Globally Important Ingenious Agricultural Heritage Systems (GIAHS): An Eco-Cultural Landscape Perspective

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Introduction

Human beings interact with ecosystem through concrete practices, these practices being determined by changing cultural perceptions, both in space and time. There is a wide recognition throughout the globe and across disciplines that regions of ecological prudence exhibit a symbiotic relationship between habitats and culture (Ramakrishnan, 2001). This explicates that culture and environment have held a symbolic relationship throughout human evolution, until the beginning of industrialization. The concept of the 'sacred' in a cultural sense, an intangible entity has entered into the ecological paradigm, not only because human societies have traditionally looked at Nature with awe and reverence, but also because of their strong dependence on Nature to obtain their livelihood needs (Ramakrishnan, 1992; Ramakrishnan *et. al.,* 1998). The concept of culturally valued - sacred species, sacred groves (ecosystems) and sacred landscapes (landscapes) come under this category. With an exploitative viewpoint rapidly replacing the traditional value systems which determined ecosystem integrity, and the linked traditional management practices. Understanding the drivers of this change is an interesting area of study from a historical ecology perspective (Heer, 1975; Sanders, 1960; Ovsiyannikov and Terebikhin, 1994; Hughes, 1998).

The World Heritage convention, 1972 is a unique international instrument for conserving cultural and natural heritage of outstanding universal value. This provided an opportunity for protecting natural sites and archaeological sites of outstanding universal value, from a historical, ethnobiological or aesthetic perspective. With the World Heritage Convention recognizing three categories of cultural landscapes, namely, (i)'clearly defined landscapes designed and created intentionally by humans', such as garden and parklands; (ii) 'organically evolved landscapes' that may still be organically evolving or relicts; and (iii) 'associative landscapes', by virtue of religious, artistic or cultural associations that are intangible (Rossler, 2001), the cross-cutting dimensions of ecology, economics and ethics (Ramakrishnan, 1998) spread across a variety of disciplinary realms is becoming more and more relevant for natural resource management. In the contemporary context, these cultural entities provide not only intangible benefits that enable humans to arrive at a harmonious relationship with Nature, which includes leisure, as well as providing tangible benefits through the biodiversity that is conserved and managed through human actions.

In the contemporary context of 'global change' (Walker *et. al.,* 1999) in an ecological sense, and 'globalization' in an economic context, (Daly and Cobb, 1989; Dragun and Tisdell, 1999), which is rapidly overtaking traditional approaches to ecological inquiries, there is an urgent need for interaction between the ecological, social and cultural dimensions of a given environmental

problem; there is a need to look into the wider context of how societal perceptions differ and how the same environmental issue, oftentimes, is perceived differently by different cultural groups, which may form the basis for coping with greater environmental uncertainties arising from 'global change' and 'globalization' (Ramakrishnan, 2001). It is in this context that the 'Globally Important Ingenious Agricultural Heritage Systems' (GIAHS) become significant

What are GIAHS ?

'Globally Important Ingenious Agricultural Heritage Systems' (GIAHS) are multi-species (including cultivars), complex agroecosystems maintained by traditional societies, which are managed casually or at low intensities (Fig. 1), as an integral component of a cultural landscape, conserved by societies through a value system that has strong socio-cultural interconnections with the landscape in which they are placed. They are products of eco-cultural interactions occurring in space and time, and may still be evolving.

Eco-cultural interactions

Humans are relative newcomers to a complex environment in which evolution driven by natural forces has shaped a complex set of constraints; understanding these sets of complex interactions, and the responses by indigenous forest people may help in understanding possible sustainable use of forest resources (Ballee, 1989). The concept of domestication of the landscape, with crop species planted at random within a forested area, often referred to as 'domiculture' by archaeologists and ethnobiologists (Hynes and Chase, 1982) is an attempt by aborigines in Australia, and many other indigenous societies elsewhere in Papua New Guinea (Groube, 1989), in concentrating biodiversity of economic value to society as part of overall landscape management. This is the necessary first step taken towards better organized agriculture of domesticated plant/animal populations. Such an attempt to domesticate the landscape around traditional societies is different from the intensified agriculture where the emphasis would be on modification of individual crop species and organization of crop species in agricultural plots. Whilst 'domiculture' may lead to more organized agricultural development (Lathrap, 1977), this may not always happen (Yen, 1989).

The move towards to domestication of crop species and their cultivation as part of an organized system arising from 'domiculture' is not difficult to see. Trail-side plantings by the nomadic northern Kayopo Indians in Amazonia, as part of their nomadic agricultural practices, where food sources were made available as 'hidden resource islands'; during war raids or during visit on long treks to distant villages, it is an attempt to provide small 'forest islands' filled with economic species needed for survival (Posey, 1985). Domiculture is a incipient form of well integrated land use practice, involving mere aggregation of economically important species collected from the wild found in the surrounding landscape itself.

The transition to casually managed shifting agriculture (Fig. 1), where economically selected crop species and crop cultivars, as part of a multi-species complex agroecosystem, being concentrated in agricultural plots, as part of the overall landscape organization is not difficult to visualize. The shifting agricultural system which is essentially based on 'farming the forest' (Ramakrishnan, 1992), is the next important step in the socio-ecological evolution of 'domiculture. Further, cultural diversification could lead to more intensely managed multi-

species complex agroecosystems (a variety of agroforesty systems, home gardens, compound farms, etc.), whilst still maintaining the overall integrity of the landscape unit (Swift et. al., 1996). All these traditional food production systems are less energy intensive, largely dependent upon resource recycling from within the surrounding landscape. In a sense, therefore, these complex agroecosystems are based on the background information that the surrounding landscape has to offer, though they are based on small but significant changes in the biotic composition or agricultural practice in response to local necessities or modified goals.

These modifications brought about in traditional agroecosystems imply that there is adaptive evolution in many of these agroecosystems. In this process, the interactions between proximal drivers of land use/cover change such as land degradation linked biodiversity loss and soil fertility decline, and more distant drivers such as governmental policies determining deforestation and market forces play an important role (Ramakrishnan, 2001). All these agroecosystems that could potentially be of cultural concern to us stand apart from the high energy input modern agriculture, where a monoculture of a crop species or indeed of a given cultivar stands out as part of a highly homogenized landscape, almost irrespective of background ecological conditions.

The end-point in this scale of intensification of agriculture is the high energy input modern agriculture where a monoculture of a crop species or indeed a given cultivar stands out as part of a highly homogenized landscape of the present-day industrial societies. Rather than building agroecosystem models based on the background information that the landscape could provide, these highly management intensive systems are based on a more regulated and planned approach to agriculture development. Bringing in only those biological and chemical elements that the planner desires, almost irrespective of background ecological conditions (Swift et. al., 1996). This modern version is a product of intense industrialization of agriculture during the post-World War II period, extensively distributed in many parts of the world, and represents the ultimate reduction in biodiversity – the genetically uniform, continuous cultivation of a monocrop, relying on mechanized tillage.

Recognizing that landscape level heterogeneity ensured until recent times by human societies, and which is still prevalent in more remote areas of the world where traditional societies live, is crucial for sustainable management of natural resources, the issue that is the present concern is the options that are available to reverse the process of landscape homogenization that has lead to unsustainable land use practices.

Why are GIAHS World Heritage?

GIAHS, if they are to be developed as 'Natural World Heritage' sites, should be one done in the context of: (i) a unique socio-ecological context, such as an agri-pastoral system that is characteristic of the cold mountain desert of Ladakh (Kaushal, 1991); or (ii) a agricultural system that is a unique treasure house of traditional ecological knowledge such as the Apatani integrated wet rice-pisciculture cultivation in Arunachal Pradesh (Box 1), which enabled the system to have a high energy efficiency of over 60-80 units output for each unit of energy input, and at the same time with high economic efficiency (Kumar and Ramakrishnan, 1990; Ramakrishnan,

1992); or (iii) a rich 'traditional ecological knowledge' (TEK), heritage that is important both from a structural and functional persepctive; (iv) that is based on innovative traditional technology, such as some of the interesting traditional water harvesting technologies of the arid land agriculture in Iran (Talebbeydokhti *et. al*., 1999) or of the kind that is recorded from India (Agarwal an Narain, 1997); or (iv) that has associated with it unique religious and cultural heritage, as for some of the shifting agricultural calendar of the tribes like the 'Garos' in north-east India, with their elaborate dance and music forms (Ramakrishnan,1992), or that of others elsewhere (UNESCO, 1983).

Need for Conserving GIAHS

Traditionally agricultural scientists have largely been involved with increasing global/national food production through high energy input modern agriculture. It is only in more recent times that traditional agricultural systems have started receiving attention, and that too from a limited number of agroecologists (Altierie, 1988; Gleissman, 1990; Ramakrishnan, 1984, 1992), in the context of growing interest in designing sustainable agriculture models. A consequence of this neglect of these traditional systems which function often as an integrated eco-cultural unit has been that there has been an attempt on the part of the agricultural scientific community and the developmental agencies to transplant an agricultural model generated in the experimental garden. This implies an attempt to impose a value system, which is alien to the traditional socio-cultural value system the local communities operate, often with disastrous consequences to GIAHS, and without any sustainable agroecosystem/s in place (Ramakrishnan, 2001).

Many of the GIAHS often being dependent upon the natural ecosystems in the landscape, large-scale deforestation and land degradation have made these traditional systems untenable. The causative factors for the land degradation has been a variety of external pressures in which the local community has only a very limited role, if at all. There is now increasing evidence to suggest that national policies, national and international market forces, and institutional interplay and inter-institutional conflicts (Lambin *et. al*., 2001; Ramakrishnan, 2001; Indian National Science Academy *et. al*., 2001) play a major role in degradation of the land and the associated GIAHS. In a socio-cultural context, an important driver is the change in the value system of local communities, as has happened in the north-eastern India, during the last 100 years with the introduction and spread of Christianity in the region. Many of the traditional practices linked with Nature worship and anemistic religious practices were branded to be primitive, with the consequent dilution/loss of the traditional value system, that linked people with Nature (Ramakrishnan, 1992).

In the context of 'globalization' and large-scale movement of people and technologies, external influences tend to have an adverse impact on traditional values. Added on to this increasing population pressure within a given region, and large-scale migration of male members of the family moving out in search of jobs elsewhere, as in the Central Himalayan region, often creates a gender imbalance (Ramakrishnan *et. al*., 2000). The net outcome is the rapid distortions in the operation of these traditional systems, and their break-down, without any alternatives in place. Marginalization of the traditional societies is the consequence due to deforestation an associate land degradation.

GIAHS are important from two important perspectives – for conserving agricultural and even natural biodiversity, since all these function as part of an integrated whole. Protecting cultural diversity against gradual the current danger from homogenization of societies through globalization (Ramakrishnan, 1998) is important. Equally important are crop biodiversity, which not only ensures livelihoods of these traditional societies themselves, but even for the general health of 'modern agriculture', realizing that the latter is dependant upon the sub-specific and species level crop diversity contained within these traditional systems. This particularly so when we realize that the life-span of a given bred crop variety in modern agriculture, is often not more than 5-6 year, and needs to be frequently replaced through traditional breeding or through biotechnological tools. Therefore, the challenge before the scientific community, conservationists and the development planners is ensuring conservation of cultural with the biological diversity, and at the same time ensuring sustainable development of these socio-cultural systems (Ramakrishnan et. al., 1996).

Criteria and Indicators of GIAHS

Does it fall under 'associative landscape' category?:

Of the three landscape formations of the World Heritage convention, mentioned earlier on in this discussion, GIAHS could be viewed as falling under the 'organically evolved/evolving 'associative landscapes', with intangible religious, artistic or cultural associations. The implications of this is that firstly that there GIAHS should have a strong socio-cultural connotation, and therefore, the intangible benefits should be an important consideration for declaring a site as GIAHS. In this, intangible elements should be part of a unique socio-ecological system, connected to a 'place', as in the 'Demojong landscape of the Tibetan Buddhists (Box 2), which could then be evaluated in more tangible terms, as one of outstanding value. In all these, due attention should be paid to Human-Nature interactions.

Uniqueness of linkages of GIAHS as part of a cultural landscape:

Since GIAHS is connected to a 'place', and there is resource flow into it from the landscape in which it is placed, the spatial dimension of the GIAHS should encompass, both the natural ecosystem/s, and the social system/s in which it is placed. In other words, it may often be necessary to identify GIAHS as part of a cultural landscape. (eg. the 'Demajong' landscape (Fig. 2) of the Tibetan Buddhists of Sikkim, with a variety of 'traditional agroecosystems operated by distinct cultural groups, along with nomadic tribes involved in animal husbandry practices, as part of a landscape unit, codified and/or non-codified institutional arrangements for equitable resource sharing (Ramakrishnan, 1996; Ramakrishnan *et. al*., 1998).

Uniqueness of the socio-ecological system attributes:

Both within and outside CIAGHS, the driving forces determining ecosystem/landscape level processes could be unique, which in turn determine structural and functional attributes of the landscape in general, and GIAHS in particular. This may be related to the tangible and often intangible social arrangements that determine the permissible levels of perturbation, extraction of natural resources of economic value, sharing of space and material resources from the system,

etc. In many such instances as in the 'Demajong' landscape, traditional institutional arrangements could play an important role in determining what is permissible or not. Therefore, the inter-linked biophysical and human dimension related attributes of the given socio-ecological system would become an important criterion for evaluating CIAGHS.

Obvious and not-so-obvious TEK linked with biodiversity:

A given GIAHS may be the basis for a rich Traditional Ecological Knowledge (TEK) heritage. Such a hertitage may operate at a purely socio-economic level, in terms of its human value alone. More interestingly, TEK may be linked with ecosystem processes and functions - playing an important role in nutrient management, sustainability of soil fertility, nutrient cycling attributes of the ecosystem/s, keystone value of species that are often socially selected linked with associated biodiversity and ecosystem/landscape integrity. (Ramakrishnan, 2001).

TEK linked with biodiversity manipulations may determine the overall integrity of the system itself, at the ecosystem/landscape level. Crop diversity at species/sub-specific levels and even associated biodiversity (weed management rather than weed control for resource conservation) may often play a role, determining ecological/economic efficiencies of the system itself, as was recognized by us for the Apatanis doing a highly evolved rice-fish culture, in north-east India, or for the swidden farmers in the region (Ramakrishnan, 1992). Such a system may also be linked with unique eco-technological attributes such as water harvesting and distribution systems using bamboo pipes, as is done by the the Apatanis in north-eastern Himalayas, or as that of the Ladakhis in the trans-Himalayan cold desert region of India (Agarwal and Narain, 1997; Ramakrishnan, 2001).

Socio-cultural institution/s promoting equity and gender considerations:

GIAHS is a socio-cultural institution. It follows from this that social institutions play a trigger role in conserving GIAHS with community participation. Institution building and the way it is accomplished is an important criterion for GIAHS conservation, but also is an important indicator for sustainable management of these systems. A case in point is the manner in which TEK of the local communities in terms of the cultural values were integrated in institution building for ensuring community participation, for sustainably managing traditional slash and burn agroecosystem in the State of Nagaland, in north-east India (Box 3). If such institutions are of value for promoting equity and gender participation in societal functions, it has added value.

How to Revitalize GIAHS?

If we consider high-input modern agriculture as only one of the possible pathways for agricultural development, one could have at least two additional pathways for sustainable agriculture, in the context of GIAHS: (a) evolution by incremental change, (b) restoration through the contour pathway. These two additional pathways differ from modern agriculture which is an artificial entity, standing apart from the rest of the landscape - an attempt to convert the natural ecosystem into one that contains only those biological and chemical elements that the planner desires, almost irrespective of the background ecological conditions. (Swift, *et. al.*, 1996).

The 'contour pathway', unlike modern agriculture, seeks to acknowledge and work with the ecological forces that provide the base on which the system must be built, well integrated into the landscape unit, while acknowledging at the same time the social, economic and cultural requirements of the farming communities. Working with Nature, rather than dominating it, this approach would involve active planning with the nature of the background ecosystem fully in mind. Many agroforestry system types in the 'low' and 'middle' intensity management categories will come under this pathway. 'Contour pathway' is aimed towards ensuring overall landscape integrity.

Many traditional agricultural systems need to be redeveloped through incremental, rather than quantum change – 'incremental pathway'. Building upon traditional ecological knowledge, step by step, this approach is a process of gradual change, since anything drastic may not find acceptance by the local communities. In this incremental change towards sustainable development, one may have to consider a short-term strategy that may be constrained because of ecological, economic, social or cultural reasons, apart from a more ideal and perhaps more desirable long-term strategy. One of the good examples of the 'incremental pathway', is the north-east Indian case study in the shifting agricultural country where models are built towards strengthening the forestry component of shifting agriculture that has gone weak (Ramakrishnan, 1992). Nepalese alder (*Alnus nepalensis*), in north-east India, is one such example of an ecologically significant and socially valued keystone species which contributes to overall soil fertility through nitrogen fixation up to about 125 kg ha^{1} yr^{1}. (Ramakrishnan, 1992). Building upon this TEK of local communities, people's participation was solicited. The conclusions arising out of this analysis, which is now being implemented in over 1200 villages in Nagaland in north-east India (NEPED and IRR, 1999), has indeed wider applications for this land use system prevalent all over Asia, Africa and Latin America (Box 3).

In all these efforts, the effort should be to strengthen the working of the GIAHS systems, rather than replacing it with a drastically changed land use system, for an improved quality of life of the local farmers. There are many examples of this in the context of UNESCO's Biosphere Reserves and Natural World Heritage sites from south and central Asia (Ramakrishnan *et. al*., 2002), and therefore, building appropriate bridges, as visualized by FAO, between GIAHS and Biosphere Reserves and Natural World Heritage concepts will be of added value to the proposed GIAHS initiative.

Launching GIAHS Initiative in the 'Year of the Mountain, 2002'

Much of the possible GIAHS sites are often part of the mountain systems heritage of the world, since mountain systems are remotely placed, being often cut-off to a larger or lesser extent, from external pressures, with cultural landscapes (Box 2) having survived to this day in the developing tropical world (Messerli and Ives, 1997). The concept of *'cultural landscapes'* (*'sacred landscapes'*), often with GIAHS embedded within are spread across the mountains all over the world. They are an outcome of the recognition by traditional societies, that Human-Nature interconnections are important for maintaining the landscape in a diverse and productive state, the tool used being locally evolved TEK. The guiding principles that regulate the use of natural resources, are embedded in the codified and often non-codified institutions that they have evolved (Ramakrishnan *et. al*., 1998). These sacred institutions were originally intended to

boost social solidarity rather than promoting environmental consciousness *per se,* but the conservation values, *ipso-facto*, also get fulfilled. We have to learn many lessons to learn from the way sacred landscapes are sustained through traditional institutions in the developing tropics. The problem of coping with uncertainties in the context of 'global change' is an issue that demands prudent management of the natural and human-managed biodiversity, in the mountains for a sustainable future.

Mountain regions in the developed temperate world remain to a large extent heterogeneous in a biophysical sense, due to uneven topographical features; but the societies have been, largely if not completely, homogenized under the influence of industrialization and urbanization, unlike in the developing tropics where the socio-cultural heterogeneity is still being held to. However, we in the developing tropics are struggling to sustain socio-cultural heterogeneity whilst aiming to provide a better quality of life for the mountain people (Ramakrishnan, 2001). In contrast, in the developed world, the local communities are struggling to rediscover their 'cultural landscape', with a desire to redevelop the 'organically connected agriculture', and retrieving their lost linkages with Nature and natural resources. The overall objective remains the same, but the beginning for a common goal is being attempted from two opposite points, for obvious historical reasons.

The 'Biosphere Reserve' 'Natural World Heritage site' concepts of UNESCO is indeed a rediscovery of the 'sacred landscape' belief system of traditional societies, and is an attempt towards an integrated management strategy to conserve natural resources for sustainable use, with inter-generational equity concerns. GIAHS concept is often embedded within all these human endeavors. Therefore, the GIAHS initiative comes at an appropriate time, based upon landscape management principles, based upon a management plan that demands flexibility, capable of small-scale operations, information-sensitive, and composed of elements that are integrated and yet independent (Ehrenfeld, 1991). Such a strategy will ensure the desired level of location-specificity, with community participation ensured through appropriate institutional arrangements, based on traditional values. In this situation and in all other similar landscape situations, maintenance of the overall sustainability of the systems demand a loosely coupled management, specifically designed to accommodate large variability in ecosystem complexity within a landscape mosaic, which includes GIAHS managed, for their long-term sustainability as a bio-cultural system.

References

Agarwal, A. and Narain, S. 1997. *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems.* Centre for Science and Environment. 404 pp.

Altieri, M.A. and Liebman, M. (Eds.).1988. *Weed Management in Agroecosystems: Ecological Approaches*. CRC Press, Boca Raton, Florida. 354 pp.

Balee, W. 1989. The culture of Amazonian forests. *Adv. In Economic Botany,* **7**: 1-21.

Daly, H. and Cobb, J. 1989. For the Common Good. Beacon, Boston, U.S.A.

Dragun, A.K. and Tisdell, C. (Eds.).1999. *Sustainable Agriculture and Environment: Globalization and the Impact of Liberalisation.* Edward Elgar, Cheltenham, U.K. 308 pp.

Ehrenfeld, D. 1991. The management of biodiversity: A conservation paradox. In: F.H Bormann and S.R. Kellert (Eds.) *Ecology, Economics, Ethics: The Broken Circle*. pp. 26-39. Yale Univ. Press, New Haven.

Gliessman, S.R. 1990. *Agroecology: Researching the Ecological Basis of Sustainable Agriculture.* Ecol. Studies 78, Springer-Verlag, New York. 380 pp.

Groube, L. 1989. The taming of natural forests: A model for late Pleistocene forest exploitation in New Guinea. In: Harris, D.R. and Hillman, G.C. (Eds.). *Foraging and Farming – The Evolution of Plant Exploitation.* pp. 292-304. Unwyn Hyman, London.

Heer, 1975. *Charlemagne and His World*. Macmillan, New York.

Hughes, J.D. 1998. Sacred groves of the ancient mediterranean area: Early conservation of biological diversity. In: Ramakrishnan, P.S., Saxena, K.G. and Chandrashekara, U.M. (Eds.). *Conserving the Sacred: For Biodiversity Management.* pp.101-121. UNESCO and Oxford & IBH, New Delhi.

Hynes, R.A. and Chase, A.K. 1982. Plants, sites and domiculture: Aboriginal influence upon plant communities in Cape York peninsula. *Archaeology in Oceania*, **17**: 38-50.

Indian National Science Academy, Chinese Academy of Sciences and the U.S. National Academy of Sciences, 2001. (Expert Panel: Wolman, M. G., George, P. S., Kulkarni, S., Vashishtha, P. S., Shidong, Z., Qiguo, Z., Yi, Z., Long J. F., Rosenzweig, C., Solecki, W. D.). *Growing Populations, Changing Landscapes: Studies From India, China and The United States.* National Academy Press, Washington DC. USA. 299 pp.

Kaushal, M. 2001. Driving the landscape - The Gaddi and his land. In: Sen, G. and Banerjee (Eds.). *The Human Landscape.* pp.31-40. Orient Longman & India International Centre, New Delhi.

Kumar, A. and Ramakrishnan, P.S. 1990. Energy flow through an Apatani village ecosystem of Arunchal Pradesh in northeast India. *Human Ecology*, **18**: 315-336.

Lambin, E.F., Turner II, B.L., Geist, H.J., Agbola, S., Angelsen, A., Bruce, J.W., Coomes, O., Dirzo, R., Fischer, G., Folke, C., George, P.S., Homewood, K., Imbernon, J., Leemans, R., Li, X., Moran, E.F., Mortimore, M., Ramakrishnan, P.S., Richards, J.F., Skånes, H., Steffen, W., Stone, G.D., Svedin, U., Veldkamp, T., Vogel, C. and Xu, J. 2001. The causes of land-use and land-cover change: Moving beyond the myths. *Global Environmental Change: Human and Policy Dimensions* **11**: 261-269.

Lathrap, D.W. Our father the Cayman, our mother the Gourd: Spinden revisited. Or a unitary model for the emergence of agriculture in the New World. In: Reed, C.A. (Ed.). *Origins of Agriculture*. pp. 713-752. Mouton, The Hague.

Leach, G. 1976. *Energy and Food Production.* IPC Science and Technology Press, Guildford. 137 pp.

Messerli, B. and Ives, J.D. 1997. *Mountains of the World.* Parthenon Publ., Carnforth, Lancs., U.K. 495 pp.

Mitchell, R. 1979. *An Analysis of Indian Agroecosystem*. Interprint, New Delhi. 180 pp.

NEPED and IRRR, 1999. *Building Upon Traditional Agriculture in Nagaland*. Nagaland Environ. Protection & Economic Development, Nagaland, India & International Inst. of Rural Reconstruction, Phillippines. 235 pp.

Ovsiyannikov, O.V. and Terebikhin, N.M. 1994. Sacred groves in the culturel of the Arctic regions. In: Carmichael, D.L., Reeves, J.H.B., and Schanche, A. (Ed.s). *Sacred Sites, Sacred Places.* pp. 44-81. Routledge, London.

Posey, D.A. 1985. Indigenous management of tropical forest ecosystems: The case of the Kayapo Indians of the Brazilian Amazon. *Agroforestry Systems*, **3**: 139-158.

Ramakrishnan, P.S. 1992. *Shifting Agriculture and Sustainable Development: An Interdisciplinary Study from North-Eastern India*. UNESCO-MAB Series, Paris, Parthenon Publ., Carnforth, Lancs. U.K. 424 pp. (republished by Oxford University Press, New Delhi 1993).

Ramakrishnan, P.S. 1984. The science behind rotational bush-fallow agriculture system (jhum). *Proc. Indian Acad. Sci. (Plant Sci.)* **93**: 379-400.

Ramakrishnan, P.S. 1992. *Shifting Agriculture and Sustainable Development: An Interdisciplinary Study from North-Eastern India*. UNESCO-MAB Series, Paris, Parthenon Publ., Carnforth, Lancs. U.K. 424 pp. (republished by Oxford University Press, New Delhi 1993).

Ramakrishnan, P.S. 1996. Conserving the sacred: From species to landscapes. *Nature & Resorces*, UNESCO, **32**: 11-19.

Ramakrishnan, P.S. 1998. Ecology, economics and ethics: Some key issues relevant to natural resource management in developing countries. *International Journal of Social Economics,* 25: 207-225.

Ramakrishnan, P.S. 2000. Sacred mountain forests and biodiversity. In: Price, M.F. and Butt, N. (Eds.). *Forests in Sustainable Mountain Development: A State of Knowledge Report for 2000.* pp. 117-126. CABI Publ., Wallingford, U.K.

Ramakrishnan, P.S. 2001. *Ecology and Sustainable Development.* National Book Trust, India, New Delhi 198 pp.

Ramakrishnan, P.S., Das, A.K. and Saxena, K.G. (Eds.). 1996. *Conserving Biodiversity for Sustainable Development*. Indian National Science Academy, New Delhi. 246 pp.

Ramakrishnan, P.S., Saxena, K.G. and Chandrashekara, U.M. (Eds.). 1998. *Conserving the Sacred: For Biodiversity Management*. UNESCO and Oxford and IBH Publ., New Delhi. 480 pp.

Ramakrishnan, P.S., Chandrashekara, U.M., Elourd, C., Guilmoto, C.Z., Maikhuri, R.K. Rao, K.S., Sankar, S. and Saxena, K.G. (Eds.). 2000. *Mountain Biodiversity, Land Use Dynamics and Traditional Ecological Knowledge*. UNESCO and Oxford & IBH Publ., New Delhi. 353 pp.

Ramakrishnan, P.S., Rai, R.K., Katwal, R.P.S. and Mehndiratta, M. (Eds.). 2002. *Traditional Ecological Knowledge for Managing Biosphere Reserves in South and Central Asia*. UNESCO and Oxford IBH., New Delhi. 536 pp.

Rodrmguez Navarro, G.E. 2000. Case study: Sacred forests in Sierra Nevada de Santa Marta, Columbia. In: Price, M.F. and Butt, N. (Eds.). *Forests in Sustainable Mountain Development: A State of Knowledge Report for 2000.* pp. 128-130. CABI Publ., Wallingford, U.K).

Rossler, M. 2001. Sacred landscapes: New perspectives in the implementation of the cultural landscape concept in the framework of the UNESCO world heritage convention. In: *UNESCO Thematic Expert Meeting on Asia-Pacific Sacred Mountains, Final Report*. pp. 27-41.World Heritage Centre, UNESCO, Paris, Agency for Cultural Affairs of Japan & Wakayama Prefectural Govt., Japan

Sanders, N.K. 1960. *The Epic of Gilgamesh.* Penguin Books, Harmondsworth. (Translated)

Swift, M.J., Vandermeer, J., Ramakrishnan, P.S., Anderson, J.M., Ong, C.K. and Hawkins, B. 1996. Biodiversity and agroecosystem function. In: Mooney, H.A., Cushman, J.H., Medina, E, Sala, O.E. and Schulze, E-D (Eds.) *Functional Roles of Biodiversity*: A Global Perspective. pp. 261-298. SCOPE Series. John Wiley, Chichester, U.K.

Talebbeydokhti, N., Telvari, A. and Heydarian, S.A. (Eds.). 1999 *Traditional Water Harvesting Systems.* Proceedings UNESCO Regional Workshop. pp. 71-90. Dep. of Watershed Management, Ministry of Jihad-e-Sazandegi, Tehran, Iran.

UNESCO, 1983. Swidden Cultivation in Asia. Vol. 2. UNESCO Regional Office for Education in Asia and the Pacific, Bangkok. 309 pp.

Vatsayan, K. 1993. *Prakriti*. Indira Gandhi National Centre for the Arts, New Delhi. 64 pp.

Walker, B.H., Steffen, W.L. and Langridge, J. 1999. Interactive and integrated effects of global change on terrestrial ecosystems. In: Walker, B., Steffen, W., Canadell, J. and Ingram, J. (Eds.) *The Terrestrial BIosphere and Global Change: Implications for Natural and Managed Ecosystems*. pp. 329-375. Cambridge Univ. Press, Cambridge, U.K.

Yen, D.E. 1989, The domestication of environment. In: Harris, D.R. and Hilman, G.C.(Eds.). *Foraging and Farming: The Evolution of Plant Exploitation*. pp. 45. Unwin Hyman, London.

Box 1. Wet rice cultivation of Apatanis – A Unique and highly organized land use system in north-east India (from Kumar and Ramakrishnan, 1990)

- Apatanis, make effective use of their irrigated land by planting early and late ripening varieties of rice. With an elaborate water management system designed with bamboo tubings, and with recycling of village wastes and pig dung generated within the village, the soil fertility follows a gradient, with nutrient-rich plots closer to the village and nutrient-poor plots farther away.
- Closer to the village is a late-maturing variety of rice which is combined with pisci-culture. Fish culture in plots closer to the village synchronizes well with the late ripening rice variety, making harvest of both easy and manageable.
- Early-maturing variety is sown farther away from the village, where disturbance by wild animals, low nutrient status of the soil and poorer irrigation facilities, act as major constraints.
- Rice is supplemented with *Eleusine coracana* cultivated on elevated partition bunds between the rice plots. The yield per hectare of *Eleusine coracana* grown on raised partitions between rice plots was higher in plots with early variety than in those with the late variety.
- The early-maturing variety of rice had higher density but with reduced basal area compared to the late variety. Economic yield per plant and per unit area of the early variety was significantly lower compared to the late variety. However, when combined with fish yield, the total per unit area was much higher than the late-maturing variety.
- With human labour as the major input (both men and women participating), the Apatanis obtain a high energy output. Labour input for rice/rice + millet where early variety of rice is grown was higher than for the late variety of rice, the Apatanis obtain an exceptionally high output from the system, which is comparable to the traditional rice cultivation systems in the plains of the country. The economic and energy efficiencies, and output per unit labour hour were higher under late-maturing variety of rice, compared to the other.
- The exceptionally high energy efficiency of this valley land agroecosystem (60 to 80 units per unit energy input) is markedly different from the values discussed for other rice systems of the Indian plains, which has an energy efficiency of about 9 (Mitchell, 1979), or that available for other traditional mountain systems in the region, which is in the range of 9-50 (Ramakrishnan, 1992), or less than 1 for modern 'green revolution' agriculture.
- Widening plots by digging adjacent higher ground down to an irrigable level is a successful response of the society to increased population pressure as well as to new market opportunities, suggestive of constant adaptation both in space and time.
- Though the Apatani system is unique in many ways, the agroecosystem offers opportunities for improvement through appropriate crop rotation, and productive utilization of the land during the winter season. Inspite of these possibilities, the Apatani village ecosystem is a good example of economic self-sufficiency of a traditional agricultural society that practices ecologically sound sedentary agriculture in the north-eastern hill region of India.

Box 2. Examples of GIAHS linked sacred landscapes around the world (From: Messerli and Ives, 1997; Rodrmguez Navarro, 2000; Ramakrishnan, 2000)

- An example of a 'diffused sacred landscape' (one which has a wide geographical spread in terms of its influence, across the Indian subcontinent and for the Hindus all over the world, but with very loose institutional arrangements), is the landscape along the course of Ganga river system in India, originating at Goumukh in the higher reaches of the Garhwal Himalaya, tracing through the northern plains of the States of Uttar Pradesh, Bihar and West Bengal, before the river drains into the Bay of Bengal in the east. The sacred land, the river tributaries, the human habitation, all the natural and human-managed ecosystems, and a chain of temples in the mountain landscape dating back to antiquity, all together represent a a cultural landscape of which GIAHS form an important component. A large chunk of the GIAHS of the mountain region is driven by Quercus spp. (Oaks), which are culturally valued 'sacred species', with associated folk literature, poetry, music and dance forms (Ramakrishnan et. al., 1998).
- Padmasambhava, who is worshipped by the Sikkimese Buddhists is considered to have blessed Yoksum and the surrounding sacred land and water bodies in West Sikkim District in eastern Himalaya, having placed a large number of hidden treasures ('ter'). It is believed that these treasures are being discovered slowly and will be revealed only to enlightened Lamas, at appropriate times. Conserving these treasures, protecting them from polluting influences is considered important for human welfare. The area below Mount Khangchendzonga in West Sikkim, referred to as 'Demojong' is the core of the sacred land of Sikkim. The protective deities are made offerings to, but no meaningful performance of Buddhist rituals are possible if this land and water is desecrated. Village level activities on the land and water resources are permitted. Any large-scale human-induced perturbation in the land of the holy Yoksum region would destroy the hidden treasures (ters), in such a manner that the chances of recovering them sometimes in the future by a visionary will diminish (the last such discovery was suggested to have occurred 540 years ago). Any major perturbation to the river system would disturb the ruling deities of the 109 hidden lakes of the river, thus leading to serious calamities. Indeed, the very cultural fabric of the Sikkimese society is obviously dependent upon the conservation of the whole sacred landscape. The uniqueness of this heritage site lies in the holism and interconnections between the soil, water, biota, visible water bodies, river and the lake systems on the river bed, all taken together with the physical monuments such as the monasteries. A variety of traditional agricultural systems inter-linked with nomadism of some of the tribes like the 'Bhutias' makes this an interesting GIAHS system.
- The Buddhist Dai (T'ai) tribe of Xishuangbanna in Yunnan province in southwest China has many holy hills, 'Nong Ban' and 'Nong Meng', belonging to a village or a cluster of villages, spread over a large area, with hundreds of small or large forested reserves. Agroecosystems and village systems interspersed throughout the region has close connections with the sacred mountain landscape in which it is placed.
- The sacred forests in the Sierra Nevada de Santa Marta in northern Columbia are sacred for the indigenous Kogi, Arhuaco and Wiwa cultures. Rich in natural and crop biodiversity, they

believe that there exists an equilibrium which might easily be disturbed by irresponsible human induced impacts on the natural resources. Through an elaborate code of conduct considered to be in harmony with biological cycles, astral movements, climatic phenomena and the sacred geography of the land, they have traditionally conserved their natural resources.

Box 3 Building upon the TEK associated with Shifting agriculture and other related land uses in Nagaland, north-east India (based on this author's analysis of NEPED and IRRR, 1999)

NEPED project on traditional agroecosystem redevelopment is a unique experiment of its own kind to be initiated for the first time in the north-eastern India. The objective was to find a meaningful solution to the problem of shifting agriculture, which has defied any solution over the last over 100 years, inspite of repeated attempts by governmental agencies. The philosophical basis for this developmental activity was to build step by step on the rich TEK of the local tribal communities, and centred around the land use system/s in the region. The objective was into consideration the strong interconnections that exist in the land use practices in the region - ecological, socio-economic and cultural attributes of the traditional societies, through an 'incremental' build up.

- The magnitude of the effort: involvement of all the villages of the State of Nagaland -about 1200 villages; about 200 experimental plots in farmer's fields for agroforestry technology redevelopment, with a coverage of about 5500 ha. of replicated test plots.
- Farmers have adopted tree-based strengthened shifting agricultural systems based on agroforesty principles, for local testing in 870 villages, covering a total area of about 33,000 ha (38 ha per villages x 870 villages); in these plots, local adaptations and innovations for activities such as soil and water management are emphasized.
- Locally identified edible legume cover crop is cultivated as part of the cropping phase of about 3-4 years, followed by fallowing the land as a pure tree crop, before tree harvest.
- Nepalese Alder (*Alnus nepalensis*) tree based TEK which is incorporated both during the cropping and the fallow phases of shifting agriculture, which is widespread throughout the north-eastern region, but further sharpened by the Angami tribe of Khonoma Village near Kohima, and which fixes up to 120 kg N per ha. per yr., is the starting point and the basis for identifying a number of other tree species, for a redeveloped agroecosystem.
- Ten selected tree species for poles for house construction and fuelwood that could be harvested between 5-10 yrs after planting and 20 tree specie of value for timber have been identified and introduced into shifting agricultural plots, to strengthen the agroecosystem, in consultation with local communities.
- Traditional rainwater harvesting systems and erosion control measures are incorporated into the redeveloped agricultural practices, where appropriate.
- Controlling the thatch grass, known in the south-east Asian region as 'Alang Alang' (*Imperata cylindrica*), which is extensive in the north-east India too was shown to be controlled through dense Cassava cropping.
- Mixed tree plantations in the jhum plots were shown to be superior to monocultures and these are being recommended and accepted by local communities.
- Agroforestry related cultivation of non-traditional crops such as tea and oyster mushrooms are being promoted as additional possibilities.
- Improving the yield from the home garden systems through value-added vegetable cultivation is identified to be an option for cash income; similarly multipurpose bamboo

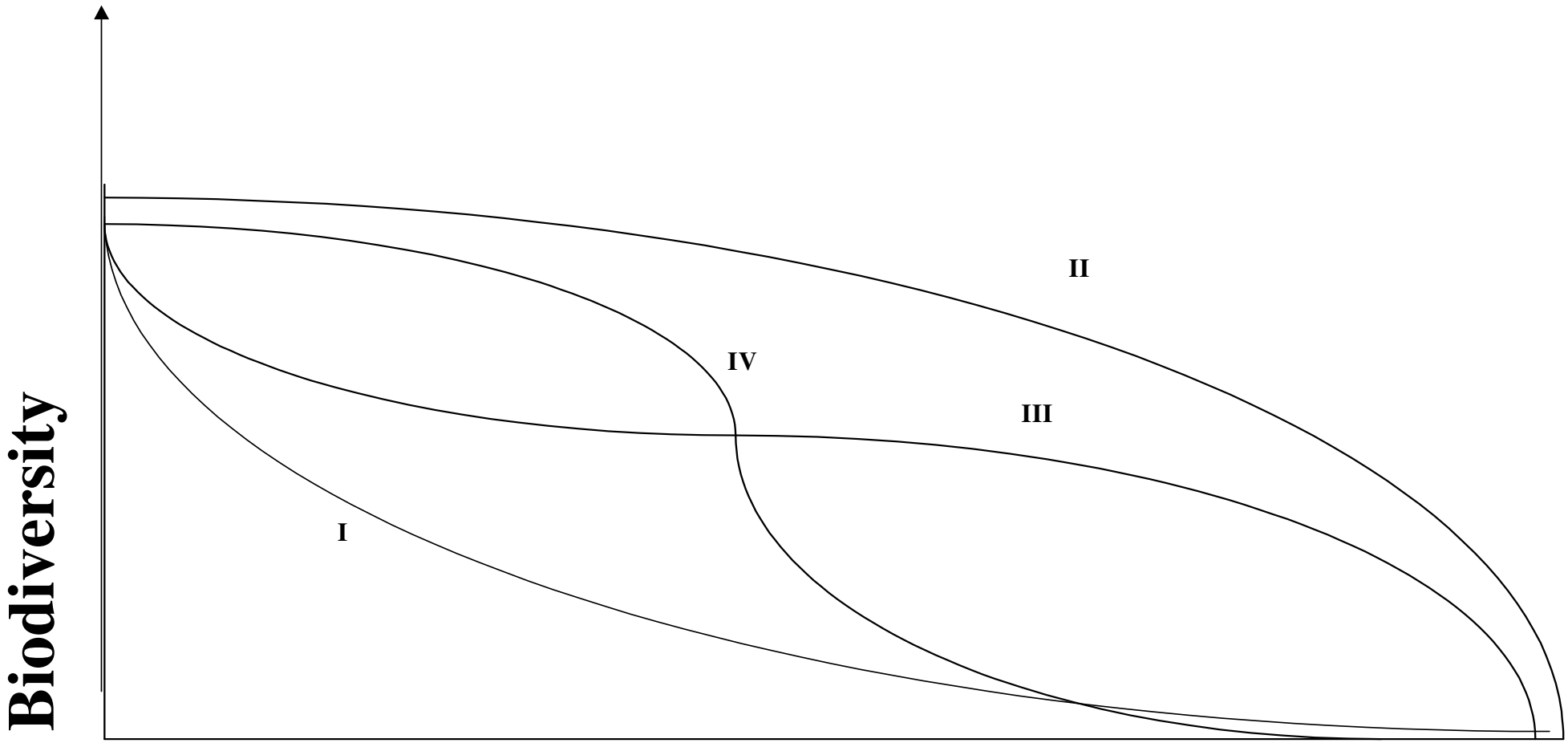
cultivation, including that for bamboo shoot as a food item is being integrated into land use redevelopment.

- Biodiversity (both natural and human-managed) conservation is an important agenda taken on board for the redeveloped agroecosystem management.
- Land use redevelopment is initiated through participatory extension and dissemination; gender issues are adequately taken care of.
- VDBs (Village Development Boards) constituted on the basis of the local value system of a large number of cultural and linguistic traditional societies living in the State of Nagaland, form the vehicle for land use linked development, and participatory decision making process.

Explanation to Figures

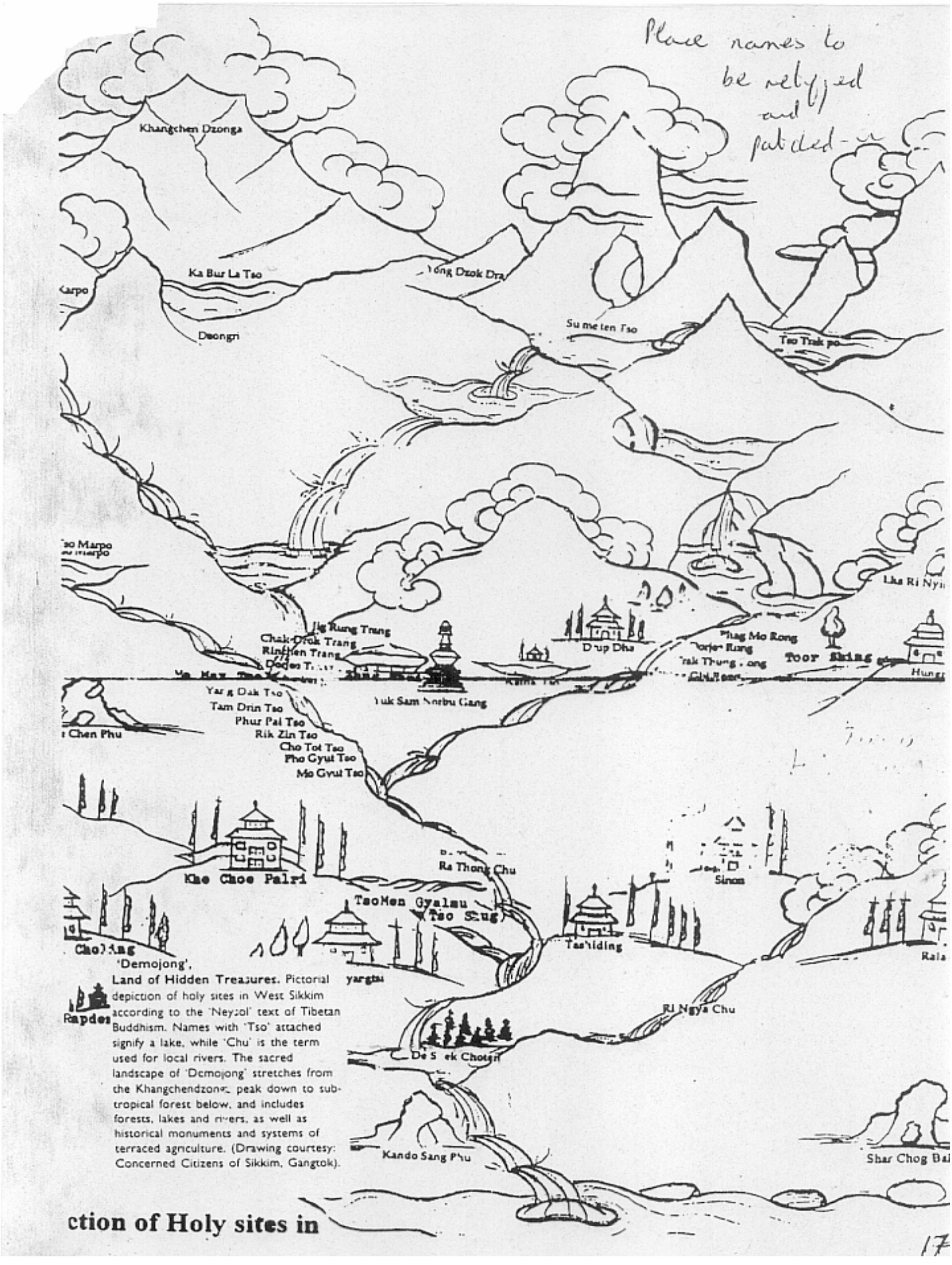
Fig. 1. Biodiversity changes (four patterns) as related to agroecosystem types and intensity of management. Curve I and Curve II represent two extreme possibilities that seem to be unlikely. Curve III is a softer version the ecologists' expectations, whilst Curve IV seems to be more likely and is the most interesting from the point of view of biodiversity conservation. Efforts for sustainable development of these traditional agroecosystems should be based on conserving agricultural biodiversity within the system for resilience of the system with concerns for productivity (From: Swift, *et. al*. 1996).

Fig. 2. Pictorial depiction of the Demojong landscape of hidden treasures - a sacred landscape of the Tibetan Buddhists of Sikkim Himalaya, India, stretching from the Khangchendzonga peak down to sub-tropical forests down below. 'Tso' means Lake; 'Chu' means River (from: Ramakrishnan *et. al.*, 1998).



CURVE I & CURVE II are extreme possibilities
CURVE III is a softer version (ecologists expection)
CURVE IV is more probable & interesting

Fig.2


Place names to be retyped and pasted
Khangchen Dzonga
Ka Bur La Tso
Dzongri
Su me ten Tso
Tso Trak po
Chak Drok Trang
Rinchen Trang
Yuk Sam Nortbu Gang
Dup Dha
Phag Mo Rong
Toor Shing
Yarg Dak Tso
Tam Drin Tso
Phur Pai Tso
Rik Zin Tso
Cho Tot Tso
Pho Gyut Tso
Mo Gyut Tso
Khe Choe Palri
Ra Thong Chu
Tashiding
Sinon
Rapdes
Ri Ngya Chu
Kando Sang Phu
Shar Chog Ba
'Demojong', Land of Hidden Treasures. Pictorial depiction of holy sites in West Sikkim according to the 'Neyzol' text of Tibetan Buddhism. Names with 'Tso' attached signify a lake, while 'Chu' is the term used for local rivers. The sacred landscape of 'Demojong' stretches from the Khangchendzonga peak down to sub-tropical forest below, and includes forests, lakes and rivers, as well as historical monuments and systems of terraced agriculture. (Drawing courtesy: Concerned Citizens of Sikkim, Gangtok).
ction of Holy sites in