

THE PROCESS OF NATURAL FOREST REGENERATION AFTER SHIFTING CULTIVATION IN KY SON DISTRICT, NGHE AN PROVINCE, VIETNAM

*Hoang Van Son*¹

ABSTRACT

Plant succession was studied in agricultural fallow fields at two sites in Ky Son district (a mountainous area of Nghe An province, Vietnam) and wildlife in these areas was recorded.

There was clear evidence of forest regeneration at both sites. At the upper site (1,020-1,120 m elevation) 133 species belonging to 52 families were recorded in fallow fields aged one to six years. The dominant vegetation changed from light-demanding herbs and shrubs in the first year of fallow to large shrubs and small pioneer trees in the second and third years. By the sixth year, a multi-layered, secondary forest formation had developed, with a canopy of timber trees (11 species) and large shrubs, an understorey of small shrubs and climbers and a ground layer of shade-tolerant ferns, herbs and moss.

In the lower site (650-750 m elevation), 98 species belonging to 47 families were recorded in fields aged one to six years, rising only to 106 species and 52 families when ten-year-old fields were included. *Eupatorium odoratum* dominated the fallow fields for the first three years, with a frequency of 90%. In the second and third years, several species of small tree began to regenerate, including *Trema orientalis* and *Mallotus philippensis*. In the fourth year, *E. odoratum* declined to 60%, while shrubs and trees began to form an open canopy, interspersed with bamboo (*Bambusa schizostachyoides*). After ten years, the coverage of *E. odoratum* was greatly decreased (10%) and a closed tree canopy had started to emerge.

Of the 37 rare and endangered animal species present in Nghe An province, 16 species (43%) were found in the research areas, of which four were endangered.

INTRODUCTION

In mountainous areas, the restoration of forest cover after cultivation of fields has a fundamental effect on other natural processes, such as the restoration of soil nutrition, the system of water regulation and the creation of habitats for wild animals. Forest restoration is thus essential for management of resources for agriculture and conservation. Natural regeneration can play a key role in resource management policies at both the community and national levels.

Ky Son district of Nghe An province is situated in the north central region of Vietnam. Ky Son is in the highlands, located at 18⁰10 to 18⁰41 N and from 103⁰52 to 104⁰29 E, about

¹ Vinh University, 182 Le Duan Street, Vinh, Vietnam.

600 m to 1400 m above sea level. The total area is 1,891.7 km², of which forest and forestland (i.e. previously forested land, now bare) account for 163,468 ha. Exploited timber forest (i.e. areas with logging concessions) covers 3,186 ha and the unexploited areas total 2,982 ha. Forest for “special use” covers 347 ha, forest for national defence, 4,260 ha and protected forest, 15,450 ha.

Ky Son has a tropical monsoon climate, with two seasons: the dry and cold season is from November to March, under the influence of north east winds and the hot and humid season is from April to October, under the influence of south east winds. Muong Xen is the main town in Ky Son. It is one of the driest regions of Vietnam with an average annual rainfall of 1,200 mm to 1,400 mm and a dry season of seven to nine months. The dominant plant families in the area are *Poaceae*, *Euphorbiaceae*, *Anacardiaceae*, *Cycadaceae* and *Dilleniaceae*. The forest is predominantly deciduous (VAN TRUNG, 1976). There are many fallow fields dominated by early successional communities including species such as *Saccharum spontaneum*, *Ageratum conyzoides*, *Erigeron crispus* and *Eupatorium odoratum*. These fields eventually develop into secondary shrub and bamboo forests.

Compared with the 1970's, the forest of Ky Son is now under threat due to cultivation in mountainous areas (TAT CHUNG & CONG HOAN, 1995). As a result of increasing population pressure and loss of forestland, the fallow period in shifting farming is steadily declining. In the 1930's to 1960's, the land was cultivated for three to four years and then allowed to lie fallow for 15 to 20 years to fully restore productivity. Now, in many places, fields are cultivated for three to four years, then allowed to lie fallow for the same period. This shortened fallow period results in decreased soil fertility and increased weed competition (JAMIESON *ET AL.*, 1998). Also, the abundance of tree seeds in the soil seed bank is severely reduced, which consequently reduces the potential for natural forest regeneration. Due to continued destruction of vegetation cover, many hills and mountains in Vietnam are unable to regenerate naturally. Tree planting in such areas is one measure to restore vegetation cover.

OBJECTIVES

The objectives of this research were to describe the natural regeneration of vegetation in fallow areas in Ky Son district and assess the species richness of wildlife in the regenerating areas. This information will be of practical use in developing agro-forestry ecosystems and in devising methods to promote natural forest regeneration.

METHODS

Pioneer vegetation differs between areas at 900 – 1,200 m and 600 – 800 m elevation. At upper elevations, recently abandoned agricultural fallows are dominated by *Saccharum spontaneum*, *Miscanthus japonicus* and *M. nepalensis*, while at lower elevations the dominant species are *Eupatorium odoratum* and *Imperata cylindrica*. For this reason, vegetation surveys were carried out in two areas: one at 1,020-1,120 m elevation and the

other at 650-750 m. At 1,020-1,120 m elevation, forestland covering approximately 700 ha at Nam Can village was chosen and at 650-750 m elevation forestland at Ta Ca village was selected, covering about 1000 ha. After interviewing local people, land in both research areas was chosen for study on the basis that it had been used for slash-and-burn agriculture for at least 40 years.

Because of the short time available for fieldwork, it was not possible to return to the same newly created site and repeat the measurements year after year, so regeneration was assessed in fallow fields of different ages. At the upper site, fields in the first, second, third and sixth year of fallow were surveyed, while at the lower site the survey was repeated in fields in the first, second, third, fourth and tenth year of fallow. Three 30 m x 30 m permanent plots were randomly established in fallow fields of each age. All plants, at least 5 cm tall, were included in the survey. Identification followed HOANG HO (1991, 1992 and 1993). The frequency of each species was determined for each site in each year by calculating the percentage of all plots in which each species was recorded. Data on the presence of mammals and reptiles at both sites was obtained by interviewing local hunters, farmers and foresters.

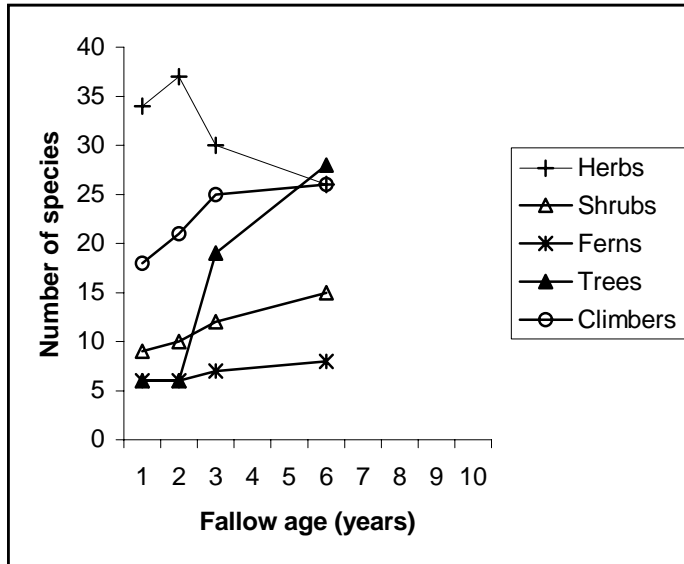
RESULTS

Upper site at 1,020-1,120m elevation

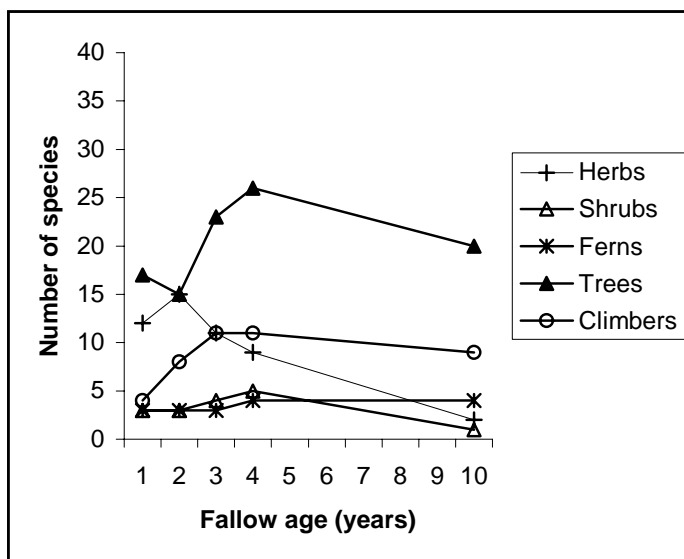
During the first six years of the fallow period, 133 species belonging to 52 families were recorded and there was clear evidence of natural succession. In the first three years, light-demanding herbs and shrubs dominated the vegetation (Figure 1a). Herbs such as *Ageratum conyzoides*, *Erigeron erispus* and *Saccharum spontaneum* and small shrubs such as *Glochidion hirsutum* and *Glochidion laevigatum* predominated in the first year, while in the second year, large shrubs and pioneer small trees such as *Caesalpinia crista*, *Mallotus barbatus* and *Mallotus microcarpus* became equally dominant. The first timber tree species, *Melia azedarach*, was recorded in the second year. By the third year, the incidence of herbs and shrubs was much reduced and the vegetation became dominated by pioneer trees. In this year there appeared many species of climber (e.g. *Tetracera sarmentosa*, *Pueraria montana* and *Smilax ovalifolia*), and several shade-demanding ferns (e.g. *Lygodium conforme*, *L. japonicum*) and herbs (e.g. *Artemisia vulgaris*, *Apludia mutica* and *Aristida chinensis*). Nine timber tree species were recorded. By the sixth year, a multi-layered, secondary forest formation had developed, with a canopy of timber trees and large shrubs, an understorey of small shrubs and climbers and a ground layer of shade tolerant ferns, herbs and moss. Eleven tree species of timber trees were recorded.

Figure 1. The total number of species of each life-form in fallow fields of different ages, at two sites. Vegetation was recorded in three 30 m x 30 m plots, randomly established in fallow fields of each age.

a) Upper site (1,020 – 1,120 m).



b) Lower site (650 – 750 m).



Lower site at 650-750m elevation

In the lower site, 98 species belonging to 47 families were recorded during the first six years with a total of 106 species and 52 families during the first ten years. In this area, *Eupatorium odoratum* dominated the fallow fields for the first three years, with a frequency of 90%. Also present from year one were several species of climber (*Desmos chinensis*, *Tetracera scandes*, *Acacia megaladina*), light-demanding shrubs (*Urena lobata*, *Sida rhombifolia*) and canopy trees (e.g. *Cratocylon maigayi*, *C. prunifolium*, *Lagerstroemia calyculata*, *Aporusa sp* and *Wrightia tomentosa*) with a combined frequency of 10-15%. In the third year the number of species of shrubs and canopy trees increased (Figure 1b) and several species of small tree began to regenerate, including *Trema orientalis* and *Mallotus philipensis*. In the fourth year, the incidence of *E. odoratum* declined to 60%, while the shrubs and trees began to form an open canopy, interspersed with bamboo (*Bambusa schizostachyoides*), which had a frequency of 20%. After ten years, the coverage of *E. odoratum* was greatly decreased (10%) and a closed tree canopy was beginning to emerge. Between four and ten years after fallow abandonment, the number of tree species remained relatively stable. Several timber tree species were recorded, including *Elaeocarpus griffithii*, *Aporusa sphaerosperma*, *Mallotus philipensis*, *Castanopsis sp.*, *Cratocylon prunifolium*, *Lagerstroemia calyculata* and *Phoebe lanceolata*.

In exploited forest surrounding the fallow sites, common tree species included *Engelhardtia roxburghiana*, *Aporusa sp.*, *Vatica odorata*, *Lithocarpus pseudosundai*, *L. elegans*, *Schima sp.* and *Bambusa blumeana* (present with a frequency of c.20%), while *Cycas simplicipinna* occurred with a frequency of 10%.

Wildlife in the research areas

Interviews with local people indicated that several valuable and rare animal species were to be found in the regenerating fallow (Table 1). Of the 37 rare and endangered animal species present in Nghe An province, 16 species (43%) were reported as present in the research areas and of these, four were endangered species.

CONCLUSIONS AND RECOMMENDATIONS

1. In Ky Son district, there was clear evidence of natural forest regeneration in fallow fields, at both the upper and lower sites. Trees began to regenerate in the first or second year and had generally formed a canopy over the weeds and shrubs by the sixth year. The increasing tree cover was matched by a gradual decline in light-demanding herb and shrub species and an increase in shade tolerant herbs, shrubs, ferns and mosses.
2. Shifting cultivation in the research areas had a great effect on forest resources. People continuously exploited woody species before they had developed into stable forest cover, creating sub-climax communities dominated by shrubs and grasses.

Table 1. Animals in the Ky Son district¹, their rarity status and presence in research areas.

Vietnamese name	Scientific name	Rarity status ²	Species present in research area (X)
Soc bay lon	<i>Petaurista petaurista</i>	2	
Soc den trang	<i>Hylopetes alboniger</i>	2	
Don	<i>Atherurus macsirrurus</i>	1	
Te te	<i>Manis pentadactyla</i>	1	X
Chon doi	<i>Cynophalus variegatus</i>	2	
Cu li lon	<i>Nycticebus coucang</i>	1	
Cu li nho	<i>Nycticebus pygmaeus</i>	1	
Khi mat do	<i>Macaca arctoides</i>	1	X
Khi moc	<i>Macaca assamensis</i>	1	X
Khi duoi lon	<i>Macaca nemestrina</i>	1	
Vooc xam	<i>Trachypithecus phayrei</i>	1	
Vooc va	<i>Pygathris nemaus</i>	3	
Vuon bac ma	<i>Hylobates concolorleucogenis</i>	3	
Soi do	<i>Cuon abpinus</i>	3	
Gau cho	<i>Helarctos malayanus</i>	3	X
Gau ngua	<i>Selenarctos thibetanus</i>	3	X
Rai ca	<i>Lutra lutra</i>	1	
Cay muc	<i>Artictis binturong</i>	1	
Beo lua	<i>F. temmicki</i>	1	
Bao gam	<i>Neofelis nebulosa</i>	1	
Bao hoa mai	<i>Panthera pardus</i>	3	
Ho	<i>P. tigris</i>	3	X
Voi	<i>Elephans maximus</i>	3	
Sao la	<i>Pseudoryx nghetinhensis</i>	2	
Bo tot	<i>Bos gaurus</i>	3	
Son duong	<i>Capricornis sumatraensis</i>	1	
Mang lon	<i>Megamuntiacus vuquangensis</i>	2	
Cheo cheo	<i>Tragulus javanicus</i>	1	
Tac ke	<i>Gecko gecko</i>	1	X
Ky da, Rong dat	<i>Physignathus cocincinus</i>	1	X
Tran dat	<i>Python molurus</i>	1	X
Rua nuivien	<i>Geochelone impressa</i>	1	X
Rua hop tran vang	<i>Cuora galbinifrons</i>	1	X
Rua hop vach	<i>Cuora trifasciata</i>	1	X
Rua nui vang	<i>Indotestudo elongata</i>	1	X
Ran cap nong	<i>Bungarus fasciatus</i>	1	X
Ran ho mang	<i>Naja naja</i>	1	X
Ran ho chua	<i>Ophiophagus hannah</i>	3	X

¹ Species list from the Red Data Book of Vietnam (Ministry of Science, Technology and Environment, 1993).

² 3 = In danger of extinction; 2 = rare; 1 = uncommon.

3. In comparison with regenerating areas in Con Cuong, another mountainous area in Nghe An province (TRONG CUC & HONG BAN, 1996; HONG BAN, 1997; VAN LUYEN, 1998; VAN SON, 1998), there were fewer timber trees regenerating in the fallow fields of Ky Son. The species composition of regenerating trees and shrubs was also different. This shows how variable regeneration patterns can be within the same region.
4. Although some trees were regenerating successfully in the undisturbed fallow fields, species of high economic value, such as *Chukrasia tabularis* and *Erythrophloeum fordii*, were rare. It is suggested that measures be taken to promote the regeneration of desired species, such as pruning back shrubs and lianas around naturally regenerating seedlings or alternatively introducing the species into regenerating areas through enrichment planting.
5. A successful technique traditionally used by the Tay people of Northwest Vietnam, is to scatter seeds of *Melia azedarach* in fallow fields before burning to remove the weed cover. Fire stimulates germination of the thick-coated seeds, which may otherwise have low percentage germination. In this way, the Tay people can harvest timber after five to seven years, while planting rice during the first to third years, while the *Melia azedarach* seedlings are small. The area ultimately develops into mixed forest.
6. Evidently, areas of regenerating forest can provide suitable habitats for some rare and endangered wildlife species.

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Appendix - Plant species recorded at the two sites.

Family	Species	Life form	Age of fallow where recorded (years)	
			1020-1120m	650-750m
Lycopodiophyta				
Lycopodiaceae	<i>Lycopodiella cernuna</i>	Herb		4
Selaginellaceae	<i>Selaginella uncinata</i>	Herb	1,2,3,6	2,4
Polypodiophyta				
Aspleniaceae	<i>Asplenium nidus</i>	Fern	6	
Athyriaceae	<i>Diplazium esculatum</i>	Fern	3,6	
Blechnaceae	<i>Blechnum orientale</i>	Fern	1,2,3,6	
Cyatheaceae	<i>Cyathea contaminans</i>	Fern		4
Diksoniaceae	<i>Cibotium borometz</i>	Fern	1,2,3,6	
Lygodiaceae	<i>Lygodium conforme</i>	Fern	1,2,3,6	1,2,3,4,10
	<i>Lygodium japonicum</i>	Fern	1,2,3,6	1,2,3,4,10
	<i>L. microphyllum</i>	Fern		1,2,3,4,10
	<i>Pteris ensiformis</i>	Fern	1,2,3,6	
Thelypteridaceae	<i>Cyclosorus paraciticus</i>	Fern	1,2,3,6	
Gymnospermae				
Cycadaceae	<i>Cycas siamensis</i>	Fern		10
Angiospermae				
Dicotyledones				
Alangiaceae	<i>Alangium chinensis</i>	Tree		3
Amaranthaceae	<i>Amaranthus tricolor</i>	Herb	1	
Anacardiaceae	<i>Rhus javanica</i>	Tree	3,6	
Annonaceae	<i>Alphonsea tonkinensis</i>	Tree		4
	<i>Desmos chinensis</i>	Climber	3,6	1,2,3
	<i>Xylopi sp.</i>	Tree		1,2
Apocynaceae	<i>Alyxia kongtumensis</i>	Tree		4
	<i>Strophanthus divaricatus</i>	Climber	3,6	
	<i>Wrightia pubescens</i>	Tree		1
Asclepiadaceae	<i>Dischidia acuminata</i>	Climber	1,2,3,6	
	<i>Streptocaulon juvenas</i>	Climber	1,2,3,6	1,2,3
Asteraceae	<i>Ageratum conyzoides</i>	Herb	1,2,3	1,2
	<i>Artemisia vulgaris</i>	Herb	1,2,3	1,2,3
	<i>Blumea balsamifera</i>	Herb	2,3,6	
	<i>Eclipta scaber</i>	Herb	1,2,3	
	<i>Erechtites hieracifolia</i>	Herb		4
	<i>Erigeron erispus</i>	Herb	1,2,3	
	<i>Eupatorium odoratum</i>	Herb	1,2,3	1,2,3,4,10

Family	Species	Life form	Age of fallow where recorded (years)	
			1020-1120m	650-750m
	<i>Gynura crepidoides</i>	Herb	3,6	
	<i>Parthenium hysterophorus</i>	Herb	1,2	
	<i>Pluchea indica</i>	Herb	1,2,3	
	<i>Siegeshockia orientalis</i>	Herb	1,2,3	
	<i>Spilanthes acmella</i>	Herb	1,2	
	<i>Tithonia diversifolia</i>	Herb	1,2,3	1,2,3
	<i>Xanthium inaequilaterum</i>	Herb	1,2	1,2
	<i>Vernonia cinerea</i>	Herb	3	3,4
	<i>Wedelia biflora</i>	Herb	1,2	
Betulaceae	<i>Betula alnoides</i>	Tree	3,6	
Bignoniaceae	<i>Oroxylum indicum</i>	Tree		1,2,3,4
Bombacaceae	<i>Gossampinus malabarien</i>	Tree		10
Burseraceae	<i>Canarium album</i>	Tree		10
Buddleiaceae	<i>Buddleia asiatica</i>	Shrub	3,6	
	<i>Buddleia paniculata</i>	Shrub	3,6	
Caprifoliaceae	<i>Sambucus hookeri</i>	Shrub	6	
	<i>Viburnum coriaceum</i>	Tree	6	
	<i>Lonicera japonica</i>	Climber	6	
Cuscutaceae	<i>Cuscuta australis</i>	Climber	1	
Dilleniaceae	<i>Dillenia heterosepata</i>	Tree		10
	<i>Tetracera sarmentosa</i>	Climber	2,3,6	
	<i>Tetracera scandes</i>	Climber	2,3,6	4,10
Dipterocarpaceae	<i>Hopea pierrei</i>	Tree		10
	<i>Vatica dyeri</i>	Tree		10
Ebenaceae	<i>Diospyros tonkinensis</i>	Tree		4
Elaeocarpaceae	<i>Elaeocarpus griffithii</i>	Tree		4, 10
	<i>E. hainanensis</i>	Tree		1,2,3,4,10
Euphorbiaceae	<i>Aleurites fordii</i>	Tree		3,4,10
	<i>Antidesma montanum</i>	Tree		4
	<i>Antidesma anamense</i>	Tree		4
	<i>Antidesma sp.</i>	Tree	3,6	
	<i>Aporusa sphaerosperma</i>	Tree	3,6	1,2,3,4,10
	<i>Glochidion hirsutum</i>	Shrub	1,2,3	
	<i>Glochidion laevigatum</i>	Shrub	1,2,3	
	<i>Macaranga denticulata</i>	Tree	1,2,3,6	
	<i>Mallotus barbatus</i>	Tree	1,2,3	
	<i>Mallotus microcarpus</i>	Tree	1,2,3	
	<i>Mallotus repandus</i>	Climber	1,2,3	
	<i>Mallotus philipensis</i>	Tree		2,3,4,10

Family	Species	Life form	Age of fallow where recorded (years)	
			1020-1120m	650-750m
	<i>Phyllanthus emblica</i>	Tree		1
	<i>Phyllanthus reticulata</i>	Shrub		4
	<i>Securinega spirei</i>	Shrub	1,2,3,6	
Fabaceae:				
<i>Caesalpinioideae</i>	<i>Bauhinia scandes</i>	Climber	1,2,3,6	
	<i>Bauhinia variegata</i>	Tree	3,6	1
	<i>Caesalpinia bonduie</i>	Climber	1,2,3,6	
	<i>Caesalpinia crista</i>	Shrub	1,2,3,6	
	<i>Caesalpinia minax</i>	Climber	1,2,3,6	
	<i>Cassia siamea</i>	Tree	3,6	1,2
	<i>Cassia alata</i>	Shrub	3,6	
	<i>Cassia tora</i>	Herb	1,2	
	<i>Tamarindus indica</i>	Tree	1,2,3	
<i>Mimosoideae</i>	<i>Acacia megaladina</i>	Climber		2,3,4,10
	<i>Archidendron clypearia</i>	Tree	3,6	
	<i>Mimosa pudica</i>	Herb		2,3,4
<i>Papilionoideae</i>	<i>Desmodium triflorum</i>	Herb		3
	<i>D. triquetrum</i>	Herb		2
	<i>Pueraria montana</i>	Climber	1,2,3,6	1,2,3,4
	<i>Ormosia balansae</i>	Tree	3,6	
Fagaceae	<i>Castanopsis sp.</i>	Tree		3,4,10
	<i>Lythocarpus elegans</i>	Tree		10
Guttiferae	<i>Cratocylon maigayi</i>	Tree	1,2	3,4,10
	<i>Cratocylon prunifolium</i>	Tree	3,6	1,2,3,4
	<i>Garcinia cowa</i>	Tree		10
Juglandaceae	<i>Engelhardtia roxburghiana</i>	Tree		3,4,10
Lauraceae	<i>Litsea cubeba</i>	Tree	3,6	
	<i>Litsea glutinosa</i>	Tree		2
	<i>Phoebe lanceolata</i>	Tree		3,4,10
Lythraceae	<i>Lagerstroemia calyculata</i>	Tree		1,2,3,4,10
Malvaceae	<i>Urena lobata</i>	Shrub	1,2	3
	<i>Sida rhombifolia</i>	Shrub	1,2	3
Melastomataceae	<i>Melastoma normale</i>	Shrub	1,2,3,6	
	<i>Melastoma saigonense</i>	Shrub	1,2,3,6	
	<i>Melastoma setigerum</i>	Shrub	1,2,3,6	
	<i>Memecylon edule</i>	Tree		1,2,3,4
Meliaceae	<i>Chukrasia tabularis</i>	Tree	6	
	<i>Melia azedarach</i>	Tree	2,3,6	1,2,3
Menispermaceae	<i>Cissampelos pareina</i>	Climber	1,2,3,6	2,4,10

Family	Species	Life form	Age of fallow where recorded (years)	
			1020-1120m	650-750m
	<i>Cissampelos sp.</i>	Climber		4,10
	<i>Stephania longa</i>	Climber	3,6	
Moraceae	<i>Broussonetia kazinoki</i>	Shrub	3,6	
	<i>Broussonetia papyrifera</i>	Tree		2
	<i>Ficus cardiophylla</i>	Shrub	2,3,6	
	<i>Ficus hirta</i>	Tree	2,3,6	
	<i>Streplus asper</i>	Tree		2,4
	<i>Streplus inlicifolia</i>	Shrub		2
Myristicaceae	<i>Knema sp.</i>	Tree	6	
Myrsinaceae	<i>Ardisia crenata</i>	Shrub		4
	<i>A. aciphylla</i>	Shrub		1,2,4
	<i>Embelia ribes</i>	Climber		4
	<i>Maesa perlarius</i>	Shrub	6	1
Myrtaceae	<i>Decaspermum parviflorum</i>	Tree		4
	<i>Psidium gujava</i>	Tree	1	
	<i>Syzygium zeylanicum</i>	Tree	6	3,4
Passifloraceae	<i>Passiflora foetida</i>	Climber		2,3
Piperaceae	<i>Piper betle</i>	Herb	6	
	<i>Piper lotot</i>	Herb	3,6	
	<i>Piper pseudonigrum</i>	Herb	6	
Polygonaceae	<i>Polygonum multiflorum</i>	Climber	2,3,6	
Proteaceae	<i>Helicia tonkinensis</i>	Tree		3
Rhamnaceae	<i>Ziziphus oenoplia</i>	Tree		1
Rhizophoraceae	<i>Carallia brachiata</i>	Tree		1
Rosaceae	<i>Prunus fordiana</i>	Tree		2
	<i>Rosa longicuspis</i>	Climber	1,2,3,6	
	<i>Rubus alceaefolius</i>	Climber	1,2,3,6	
Rubiaceae	<i>Cephalanthus tetradra</i>	Tree		3,4,10
	<i>Morinda citrifolia</i>	Tree		4
	<i>Paederia lanuginosa</i>	Climber	1,2,3,6	
	<i>Randia tomentosa</i>	Tree	3,6	1,3
	<i>Paederia scandens</i>	Climber	1,2,3,6	
Rutaceae	<i>Chusena dunniana</i>	Shrub		1
	<i>Clausena excavata</i>	Shrub	6	
	<i>Euodia meliaefolia</i>	Tree		1,10
Sapindaceae	<i>Paviesia annamensis</i>	Tree	6	2,3,4,10
	<i>Dimocarpus longan</i>	Tree	3,6	
	<i>Litchi sinensis</i>	Tree	6	

Family	Species	Life form	Age of fallow where recorded (years)	
			1020-1120m	650-750m
Sargentodoxiaceae	<i>Sargentodoxia cuneata</i>	Climber		3,10
Simaroubaceae	<i>Brucca javanica</i>	Tree		1
Solanaceae	<i>Solanum torvum</i>	Herb	1,2	
	<i>Solanum verbascifolium</i>	Herb	1,2	
	<i>Solanum thurpii</i>	Herb	1,2	
Sterculiaceae	<i>Helicteres angustifolia</i>	Shrub		2,3,4
	<i>Streculia lanceolata</i>	Tree		3
Umbelliferae	<i>Centella asiatica</i>	Herb	1,2,3	
Verbenaceae	<i>Clerodendrum philippinum</i>	Herb	1,2	
	<i>Vitex pinnata</i>	Tree		1,2,3,4,10
Vitaceae	<i>Ampelocissus martinii</i>	Climber	6	2
Monocotyledones				
Araceae	<i>Amorphophallus tonkinensis</i>	Herb		4
Commelinaceae	<i>Commelina bengalensis</i>	Herb	1,2	1,3
	<i>Commelina communis</i>	Herb		1,3
	<i>Commelina diffusa</i>	Herb	3,6	
	<i>Floscopa glabratus</i>	Herb	3,6	
Cyperaceae	<i>Carex sp.</i>	Herb	6	
Dioscoreaceae	<i>Dioscorea bulbifera</i>	Climber		3,4,10
	<i>Dioscorea cirrhosa</i>	Climber	1,2,3,6	
	<i>Dioscorea membranacea</i>	Climber	3,6	
	<i>Dioscorea persinulis</i>	Climber	1,2,3,6	1,2,3
Maranthaceae	<i>Phryrium placentarium</i>	Herb	6	
Musaceae	<i>Musa balbisiana</i>	Herb	6	
Palmae	<i>Calamus rudentum</i>	Climber		2,3
	<i>Calamus tonkinensis</i>	Climber	6	3,4
	<i>Caryota mitis</i>	Tree	6	
	<i>Caryota sp.</i>	Tree	3,6	
	<i>Phoenix humilis</i>	Shrub	6	
Padanaceae	<i>Pandanus tonkinensis</i>	Herb	1,2	
Poaceae	<i>Apludia mutica</i>	Herb	1,2,3,6	
	<i>Aristida chinensis</i>	Herb	1,2,3,6	
	<i>Arundinella bengalensis</i>	Herb		1
	<i>Axonopus compressus</i>	Herb		1,2
	<i>Bambusa schizostachyoides</i>	Shrub	6	3,4,10
	<i>Capillipedum cinetum</i>	Herb	1,2,3,6	
	<i>Centotheca litifolia</i>	Herb	1,2,3,6	1,2,3,4,10
	<i>Chloris barbata</i>	Herb	1,2	

Family	Species	Life form	Age of fallow where recorded (years)	
			1020-1120m	650-750m
	<i>Dichanthium annulatum</i>	Herb	1,2,3,6	
	<i>Digitaria timosensia</i>	Herb	1,2,3,6	
	<i>Imperata cylindrica</i>	Herb	1,2,3,6	
	<i>Isachne miliaceae</i>	Herb		1,2
	<i>Leptochloa filiformis</i>	Herb	1,2,3,6	
	<i>Miscanthus nepalensis</i>	Herb		2
	<i>Panicum brevifolium</i>	Herb	1,2,3,6	
	<i>Saccharum spontaneum</i>	Herb	1,2,3,6	1,2,3
	<i>Sinocalamus giganteus</i>	Tree		3,4
	<i>Thysanolaena maxima</i>	Herb	2,3,6	
Smilacaceae	<i>Smilax ovalifolia</i>	Climber	1,2,3,6	3,4,10
	<i>Smilax lanceifolia</i>	Climber	1,2,3,6	3,4,10
	<i>Smilax sp.</i>	Climber	1,2,3,6	4,10
	<i>Heterosmilax gaudichaudiana</i>	Climber	2,3,6	
Stemonaceae	<i>Stemona tuberosa</i>	Climber	2,3,6	
Zingiberaceae	<i>Alpinia macroura</i>	Herb	2,3,6	
	<i>Amomum tonkinensis</i>	Herb	1,2,3,6	
	<i>Costus tonkinensis</i>	Herb		2
	<i>Zingiber zerumbet</i>	Herb	2,3,6	2,3,4