no longer serving as a surrogate battle ground for the world's principal hegemonic powers. Although the development potential of the Mekong River has been acknowledged for half a century, it is only in the last few years of relative tranquillity that that potential is being transformed into reality. The first mainstream impoundment, the Manwan Dam in Yunnan Province, China, generating 1500 MW for local mining and manufacturing, has been completed²² as have tributary impoundments in Laos. Construction and financing are matters of bilateral agreement between a lending agency and a borrowing country, but in principle there is overall coordination the Mekong Committee, a UNDP-funded organization of the four countries of the lower basin, with observer status accorded to the two upstream countries. A 1973 report to the Ford Foundation commented on coordination:

Integrated development of the Mekong must begin with proof that the potential benefits of international cooperation justify the required changes in national sovereignty. The Committee... was established for this purpose. After 15 years of slow but perceptible progress, they have achieved international agreement on a plan for technical coordination (Conway and Romm 1973:45).

The report noted two potentially adverse environmental consequences of development involving the river:

First, environmental costs of development will not be distributed equally. Changes in fish population, land inundation and resettlement, and soil salinization, for example, will bear on specific localities and nations [and social groupings such as age, class, gender -- PMcE and MMH], not on the whole region... Second, detrimental effects of upstream activities on water quality, quantity, and timing will become increasingly apparent as uses of the river intensity and grow more

interdependent and valuable (Conway and Romm 1974:46).

Despite the acknowledgement that the Mekong's waters support fishing, farming, agriculture, transportation, and biodiversity throughout the region, development thinking in the area has focused almost uniquely on hydropower, irrigation, and flood control. A 1972 World Bank review says "The immense water resources of the Lower Mekong Basin are as yet *virtually unexploited*" (1972:1, emphasis added), as if the millions and millions of people who depend on the river's bounty were not "exploiting" it.

The Mekong Committee itself is not, of course, unaware of the river's environmental and social benefit. In 1962, the Mekong Secretariat accepted the recommendation of a team led by Gilbert White that economic, institutional, and social data be incorporated into the planning process. Despite this, the approach to development on the Mekong has remained largely technocratic.

George Radosevich, appointed by UNDP in 1993 as advisor to the Mekong Secretariat, writes:

A unique combination of events are now taking place in the region -- including development of market economies; private enterprises; legal and institutional reforms, encompassing water and environmental policies and laws; and negotiations to establish a future framework for continuing Mekong cooperation. These events are opening a window of opportunity... to contribute to a sustainable development and environment management effort in one of the world's important international river basins.

We share the viewpoint of the Chair of the Mekong Dialogue for Sustainable Development, Professor VoTong Xuan, writing in April 1996:

At stake are the Mekong's long-term economic potential and the maintenance of the broader natural environment that many of the region's people depend upon. Due to significant international involvement, an opportunity to broaden the development focus in a comprehensive watershed planning context exists. Delays in the development of the Mekong have made it possible for the planners and developers of this system to benefit from the experience and lessons learned from other river basins. The cost-savings to the region are compelling and substantial.

The effects of a narrow development focus in traditional river management, as demonstrated by virtually all the other developed world rivers, has been to significantly undervalue the negative economic and ecologic effects... This includes *systemic* effects, such as permanent displacement of the resource benefits, habitat loss and impoverished biological diversity, and poor land use practices and infrastructure placement. It can not be emphasized enough how costly it is to reverse a small part of any one effect.

This review of the literature was discussed by the Oxfam America Mekong Basin Initiative Partners at their meeting in Ho Chi Minh City in January 1999. The countries of the lower Mekong basin are undergoing a tremendous series of changes—environmental, political and economic—whose social and ecological dimensions remained to be understood. As the available literature indicates, there is a wealth of information extant; yet its social analysis is, at best, rudimentary and tentative. Nonetheless, the review allows us to make certain conclusions:

- A. there is a tremendous need to upgrade health and educational conditions, especially in the rural areas of Laos and Cambodia;
- B. far more attention needs to be paid to the gender dimensions of development throughout

the region;

- C. there is an urgent need for meaningful employment and small enterprise generation;
- D. far more must be done to reverse accelerating environmental degradation, due in part to uncontrolled lumbering that vastly exceeds the forests' sustainable yields and is leading to rapid erosion and threatening the basin's land and water resources;

To achieve these goals in socially equitable and sustainable ways will require not only marked increases in multilateral, bilateral, and nongovernmental assistance to the region, but also a more integrated approach to the training of development professionals. The technical competence in the region is high, and there are excellent centers—such as Can Tho University—providing research and advanced training in hydrology, agronomy, agropedology, and the like. What now needs to be done is to assure that this technical competence is well-informed by understandings of their social dimensions, and that social scientists, both within the region and from outside, improve their understandings of the environmental dimensions of their work. The tasks are massive, but achievable. It is hoped that this review of the social and environmental literature of the lower Mekong basin will contribute to the achievement of equitable, sustainable, and just development for the peoples of the region.

Notes

⁸Evans points out that even in the immediate post-independence years, following 1953, "the elite did not turn to land as a source of wealth and productivity; rather, because of Laos' strategic location in Southeast Asia, a fabulous new source of sustenance became available in the form of US aid. In the first four years of independence the Lao government received \$166 million of aid from the United States, and a further \$125 million was programmed to establish Lao armed forces... The traditional aristocracy and their relatives were well placed to reap the benefits of this US aid bonanza, and some of them grew very rich by channeling aid to suit their own purposes... Yet little of the influx of US dollars... was invested in productive activities..." (1990:34).

⁹A useful review of Chinese migrations to Vietnam is presented by Tran Khanh, who notes optimistically: "In the last decade, the open-door policy and economic reforms of Vietnam, as well as the improved economic and diplomatic relations of Vietnam with the Southeast Asian countries where many ethnic Chinese reside have led to the resumption of the roles played by the ethnic Chinese in Vietnam's economy. The ethnic Chinese community once again became influential in the development of the domestic trade, and the restoration and diversification of business links between Vietnam and the region. It seems that changes in Vietnam in the last decade have also contributed to the ethnic Chinese being better integrated with the large Vietnamese economy" (1997:267). For the history of Chinese migration to both mainland and insular Southeast Asia, see Reid (1996).

¹⁰ Our earlier assessment that swidden agriculture, despite its critics, may be sustainable, is not shared by all anthropologists. The Swedish anthropologist, Jan Ovesen, who carried out fieldwork among the Hmong as part of the Environmental Impact Assessment for the Nam Mang 3 Hydropower Development Project in Vientiane Province, writes that the Hmong's "comparatively rapid southward movement into Viet Nam, Laos and Thailand during the last 100 years serve to indicate the fact that they have never stayed long enough in one place to have had the opportunity to develop an environmentally sustainable system of shifting cultivation" (1995:11).

¹¹"The heaviest bombing—according to public records the Lao hold the dubious distinction of

being the most heavily bombed people in the world's history on a per capita basis-occurred in the tribal areas" (Batson 1991:135).

¹²"Lao PDR is heavily dependent on its natural resource base to provide a livelihood for the bulk of its population and to earn foreign exchange. In 1991, wood products accounted for up to 54% of official exports, while the share of forestry in the GDP was estimated at about 15%. Moreover, some 80% of domestic energy consumption is wood-based... However, the forest cover of Lao PDR is declining steadily. In 1940, about 70% of the country... was covered by forests, but by 1981 this had fallen to only 48%... corresponding to an average annual forest area loss of about 1% of total forest areas per annum... [Of] the annual area of 300,000 ha under slash-and-burn cultivation, about 100,000 ha involved clearing of forest land. Another 100,000 ha are degraded by forest fires, while about 150,000 m³ of valuable logs are removed through illicit logging" (World Bank 1994: 1).

¹³The major point of the titling project is to facilitate creation of an economically efficient land market. "Efficient land markets and security of land tenure ... are important in order to permit land to get allocated to its most efficient use and users and to encourage land-related investments and sustainable use of land... There is a prevalence of illegal possession, sale and use of land and a large number of court cases relating to land, many of which are hampered by lack of ascertainable rights to and clear information on land, All these represent symptoms of an inefficient land market. Moreover, the great majority of the sale transactions are not registered. And since land registration is not common, there are foregone opportunities of using land as collateral to obtain loans from banks" (World Bank 1996:1-2).

¹⁴Ovesen (1993:13) notes that Lao Loum housing is often raised on stilts even where there is not much risk of flooding, "because the space under the house has its special usages. It is often occupied by a rice pounder and a weaving stool, and it is further used for storing firewood as well as for keeping pigs and buffaloes. Next to the house is the rice barn, similarly built on stilts and normally locked."

¹⁵ The importance of the Mekong River for communication is well illustrated in an account of the first exploration upstream by Europeans in 1641... Under the direction of Gérard van Wustoff, an employee of the Dutch East Indies Company, a group of merchants travelled by boat from Phnom Penh to Vientiane. Their account has survived, and provides much information on the land and its people. The area was densely forested, and game abounded... Van Wustoff noted how much easier it was to travel by boat than by land' (Higham 1996:183).

¹⁶ Vietnamese and other Southeast Asian women's involvement with military actions, is only begin to be appreciated (Turner 1998). How this major involvement of women in war affected their self-perceptions and men's gender stereotyping has not, to our knowledge, been studied.

¹⁷ Official figures on West Sobay list 421 persons: 339 females (80.5 percent of the population) and 82 males" (Ebihara 1993:159).

¹⁸ Highland Lao (Lao Sung), comprised largely of Mien and Hmong, tend to patriarchal family and kinship institutions.

¹⁹ Referring to lowland Lao, Carol Ireson presents a slightly different ethnography of uxoriality, which points to a kind of uterine ultimogeniture: "A newly married couple most often lived with the wife's family for a few years before moving into their own dwelling. One daughter, customarily the youngest one, and her husband stayed with her parents to care for them in their old age. This couple then inherited the house compound and much of the parental rice paddy land" (1992:7). A group of Swedish anthropologists make similar observations about Cambodia: "Among the rural Khmer population, there is ... a preference for

uxorilocal residence... Due to the traditional matrilocality in the rural society, younger daughters usually inherited the better part of the rice fields, as a compensation for caring for parents in their old age" (Ovesen et al. 1996:55).

²⁰ On the other hand, the Vietnamese Women's Union has had a more active feminist agenda (see Eisen 1984).

²¹ According to Tarling, the Vietnamese expression of communism was implicitly informed by Confucian spirituality. "This culturally rooted sense of the revolution remained largely invisible to French or American analysts and strategists. By focusing on ideologies, institutional structures, and urban centres, they consistently failed to register that the mobilization of popular will conceived locally as spiritual even when communist, influenced events more than formalized ideologies" (1992-11-539, emphasis added).

²² "Over the next three decades China hopes to build eight more dams on the Mekong to spur development in one of its most backward regions" (O'Neil 1993:14).