UNSUSTAINABLE PRACTICES IN THE MEKONG RIVER BASIN

FUNDAMENTALS OF THE ENVIRONMENT AND ECOSYSTEMS

Definitions

The environment consists of the combination of natural and 'built' surroundings – air, water, land, minerals, plants, animals (from insects to elephants), micro-organisms, solar energy, humans, and human structures.

An ecosystem is made up of the dynamic interactions and interdependencies between each of the components of the environment – air, water, land, and biological – and the flow and transformation of energy among them.

Characteristics of Ecosystems

An ecosystem evolves from pioneering, immature states that specialise in growth. They stabilise the soil, check erosion, bring trace elements up from the subsoil and prevent deterioration that would occur in their absence. These initial colonisers are succeeded by increasingly complex organisms and relationships through several intermediate stages. Eventually mature systems are established that are efficient, resource-conserving, and the best possible adaptation to the local environment. Mature, climax systems consist of an association of organisms that reach a state of equilibrium which leaves the habitat largely unchanged from year to year. Even climax communities do not last forever, but they are the most diverse, stable and complex of communities, and more resilient to disturbances than other stages of ecosystem development. Through complex interchange of nutrients, gases, and energy, mature systems create the greatest amount of biomass with the least amount of resources.

An ecosystem is in a constant flux of energy and matter, striving to achieve maximum entropy and overall stability in a dynamic equilibrium. Diversity is a sign of maturity in an ecosystem. For optimum survival, each plant and animal has its own niche, consisting of natural habitat, climatic and physical needs. Since no ecosystem is closed to outside influences, changes constantly occur as a result of the system equilibrium being disturbed; the ecosystem is continuously adapting to new inputs or expenditure of energy. In this way, an ecosystem is at the same time resilient and fragile.

UNSUSTAINABLE HUMAN IMPACTS ON ECOSYSTEM COMPONENTS IN THE MEKONG RIVER BASIN

Natural Forests

Forest cover in all Mekong River Basin (MRB) riparian countries has diminished rapidly over the past 30 years. In the past ten years or so, forest losses have been accelerating in Lao PDR and Cambodia, whereas in Thailand and Vietnam the rate of forest cover reduction appears to have slowed somewhat in recent years due to the shrunken residual base of forested land. Forest cover in the MRB today is estimated to be less than half what it was in 1970, though accurate data are not available because of a shortage of

human resources to monitor and inventory forests.

Most of the pressure on forests comes from commercial logging, much of which has been enabled by preferential concessions awarded by governments. Concurrently, extensive illegal logging by the concessionaires and other pirate operations is contributing to extraction of high value tree species, accompanied by much collateral damage to the remainder of the forest ecosystem. According to MRC (1997), 2,500 truck loads of logs a day leave Cambodia, many of them illegal shipments providing no benefit to the Cambodian treasury.

Traditional gathering of fuelwood by local communities, clearing of forests for agriculture using slash and burn techniques, swidden cultivation, road construction, and reservoirs are some of the other reasons the remaining forests are disappearing. Fuelwood collection is sometimes perceived as a primary source of forest loss, but must be viewed in the larger systemic context of winners and losers in economic development. When traditional lifestyles and practices are put under pressure by developments such as logging, those excluded from the benefits must survive with less resources than they had access to before the development took place. The relative significance to forest depletion of fuelwood scavenging compared with large-scale logging is not clear.

Obviously, losing large tracts of forest trees and the accompanying plants, understory vegetation, animals, organisms, and soil structure destroys what were stable, mature ecosystems, and decimates biodiversity. All this might be seen as the price of progress if the logging revenues were collected and distributed equitably, and the resulting environmental changes could be mitigated. In practice, as noted above for Cambodia, this is not the case.

Land that has been deforested and abandoned or converted to agriculture does not retain much of its original fertility. In a tropical forest, most of the nutrients are stored in the living canopy, not in the soil. The residual soil-based nutrients are quickly exhausted in the first agriculture cycles, after which only intensive practices using artificial fertilization will produce acceptable yields of produce.

To add insult to injury, forest soil that has been stripped of its protective cover of vegetation is directly exposed to wind and rain, which erode the surface and flush material into streams, where it may eventually settle, blanketing bottom habitat, or contribute to silt accumulation at the bottom of reservoirs, with subsequent reduction in their storage capacity and useful life.

There are fears that silt accumulation in the Tonle Sap (or Great Lake), caused by run-off from nearby cleared forest land, is causing the Lake depth to decrease, lowering its storage volume, and increasing water temperature, each of which adversely affects the ecology of this critical area in the MRB.

Another consequence of widespread deforestation is its impact on global warming. Forests consume carbon dioxide as part of the photosynthetic cycle, and also reduce the amount of heat reaching and reflecting from the earth's surface. When stripped of forest cover, an area becomes a contributor to

global warming, rather than a buffer against it.

Plantation Forests

Logging proponents point out that forests are a renewable resource. This is true if logging is done responsibly; when adequate residual species are left to provide an ecological support base; and the forest is allowed sufficient time to regenerate naturally. However, supplanting a logged natural forest with a plantation forest is like replacing an original piece of art with a moulded plastic imitation. Almost always, plantation forests are developed in an agricultural framework, with a single tree species for commercial timber use planted in regimented rows, and no understory plants – in fact extra vegetation is removed manually or using herbicides to increase the plantation species' growth rate. Fertilizer supplements are needed, because of the low residual nutrients in the soil, the high nutrient demand of the newly planted species, and the urgency for the crop to reach harvestable size in minimum time. And after all this effort and cost, monoculture plantation forests are much more vulnerable to being wiped out by disease than are naturally diverse forests.

Plantation forests provide little in the way of accessories to their basic purpose. They contain no natural sources of food or medicines, they offer sparse cover or habitat suitable for animals, no downed wood for fuel, and in some commonly used species, the leaf litter rather than nourishing the soil, harms it. Biodiversity in a plantation forest is a pale imitation of the real thing.

Perhaps more sinister is the fact that plantation forests do not require as much labour to maintain and harvest as do natural forests. Local communities may be promised employment in plantation forests, but work is intermittent, unfulfilling, and usually insufficient to support families. Since plantation forests take up land previously available as a food source, local communities are often worse off than before, and must resort to environmentally damaging practices of survival, such as fuelwood collection and slash and burn agriculture in naturally forested areas. In addition, land converted to commercial operation is vulnerable to property speculation and corrupt practices, resulting in loss of influence and power by the majority of local people.

Mangrove Forests

In recent years, drastic reductions have taken place in the areas occupied by coastal mangrove forests of the Mekong Delta, often to make room for commercial aquaculture operations. Their loss has exposed the coast and delta lands to direct wave forces from the sea, with resulting erosion of coastline and intrusion of saltwater into the Delta. Native species of fish and crustaceans, which rely on the root systems of mangroves for habitat and sustenance sources, have declined and have been replaced by intensive aquaculture. Done well, aquacultural practices can add to economic development with acceptable, minimal impacts on the local ecosystem. Over-exploitation of aquacultural practices, however, causes contamination of the environment by fish and crustacean excreta; chemicals, in the form of hormone supplements, antibiotics, and

pesticides; and the decomposing carcasses of deceased fish.

Wetlands

Wetlands throughout the MRB provide many vital services, such as water flow equalization basins; nurseries for fish and other aquatic organisms; habitat for a wide range of birds, mammals, amphibians, and reptiles; and as a chemical buffer against increasing soil acidification and salinity. Removal of wetlands has been going on worldwide for many years, though their contributions to ecosystems are now being appreciated more and conservation measures taken. Biodiversity in wetlands is among the highest of all ecosystems; their removal in areas such as Boeung Thom Lake in Cambodia, Vientiane urban wetlands in Lao PDR (case study examples in this course), and the Plain of Reeds in the northern areas of the Mekong River Delta is cause for great concern.

Fisheries

As in many places in the world, one of the challenges faced by fisheries in the MRB is the situation of too many people in pursuit of too few fish. Overfishing is one of the more obvious causes of declines in fish catches experienced in many areas of the Mekong River system. The Boeung Thom Lake in Cambodia and Nam Ngum reservoir fishery in Lao PDR are case study examples. The solution to this problem is to be found in refining legislation, regulations, and enforcement – easy to say but difficult to implement. Other less directly visible causes of the downward trend in fisheries yields are the many and varied losses of habitat frequented by fish, in particular the previously mentioned flooded forest in the Tonle Sap, mangrove forests in the Mekong Delta, and wetlands throughout the MRB.

Hydrology and water chemistry changes in the Mekong River system have contributed to tougher times for fish. Dams on the Theun and Ngum Rivers in Lao PDR, the Mun River in Thailand, and the Se San River in Cambodia and Vietnam have blocked passage of migrating fish and thereby prevented reproduction of those fish species that spawn upstream of the dams and migrate to river reaches below the dams. The volumes and peak periods of water flow in these rivers have been modified, and the natural patterns, on which many aquatic species rely for their life cycles, have been altered.

Water spilled over a dam has a different composition of dissolved constituents and suspended material than water in the original river. Immediately downstream of the dam, the water may be supersaturated with nitrogen and oxygen because of turbulent aeration below the spillway. Some dissolved nutrients and minerals precipitate from the water or are consumed by biological processes during residence time in a reservoir, leaving the outlet water depleted. And suspended solids settle in the still waters of a reservoir, to the detriment of its holding capacity and the natural solids deposition-uptake dynamic that used to take place downstream of the dam. Each of these changes alters the conditions under which native fish have previously found their ecological niche – the lifestyle to which they have become accustomed. Some adapt; some cannot, and disappear.

In other reaches of the river system, increased water turbidity and solids

loadings due to run-off from deforested land impede the search for food by fish, and sedimentation clogs otherwise clean habitat with silt.

Illegal fishing, and the introduction of foreign species pose additional threats to fish populations in the MRB. Illegal fishing includes unauthorised fishing in controlled areas, for instance in the regulated fishery of the Tonle Sap, and the use of illegal catch methods, such as dynamite, electro-shocking (e.g., in Boeung Thom Lake, Cambodia), and chemical poisons, which kill a broad swath of aquatic life, not just the species being fished for. Exotic species introduced to stock reservoirs, or escapees from aquaculture operations can dominate an aquatic ecosystem, driving out native fish. The tilapia (*O. nilotica*) is an example of a non-native fish that is widespread in the Basin, especially the Delta. It is highly adaptable and may pose a threat to some indigenous species.

Dams

Some effects of dams on fish in the MRB have been noted in the previous section. Dams – sometimes for better, sometimes for worse – affect the volume and timing of downstream flow, by regulating releases to suit their purpose, whether irrigation, hydropower generation, or flood control. Dams in the MRB are generally designed for hydropower, so storage and release of water are scheduled to optimise continuous production of power. To this point, downstream effects of existing dams are not detectable in the mainstream Mekong River, but traditional fisheries, agriculture, and river uses in the watersheds of the dammed tributaries have been affected.

An effect of dam impoundments that has recently come to light is the contribution to the emissions of greenhouse gases, such as methane and carbon dioxide, from submerged, decomposing vegetation. Hydro-electricity has been viewed as a non-polluting option in power generation, compared with fossil fuels, but this claim is no longer so clearly valid. Other effects of anaerobic fermentation of organic matter in reservoirs are discussed in a later lesson. Uncleared standing trees and forest plants left in reservoirs often become fishing and navigation hazards.

Although not yet a consequence of dams in the Mekong River system, there is a potential for further encroachment of saltwater into delta areas if mainstream river flows decrease as a result of upstream controls. Further salt incursion would affect the Mekong Delta ecosystem and harm the fertility of cultivated areas.

A significant impact of dam development is its effects on communities who find themselves in target areas – upstream of the dam in the zone to be flooded by the reservoir, in the vicinity of the dam and electricity generating structures, or in the nearby downstream riparian areas of the basin. Ecologically, the impacts on humans in these developments are often at least as traumatic as on wildlife, fish, and biota. The outcome of relocating people to make way for a dam is frequently impoverishment and community decay. More on this issue will be covered in Lesson 6 of this course.

Irrigation

As with aquaculture, done well, irrigation is a boon; done poorly it can be a disaster. Irrigation in upstream

areas may reduce water flow downstream, and deprive communities lower in a river basin of their fair share of the supply. When regularly flooded by irrigation, mineral salts in some soils are leached out and remain at or near the surface, inhibiting soil fertility. A similar effect occurs if the groundwater table is raised close to the soil surface by excessive irrigation. The obverse is also true: over-consumption of groundwater for irrigation can result in depletion of the resource, lowering of the water table, and increase in salinity of the residual groundwater from mineral leaching.

Irrigation for agricultural purposes is usually accompanied by intensive farming practices using fertilizers and pesticides. A substantial portion of these can end up in the irrigation run-off and are flushed to the nearest river where they contaminate water for downstream users and may harm aquatic life. Case studies in the Mekong Delta and at the Boeung Thom integrated wetland management initiative in Cambodia examine these questions.

Accompanying the chemical load in run-off is soil scoured from cultivated areas, which contributes to in-stream sediment loadings and the previously mentioned effects on aquatic habitat. Improperly constructed irrigation schemes in mountainous areas can result in sloughing of hillsides and landslides, further adding to the sediment load, and potentially threatening human life.

Water storage in reservoirs, whether used for irrigation, flood control, or power generation results in losses to the atmosphere through evaporation. In hot climates, up to 7% of the volume of water stored is lost in this way, with the added consequence of higher dissolved solids in the remaining water body and risk of increased salinification of soils if the water is used for irrigation.

Urbanization

Contrary to the stated intention of improving the human condition in rural areas, development plans sometimes result in migration away from the country into major cities, where overcrowding and other afflictions await. The infrastructures of most large cities in Southeast Asia are imploding under the weight of humanity that has crowded into them from the countryside. The ecology of cities is a subject in itself, but suffice to say that overcrowding; inadequate water supply, waste disposal, and sanitation; choking air pollution from factories and vehicles; the poor public health resulting from these abuses; unemployment, under-employment, and low productivity compared with rural life; family and social breakdown and loss of cultural traditions; and the concomitant rise in crime and loss of human dignity are evidence of a very unhealthy and unstable ecological system. People living in big cities are entirely cut-off from the processes and rhythms of natural ecosystems, though the underlying dynamics of ecosystems still apply, albeit in dysfunctional ways.

Legal and Bureaucratic Systems

An ecosystem is not a series of compartments operating independently, yet that is how most countries attempt to manage their environmental and natural resources portfolios. Because all elements of ecosystems are mutually interdependent, an effect on one part can ripple through the whole system.

Segmented jurisdiction, as if each area can be treated as a separate box, leads to overlap of responsibilities between government departments, omission of some important aspects, inter-department conflict and competition, ineffectiveness and inefficiency in administering laws and regulations, which are crafted with these artificial boundaries as a base. Thus, government agencies responsible for fish, agriculture, forests, power, water resources, tourism, industry, environment, and others need to coordinate their mandates, work to reflect the way the real world functions, and maximise their limited resources. A demonstration of how this problem can be addressed will be found in the Prek Toal Biosphere Reserve case study in Cambodia.

A topic that will be dealt with in more detail in Lesson 3 (Sustainable Development Principles), is the fundamental inequity in land ownership and wealth. In developing countries, especially, land ownership is in the hands of a few; but the land is worked on by many. This situation is not ecologically stable nor sustainable. Indeed, wealth distribution worldwide is inequitable and unsustainable.

Attitudes and Beliefs

Our attitudes to the environment and to nature in general have evolved over time as an outcome of our various cultural beliefs and values. In many areas of the world, the predominant philosophy has been that nature exists to be tamed, controlled, and used for the exclusive benefit of humans, without reciprocal concern for its welfare. This attitude, though not universal, has led us to the present situation of over-exploitation, depletion, and contamination of many resources, and the loss of some altogether.

In the past fifteen or so years, realisation that the earth's resources have limits has started what may be a sea-change in attitude, from acquisition, domination, and consumption to sharing resources, conservation, and sustainable development. It would appear that no other path is life-supporting. The previous road can only lead to exhaustion of natural resources and of the human body and spirit.

The prospect of re-directing the emphasis from headlong consumption by a few at the expense of many, must be halted and replaced with another ethos, which is founded on the concept of sustaining resources while advancing human development for all.

SUMMARY OF KEY POINTS

- The environment consists of air, water, land, minerals, solar energy, plants, animals, micro-organisms, humans, and human structures.
- An ecosystem is the dynamic interactions and interdependencies between each of the components of the environment and the flow and transformation of energy among them.
- Healthy ecosystems sustain themselves, and have built-in resilience, but at the same time are delicately poised and easily destroyed by human intervention.
- Many environmental components of the MRB are being depleted, damaged, and in some cases, destroyed by human activities. Examples include, forests, fisheries, agriculture, wetlands, urban expansion, and river impoundments.

- Bold new visions and plans are needed to change the methods and direction of development to provide a sustainable and more equitable distribution of benefits from the use of natural resources.