Forest Resource Conservation for Biodiversity through Kyusei Nature Farming

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***Abstract** : The cooperation project on the forest resource conservation for biodiversity between the Thai Royal Forest Department and Sekai Kyuseikyo Thai Headquarters, Saraburi province. During 1999 - 2001, the Kyusei Nature Farming was applied to the national reserved forest (lower mixed deciduous forest type) to increase the forest biodiversity, simultaneously with the intensive forest fire protection. The preliminary study revealed that EM technology was progressively introduced to the forest ecosystem, the species diversity were increased especially the undergrowth such as herbs, ferns, rattans and mushrooms, also the fauna such as amphibians, reptilians, avians and mammalians.*

Introduction

Recently, there has been an alarming decrease in the amount of the total forest areas in the tropical region, also in Thailand. The Royal Forest Department, Thailand suggested that 0.46 million ha of the forest land had been destroyed annually during the past three decades and the last reported (RFD, 2001), the forest area is only 25.28% of the whole kingdom area. In spite of being announced to conserve as biological protected areas the rate of forest degradation and deforestation is continuously increased (Boontawee et al, 1995). Definitely, if the rapid and profound changes are still remaining, species diversity of Thailand's forest ecosystem will be in danger. As far as diminishing in forest biodiversity is concerned, making efforts to develop more powerful and effective planning for forest conservation and sustainable management needs to be considered.

Materials and Methods

Field study area was carried out at the Sechi Saraburi forest (the natural forest reserved area) area about 800 ha ($14^{o}10´N$ $101^{o}15´E$, 28-$40^{o}C$, 100-300 m above sea level). The seasonal forest type can be sub-divided as Lower Mixed Deciduous Forest, the precipitation is between 1,200-1,400 mm. and the soil is either sandy or gravelly loam and lateritic soil area of deep well drained soils, where tree species shed their leaves during the dry season. The height of predominant trees is comparatively lower (10-25 m.) than that of the evergreen forest. The forests of this formation are more or less subjected to ground fire during the dry period (December - March). Some evergreen species are occasionally found in the area especially along the streams.

The 4 permanent plots with 40 x 40 m^2 was set up in the transect of the area and 10 quadrates of 10 x 10 m^2 were randomly selected for all tree individuals with Diameter at Breast Height (DBH) $\geq$ 4.5 cm, and height were tagged and recorded for the Important Value Index (IVI) (Muller - Dombois and Ellenberg, 1974)
The intensively ground forest fire protection was done during 1999-2000. Kyusei Nature

Farming application was used and EM Bokashi was applied to the forest floor totally 10 metric tons average in the study area, 100 gm per m^2 (1000 kg/ha) and extended EM average 62.5 litres/ha (10 litres/rai).

Results and Discussion

Structure and Species Composition

In the Lower Mixed Deciduous Forest (Sechi Saraburi Forest), the canopy openings were found, sapling and seedling were increasingly established after fire protection. Tree canopy was divided into three main layers. The top canopy was higher than 15m.and dominated by *Pterocarpus macrocarpus* Kurz, *Afzelia xylocarpa* Craib, *Bombax valetonii* Hochr, *Lagerstroemia duperreana* Pierre and *Cratoxylum formosum* (Jack) Dyer.

The lower layer was between 10-15 m. high, the dominant trees in this layer were *Canarium subulatum* Guill, *Hularrhena antidysenterica* Wall, *Cassia fistula* Linn, *Albizia lebbeck* (L.) Benth, *Spondias pinnata* (L.f.) Kurz, *Grewia paniculata* Roxb.ex DC. and *Ficus hispida* Linn.f. The ground layer is densely covered with grass intermixing with sapling, seedling, rattans, zingiberaceae, herbs, ferns and mushrooms.

The lower mixed deciduous forest covers rather more moist site. The main bamboo species in this sub-type are *Dendrocalamus strictus* (Roxb.)Nees., *Bambusa arundinacea* (Retz.)Willd., *Gigatochloa albociliata* Munro., *Thyrsostachys siamensis* Gamble and *Cephalostachyum pergracile* Munro

Species composition

In the LMDF ecosystem, dominant species of the tree was *Pterocarpus macrocarpus* Kurz., *Bombax valetonii* Hochr. and *Lagerstroemiu duperreana* Pierre the IVI of *Pterocarpus macrocarpus* Kurz was 117.38 (Table 1). The important value index (IVI) of some dominant species in the MDF, as shown in Srikanha and Gajaseni (2000), whereas *Terminalia nigrovenulosa* Pierre ex Laness (IVI 57.73) and sapling group *Lagerstroemia duperreana* Pierre(IVI 143.76) are the most dominant species while Ruangpanit (1993) revealed that the LMDF forest covers rather more moist site, occasionally found in the area, especially along the streams such as *Hopea odorata* Roxb., *Shorea thorellii* Pierre ex Laness, *Eugenia cumini* (L.) Druce, *Dipterocarpus alatus* Roxb. and *Dipterocarpus turbinatus* Gaertn.f. intermixed with some other medium size evergreen trees.

Table 1. Tree Species Composition, Density (D), Frequency (F), Basal area (BA), Relative Density (RD), Relative Frequency (RF), Relative Dominant (RD) and Important Value Index (IVI) in the Lower Mixed Deciduous forest, Saraburi Province. (10 quadrates of 10 x 10 m^2)

No	Scientific Name	D $100m^2$	F %	BA $m^2/100m^2$	RD %	RF %	RD %	IVI %
1.	*Pterocarpus macrocarpus* Kurz.	1.5	70	0.0302	34.88	22.58	59.92	117.38
2.	*Bombax valetonii* Hochr.	0.5	40	0.0246	11.62	12.90	16.35	40.87
3.	*Lagerstroemia duperreana* Pierre	0.4	30	0.0225	9.30	9.68	14.96	33.94
4.	*Terminalia bellerica* Roxb.	0.3	20	0.0135	6.98	6.45	8.98	22.41
5.	*Albizia lebbeck* (L.) Benth.	0.3	30	0.0070	6.98	9.68	4.65	21.31
6.	*Canarium subulatum* Guill.	0.1	10	0.0153	2.33	3.23	10.17	15.73
7.	*Afzelia xylocarpa* Craib.	0.1	10	0.0141	2.33	3.23	9.37	14.93
8.	*Holarrhena antidysenterica* Wall.	0.2	20	0.0042	4.65	6.45	2.79	13.89
9.	*Spondias pinnata* (L.f.) Kurz.	0.2	20	0.0023	4 65	6.45	1.53	12.63
10.	*Bauhinia malabarica* Roxb.	0.2	20	0.0015	4.65	6.45	0.99	12.09
11.	*Grewia panicalata* Roxb.ex DC.	0.1	10	0.0085	2.33	3.23	5.65	11.21
12.	*Ficus hispida* Linn.f.	0.2	10	0.0021	4.65	3.23	1.40	9.82
13.	*Cratoxylum formosum* (Jack) Dyer.	0.1	10	0.0031	2.33	3.2	2.06	7.62
14.	*Cassia fistula* Linn.	0.1	10	0.0015	2.33	3.23	0.99	6.55
		4.3	310	0.1504	100.0	100.0	100.0	300.0

Ecological Dynamics

Forest dynamics can be divided into three categories ; evolution, succession and fluctuation. Evolution is the process of developing a new form or species in plants or animals on earth and add up to the biotic community such as the existing broad leaf species to replace the coniferous species in the tropical zone. It takes a very long period of time in which it is beyond ecological concern.

The succession is the process of progressive or retrogressive changes in plant community. The ending stage of progressive succession is the climax community. Community fluctuation is the cyclical changes in plant community such as seasonal variation in grassland community or phases in ground cover under the deciduous forest. The species composition and other structure will be similar to the previous year again in the same seasons.

Secondary succession after forest destruction by ground fire in the studied forest areas, *Imperata cylindrica* Beauv. come to occupy the site, and this grass community will be maintained as long as it still has annual forest fire in the area, *Eupatorium odoratum* Linn. (Siamese grass) and *Pennisetum polystachyon* Schult are the common pioneer species intermixing with shrubs and small sapling.

After the cooperation project on forest resource conservation was done, there is no annual forest fire. Simultaneously with Kyusei Nature Farming and EM technology application, it revealed progressively success to the trees and shrub stage within few years (1999-2001). The improvement of forest ecosystems related with the watershed area in the site, and the forest type developed gradually to the dry evergreen forest type.

Biodiversity

Biodiversity is a term that has been recently widely used. It refers to variety of lifeforms and biological species, hence encompassing both intraspecific diversity and interspecific diversity. The number of species in the world today is around 1.4 millions and it is estimated that the total number could be around 5 to 30 million (Wilson, 1988). Much of the biological wealth is found in the tropical moist forests of South East Asia. It has been quoted that tropical rain forest contain over 50 percent of the world's total number of species. With this linkage, tropical moist forest therefore become critical for global biodiversity conversation.

In consideration of biodiversity issues for the future, studied in the lower mixed deciduous forest (Saraburi), there are two concepts, species richness and species diversity. However species diversity took into account species numbers, populations, and distribution within a given unit area. Table 2 illustrates some occurrence of the species diversity, especially undergrowth such as herbs, ferns, rattans and mushrooms.

Table 2. Species Diversity of the Secondary Plant Succession and Occurrence (undergrowth) during the Studied Period (1999-2001)

Undergrowth	Scientific Name	Family
Herbs	*Catimbium malaccensis* (Burm.f.) Hiltt.	ZINGIBERACEAE
	Zingiber officinale Roscoe.	ZINGIBERACEAE
	Zingiber zerumbet Smith.	ZINGIBERACEAE
	Kaempferia marginata Carey.	ZINGIBERACEAE
	Clerodendrum paniculatum Linn.	VERBENACEAE
	Amorphophallus campanulatus Bl.ex Decne.	ARACEAE
	Pseudodracontium brevispathus Gagnep.	ARACEAE
	Amorphophallus saraburiensis Gagnep.	ARACEAE
	Costus speciosus Smith.	ZINGIBERACEAE
Ferns	*Dryopteris amboinensis* Ktze.	DRYOPTERIDACEAE
Rattans	*Daemonorops angustifolia (Griff) Mart.*	PALMAE
	Calamus acanthophyllus Beec.	PALMAE
	Calamus trigrinus Kurz.	PALMAE
Mushrooms	*Tricholoma crassum* (Berk) Sacc.	TRICHOLOMATACEAE
	Dictyophora indusiata (Pers) Fisch.	PHALLACEAE
	Microporhs xanthopus	POLYPORACEAE
	Cyathus olla (Batsch) Pers.	NIDULARIACEAE
	Daedalea confragosa Bolt ex Fr.	POLYPORACEAE
	Termitomyces fuliginosus Heim	AGARICACEAE
	Trametes sanguinea Fr ex Lloyd.	POLYPORACEAE

Table 3. Some Abundant and Occasional Animal Species after the Forest Resource Conservation through the Kyusei Nature Farming in 2001.

Fauna	Common name	Scientific name	Family
Amphibians	Common Asian Toad	*Bufo melanostictus*	BUFONIDAE
	Green Paddy Frog	*Rana erythraea*	RANIDAE
	Banded Bull Frog	*Kaloula pulchra*	MICROHYLIDAE
Reptilians	Malayan Box Turtle	*Cuora amboinensis*	EMYDIDAE
	Butterfly Lizards	*Leiolepis belliana*	UROMASTICIDAE
	Brown-headed Lizards	*Calotes emma*	GEKKONIDAE
	Water monitor	*Varanus salvator*	VARANIDAE
	Reticulated Python	*Python reticulatus*	PYTHONIDAE
	Monocled Cobra	*Naja Kaouthia*	ELAPIDAE
Avians	Cattle Egret	*Bubulcus ibis*	ARDEINAE
	Zebra Dove	*Geopelia striata*	COLUMBIDAE
	Greater Coucal	*Centropus sinensis*	CUCULIDAE
	White-breasted King fisher	*Haleyon smyrnensis*	ALCEDINIDAE
	Chestnut-headed Bee-eater	*Merops leschenaultia*	MEROPIDAE
	Indian Roller	*Coracias benghalensis*	CORACIIDAE
	Lineated Barbet	*Megalaima lineate*	MEGALAIMIDAE
	Asian Paradise-flycatcher	*Terpsiphone parade*	MUSCICAPINAE
	Hill Myna	*Gracula religiosa*	STURNIDAE
	Red Junglefowl	*Gallus gallus*	PHASIANIDAE
Mammalians	Common Treeshrew	*Tupaia glis*	TUPAIIDAE
	Pig-tailed Macaque	*Macaca nemestrina*	CERCOPITHECINAE
	Cream-colored Giant Squirrel	Ratufa affinis	SCIURIDAE
	Common wild pig	*Sus scrofa*	SUIDAE
	Plantain Squirrel	*Callosciurus notatus*	SCIURIDAE

Conclusion

Tropical seasonal forest exhibit significant variation in structure, species composition, and ecological dynamics. According to FAO (1990) forests in the tropic are being destroyed at a rate of 17 million hectares annually. Forest depletion is mainly attributable to conversion of forest land to agriculture to meet basisc needs of the rural poor. Forest degradation due to the exploitation of natural forest in the tropical seasonal forest has also been linked to the loss of biodiversity and climate change.

In considering the global environment issue of climate change and loss of biodiversity, a more holistic and pragmatic approach will have to be adopted. Kyusei Nature Farming using the technology of Effective Microorganisms (EM) is a system of agriculture that improves the ecosystem and biodiversity and also the productivity of tropical wastelands. It is recognized that with EM technology the species diversity of both flora and fauna were increased.

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