Information Paper I

Features of socio-ecological production landscapes of the world and their benefits for biodiversity and human well-being

1. Introduction

This information paper presents features of socio-ecological production landscapes of the world and their benefits for biodiversity and human well-being, as well as challenges faced and ways to overcome them. In the previous information paper from the Asia-Pacific Regional Workshop on the *Satoyama* Initiative Concept held in Penang, Malaysia on 1-3 Oct 2009, entitled "Ecosystem Services in the Asia-Pacific Region", a synthesis of the characteristics, challenges and benefits of these landscapes in the Asia-Pacific region was presented. The current paper was specifically prepared for the Global Workshop on the *Satoyama* Initiative to be held in Paris, France on 29-30 January 2010, entitled "Ecosystem Services and Human Well-being". Hence, this paper covers case studies found not only in the Asia-Pacific region, but around the world.

Information contained herein is based on 16 case studies provided by the Secretary of Convention of Biological Diversity (SCBD) (9), Japan Wildlife Research Center (JWRC) (3), as well as field studies co-organized by United Nations University Institute of Advanced Studies (UNU-IAS) (4). Case studies from SCBD were reports submitted by experts as voluntary contributions to the call made by SCBD in collaboration with the Ministry of Environment of Japan (MOE-J) and UNU-IAS, as part of an in-depth review of work on sustainable resource use in preparation for the 14th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-14) and the 10th meeting of the Conference of the Parties (COP-10). Case studies from JWRC are studies commissioned by the MOE-J.

The case studies cover 14 countries: Argentina, Bangladesh, Cambodia, India, Ireland, Japan, Mexico, Peru, Portugal, Spain, Sri Lanka, Solomon Islands, Tanzania, and United States of America. They also cover the tropical, sub-tropical, Mediterranean, and temperate regions, with various geomorphic environments including plains, hills, coasts and mountainous areas, or a mixture of these, such as the integrated highland-lowland river basin in Tanzania. Besides, they also represent areas with diverse historical, cultural and socio-economic conditions, from subsistence communities in the remote mountainous villages of Peru to the urban fringes of metropolitan Tokyo, Japan.

2. Features of socio-ecological production landscapes

The need for survival has led humans to explore and open up their surrounding natural environment for usable resources and cultivation. Adaptation to the natural environment has in turn led humans to

master the various uses of available natural resources, as well as to find the best ways of extracting them. On the other hand, humans have also learned the negative impacts of their activities on the natural environment, such as natural resource depletion, decreased production, soil erosion *etc.*, through direct experience, and that a balanced way of utilizing and managing land and natural resources are vital, so that their activities do not upset natural systems while ensuring that the land continuously provides necessary natural resources. Over time, humans have gradually developed unique sustainable systems, based on the harmonious interaction with their natural environment. These systems, when incorporated into their socio-cultural conditions, have enhanced land management practices and made natural resource use more effective, as can be seen in communal land use, taboos that restrict access to use of forest resources, *etc*. These traditional ecological knowledge and socio-cultural systems, accumulated and practised for centuries, are forces that have shaped and formed unique landscapes adapted to various geographical and socio-cultural backgrounds around the world. Such sustainable human-influenced landscapes which have been known to be beneficial for biodiversity conservation and human well-being are referred to here as **socio-ecological production landscapes**.

(1) Physical Structure

Human activities such as agriculture, forestry and fishing have significant influence in shaping socio-ecological production landscapes. Although the size of the landscapes can vary from a few acres to hundreds of hectares, most case studies showed an integrated land use system within a single landscape. Traditionally, settlements form the core of the management of different types of land use. For example, in most parts of Asia, vegetable plots, crop fields, fish ponds, rice fields, pasturelands, and forests in mountain areas *etc.*, can be found at various distances from settlements. As a result, these landscapes often show patches of varied land use corresponding to distances from settlements, topography *etc*. Such a spatial pattern consisting of various patches of land use is often referred to as a "mosaic" pattern landscape. In Tanzania, the *ntambo* land use system uses different topographies for different purposes — forest and shrubs in ridges and slopes above settlements, homegardens in and around settlements, coffee gardens immediately below settlements, followed by *ngolo* fields on steep slopes for maize and other crops, with valley terraces, valley bottoms and streams below the *ngolo* fields. Mosaic patterns of land use can also be found in the *satoyama* of Machida, Tokyo, where rice fields are located in valleys along rivers, crop fields and settlements are located on terraces, and secondary woodlands in the surrounding hills. In the Solomon Islands, whose inhabitants are mostly involved in shifting agriculture, newly regenerated forest (*nobo*) where residents collect medicinal plants, older secondary forest (*emata*), primary forest (*muge*), taboo forest (*hope*) used for sacred rituals, forest reserves and plantations, together with other types of land use, such as mangroves and lagoons for coastal fishing, and settlements and farmlands, create a mosaic pattern landscape in the

islands. Mosaic pattern land use can also be observed in Argentina, Kyoto in Japan, and Kandy in Sri Lanka.

Homegarden agroforestry systems consisting of complex and multipurpose land use structured by multi-layered vegetation, which provide staple food, fruits, vegetables, spices, fuel, *etc*, with livestock raising near dwelling places, are common throughout the tropics and sub-tropics, as seen in Sri Lanka, Bangladesh, India and Tanzania. In Kandy, Sri Lanka, agroforests constitute more than 50% of vegetation cover, compared to less than 10% of natural forest. In Bangladesh, homegardens are the greatest reservoir of biodiversity and are referred to as "biodiversity islands", which besides providing year-round food supply and construction materials, also provide a wide range of ecosystem services such as soil erosion control, amelioration of microclimate, and provision of habitats for wild and domesticated flora and fauna. In Spain and Portugal, agrosilvopastoral systems consisting of agriculture, forestry and grazing are practised in areas where arable farming is extremely limited due to soil low in nutrients, with little capacity for moisture retention, forming landscapes called *dehesa* or *montado*. In the *dehesa*, oaks adapted to survive in prolonged hot summers and cold winters provide shade for livestock, and at the same time control microclimates by intercepting rain and solar radiation, reducing runoff and mitigating the drying effect of wind. These land use systems are examples of multi-purpose, multi-layered and optimized land use associated with socio-ecological production landscapes.

(2) Management techniques

In adapting to natural environments and in overcoming natural difficulties such as steep terrain and infertile soil unsuitable for cultivation, humans have developed various techniques or systems of utilization and management of land and natural resources to avoid environmental degradation while optimizing land utilization.

Management based on a rotational system is widely seen in many of the socio-ecological production landscapes. For instance, in the Cusco Region of Peru, the *Muyuy* ("movement" in Quechua) practice directs the movement of people, animals, knowledge, rituals, wildlife and seeds, with a seven-year rotation period. Under this system, the community is divided into seven areas or sectors, and in each year, cultivation occurs within two sectors. During the rest / fallow period, terrain may be utilized as pastureland for livestock for six years. Such a rotational system has created unique and interdependent management techniques forming mosaic patches of crop fields, native tree stands, fruit and shrub fields, pasture and flower gardens, which maintain soil fertility and control pests and disease.

Rotational systems can also be seen in the shifting agriculture practised in the Solomon Islands. After a forest is cleared crop cultivation lasts for 2-3 years, after which the land is allowed to enter a fallow period of about 30 years. During the resting period, the secondary forest that succeeds the cultivated field provides various products such as medicinal plants and rattan, before being used again for cultivation.

Before the second half of the twentieth century, an agricultural system in Galicia in northwest Spain centred on the *agras* or contiguous arable fields belonging to different owners with no internal physical separation between them, but jointly delimited by small stone walls from the rest of the territory. Under this system, wheat, potatoes, corn, turnips were planted on a two-year rotation, and all the plots in the same *agras* were planted with the same crop at a given time so that the system ensured one potato and wheat harvest each year for the village and a share for each family.

In the highlands of Tanzania, which form a part of the catchment area of Lake Nyasa, a unique indigenous cultivation system, known as the *ngolo* (pits surrounded by four-tied ridges) cultivation system, is practised. Situated between settlements on the upper terrace and the lower valley and stream, *ngolo* are constructed on steep slopes for planting maize, beans and wheat on a rotational basis. In the rainy season, these pits act as reservoirs preventing the destructive effects of surface runoff in the steep cultivated slopes.

In the Burren hills in Ireland, a 'reverse' transhumance system, where livestock are moved to the Burren hills in late autumn to spend the winter grazing in the upland grasslands, instead of moving them to the uplands in the summer, has been practised for a long time. In the summers, the cattle are moved to the more productive lowland grasslands, while the Burren uplands are left fallow or lightly grazed. Although the clear reason for this "reverse" transhumance is not known, winter grazing in the uplands itself is one of the reasons for the high biodiversity in this area, because it removes accumulated dead vegetation which would otherwise diminish the habitat for less competitive light-dependant herbs, and allows the plants on the uplands to grow, flower and set seed unhindered during the summers.

A traditional farming system of rotating cattle pasturelands with rice fields can be found in Allen Parish, Louisiana State, United States of America. This traditional system has been known to maintain soil fertility and control mosquito-related diseases such as malaria and Japanese encephalitis. Under this system, livestock are moved to rice fields after one year of rice cultivation, and allowed to remain there for about two years, before rotating back to rice cultivation. As a result, manure from the livestock increases the fertility of the soil, and mosquito-related diseases are decreased since the rice fields, which provide a habitat for mosquitoes to lay their eggs, are kept intermittently dry instead of continuously flooded.

In Kyoto, Japan, new technologies based on biomass power generation and forest dairy farming have been undertaken by a private company and the local government in collaboration with farmers, to integrate various land uses which have been disrupted due to changes in socio-economic conditions. This is an example of a holistic management system based on the concept of resource circulation systems aimed at restoring devastated natural environments and promoting new industries in a rural mountain village.

(3) Social system

Land and natural resource management in socio-ecological production landscapes are often managed by a single family, extended family unit, or co-managed by a village community, depending on the socio-cultural background of the area. For example, homegardens in the tropics and sub-tropics are usually managed by a single family unit, although management is sometimes shared among the residents of the same village who do not have access to resources such as fuelwood. In Tanzania, the unique *Ntambo* landholding system is managed by patrilineal extended families, and it has at all times influenced the unique pattern of land use in the Matengo highlands. In northwest Spain, community-based management of resources in common land with the rotation of shrubs, cereal and pasture existed until the second half of the twentieth century.

With the weakening of traditional community systems centred on farmers, NGOs/NPOs, in collaboration with researchers and private enterprises, often take up the leadership of the management of the revitalization of socio-ecological production landscapes. For example, in the past, due to water shortages in Kanakura, Ishikawa Prefecture, Japan, reservoir management for terraced rice fields was shared by village communities. Communities built a reservoir called *Hosyo-ike* (life sustaining pond) and an additional 11 reservoirs that receive water from the life sustaining pond. However, due to socio-economic changes in the village, the locally formed NPO called Kanakura School, consisting mainly of teachers, has taken up the lead in revitalizing the communities based on the traditional concept of co-management. The members of the Kanakura School gather to discuss history, culture and nature, and have been active in collaborating with land owners, the Kanazawa University, local government and private enterprise to attract visitors and to revitalize the communities through the use of local resources and promotion of local products. As a result of these efforts, the traditional landscapes consisting of terraced rice fields and reservoirs in Kanakura are still maintained and the village, which has a population of only 160 people, attracts as many as 8,000 visitors annually.

In Cambodia, traditional village communities are involved in homegardens, rice cultivation and other agricultural activities. With the help of international NGOs, villagers have been applying sustainable methods of composting readily available crop residue, animal manure and water hyacinth into natural fertilizer. They have thus been able to decrease their dependence on chemical fertilizers, and use alternatives which are economically viable and environmentally friendly.

There are cases where traditional social systems co-exist with modern technologies in the management and utilization of land and natural resources. For instance, in the Oaxaca State of Mexico, a traditional local governance system, called *Usos y Costumbres* (Uses and Customs) system which is rooted in indigenous systems of community service that gives particular importance to village elders, open assemblies, and consensus, has been successfully incorporated into modern community-forestry enterprises. All issues related to the local community, including forestry management, are decided through the *Asamblea General* (General Assembly), which is made up of all the community members. Local governance structures have contributed to efficient decision-making on major issues related to

natural resource management including the definition of rules governing access to forest resources, the planning and construction of road networks, the production of sawn-timber and the obligation of community members to participate in forest protection.

As mentioned earlier, in the case of Kyoto, Japan, a private company undertakes sustainable management of land and natural resources and generates profits by adding value to their products through practices such as forest dairy farming.

In some cases, social systems that govern the management and utilization of land and natural resources are deeply rooted and influenced by traditional beliefs in the area. For instance, in the Potato Park in Cusco, Peru, decision making is based on Andean beliefs, guided by the principles of *ayni* (reciprocity), that all elements of nature, including human beings, give and receive, thus contributing to the common good and harmony of the world. Therefore, all profits must be distributed and redistributed. This principle can be seen in seed exchanges among the communities and in the distribution of agricultural work.

3. Benefits and challenges of socio-ecological production landscapes

(1) Biodiversity

Most reports mentioned the importance of biodiversity in the study areas in the broader context, such as diverse habitats leading to higher biodiversity. For example, the Potato Park in Peru is the centre of the origin of potato and the region is home to 8 known native cultivated species and 2300 varieties of the 235 species and over 4000 varieties found in the world. The genetic diversity found within one plot can reach up to 150 varieties. Most studies also reported that a relatively healthier system with higher biodiversity is maintained in homegardens as compared to other agricultural systems. Case studies from Spain, Portugal and Ireland show that grazing management systems contribute to the nurturing of unique biodiversity seen in grasslands. Three-quarters of Ireland's 900 native plants are found in the Burren, and many of them flower in a profusion not seen elsewhere in Britain and Ireland. These flower-rich habitats support a large, but under-researched, variety of invertebrates including Ireland's only butterfly (March Fritillary), as well as populations of important pollinators that are in decline elsewhere (Shrill Carder Bee).

While most studies pointed out the significance of socio-ecological production landscapes in maintaining biodiversity, it should also be noted that, as shown in Bangladesh, biodiversity of socio-ecological production landscapes is not always comparable with or as good as in pristine ecosystems. Further research on the relationships between various socio-ecological production landscapes and biodiversity is needed so that more appropriate land and natural resource utilization and management strategies in advancing socio-ecological production landscapes globally can be developed.

(2) Ecosystem services

(i) Provisioning services

One of the main ecosystem services of socio-ecological production landscapes, as seen in the case studies, is the supply of food, fuel, and medicinal plants. For instance, in Bangladesh, Sri Lanka (Kandy), and Tanzania, homegardens supply products for multiple purposes year-round. These products are a vital source of food and income, especially during difficult economic times, and help contribute to the improvement of livelihoods in developing countries. In Kandy, Sri Lanka, homegardens were reportedly providing 30-50% of household income. Besides, the supply of organic fertilizer produced within the communities, such as in Cambodia, can help reduce the use of chemical fertilizer, and helps improve the livelihood of farmers while maintaining soil fertility.

(ii) Regulation services

Regulation services include maintaining soil fertility, preventing soil erosion, improving water quality which affects biodiversity and human health, carbon sequestration as described in the report from India, and regulating microclimate as reported in the dry climate area of Bangladesh.

(iii) Cultural services

Cultural services include the sense of pride of place or in a way of life. For example, in the Burren hills of Ireland, with the creation of better awareness and understanding of the heritage of the Burren within the local and wider community, and other conservation efforts, farmers are now proud of their place and no longer see themselves as living in a 'landscape of shame' as they did before. Similarly, in Peru, the Quechua communities have developed a sense of pride in their traditional way of life. With tourism in the Park, the communities now co-manage a restaurant of traditional cuisine and a handicraft centre that uses local wool and natural dyes, and provide nature trekking guides with an understanding of the ecological and cultural aspects of their landscapes.

(3) Human well-being

In many studies, the securing of stable access to natural resources such as food, fuels, and fertilizers has been described. Value added food products can create opportunities to earn income and improve livelihoods by informing consumers of the production of goods using traditional and/or environmentally sustainable methods. Besides, prevention of natural disasters and improvement in health conditions have also been mentioned in the reports. Understanding the linkages between natural resource management and utilization, ecosystem services and biodiversity, and their contribution to human well-being in socio-ecological production landscapes is important for strengthening, maintaining and rebuilding a positive nature-human relationship.

4. Challenges and ways to overcome them

(1) Challenges

Most challenges encountered in the case studies include direct and indirect factors of biodiversity loss and ecosystem degradation. Direct factors which are causing or have already caused biodiversity loss and ecosystem degradation are land conversion for urban development, cultivated fields, *etc*., and unsustainable logging and plantations. In addition, change from multiple-cropping to sole-cropping systems and the introduction of new crop species, including high yield species, have been reported to cause loss of species and genetic diversity of cultivated plants. Other factors include inappropriate cultivation or management methods such as the excessive use of agricultural chemicals, abandonment of agricultural land, grassland and forests, and disease and pest outbreaks. Some indirect factors are the loss of traditional / indigenous knowledge, collapse of traditional organizational system, farmers' economic difficulties, *etc*.

These are caused by global and long term socio-economic changes such as globalization, industrialization, urbanization including migration, population increase and decrease, and technological advancement. There are some differences between challenges that developed countries and developing countries face. For example, decreasing population and ageing in rural areas coupled with other factors cause abandonment of farmland, forest, and grassland. Vegetation changes are therefore common in developed countries. In contrast, expansion of agricultural lands in forest areas was observed to be the common factor in developing countries.

In addition to these, regional and/or national policies are also affecting some of these factors. For example, agricultural and forestry policies to promote large scale cultivation of a single species of crop or monoculture forest plantation may affect crop diversity directly, and cause economic difficulties for farmers in environmentally disadvantaged areas. Furthermore, lack of awareness is also an important factor for these changes. Although clear evidence was not provided, some reports suggested that environmental change caused by climate change is of increasing concern especially in susceptive areas. For example, in Peru, where cultivation of various crop varieties depends greatly on altitudes, potato cultivation has been reportedly moving upward in recent years due to global warming, sparking concerns of possible genetic erosion and disease outbreak.

(2) Some experienced and proposed ways and means to overcome the challenges

Since most documented challenges are related to the economy, many reports have suggested improving the economic situation by adding value to products produced using traditional or environmentally sustainable methods, diversifying livelihoods, finding new uses for once utilized land and natural resources, such as recreation and leisure activities, and energy production. To overcome the loss of traditional ecological knowledge, several reports suggested the recording of traditional management methods of natural resources, and the building of databases to store traditional ecological knowledge especially on the uses of medicinal plants. In addition, building sustainable social systems

for effective utilization and management of natural resources was also pointed out. While farmers' associations seem to be effective especially in cooperative marketing and traditional management based on what they or their ancestors have operated, partnerships between multiple stakeholders such as farmers, local government, scientists or research institutes, and NGOs are also suggested as important and effective. Finally, raising awareness and capacity building are also essential to overcome these challenges.

List of case studies used in this information paper:

Country	Authors	Title of the study	*
Argentina	G. Aoyama and M. Toda	Land use and biodiversity on Chacras in northeast Argentina	3
Bangladesh	M. Alam and Y. Furukawa	Agroforestry homegardens in rural landscape of Bangladesh	1
Cambodia	Institute of Environment Rehabilitation and Conservation	Land Use and Natural Resource Utilization/Management Status and Activities -Sustainable Land Use and Appropriate Natural Resource Management in Kampong Cham, Cambodia-	2
India	A.V.Santhoshkumar	Land use and natural resource utilization/management status and activities	2
Ireland	S. Parr, B. Dunford, J. Moran, B. Williams and R. Ó. Conchúir	BurrenLIFE - Farming for conservation in the Burren	1
Japan	PREC Institute Inc.	Town revitalization through the utilization of the history and culture of the community in Kanakura, Machino Town, Wajima City, Ishikawa Prefecture, Japan	1
Japan	PREC Institute Inc.	Regional circulation that combines the biogas power generation with agriculture and livestock husbandry in Kyoto, Japan	1
Japan	PREC Institute Inc.	Reintroduction of traditional agriculture toward the conservation of the natural environment and the historic and cultural environment in the Zushi-Onoji region, Machida City, Tokyo, Japan	1
Mexico	K. Matsuzaki (Foundation for Advanced Studies on International Development)	The case of community-based forest management in Ixtlan de Juarez, Mexico	2
Peru	A. Argumedo	The Ayllu system of the Potato Park	2
Solomon Islands	T. Furusawa, R. Otsuka and M. Sasaoka	Living by utilizing various modified natural resources in the Solomon Islands	3
Spain	E. Corbelle-Rico, R.C. Maseda, J.M.T. Sánchez and F. Ó. López	A landscape change study in a common property regime in the municipality of Guitiriz (Norwest Spain)	1
Spain & Portugal	U. Fra Paleo	The dehesa / mantado landscape	1
Sri Lanka	D. Pushpakumara	Kandyan Homegardens: Promising land management system in Sri Lanka	1
United Republic of Tanzania	S. J. Nindi	Changing Land-use in the fragile lake Nyasa catchments of Tanzania: A lowland-highland nexus	1
United States of America	T. Inoue and M, Toda	The sustainable use and biodiversity of paddies, fields, and secondary forests in Louisiana	3

* 1, Studies submitted to SCBD; 2, Studies co-organized by IAS; 3, Studies conducted by JWRC