

1.1 Rural Landuse and Livelihood Regimes

Each class of land throughout the Mekong Basin is devoted to one or other landuse regimes; each rural family derives its livelihood from one or other or a combination of several said regimes. Each of the regimes can be sustainable only up to a certain level of population density combined with the relevant management safeguards (e.g. to prevent soil erosion or biodiversity decimation). For instance, a villager residing in a highland valley may fish in the river, have an orchard on the levee, grow rice in the back-swamp paddy fields and burn the nearby hillsides to grow cassava or maize to supplement his rice and also hunt and gather wild animals and non-timber forest products in the surrounding mountains. Each type of landuse has an impact on the atmosphere, the hydrosphere, the regosphere, the biosphere and the local and regional socio-economies. Impacts may be positive, e.g. carbon sequestration or negative, e.g. soil erosion. In accordance with their geographical location in relation to

water resources exploitation infrastructures, rural land-users may be either impactors, e.g. cultivators in the catchments, or impactees, e.g. downstream irrigators.

Sipsong Panna region of southwest China, together with the Lower Mekong Basin experience three distinct climatic seasons annually: the hot-wet season (May/June through September/ October; the cool, dry season (November through January) and the hot-dry season (February through April). In rainfed upland and highland farms, the wet season is the main season for cultivation of crops, primarily maize, cassava and upland rice (often mixed with vegetables, pulses, peanuts). Crops such as mung bean and the opium poppy may be cultivated through the cool-dry season, surviving on residual soil moisture.

Any particular parcel of land has numerous optional future uses. These range from urban development through industrial development (including mining or reservoir construction), various types of agriculture, plantation, forestry or nature conservation. The rights of access to and management of, the said parcel of land may be designated as private, communal, corporate or governmental. For a particular land parcel, the ultimate measure of landuse sustainability is the maintenance of the integrity of the topsoil, which supports the vegetation, providing foodstuffs, fodder or other commodities for the use of humankind. Provided the topsoil remains in place and its organic matter content is preserved, then any current landuse (e.g. agriculture), can be converted to any other socially or economically desired future landuse (e.g. forest plantation), by implementing the land management measures required to replace one form of vegetation with another. This is not however possible if the topsoil has been eroded or degraded except by invoking (expensive and complex) rehabilitation measures. If topsoil integrity is maintained by sustainable landuse, even the restoration of the natural (pre-human intervention) ecosystem can be achieved, provided that, at the landscape level, a certain proportion (at least ten percent) of the area has been preserved as a biogenetic "reservoir".

Man can do little to control the weather, but he can increase the productivity, or extend the growing season, of the crops on his land by providing artificial rainfall in the form of irrigation. As today's growing population, with its growing economic aspirations, calls for more and more productivity from each unit area of land, then the optimisation of irrigation system efficiency and extent takes on increasing importance. There are trade-offs that planners must keep in mind however:

- maintenance of dry season stream flow requires protection of the stream catchments, i.e. fibre or fruit-tree cropping rather than staple food arable cropping.
- expansion of agriculture into drained wetlands is generally at the expense of fish spawning grounds.

The following is a review of the rural landuse and livelihood regimes found in one or other part of the Mekong Basin. It is interesting to note that ancient and modern practices still co-exist side by side.

1.2.6 *Hunting & Gathering*

Thousands of years ago, the entire Mekong Basin was populated by hunting/gathering/fishing communities who travelled from site to site to enable depleted wildlife populations to recover their numbers before returning some months or years later to hunt and gather again.

Even today, small bands of semi-nomadic hunter-gatherers still roam parts of the Lao-Thai and Lao-Vietnam border areas. Bands of hunter-gatherers operate within a large, loosely defined territory, whose boundaries may, from time to time, be agreed or contested as the case may be, with other clans or tribes. Individuals have an equal

right to hunt or gather in their tribal territory and specialisation is at a minimum since virtually the full time of every family member is occupied in the pursuit of foodstuffs.

Hunting and gathering is a sustainable form of existence but only if overall population does not rise above a density of two persons per square kilometre. The hunter-gatherer communities inhabiting those parts of rural Lao PDR where population (i.e. resident plus transient) remains below this level have very little money but must not necessarily be considered to live in a state of livelihood poverty. Given the warm, moist climate, further modulated against extremes by the tall forest habitat, clothing and shelter needs are minimal and the jungles provide all the materials required for hunting and for making the simple tools and equipment needed for hunting and fishing.

The rivers and forests also fill a very wide range of dietary and medicinal needs, and if a shortage occurs on one tract of land, the bands merely migrate to another. Parents and tribal elders provide the children with all the education (experiential plus theoretical) required for them to maintain their livelihoods through succeeding generations. Economic prosperity has little meaning to these communities, as accumulated wealth and possessions become burdensome to transport from hunting ground to hunting ground. Because of the need to maintain low population densities to ensure survival, semi-nomadic hunter-gatherer societies have evolved several techniques for ensuring that surviving children are no closer than 4-years apart (taboos, abstinence, prolonged lactation, abortion, herbal contraception, infanticide, etc.). Environmental and ecological impacts are zero. Poverty is exhibited only in the case where childless couples become aged and infirm and have no close family to care for them.

Having no farms however and little time available away from food gathering to allow them to assemble protective militia, these communities are highly vulnerable to armed bands of hunter-gatherers from other areas, or from those who would fell the forests for lumber or for farming. In Lao PDR, only pro-active land-use zonation can preserve their social and economic integrity.

Apart from game, fish and edible shoots (including rattan and bamboo), staple foods for hunter-gatherers include sago and wild yams. Modern day hunter-gatherers supplement their diet staples with rice, which is traded for non-timber forest products.

1.2.7 *Agriculture*

Shifting cultivation provides a means of producing foodstuffs for subsistence on steep and rugged terrain, unsuited to permanent cultivation. It is sustainable, however, only at low population densities and it persists at the expense of timber production. Smallholder-based mixed farming is the most productive in terms of overall yield of consumable product, but presents problems in ensuring the uniformity of quality demanded by the urban and export markets. Large-scale commercial operations based on monoculture can be more easily geared to meet consumer demand but can lead to disparities between workers and owners and can lead to problems with chemical pollution and biodiversity degradation.

Pioneer Shifting Cultivation

The pioneer swiddeners who populated the highlands above 800 metres altitude, bringing with them the axe, the crossbow and the opium poppy, which is at once a food (poppy seed), a medicine (anti-spasmodic) and a narcotic (smoked directly, or smoked or injected as a derivative, heroin or morphine). The main pioneer cultivating groups are the Hmong, the Yao and the Akha; the most sophisticated, literate and monetised being the Yao and the Hmong. They were all originally paddy-cultivating groups in South-west China but were pushed uphill by continuous armed Chinese invasions.

Pioneer cultivators eliminate all trees and seed sources unlike the cyclic re-occupance cultivators who lop and retain tall trees as a seed source for bush fallow regeneration. When the successively cultivated pioneer swiddens are finally abandoned due to soil erosion and fertility decline, they are populated by weed grasses, particularly the fire-tolerant *Imperata cylindrica*, which is unpalatable to livestock except during its very early growth stages. Accordingly, these fields are burnt annually by graziers, effectively suppressing forest regeneration. Run-off from grassland is twice as high as for old-growth forest and evapotranspiration less than half - so aquifer recharge is also repressed due to the absence of tree root channels penetrating the bedrock. Absence of tree roots also aggravates incidence of landslides, a source of severe sediment loading in tributaries and the main stream. When grasslands are burnt late in the dry season the opening rains may cause even further topsoil erosion.

Cyclic Re-occupance Shifting Cultivation

The cyclic re-occupance shifting cultivators who populate the uplands and foothills, usually below 700-800 metres altitude, include many Tibeto-Burman, Mon Khmer and Vietic groups such as the Karen, the Khmu, etc.

The predominant livelihood system for the majority of the rural population in the uplands and highlands of the LMB is slash and burn shifting cultivation (swidden agriculture; a form of extensive agro-forestry), supplemented by the gathering of Non-Timber Forest Products (NTFPs), hunting and fishing. Under a typical swidden cultivation regime, a family would cut/slash between 1.5 - 2 hectares of secondary forest at the end of the cool-dry season in early February. The felled material is allowed to dry for several weeks during the hot dry season and is burnt in April / May before the rains start. When the rains commence, seeds of upland rice are planted in holes punched into the ash-covered topsoil using sharpened sticks. Seeds of other crops (vegetables, cotton, hemp, sorghum, spices, etc.) are inter-sown with the upland rice. The swidden fields, which are usually on steep hillsides, are weeded throughout the rainy season and the crops harvested at the beginning of the dry season in late October or November.

After one season of cropping, the plant nutrients in the top soil become depleted. Hence, the farmers allow the cleared fields to regenerate to secondary forest (bush fallow) in order to restore fertility of the top soil and suppress weed re-growth. The deep roots of the regenerating trees in the bush fallow draw nutrients from the sub-soil (beyond the reach of crop plant roots). These nutrients are then deposited on the top soil through leaf fall and from the ash resulting from the next cutting and burning event. Full restoration of soil fertility will not be achieved unless the bush fallow interval between each cropping phase is at least 7 years (on the best soils) and in other cases up to 12 or even 15 years. Hence a typical family engaged in cyclic re-occupance shifting cultivation will clear and cultivate between 1.5 - 2 hectares per year but retain traditional use rights over 10-20 hectares of associated bush fallows at various stages of regeneration.

In addition to the foodstuffs grown on the cropped fields, other wild foodstuffs (both plant and animal), raw materials for building and handicrafts, other NTFPs and fuelwood may be garnered from the bush fallows and from the adjacent old growth forests. This cyclic re-occupance swidden farming system can support population densities of between 20 persons per km² (on the best soils) and 15 per km² or less otherwise. Traditionally under this situation approximately 50% of each village territory remains under primary forest which is preserved as a sustainable source of building timber and as a food security reserve in the event of crop failure (source of edible tubers, roots, shoots, leaves, fruits and wild animals).

Under mounting population pressure, however, shifting cultivation is not a system of agro-forestry remaining viable in the long term and has a significant opportunity cost with a poverty aggravating impact as follows:

When population densities grow in excess of 15-20 persons per km², a vicious cycle of increasing poverty emerges. Continuing population growth within circumscribed village territories leads to expansion of shifting cultivation at the expense of primary / old growth forest.

This progressive loss of primary forest diminishes the food security reserve, damages watershed integrity and reduces atmospheric carbon sequestration.

Loss of old growth forest habitat degrades local bio-diversity and consequently reduces eco-tourism value, inter alia.

To expand swidden areas between \$10,000-\$20,000 per hectare worth of standing timber from primary forest may be cut and burnt to fertilize a family's upland rice field that produces at best 2 tons of rice (worth \$600) per hectare once every 10 year cycle; this equates to an average of \$30/hectare/year. By comparison, in the same 10-year period, the incremental timber growth of tall forest would amount to 20m³/hectare (2m³/hectare/year) worth \$3000/hectare or \$300/hectare/year.

When the primary forest area within a village territory has been largely cut and brought into the shifting cultivation cycle, then, under continued population growth, rotational bush fallow cycles have to be shortened, resulting in declining soil fertility recovery between re-use and hence subsequent lower crop yield and productivity.

The average family labour availability is sufficient to clear, plant and weed only about 2 hectares in any one year. With lowered crop yields per unit area and therefore lowered farm productivity, coupled with family labour constraint, the population becomes trapped into a vicious poverty spiral.

Rural communities facing such a situation will remain so trapped in an increasing poverty spiral unless there is intervention to develop alternative livelihoods based on agro-forestry systems that are sedentarised and of higher productivity per unit area and per unit of labour input.

Sedentary Farming

Most of the ethnic groups in the uplands and highlands of Southwest China have learnt how to construct contours and terraces, but this is not generally the case in the hills of Myanmar, North Thailand or Lao PDR. Instead, swidden fallow cycles become too short and weed-infestation prohibitive, the dry season is spent in hoeing the topsoil deeply to kill weeds and oxidise some of the plant nutrients in the upturned subsoil to render them available to the roots of the subsequent crop. The ultimate result is severe erosion and eventual abandonment of the whole area to the regrowth of unproductive grasses and scrub, subject to annual burning, and requiring centuries rather than generations to recover productive capacity for agriculture or forestry.

After irrigation system upgrading it is the contouring and terracing of cultivated hillsides that requires the most urgent attention in the form of technical and financial support.

Rainfed Arable Farming

Under this system, annual crops are planted every year without a respite under bush fallow, manures and fertilisers may be applied to maintain fertility. This agricultural practice may be sustainable on slopes up to 25%, provided that soil erosion control measures (e.g. contour bunds, terraces) have been installed on slopes between 5% and 25%. The main arable crops grown on sedentary rainfed farmlands in China, Myanmar and north Thailand are upland rice, maize, mung bean, soybean and peanuts. Since the 1960s, in northeast Thailand and southern Lao PDR, cassava,

sesame, sorghum, kenaf and sugarcane have been cultivated from time to time in response to the vagaries of demand from local and export industries. The expansion and diversification of commercial agriculture was triggered mainly by the expansion and upgrading of the road network in northeast Thailand. As oil prices continue to rise, it could be expected that the better quality arable soils in Thailand, southern Lao PDR and upland Cambodia sectors of the Basin would be devoted to sugarcane production, extracting ethanol for motor fuel from the juice and burning the bagasse for steam turbine electricity generation.

Irrigated Farming

Whereas hunting and gathering can sustainably support only two persons per square kilometre, irrigated agriculture on good soils with reliable water supply and sophisticated water distribution and drainage network can support up to two thousand. Compared to swidden cultivation, the sustainable population density supportable by rice-farming regimes irrigated by rainfall capture rises to between 50 and 100 persons per square kilometre. Exportable surpluses of cattle and buffalo and dry season off-farm labour become available to support urban construction or military purposes. When secondary forest is converted to hand-cultivated paddy field there is a decrease in overall annual evapotranspiration (because dry season stubbles do not transpire) and a consequent increase in aquifer recharge, although (especially if stubbles are not burnt) there is a reduction in emission of carbon dioxide, a greenhouse gas. This may be replaced, however, by the emission of methane from rotting vegetation in the ponded water. Methane has four times the heat-insulating properties of carbon dioxide. Irrigation systems are described in detail in Section 1.4 and subsequently.

Wetland Farming

Particularly in rain shadow tracts, agriculturalists have cleared the flood forests from the edges of flood reticulation wetlands (including parts of the Tonle Sap Lake shores) for the cultivation of floating rice in the wet season and/or recession rice in the cool dry season as flood levels recede. In some cases, such as in the Lower Xe Bangfai Basin, in parts of the Mekong Delta and in Cambodia, flood control and irrigation infrastructures such as levees, canals, gates or pumps have been installed to enable the production of three rice crops per annum.

1.2.8 *Animal Husbandry*

Domesticated livestock of one type or another are an integral component of smallholder agriculture Basin-wide; even the semi-nomads keep dogs for hunting. In remote rural areas, the relationship between the cause and effect of livestock diseases is not generally understood and both sanitation and health are poor. Thailand and Vietnam have the most progressive veterinary services.

Large Livestock

In the Mekong Basin, elephants, horses, cattle and buffalo have been domesticated for centuries. Elephants have been used mainly for warfare and logging, while horses are used as pack animals, particularly in mountainous areas. Apart from their use for draught, for rice cultivation and transportation, cattle and buffalo also serve as "walking savings banks". In the pre-chemical fertiliser era, they played a key role in maintaining rice field fertility - freely manuring the ground whilst grazing the stubbles in the dry season and through the accumulation of dung deposited at their night camps whilst grazing in the fields and forests during the wet season. As a rule, as population density increases, large livestock may be stall-fed on forages grown in irrigated fields and cut-and-carried to the stalls, where their dung is composted for manuring the fields. Most farm families strive to keep some large livestock but only near the larger urban areas do farmers specialise in intensive large livestock production, in beef feedlots, dairy farms, etc. Except near urban centres, buffalo or cattle are not milked.

On the Nakai Plateau (in the proposed NT2-HPP area) most of the families at Ban Bor Cho are on the military payroll. Their duty is to tend large herds of buffaloes, which are raised to provision the military, or for sale to contribute to army operating revenues. Some families in the other twenty or so riverside villages on the Nakai Plateau also raise buffalo. Some of these are family-owned, others are on loan or agistment from farmers on the Nyommalat Plain who grow dry season rice in their paddy fields, and have no alternative land for grazing their buffaloes.

Small Livestock

Small livestock husbandry throughout the Basin emphasises pigs and poultry, traditionally fed on rice bran and otherwise allowed to range freely around the villages. More recent introductions include goats, rabbits and some hamsters. In and around large urban centres, specialists raise pigs and chickens in intensive battery-cage feedlots. The risk of epidemic diseases transferring from animals to humans is becoming of increasing concern in these cases.

1.2.9 *Forestry and Tree Plantations*

Exploitive Logging

The timber harvestable from one hectare of mature, pristine forest may be worth as much as US \$20,000 at today's prices. Historically, in Southeast Asian countries, the derivation of income from timber sales has been the prerogative of the ruling elites. For almost two centuries, the exploitation of logs from the Mekong Basin has been facilitated by foreign-based companies. The British Borneo Company and the East Asiatic Company extracted teak logs from eastern Myanmar and northern Thailand. Up to the early 1950s, a French company (Compagnie Asiatique et Africaine) was extracting teak logs from Xainyabuly in Lao PDR and floating them down the Mekong for export through Saigon Port.

In Thailand and Vietnam, virtually no primary production forests remain, while sawmilling by both sides in the recent Cambodian conflict has degraded large tracts of forest in that country. Normally, when forests are logged they will regenerate, but rapidly growing rural populations, plus the fact that rural communities have previously had no legal rights to timber, has caused them to convert logged-over forest to shifting cultivation or permanent agriculture. In 1980, China embarked upon a reforestation campaign experimenting with many different models of State, State-owned, community-owned and privately owned forests. In Lao PDR, much of the potential cash value of timber from exploitively harvested logs is lost due to inefficiencies in transportation, storage, processing and marketing.

In the late 1980s, the upgrading of National Highway Route 8B opened up the Nakai Plateau for logging with timber processing facilities being established at Nakai, Mahaxay and Thakhek. Timber was trucked out in both directions, to Vietnam through Lak Xao and to Thailand through Thakhek. Branch roads were poorly maintained, and wear and tear on logging trucks very high, timber wastage was high due to inefficient forwarding practices. Very little timber revenue accrued to either local government or to the local communities. Low salary scales for civil servants has forced local government personnel to engage in income supplementary "rent seeking" rather than in the efficient execution of laws and regulations concerning the protection of the environment and ecosystem. Neither have they had the motivation, capacity or assets to effectively deliver governmental services in the fields of health, education, etc.

Sustained Yield Production Forestry

The yield of timber from production forests may be sustained indefinitely if the appropriate silvicultural management practices are applied. These involve the removal of timber at no greater than its regeneration rate and the minimisation of gaps in the

leaf canopy to ensure that re-growing trees are of good shape. Other silvicultural measures to be applied include fire protection, weeding, thinning and pruning. Logging roads are pre-surveyed, pre-constructed and protected from erosion. Mother seed trees are retained, rather than felled for sale.

With the involvement of the World Bank (Sustainable Forestry Rural Development Project [SUFORD]) and some conservation NGOs (e.g. The Forest Stewardship Council and the Tropical Timber Trust), sustainable forestry methods are being introduced into Lao PDR and Cambodia, in collaboration and shareholding with the local rural communities.

Industrial Tree Plantations

Worldwide demand for wood fibre (for paper pulp, building, etc.) continues to expand, especially since China has closed down paper production from its own resources in order to allow regeneration of deforested hillsides. In northeast Thailand, lands of inherent low soil fertility or lands depleted by exploitive cassava cultivation have been replanted to fast-growing industrial tree crops, such as *Eucalyptus* and *Acacia*. A similar landuse regime was also introduced into Lao PDR by both the private sector and the Asian Development Bank (ADB) Industrial Tree Crops Loan Project, with provisions for the incorporation of smallholders into the industry. Rubber plantations are being grown along the Mekong Valley in China, northern Lao PDR and Thailand. Further promotion of smallholder industrial tree crops plantation has great potential for the conversion of hilly lands from shifting cultivation to uses that are more productive. Other industrial species of interest include eaglewood, bamboo, benzoin, dammar and cinnamon.

Farm Forestry

A potential poverty alleviation measure for the residents of hilly catchment areas is the introduction of legalised income from forestry into the farm-family income-stream. This strategy has been incorporated into the Resettlement Action Plan (RAP) for NT2-HPP and in the planning for the project for the *Project for Poverty Alleviation, Land Use Stabilization and Environmental Protection in the Upper Nam Ha Watershed, Northern Economic Highway Corridor (ADB Route 3) (ADRA 2003)*.