Reproductive Forest Resources as Incentive of Local Community and Role of Forest Ecosystem Services

2013.9.12

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1. What are occurred in tropical forests under the present situation?

   -Forest ecosystem services are decreases-

2. Tropical forestry for supplying the reproductive natural resources

3. Incentive of local community living with the forest

4. Forestry will be the way of future

1. What are occurred in tropical forests?
(1) Forest ecosystem services

***Loss of Forest Values by Decreasing and Degraded Forests in Tropics**

***Cultural Value** — **Forest Culture**: Long term, reverence, respect

***Ecological Value** — **Mitigation of warming**: Carbon sequestration

Biodiversity: Diversity of species and gene (for medicine, industry, agriculture etc.)

Local and global environment: Water storage and balance, land slide, erosion, mitigation of climate, fire protection, amenity etc.

Fertility of soil: Fertile, sustainable primary production condition

***Socio-Economic Value** — **Reproductive forest resources**: 60 % decreasing wood supply from 1978 to 2000

Non timber forest products: Mushroom, bamboo, medicinal plants, wild vegetable etc.

1. What are occurred in tropical forests?
(1) Forest ecosystem services

Ecosystem Services — Introduction

"Ecosystem services" are the **benefits** that people receive from the environment.

PROVISIONING SERVICES

Products obtained from ecosystems

- Food
- Freshwater
- Fuelwood
- Fibre
- Biochemicals
- Genetic resources

REGULATING SERVICES

Benefits obtained from regulation of ecosystem process

- Climate regulation
- Disease regulation
- Water regulation
- Water purification
- Pollination

CULTURAL SERVICES

Non material benefits obtained from ecosystems

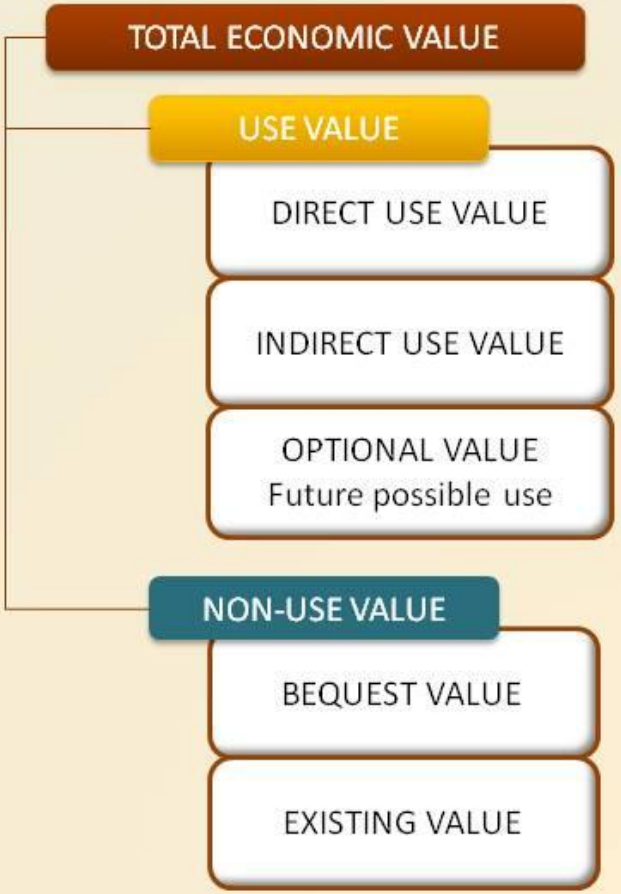
- Spiritual and religious
- Recreation and ecotourism
- Aesthetic
- Inspirational
- Educational
- Sense of place
- Cultural heritage

SUPPORTING SERVICES

Services necessary for the production of all other ecosystem services

- Soil formation
- Nutrient cycling
- Primary Production

***Millennium** Ecosystem Assessment.(2005)*



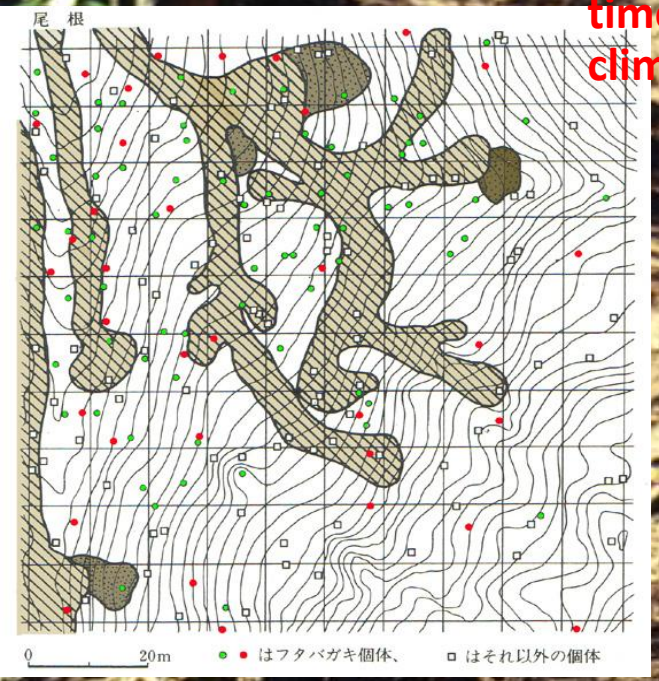
1. What are occurred in tropical forests?
(2) Loss and/or decreasing forest ecosystem services

Reproductive Natural Resources of Woods

- Forest Harvesting/Planting : Vitalize the carbon sequestration after harvesting

Strongest Human Impacts to Forest Ecosystem

- Changes Soil by Forest Harvesting : cutting/yarding, time, site preparation, planting/regeneration etc.
  climate, landform, geology, soil etc



1. What are occurred in tropical forests?

(2) Loss and/or decreasing forest ecosystem services after forest harvest

Table 1. Changes of soil properties before and after forest harvesting (Kobayashi, 1995)

Soil property	Mt. Takahara, Tochigi Pref., JAPAN	Andrews Exp. Forest, Oregon, U.S.A.	Labi Hill, BRUNEI	(Unit)
A0 thickness:				
before	3.7 ± 1.9	4.6 ± 4.2	4.8 ± 2.1	cm
after	2.1 ± 2.1	8.1 ± 9.0	4.5 ± 4.5	cm
rate	(56.8%)	(176.1%)	(93.8%)	
A thickness:				
before	11.2 ± 3.8	4.6 ± 2.0	9.8 ± 3.9	cm
after	10.3 ± 5.4	2.5 ± 2.4	6.3 ± 5.0	cm
rate	(92.0%)	(54.3%)	(64.3%)	
Bulk density:				
before	0.379 ± 0.075	0.524 ± 0.084	1.068 ± 0.153	g/cc
after	0.440 ± 0.081	0.591 ± 0.114	1.228 ± 0.290	g/cc
rate	(116.1%)	(112.8%)	(115.0%)	
Saturated hydraulic conductivity:				
before	446 ± 196	254 ± 187	61 ± 75	cc/min.
after	252 ± 129	53 ± 79	46 ± 75	cc/min.
rate	(56.5%)	(20.9%)	(75.4%)	
Non-capillary porosity:				
before	47.7 ± 4.0	48.5 ± 4.9	35.5 ± 4.9	%
after	40.5 ± 4.8	45.3 ± 6.3	24.7 ± 9.0	%
rate	(84.9%)	(93.4%)	(69.6%)	
Capillary porosity:				
before	35.4 ± 3.3	24.0 ± 3.4	21.4 ± 2.6	%
after	39.8 ± 4.0	25.4 ± 4.7	27.2 ± 5.2	%
rate	(112.4%)	(105.8%)	(127.1%)	
Total carbon:				
before	15.41 ± 3.31	7.77 ± 7.32	3.9 ± 1.4	%
after	12.38 ± 2.96	9.23 ± 3.54	2.8 ± 1.7	%
rate	(80.3%)	(118.8%)	(71.8%)	
Total nitrogen:				
before	0.75 ± 0.14	0.23 ± 0.05	0.21 ± 0.05	%
after	0.65 ± 0.14	0.25 ± 0.06	0.16 ± 0.08	%
rate	(86.7%)	(108.7%)	(76.2%)	

1. What are occurred in tropical forests?
(2) Loss and/or decreasing forest ecosystem services

Cryptmeria Japonica **and** ***Chamecypari obtusa*** **plantation in Mt. Takahara in Tochigi Prefecture**

After planting

6 months after planting

5 years after planting

10 years after planting

1. What are occurred in tropical forests?
(2) Loss and/or decreasing forest ecosystem services

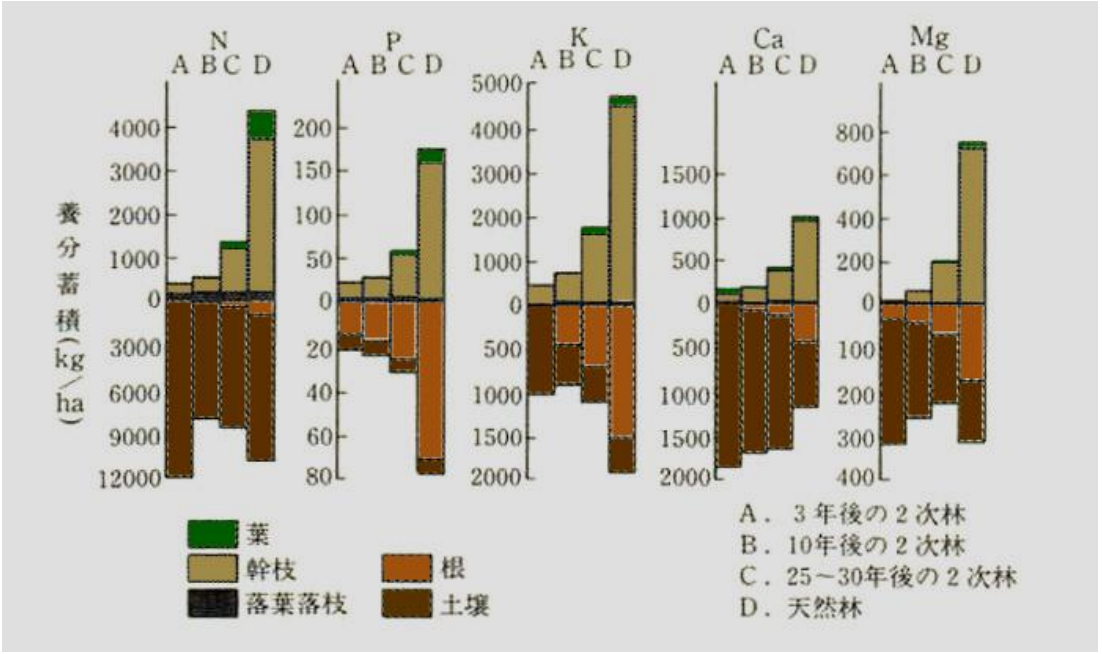
Recovery of Forest Ecosystem after Harvesting

●Vegetation-Soil Recovery

＜Secondary forest （Peru Amazon）＞

- Nitrogen, Phosphorus, Potassium etc. Storage recovery
- Grass land less than logged over forest (3 year after) in nutrient storage
- Increasing the nutrient storage in above and bellow forest ecosystem with time after harvesting

* Soil physical properties : recover



1. What are occurred in tropical forests?
(2) Loss and/or decreasing forest ecosystem services

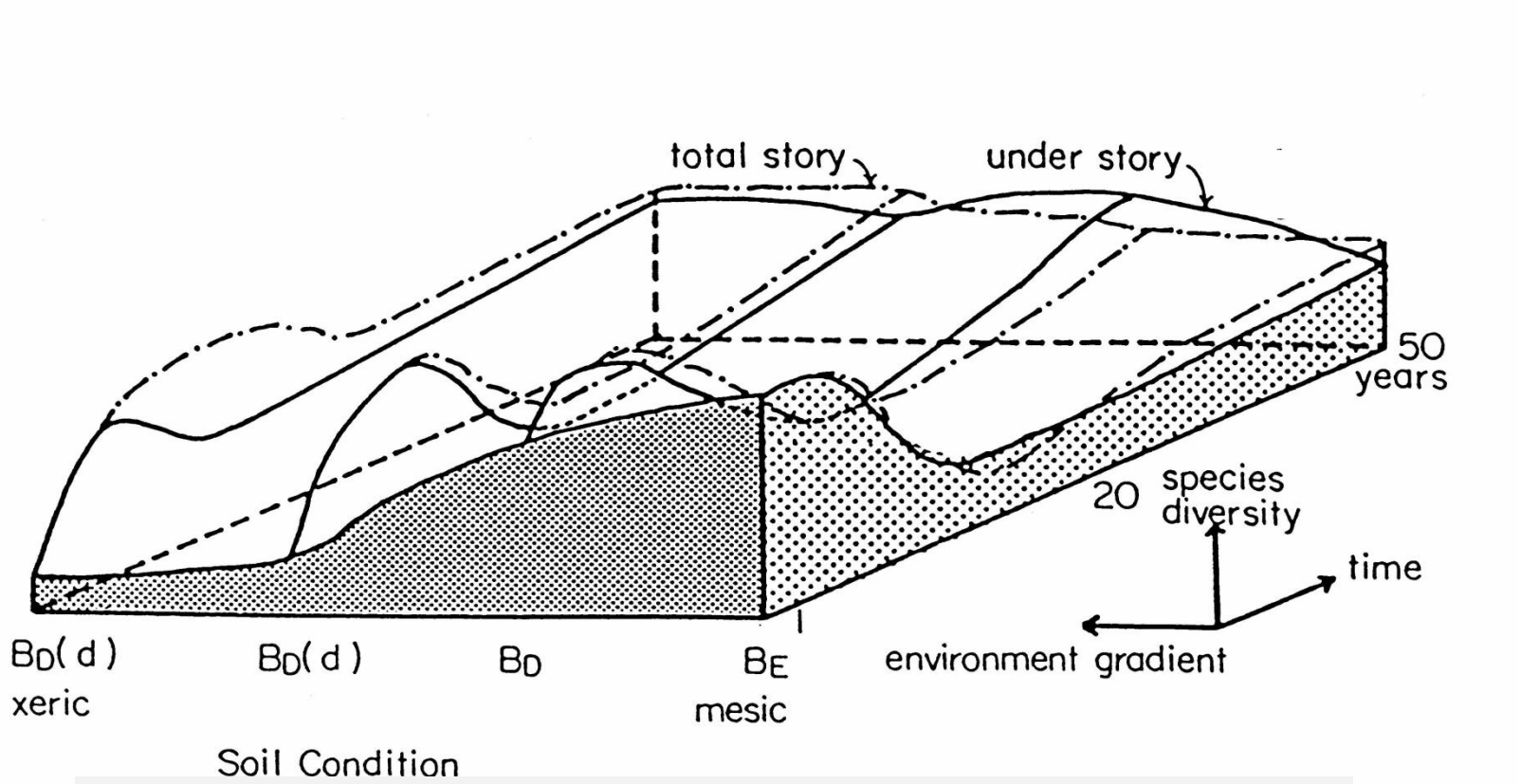


Fig. Model of species diversity change along to environmental gradient at Hinoki (*Cryptmeria japonica*) plantation (Kobayashi 1984)

2. Tropical forestry for supplying the reproductive natural resources

(1) Teak (*Tectona grandis*) forestry for production of timber

(Silvicultural techniques)

1.Seedling production

:seed resources, seed storage, accelerating seed germination, seedling storage (seed bed change, root cut, pot of seedling, transportation etc.)

2. Plantation

(1) Site preparation (nothing, burning, accumulation etc.)

(2) Planting including direct sowing and without of planting with natural regeneration (density,)

(3) Silvicutural treatment

(i) Weeding

(ii) Fertilizer spread

(iii) Thinning

(iv) Branching

2. Tropical forestry for supplying the reproductive natural resources

(1) Teak (*Tectona grandis*) forestry for production of timber

The Completely Randomized Block Design was employed having 9 treatments and 3 replications as follows:

A : Control

B : 1 : 1 mechanical thinning

C : 1 : 1 mechanical thinning + coffee as intercropping

D : 2 : 2 mechanical thinning

E : 2 : 2 mechanical thinning + coffee as intercropping

F : Low thinning

G : Low thinning + + coffee as intercropping

H : Clear cutting

I : Clear cutting + + coffee as intercropping

Each plot contains 81 teak trees (9 x 9 rows) or approximately 0.16 ha. Thus, total areas of the whole experimental plots will be 4.32 ha. The layout of the experimental plot is shown in Figure 2.

2. Tropical forestry for supplying the reproductive natural resources

(1) Teak (*Tectona grandis*) forestry for production of timber

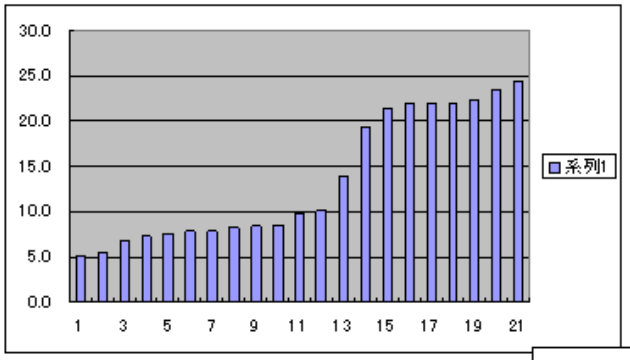
Table 1 Growth of remaining trees, coppices and seedling on the condition of treatments from 2004 to 2005

	Treatment									
	2Low:2Low		1Low:1Low		Low thinning		Clear cutting		Controle	
	height(m)	GBH(cm)	height(m)	GBH(cm)	height(m)	GBH(cm)	height(m)	GBH(cm)	height(cm)	GBH(cm)
Remaining trees										
2005	20.7	75.3	22.3	85.4	23.8	87.1	0	0	22.6	72.4
2004	23.1	77.7	23.8	86.1	25.9	88.3	0	0	22.3	70.6
annual growth	−2.4	−2.4	−1.5	−0.5	−2.9	−1.2			0.3	1.8
Coppices										
2005	8.4	19.8	8.3	21.4	6.5	15.2	10.8	20.1	0	0
2004	8.1	21.6	7.4	23.9	6.2	19.3	12.4	40.2	0	0
annual growth	0.3	−1.8	0.9	−2.5	0.3	−4.1	−1.6	−20.1		
Seedlings*										
2005	54	9.8	77.5	7.5	56.8	4	103.6	28.3	0	0
2004	32.8	9.4	53.3	6.2	39.8	3.5	104.7	32	0	0
annual growth	21.2	0.4	24.2	1.3	17	0.5	−1.1	−3.7		
	*Seedling height (cm), GBH=Seedling number per 0.16ha									

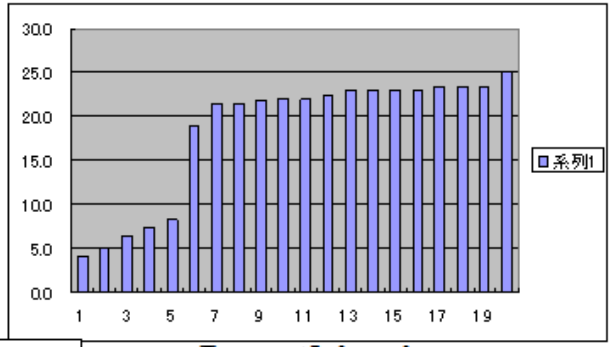
2. Tropical forestry for supplying the reproductive natural resources

(1) Teak (*Tectona grandis*) forestry for production of timber

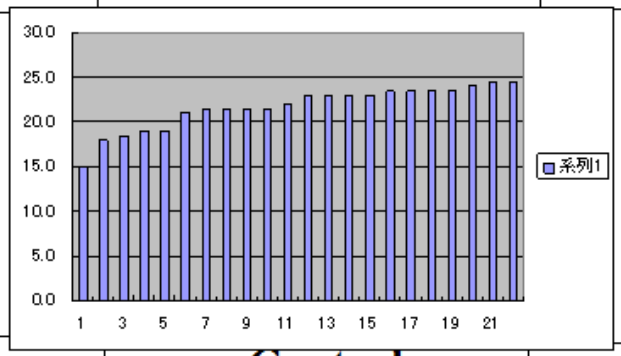
Forest structure after thinning



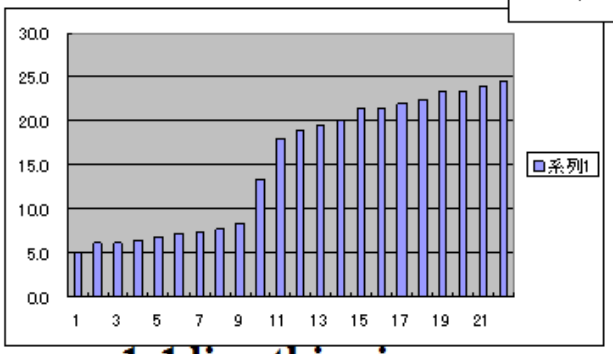
2:2 line thinning



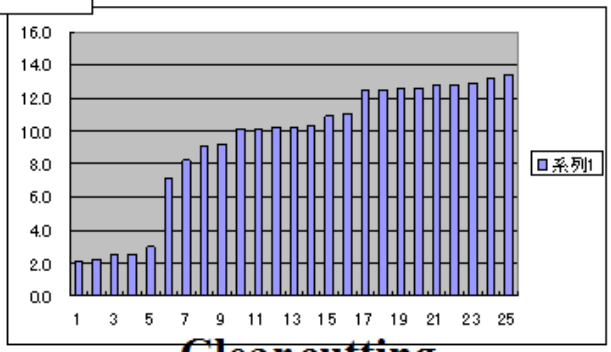
Low thinning



Control



1:1 line thinning

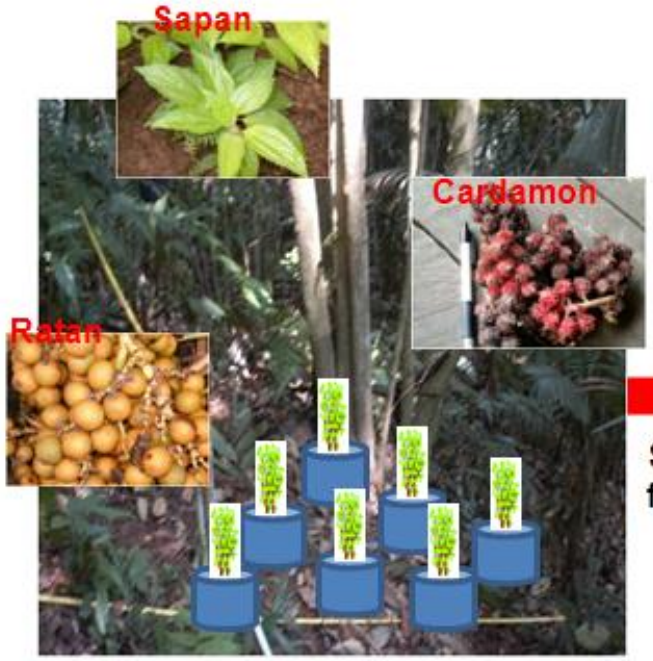


Clear cutting

Multi-story Forest

2. Tropical forestry for supplying the reproductive natural resources

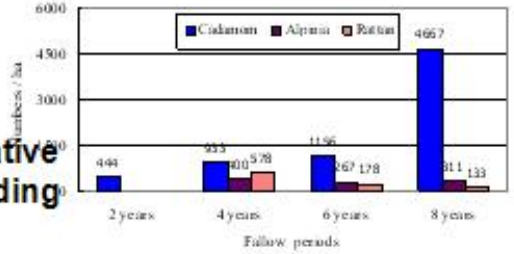
(2) Semi domestication of NTFPs at secondary, logged-over and fallow forests



Natural nursery under forest
Collecting wildings and share the vegetative Organs such as valve, rhizome and seeding using plastic bags

Measuring non-timber forest products each different fallow year

Seedlings and wildings transplanting from forest floor to fallow floor



Incentive of Local community to Non-timber forest products for REDD

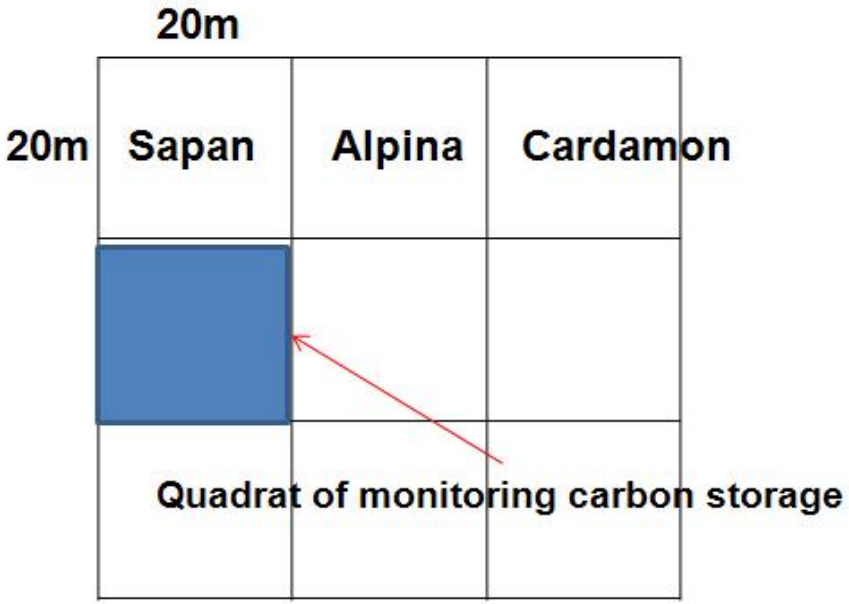
Measuring annual increment of fallow Trees and culcukate carbon storage

Create carbon crejit

Semi-domestication of non-timber forest products

2. Tropical forestry for supplying the reproductive natural resources

Nam Ha, Luang Nam Tha, Laos



Phot.1 planting wildings of cardamon at 4years old fallow

Fig.1 Experimental site for semi-domestication (Luang Nam Tha, Laos)
plantation density: 2500/ha

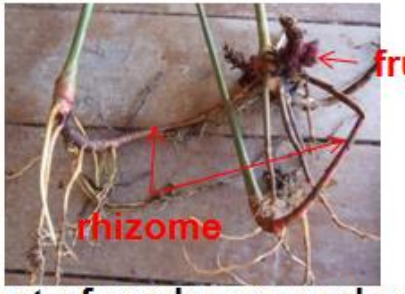


Photo. 2 Reproductive effort of cardamon and sexual (fruit)/asexual (rhizome) reproduction

(1) Site: Four years old fallow
(2) Treatment: Forest under plantation with clearing the understory
(3) NTFP's: Cardamon, Alpina, Sapan using wildings

2. Tropical forestry for supplying the reproductive natural resources

(2) Semi domestication of NTFPs at secondary, logged-over and fallow forests

*Indigenous knowledge: Produced a detail list of NTFPs and clarified the rich history of NTFPs, and proved that the sustainable use of firewood for life and swidden agriculture can coexist if traditional knowledge is fully utilized and the fallow period is long enough.

*Conservation of biodiversity: Examines the present state of swidden cultivation and reports on the progress of the introduction of lac cultivation as a strategy for the 'stabilization' of swidden cultivation in a Khmu village in Luang Prabang Province in Laos.

*Local community participation: A major cause of the loss and degradation of tropical rainforests in Amazon is the clearing of the forest by peasants who have migrated. The research analyzed community forestry cases that involve groups of people who are including women, dalits (lower-caste people), and indigenous peoples. The research described various factors and linkages that are involved in the dynamic process of community forestry, and identified problems and issues for further research.

*Carbon credit: A carbon credit of 4.87/Mg/ha/yr × 3years= 14.62/Mg/ha /3yr has been produced through the semi-domestication of non-timber forest products in fallow forest in Luang Nam Tha. Carbon storage in Luang Nam Tha is 13,633,150/Mg/3yrs, and Laos is estimated to have carbon storage of 399,300,000/Mg/yr.

3. Incentive of local community living with the forest

(1) Expectation to the forest –comparison between Thailand and Japan

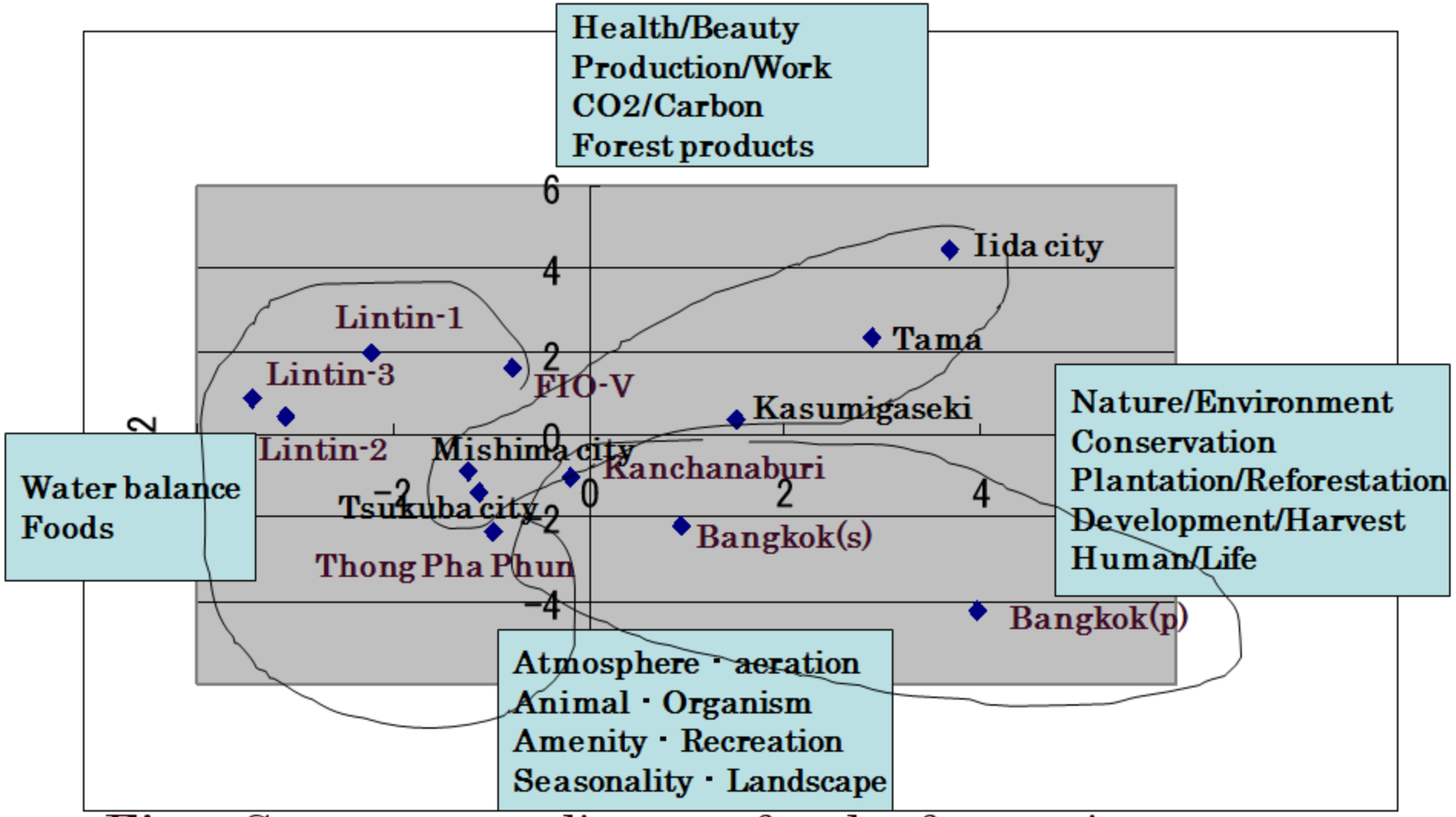
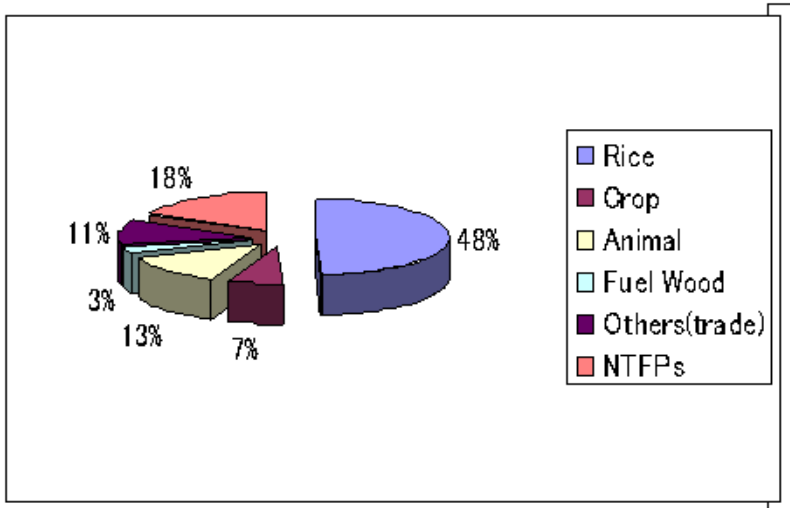


Fig. Score scatter diagram for the forest view
(two countries: Thailand 846)

3. Incentive of local community living with the forest

(2) Income generation from the forest in Laos

Comparison of annual income between Nam Ha Village and Luang Nam Tha City



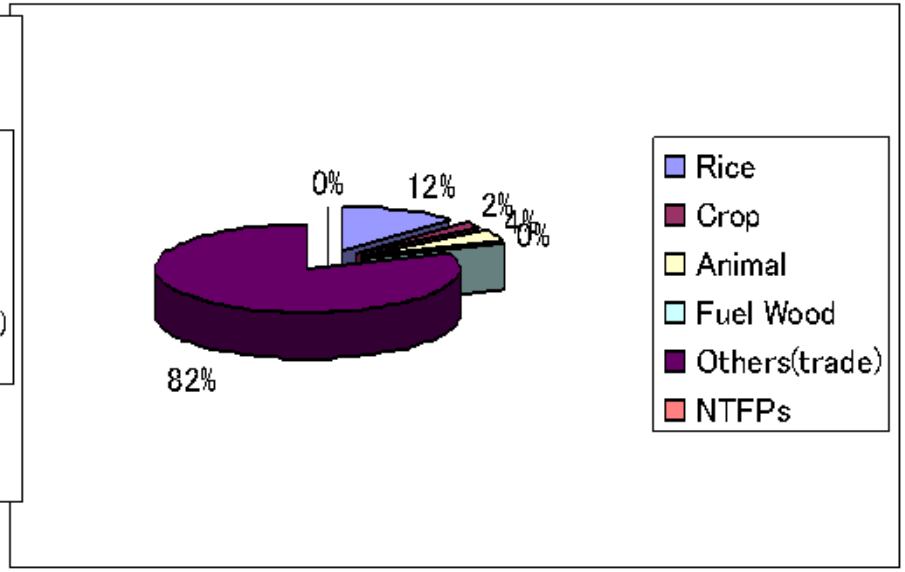


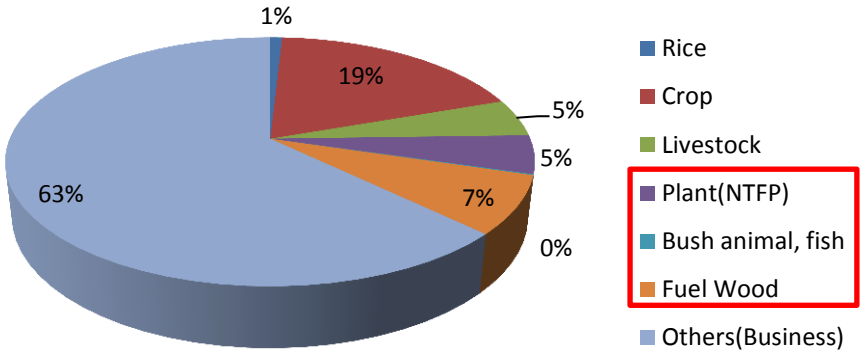
Fig.1 Annual income per household at Nam Ha V.:2,771,428 Kip (about US 308 D., Max.7,000,000, Min.50,000)
(1) Rice:1,370,238, (2) NTFPs:485,592

Fig.2 Annual income per household at Luang Nam Tha City:20,048,979 Kip (about US 2228 D., Max. 109,500,000, Min. 150,000)
(1) Business:16,206,816, (2)Rice:2,497,265

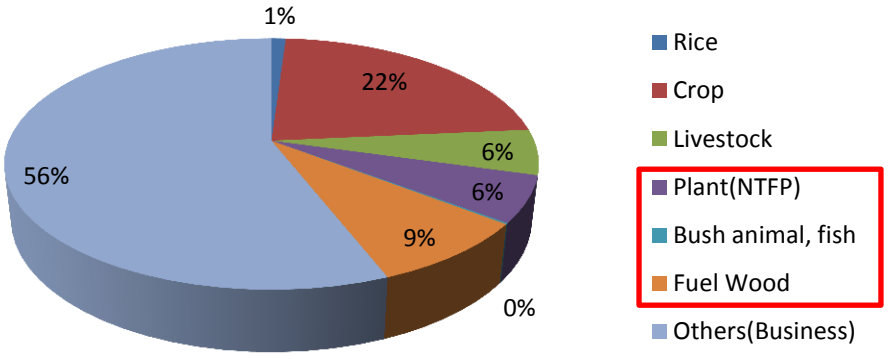
3. Incentive of local community living with the forest

(2) Income generation from the forest in Peru

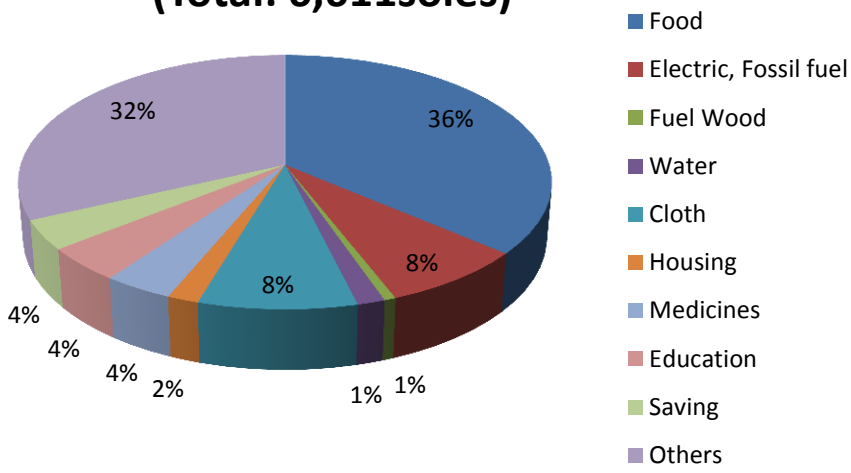
Annual income in Pucallpa (Total: 6,599soles)



Annual income in Iquitos (Total: 5,623soles)



Annual expenditure in Pucallpa (Total: 6,611soles)



Annual expenditure in Iquitos (Total: 5,633soles)

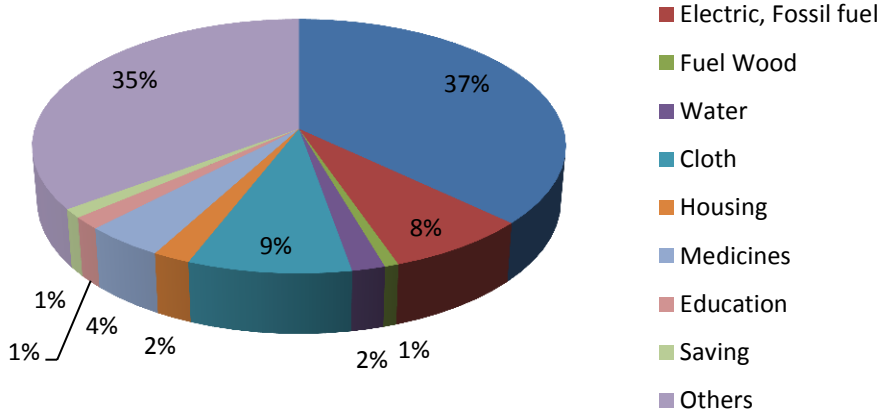


Fig.1 Comparison of annual income and expenditure between Pucallpa and Iquitos

3. Incentive of local community living with the forest

(2) Income generation from the forest in Guinea

Annual income and expenditure

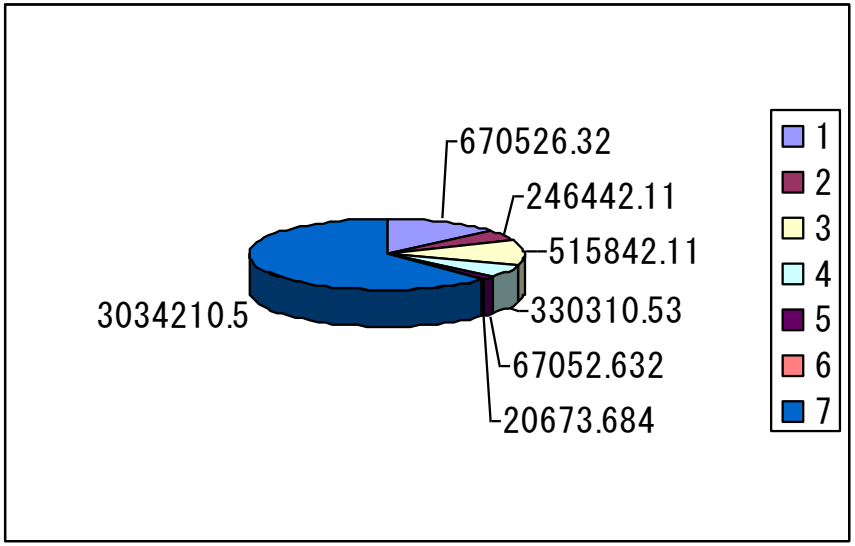


Fig.2 Annual income per household in Guinea
Total Income: 4,885,058FG
(about US 1,136 d.)
1:Rice, 2:Crop, 3: Pig, Chicken, 4:NTFP, 5:Bush Animal, Fish, 6:Fuel Woods, 7:Business, Others

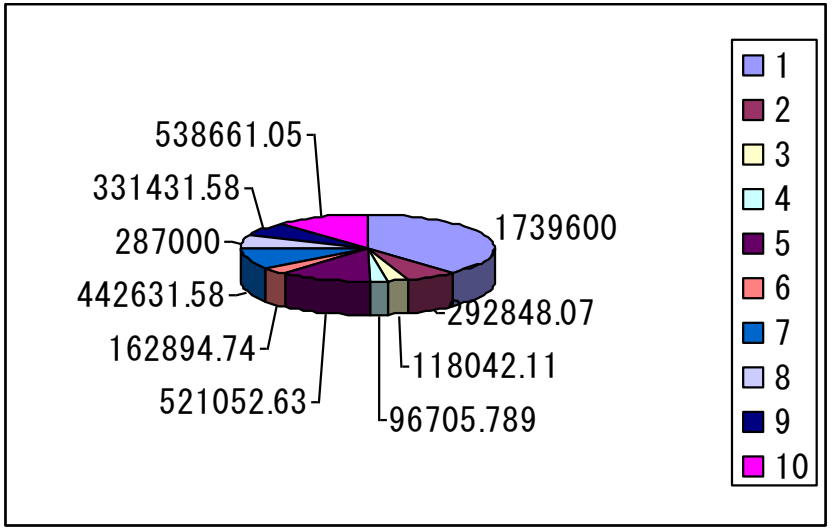
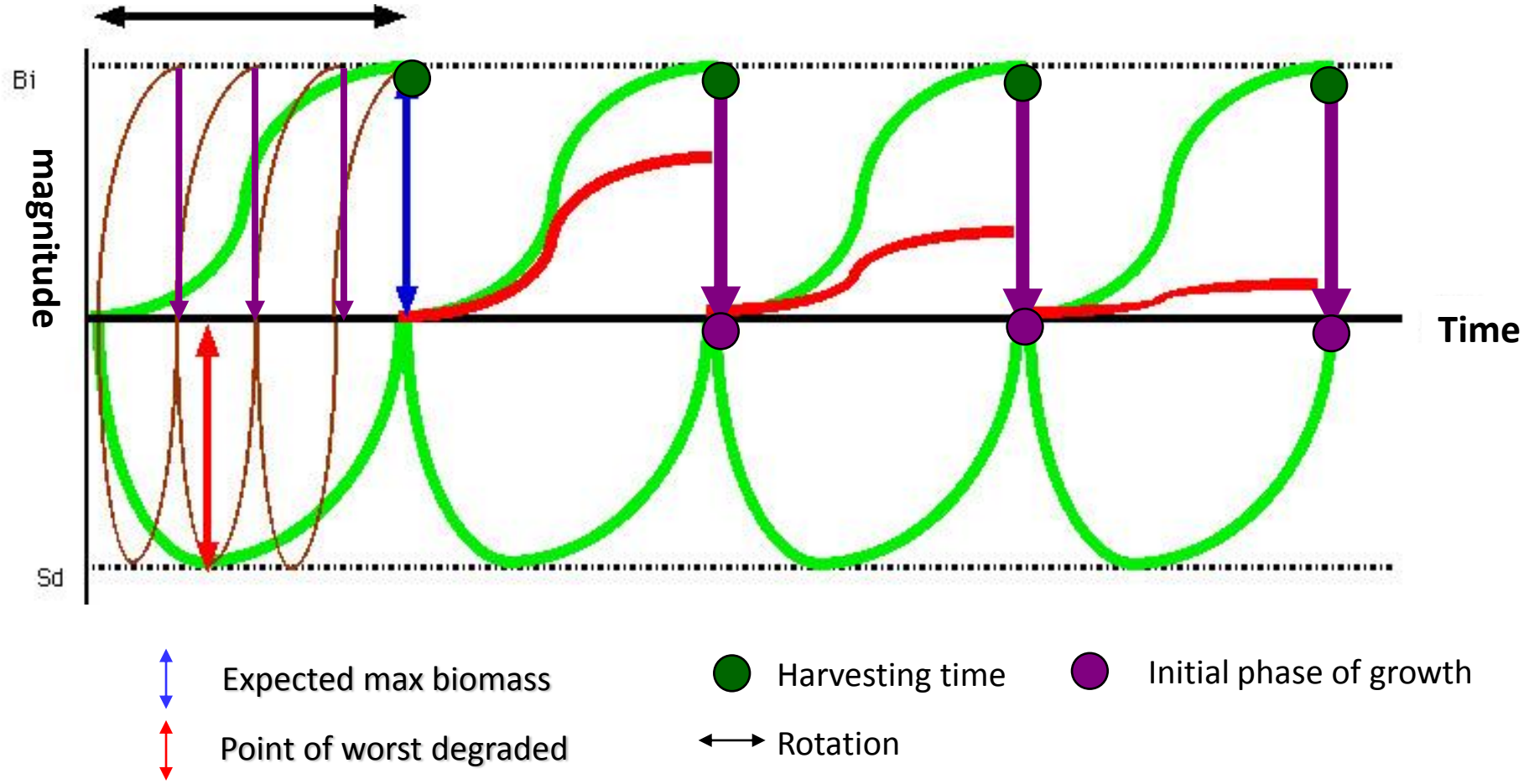


Fig.3 Annual expenditure per household In Guinea
Total expenditure: 4,530,868 FG
(about US 1,054 d.)
1:Food, 2:Electricity, Fossil Fuel, 3:Fuel Woods, 4:Water, 5:Cloth, 6:Housing, 7:Medicine, 8:Education, 9:Storage, 10:Others (Tontine)

4. Forestry will be the way of future

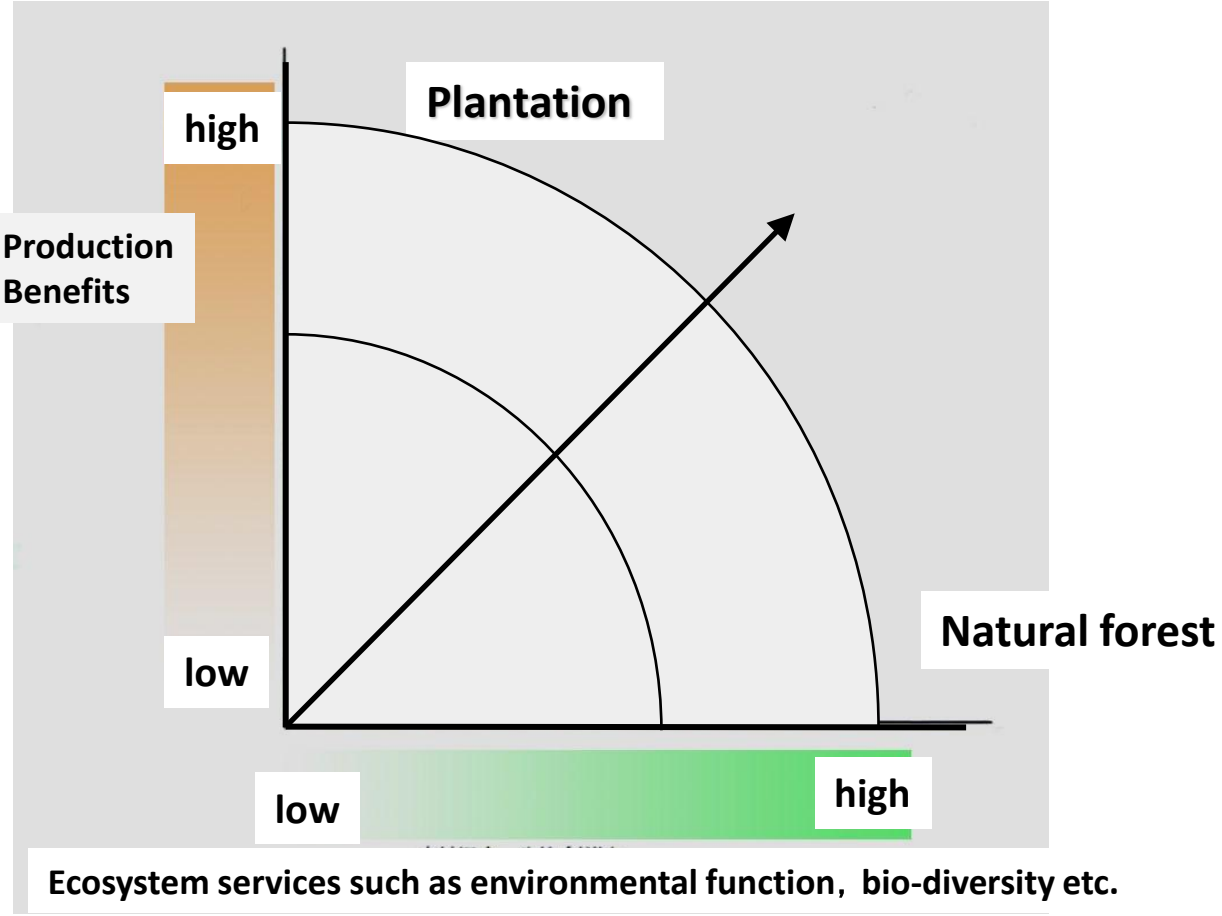
(1) Control factors for forestry and rehabilitation of degraded forest



Deference of cycle on forestry／agriculture

4. Forestry will be the way of future

(1) Control factors for forestry and rehabilitation of degraded forest



Relation of trade-off

4. Forestry will be the way of future

(2) Different incentive at different historical background of villages

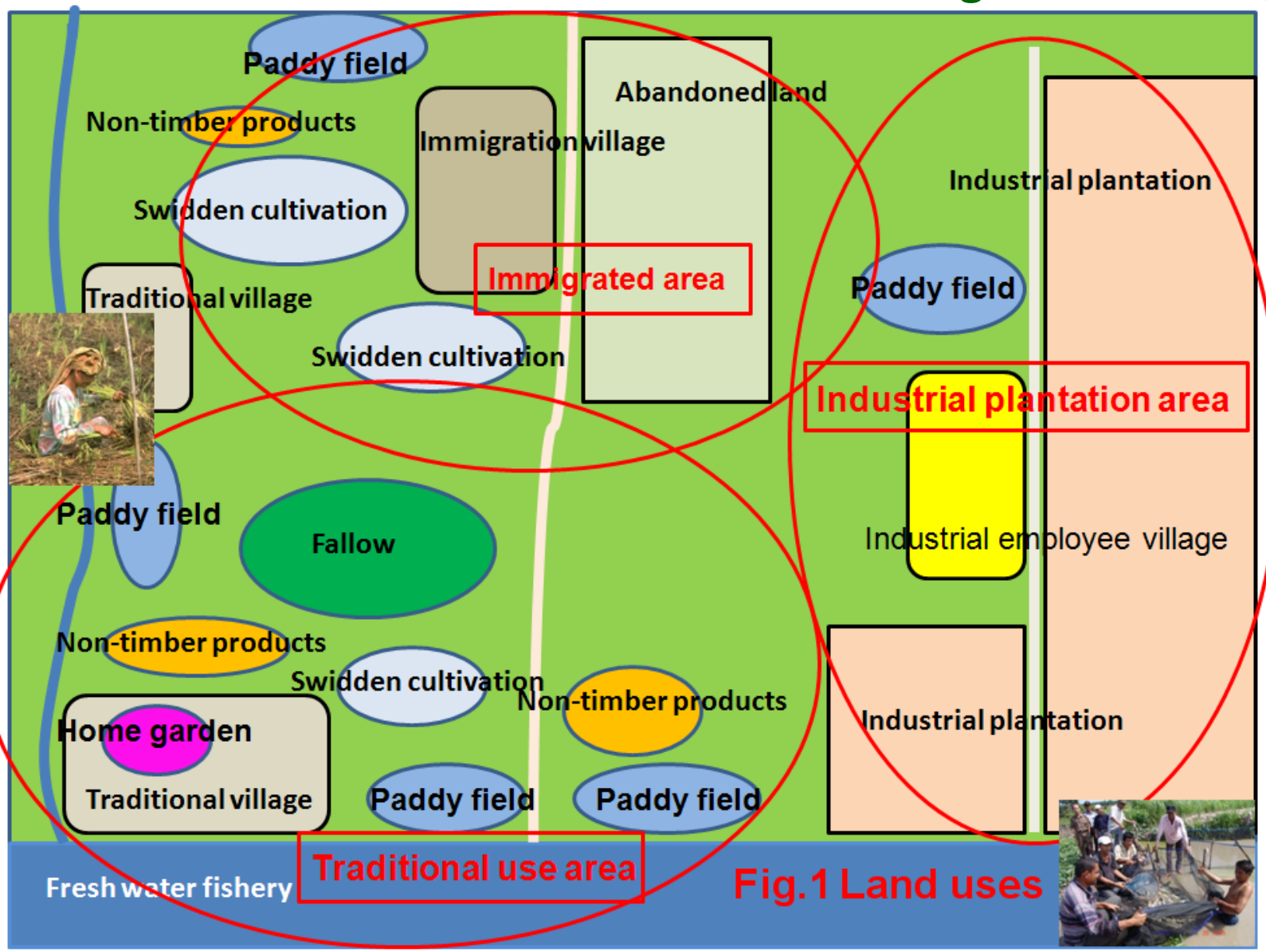
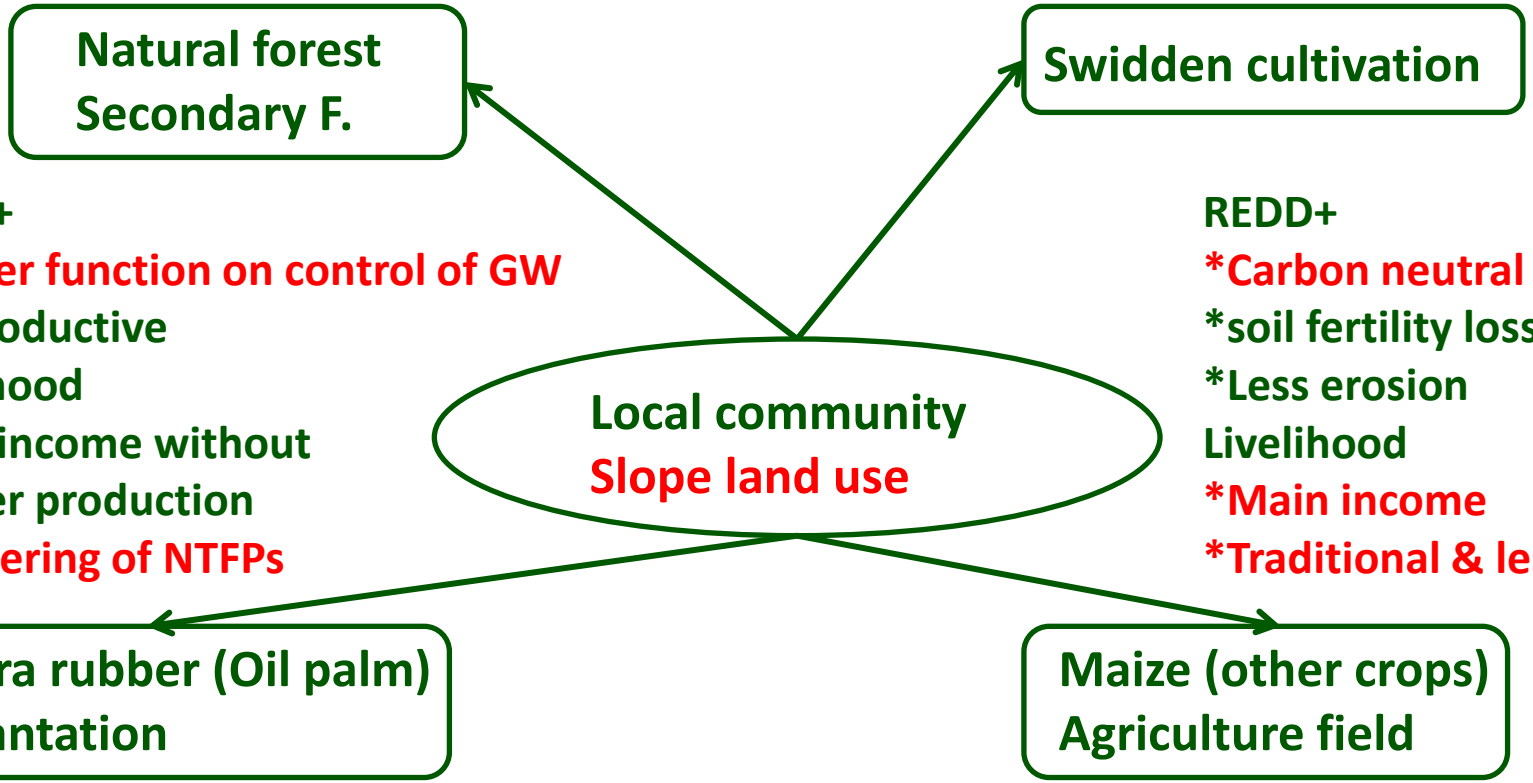


Fig.1 Land uses

4. Forestry will be the way of future

(3) Slop land use related with REDD+ and livelihoods



Forest Resources for Next Generation!

•Results of these researches supported by Ministry of Foreign Affairs, Ministry of Environment and Ministry of Education, Culture, Sports and Technology, Japan