Korean J. Ecol., 25(1): 19~24, 2002

Traditional Agricultural Landscape as an Important Model of Ecological Restoration in Japan

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ABSTRACT: The traditional Japanese agricultural landscape, in which a set of varied land-use patches functions as a sustainable ecosystem landscape unit, not only provides the local people with a stable food supply, but also offers a variety of habitats to many species of wildlife. Therefore, remaining natural habitats including those in the traditional agricultural landscape should be maintained whenever possible. In addition, restoration work should be implemented in areas where the natural habitat has been destroyed or severely degraded by human activities. This basic approach to the natural environment is a combination of maintenance and restoration. Types of maintenance and restoration can be classified into three categories according to the countermeasures employed: preservation, conservation and protection types of maintenance, and improvement, reconstruction and creation types of restoration. Four steps are proposed for ecological restoration and maintenance of a target area: exploration, diagnosis, prescription and care. In this process, a model for approaching the goal is important. One of the most important models should center on the traditional agricultural landscape involving a sustainable farming ecosystem. It is necessary to protect traditional landscapes and ecosystems from the degrading impact of urbanization and industrialization, as well as to enhance efforts at restoration.

Keywords: Agriculture, Japan, Landscape unit, Maintenance, Restoration, Traditional landscape

INTRODUCTION

The industrialization and urbanization that have occurred over the last century have resulted in rapid degradation of the natural environment in Japan and most other countries. This environmental degradation is affecting not only our present life but will also have grave effects in the future, and there is now increasing awareness of the need to protect the natural environment.

During the last two decades, there have been many environmental restoration projects in Japan, and these have become an important political issue, especially in the field of public works. However, these restoration projects are associated with many problems related to objectives, methodology and aftercare. Many have not been successful, and in fact some have actually accelerated the degradation of the natural environment. Faced with this situation, scientists in various fields have begun to cooperate to promote the ecological restoration of the natural environment and a healthy ecosystem. Ecologists, in particular, need to play a leading role in offering practical suggestions for the most appropriate, but so far little work has been done in this area.

In Japan, Korea, China and the other oriental countries, there has been a traditional agricultural landscape that not only provides the local people with a stable food supply, but also offers a variety of habitats to many species of wildlife, thus supporting a sustainable ecosystem. This landscape offers many lessons in ecological management.

This paper describes the importance of the traditional agricultural landscape as a model of ecological restoration in Japan, and also proposes a practical approach for maintenance and restoration of the natural environment.

IMPORTANCE OF ECOLOGICAL RESTORATION

Ecological restoration has developed as a craft and conservation strategy, partly because ecologists and environmentalists have been uncertain about its value for achieving conservation goals. They have welcomed it as a way of repairing environmental damage, but have been concerned that it might be accepted as an alternative to preservation.

The Seitaien project is one of the most intensive restoration projects to have been conducted in an urban park in Japan. The Seitaien, or "Ecology Park", is a study area of 7 ha controlled by the Natural History Museum & Institute, Chiba, where examples of major ecological communities native to the Boso Peninsula have been reconstructed (Nakamura and Oba 1993). These are

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various types of forest stand, grassland, coastal meadow, marsh, pond and streams. About 7,000 trees and shrubs of 130 species were planted, but no animals were introduced. After work such as mounding, planting and constructing hard-structures as fences and bridges, it was opened to the public in 1989. In the park, various habitats are being restored and maintained to achieve the goals of both ecological restoration and public education. The park is intended to function as: (1) a center for research in the ecological sciences, (2) a site for the study of ecological restoration in an urban area, (3) an outdoor classroom for nature study and environmental education, (4) an urban sanctuary for native plants and animals, and (5) a recreational area for citizens.

It has been pointed out by Jordan (1994) that restoration has two types of value or benefit: value to the environment and value to the restorationist. Value to the environment leads to an upgrading or expansion of a habitat for native species, and often to an increase in the native biodiversity of an area. The value to restorationists is akin to the effect on an audience. Restoration is not only a process or technology. Like other human-mediated processes, it is also an experience and an expressive act, and the best way to equate human activities with the natural environment. The goal of ecological restoration is to convince the observer of the desirability of a healthy ecosystem through first-hand experience. Jordan (1994) also stated that the most useful, and certainly the most ecological, way to think about restoration is to regard it as an expressive act that forms the basis of a ritual for negotiating our relationship with the natural landscape.

RESEARCH ON THE CURRENT STATUS OF NATURAL CONDITIONS

In order to achieve a rich and attractive natural environment, extant natural areas should be thoroughly understood and maximized. The first step in this process is to clarify the current status of existing natural habitats, and their flora and fauna. Next, important habitats and areas must be identified for conservation, protection or preservation. In addition, restoration work, including improvement, reconstruction and creation of natural habitats, should be implemented in areas where the habitats have been destroyed or severely degraded by human activities (Nakamura *et al.* 1997). A plan for sustainable land use, based on ecological inventories of the target area, is desirable (Shapiro 1997). The relationships between the distribution patterns of threatened wildlife species and current land-use planning were investigated in a Japanese urban area to devise a sustainable land-use plan. Spatial distributions of 165 species of threatened wildlife (99 plants and 66 animals) were obtained by surveying most of Chiba City, located in the northeastern part of the Tokyo Bay area (Numata *et al.* 1997). The distribution of these threatened species was analyzed in terms of green cover and zoning categories (Nakamura and Short 2001).

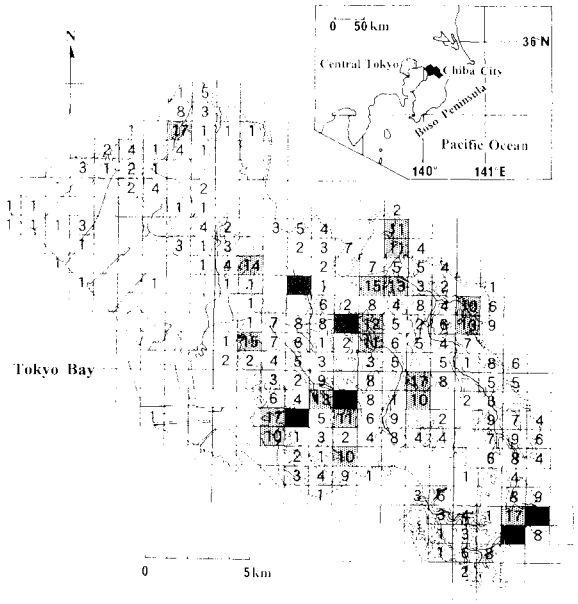

Fig. 1. Distribution of threatened species in Chiba City, Japan (Nakamura and Short 2001). Rich wild life habitats are located in the *yatsu* valleys.

Few threatened wildlife species were found in the urbanization promotion or parkland zone. Most were concentrated in the surrounding arable areas with high greenery coverage. Areas set aside for intensive agricultural development contained the greatest number of species. These areas belonged to the agricultural and urbanization control zone, where the traditional agricultural landscape still remains in and around narrow valleys known as *yatsu*. The *yatsu* are rich wildlife habitats in this region (Fig. 1). The results obtained suggest that regional biodiversity depends heavily on areas in which the traditional landscape remains relatively intact.

TRADITIONAL JAPANESE COUNTRYSIDE LANDSCAPE

Hardly any areas of untouched wilderness now remain in Japan. Most of the land is intensively utilized for agriculture and forestry, except for some alpine and coastal areas. As a result, a substantial bulk of the biodiversity depends on rural farming landscapes. The traditional Japanese agricultural landscape, with a history of over 2000 years of sustainable utilization, is still found on the outskirts of many densely populated areas.

In the agricultural landscape of the *yatsu*, there are various habitats in terms of site conditions and successional stages

Table 1. Floral changes according to site conditions and successional stages in the traditional agricultural landscape of the northern Boso Peninsula

Site conditions	Natural/ Man-made	Natural	Man-made				Natural		
	Micro-Topography	River	Pond	Canal, Ditch	Paddy	Dike	Bank	Slope	Terrace
	Water	Submerged	Submerged	Submerged	Wet	Moist	Moist to mesic	Mesic to dry	Dry
Plantation		–	–	–	Rice (Lotus)	(Soybean)	–	Saplings, Sprouts	Crops, Vegetable
Successional stage	Pioneer stage	*Potamogeton crispus*	*Chara braunii*	*Batracospermum gelatinosum*	*Spirodela polyrhiza*	*Mazus pumilus*	*Capsella bursa-pastoris*	*Erechtites hieracifolia*	*Digitaria adscendens*
		Potamogeton orientalis	*Potamogeton distinctus*	*Compsopogon coeruleus*	*Monochoria vaginalis var. plantaginea*	*Cardamine flexuosa*	*Senecio vulgaris*	*Glycine soja*	*Setaria faberi*
		Cassia nomame	*Trapa japonica*	*Potamogeton orientalis*	*Dopatrium junceum*	*Lapsana apogonoides*	*Stellaria neglecta*	*Torilis japonica*	*Ambrosia artemisiaefolia var. elatior*
		Aster subulatus	*Nymphoides peltata*	*Potamogeton crispus*	*Sagittaria pygmaea*	*Gnaphalium affine*	*Veronica persica*	*Xanthium strumarium*	*Chenopodium album*
	Grass-herb stage	*Phragmites communis*	*Typha latifolia*	*Carex dispalata*	*Equisetum palustre*	*Rumex japonicus*	*Cirsium japonicum*	*Cayratia japonica*	*Artemisia princeps*
		Polygonum perfoliatum	*Zizania latifolia*	*Sparganium stoloniferum*	*Polygonum thunbergii*	*Ixeris debilis*	*Aster ageratoides var. ovatus*	*Pteridium aquilinum var. latiusculum*	*Erigeron sumatrensis*
		Melothria japonica	*Saururus chinensis*	*Acorus calamus var. angustatus*	*Typha angustata*	*Echinochloa crus-galli var. caudata*	*Hemerocallis fulva var. kwanso*	*Pueraria lobata*	*Solidago altissima*
		Coix lacryma-jobi	*Phalaris arundinacea*	*Scirpus triqueter*	*Microstegium vimineum var. polystachyum*	*Arthraxon hispidus*	*Taraxacum platycarpum*	*Polygonum cuspidatum*	*Miscanthus sinenses*
	Shurb stage	*Salix integra*	*Salix integra*	*Salix integra*	*Salix integra*	*Salix integra*	*Clerodendron trichotomum*	*Phyllostachys bambusoides*	*Rhus javanica*
		Salix subfragilis	*Salix subfragilis*	*Salix subfragilis*	*Salix subfragilis*	*Salix subfragilis*	*Staphylea bumalda*	*Phyllostachys pubescens*	*Lespedeza bicolor*
		Phragmites communis	*Phragmites communis*	*Phragmites communis*	*Rosa multiflora*	*Rosa multiflora*	*Acanthopanax spinosus*	*Sambucus sieboldiana*	*Deutzia crenata*
					Phragmites communis	*Phragmites communis*	*Pleioblastus chino*	*Pleioblastus chino*	*Castanea crenata*
	Tree stage		*Alnus japonica*	*Alnus japonica*	*Alnus japonica*	*Alnus japonica*	*Celtis sinensis var. japonica*	*Cryptomeria japonica*	*Quercus serrata*
		–				*Celtis sinensis var. japonica*	*Zelkova serrata*	*Quercus acutissima*	*Pinus densiflora*
							Cryptomeria japonica	*Magnolia kobus*	*Carpinus tschonoskii*
							Alnus japonica	*Zelkova serrata*	*Quercus acutissima*
	Climax stage	–	–	–	–	–	–	*Castanopsis cuspidata var. sieboldii*	*Quercus myrsinaefolia*
								Machilus thunbergii	*Quercus acuta*
								Neolitsea sericea	*Castanopsis cuspidata var. sieboldii*
								Camellia japonica	*Quercus salicina*

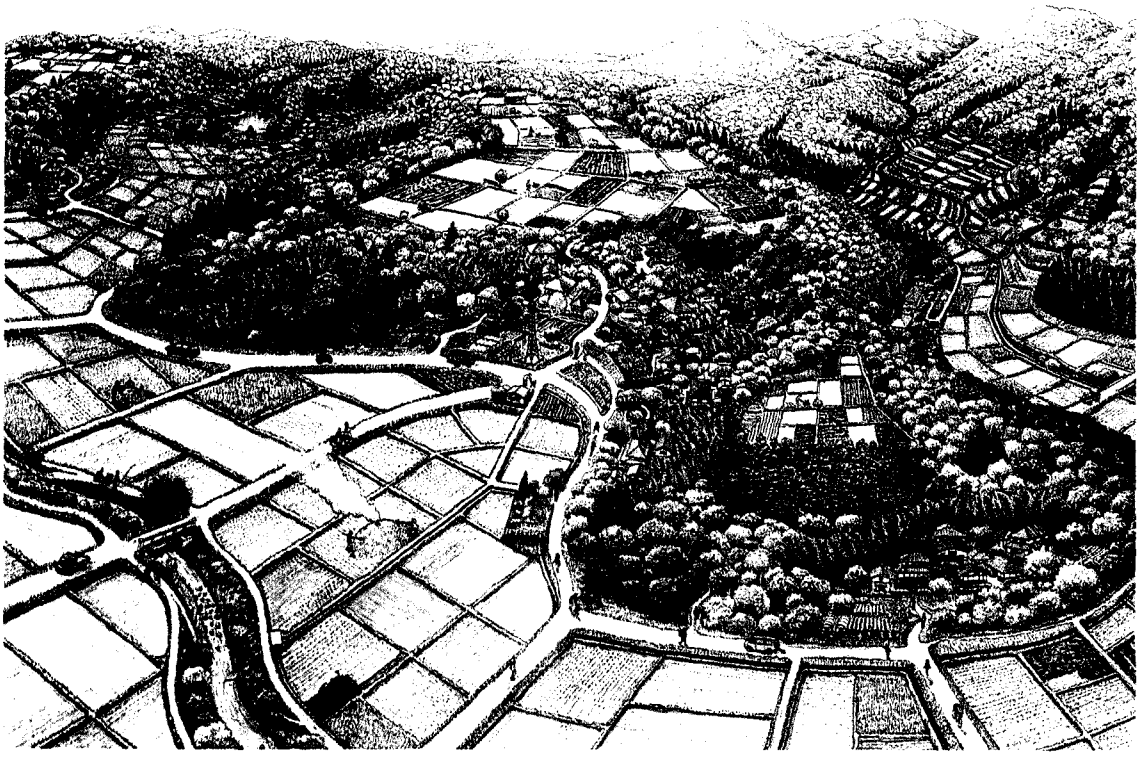

Fig. 2. Traditional agricultural landscape of the northern Boso Peninsula (illustrated by Kumeo Asai).

(Nakamura 1997). The micro-topographic sites associated with water conditions were divided into 8 types (Table 1): river, pond, canal-ditch, paddy, dike, bank, slope and terrace. Half of these types are not natural, but man-made. The man-made sites are produced and maintained in areas of rice cultivation, and they contain different plant communities in various successional stages from pioneer to climax. The plant communities are maintained by farming practices. As a result, these various habitats support a rich plant diversity, and their ecological continuity provides a valuable environment for the living native animals.

Fig. 2 shows an illustration of representative traditional farming villages in the *yatsu* of the Boso Peninsula, central Japan. The lowlands have been used as rice paddies, and upland terraces have been used for dry crops and vegetable fields. Deciduous coppice groves, Japanese red pine and Japanese *Cryptomeria* woods, and bamboo groves have been managed on terraces and slopes. Ancient stands of evergreen broad-leaved trees have traditionally protected Shinto shrines and Buddhist temples. In the traditional agricultural landscape, a set of varied land-use patches functions as the landscape unit of a sustainable ecosystem.

This ecosystem provides the local people with a stable food supply, and a variety of natural habitats to many species of wildlife. In addition, the agricultural landscape is the repository for traditional Japanese culture and lifestyle, and provides top-quality open space to all city residents. The farming ecosystem, with its rich biodiversity and traditional land ethic, can also serve as an example for practical environmental education (Short 1997).

MAINTENANCE AND RESTORATION OF NATURAL ENVIRONMENTS

Remaining natural habitats in such a traditional agricultural landscape should be maintained wherever possible. In addition, restoration work should be implemented in areas where the natural habitat has been destroyed or severely degraded by human activities. This basic approach to the natural environment involves a combination of maintenance and restoration (Nakamura *et al.* 1997).

To implement this approach, each target area must first be evaluated in terms of the stage of its natural succession or artificial degradation. Next, the goals of maintenance or restoration, in terms of the final form of the desired natural environment, must be established. Generally speaking, three choices are available: allowing natural succession to proceed on its own, checking or stopping the natural succession at its current stage, and artificially promoting natural succession (Fig. 3).

Maintenance of existing natural habitats

Existing natural areas in urban districts and their outskirts, that still remain in rural districts, must be maintained. Traditional farming techniques have created an ecosystem in which nature and human activities are well harmonized. Maintenance of existing traditional agricultural habitats is thus a major priority for urbanizing areas. A system for providing financial support to farmers should be the first approach for saving traditional agriculture and the landscape.

In urbanized areas, some parts have already been designated as parks or green belts. However few areas have been designated for the maintenance of biodiversity and regional ecosystems. These considerations should from an important factor in future planning of urban parks and public areas.

Types of maintenance of target areas can be classified into the following three categories according to the countermeasures employed:

Preservation type: The natural habitat is preserved in its current state, with the natural succession checked at the current stage. A typical example would be spring ephemeral plants such as violet tongue lily, which flourish only on floors of coppice forests that are in the secondary deciduous-forest stage.

Conservation type: The natural habitat is utilized for a variety of purposes, but all efforts are made to maintain its biodiversity and value as a wildlife habitat. Natural succession may be promoted through selective cutting and other management tools, or may be checked or even allowed to follow its own course. Typical examples would be coppice forests and rice paddies.

Protection type: Natural succession is allowed to proceed, but the area is set aside as a reserve. A typical example would be the protected climax-stage forests which surround shrines and temples.

Restoration of degraded natural habitats

Maintenance of existing natural habitats is vital for conserving biodiversity and ecosystems. Restoration work is also of great importance. An approach that combines both of these processes is thus necessary. To begin with, the extent of damage and the current direction and process of change at each site must be clearly documented. Next, the goals of maintenance or restora-

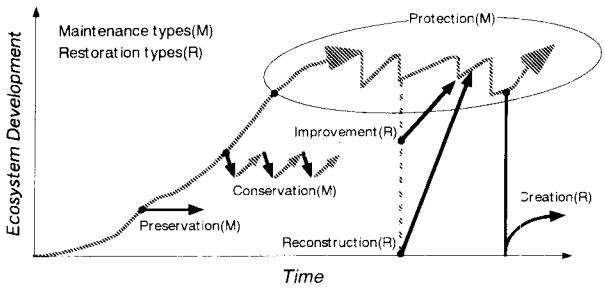

Fig. 3. Maintenance types and restoration types in relation to development of ecological succession.

tion, in terms of the final form of the desired natural environment, must be established.

Restoration should never be used as an excuse for permitting destructive development. Considerable restoration is required in many areas within urban districts and within districts zoned for intensive agricultural development. Along the coast, some restoration work has already been implemented, but this is mostly for scenic or recreational purposes, and as such is still insufficient in terms of restoration of biodiversity and ecosystems.

In addition to the traditional countryside landscape, future restoration work should concentrate on the reconstruction or creation of coastal habitats such as marshes, tidal flats and coastal vegetation communities. Riparian habitats along many rivers and irrigation canals are also in need of restoration, and city parks need to be redesigned to support a greater biodiversity. Concrete, asphalt and plastic should be replaced by wood and soil whenever possible. Treatments which promote natural succession are desirable in most cases. Types of restoration can be classified into the following three categories.

Improvement type: The current natural habitat has degraded, and is artificially managed in an attempt to return it to its original state. A typical example would be deciduous forests that have become dominated by bamboo grass or evergreen shrubs.

Reconstruction type: The original habitat has been destroyed or eliminated, but space is available for reconstruction. This type is often needed on sites from which old constructions have been removed.

Creation type: Natural habitats are created from scratch in reclaimed areas and in available parks and gardens.

ACHIEVEMENT OF ECOLOGICAL RESTORATION AND MAINTENANCE

In any maintenance and/or restoration work is to succeed, it is vital not only to have a clear restoration goal but also a model for achieving it. A chart showing the path to this approach is presented in Fig. 4.

The first step is exploration. Ecological inventories, including the current status of existing natural habitats, and their flora and fauna, should be obtained in order to understand the current conditions in the target area.

The second step is diagnosis. The present status of the target area must be evaluated in terms of the stage of natural succession or artificial degradation, and the desired form of natural conditions as a practical goal should be specifed. It is also important to understand the difference between the current conditions and the desired form. Through this process, the prescription - maintenance and/or restoration - should become clear. The prescription, which is the third step of the process, includes the planning of countermeasures and implementation of action, involving a

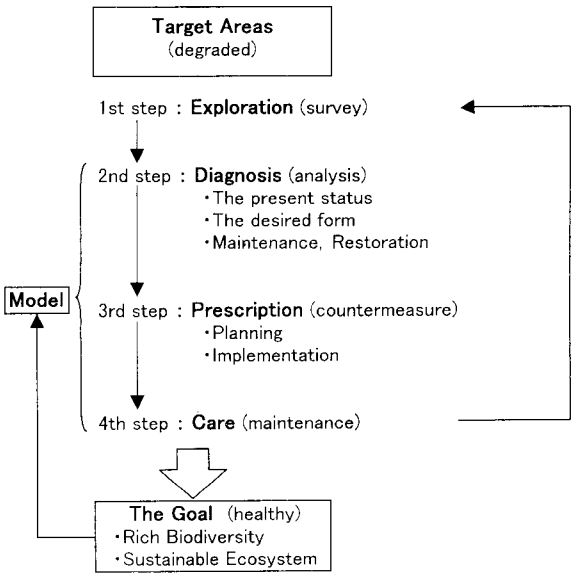

Fig. 4. Achievement of ecological restoration and maintenance.

combination of maintenance and restoration.

The fourth step is care. In changing the physical environment, any additional treatments such as introduction or removal of undesirable species may be required to approach the final goal. At this stage, monitoring work is very important, and in some cases the process should be taken back to the first step. Then, a cyclic process will be needed to approach the final goal, *i.e.* a natural and healthy environment, supporting a rich biodiversity and sustainable ecosystem.

A model for approaching the desired goal is important throughout this process. This is particularly valuable at the diagnosis step, and is also useful at the care step. The traditional agricultural landscape involving a sustainable farming ecosystem clearly provides a good model for restoration and/or maintenance of the natural environment in Japan.

Over the past several decades, urban and suburban sprawl, and changes in agricultural patterns have led to a rapid reduction and degradation of the traditional countryside landscape in Japan. As a result, many regions are suffering from a severe loss of biodiversity. In future it will be necessary to protect our traditional landscapes and ecosystems from the degrading impact of urbanization and industrialization, as well as to increase efforts at restoration.

ACKNOWLEDGEMENT

This article is my presentation for the 2001 International Symposium "Development and Roles of Restoration Ecology:

Hopes for the Future" organized by the Ecological Society of Korea and held at the Arts Center of Chung-Ang University, Seoul, in 26th-28th October, 2001. I am very grateful to Prof. Chang Seok Lee and the Ecological Society of Korea for inviting me to participate in the symposium, and for their valuable comments and encouragement.

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(Received October 26 , 2001, Accepted December 28, 2001)