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Studies on the Development of Tropical Agroforestry System Through Local People's Participation: The Case of Sitio Jordan, San Vicente, Sto. Tomas, Batangas, Philippines

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Abstract : This study aimed to develop an agroforestry technology through the participation of local people. The study was conducted in the Makiling Forest Reserve (MFR) of the University of the Philippines Los Banos (UPLB). Diagnosis and Design (D&D) methodology was employed to plan and implement effective research and development projects. Diagnostic interview and direct field observation were conducted to identify the significance of the land-use system and to understand how the system works. As a result of the diagnostic interview and direct field observation in San Vicente, old coconut-based land-use system is shifting to mahogany-based agroforestry system. One of the reasons is due to the very complicated socio-economic and silvicultural factors including lower price of coconut farm products, industry development, lack of labor force, and pest and diseases. Change in land use brought about by the shifting to mahogany-based farming system is slow. Also, mahogany trees are observed to be not well-maintained. However, mahogany based land use system gives farmers' a bigger income as well as environmental benefit. Farmer's cooperation and local forestry policy for CDM were proposed to encourage people's self-restoration effort.

Key words **:** *agroforestry, mahogany, mahogany-based multistory system, multistory, D&D, restoration by local people*

Introduction

Agroforestry, as a land use technology, is one of the most successful ways to rehabilitate the degraded forest areas can yield both wood and food while conserving and rehabilitating the ecosystems with the participation of local people. In the Philippines, particularly in Sitio Jordan – it is one of the two sites of the ASEAN-Korea Environmental Cooperation Project (AKECOP), Launched by the Korean Government from July 2000 to Jun 2005-, San Vicente, Sto. Tomas, Batangas, coconut-based multistory system, interplanted with fruit trees or coffee, is commonly being practiced by local people (Sto. Tomas CLDP 1996-2005, 1997). At present, there is an observed shift from coconut-based agroforestry system to mahogany-based agroforestry system (AKECU, 2002).

The concept of mahogany-based land use system is relatively new in the Philippines, making its adoption by farmers difficult. The idea of making mahogany-based land use system an appropriate production system is the basis for studying the desirability and cultural acceptability of the cropping system (Lee, 2002).

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Materials and Methods

1. Study area

The study was conducted around the Makiling Forest Reserve (MFR), about 65 km south of Manila in the Philippines, a forest area designated for the research activities of UPLB since 1910 (MCME, 1999). San Vicente Village lies within 14 degrees 06 inches N and 121 degrees 11 inches E (GPS reading using GEO-STAR) at the western part of MFR and has more than 100 households (Bagadion, 1999).

Results of the literature review and the pre-diagnostic survey show that there are three broad categories of farming systems within the MFR. These farming sys-

tems are: 1) kaingin (slash & burn cultivation), 2) home garden, and 3) plantation-based system. Plantation-based system, which combines the planting of agricultural crops, fruit or plantation crops, and tree crops, is the most dominant type.

2. Methodology

The research applied the basic concept of D&D methodology that was developed by ICRAF (Nair, 1993). D&D approach can be applied at different levels in the hierarchy of land-use systems. For this study, D&D was applied both at the family farm and community levels. The basic procedures of D&D consisted of five stages (Figure 1). The procedures are repeated throughout the project life in order to refine the original diagnosis and improve the technology design based from the new information from on-farm research trials and on-station investigation.

First, in pre-diagnostic stage, the research team observed distinctive combination of resources, technology and land use objectives. During the diagnostic stage, interviews and direct field observations were conducted to understand the system and find solutions in meeting the systems' objectives. As a result, development strategies to improve the present land use system and agroforestry technology were proposed (Table 1).

For the technical design and evaluation stage, several options of land use system and its evaluation, were suggested to farmers. Choice of farmer's on the appropriate technology depended on the farm's development stage and present agroforestry system including the farmer's objective.

3. Field experimental design

Three field experiments on growing mahogany and model farm development were conducted to improve land-use system (Table 2).

The profitability of the different cropping system combinations in San Vicente was analyzed for its financial profitability (Camacho, 2003). This involved the quantification of the costs and benefits for each cropping system. The streams of benefits were obtained by projecting the values of output (based on the value of crops harvested) for agroforestry and mixed perennial cropping system over 25 years. Also, local timber market survey was conducted by interviewing farmers, a harvester, and timber product sellers in the local market.

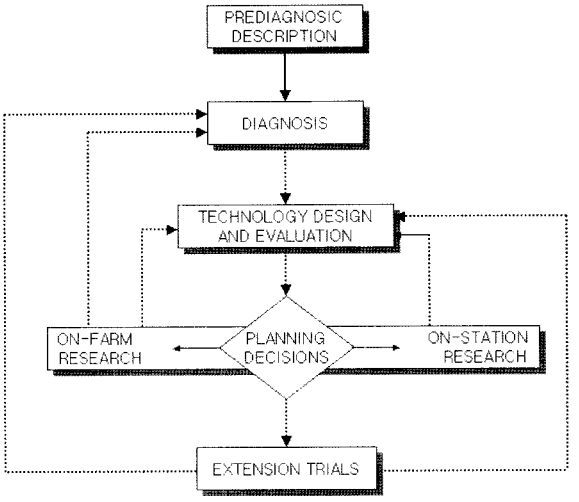

Figure 1. Flowchart of iterative activities and feedback in D&D methodology [Source: Raintree (1987)].

Results and Discussion

1. Classification of land use system in and around MFR

Mt. Makiling can be divided into four (4) zones based on predominant farming systems, including major industries found in each zone (Figure 2).

2. Socio-economic condition

Table 3 shows the major socio-economic characteris-

Table 1. Time schedule of research activity, 2000 to 2005.

Year of Project	Research Stage	Research Activity
1st year	1. Pre-Diagnostic Stage	– Review of literature and site history – Defining the land-use system
2nd year	2. Diagnostic Stage	– Direct field observation – Interview – Analysis
3rd year	3. Technical Design & Evaluation 4. Planning	– Design & Benchmarking – Workshop & Community meeting – On-site & on-farm research planning
4th year	5. On-site/On-farm Research & Extension Trial	– Conduct of experiments to improve the Mahogany-based land use system – Resource Inventory in Sitio Jordan – Survey of Local Timber Market
5th year	*6. Feedback*	*Re-diagnosis & Re-design*

Table 2. Basic features of three experiments for improving land-use systems.

Experiment 1. Effects of thinning on the growth of eight years old Mahogany and Intercropped Gabi, Edible Fern, Rattan and Ubi

- Experimental Area : 0.39 ha
- Experimental Design: RCBD with 3 blocks
- Treatments: T0 = no thinning, T1 = w/thinning
- Interplanting: Gabi: 30 plants/plot, Edible fern: 30 plants/plot; Rattan: 6 plants/ plot; Ubi: 6 plants/plot

Experiment 2. Effect of organic fertilizer and mulching treatments on the growth of three years old Mahogany plantation and intercropped Gabi and Papaya

- Experimental Area : 0.187 ha
- Experimental Design: RCBD with 2 blocks
- Treatments: T0 = No fertilizer & no mulching, T1 = w/ organic fertilizer & w/o mulching, T2 = w/ organic fertilizer & w/ mulching, T3 = w/o organic fertilizer & w/ mulching
- Replications (blocks) = 3, Sub-samples = 10

Total Experimental units = T x r x s = 3 x 3 x 10 = 60

Experiment 3. Effect of coconut frond pruning treatments on the growth and yield of interplanted mahogany

- Experimental Area: 2 ha
- Experimental Design: RCBD
- Treatments : Coconut frond pruning treatment, T0 : no pruning, T1 : with pruning
- Replications (block): 3, Sub-samples : 10

Total Experimental units: T x r x s = 2 x 3 x 10 = 60

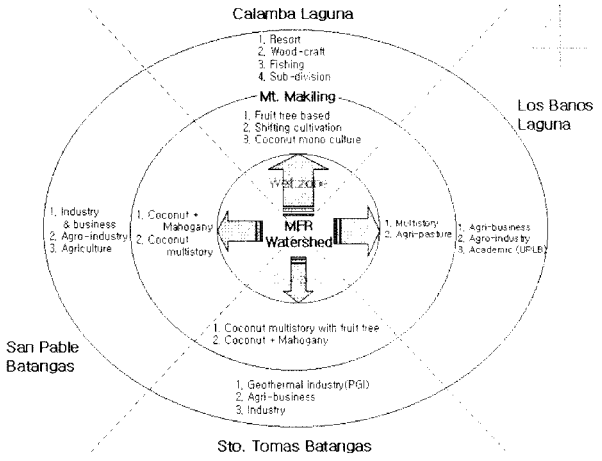

Figure 2. Classification of land use systems in MFR.

tics of farmers based from interviews, community meeting, and direct field observations within Sitio Jordan for 31 farmers.

3. Land-use system

In San Vicente, coconut-based multistory system is commonly interplanted with fruit trees or coffee. Mahogany-based agroforestry system is preferably planted within their farm lot, along boundaries, along the creeks, and under coconut. Major farming system inside MFR before 1990 was monoculture planting of citrus and coconut-based multistory system. At present, coconut- based multistory is predominantly cultivated inside and outside of the MFR area.

4. Factors affecting adoption of mahogany-based land use system

Factors affecting adoption of mahogany-based land use system, which were obtained through interview of individual farmers and holding of community workshop, are found in Table 4.

The results of the community workshop revealed that mahogany is primarily planted to supply the raw materials needed for house construction in the future. Other

Table 3. Major Socio-Economic Characteristics of Farmers in Sitio Jordan.

Parameters	Characteristics
Land-use system	Coconut-based farming system
Environment	Hilly & flat mountain area
Economy	Commercial and medium scale agriculture and agroforestry
Income level	US$70 to 1000/month
Society	Modern grassroots society
Farm size	1.5ha/1~8ha
Main products	Coconut (including copra), timber (coconut & mahogany), ginger, taro, coffee, and other fruits
Land ownership	81.5% of the farmers have tenurial security over their land
Available manpower	The majority of age range is 51 to 70 years old

Table 4. Factors affecting adoption of mahogany-based land use system.

Results from Community Workshop	Results from Individual Interview
1. Capital (for seeds and fertilizer)	1. Capital (for seeds and fertilizer)
2. Attitude of farmers (Industrious and perseverance)	2. Attitude of farmers
3. Educational campaign for information on how to plant mahogany	3. Information from others
4. Technology	4. Land availability
	5. Lack of labor availability

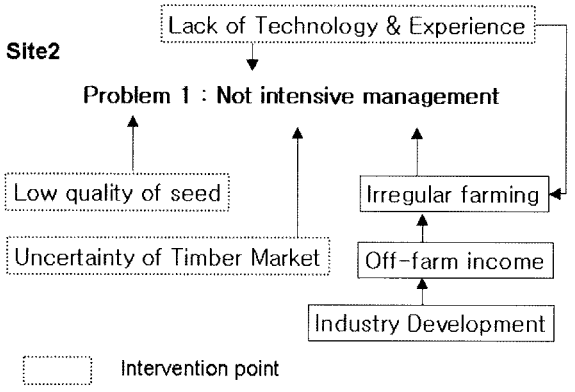

Figure 3. Causal of not intensive management in San Vicente.

reasons include: soil erosion control, source of additional income, and serves as boundary of their farm.

5. Problems and constraints

Farmers in Sitio Jordan are mostly private land-owners having with an average land holding of 2 ha, while others are tenants. From the old land-use systems of coconut-based, fruit tree-based, or coffee-based multistory system, farmers are now shifting to mahogany-coconut-mixed multistory system. This shift is caused by lower price of coconuts and the expected increase in timber products from mahogany. At present however, only a few farmers invest in mahogany plantation due to uncertainties in timber market, lack of technology/experience on growing timber species, low seed quality, and availability of jobs (Figure 3).

6. Implementation of field experiments

Three experiments dealing on the technical aspects of mahogany-based system was conducted. These are:

Experiment 1. Effects of thinning on the growth of eight-year old Mahogany and Intercropped Gabi, Edible Fern, Rattan and Ubi

The average thinning rate based on the number of trees was 46.75% whereas only 21.57% based on basal area. The original density of mahogany plantation was 2,546 trees/ha. Light intensity has increased from 310 lux to 8940 lux in the thinned plot while only 140 lux to 1110 lux was transmitted in the control plots. Agricultural crops planted under the mahogany have 100% mortality hence no yield was reported from 2003 to 2004. However, no significant difference in diameter change between thinned and unthinned plots were observed.

Experiment 2. Effect of organic fertilizer and mulching treatments on the growth of three-year old Mahogany plantation and intercropped Gabi and Papaya

Mahogany trees were planted in 1.5m by 1.5m distances. Organic fertilizer and mulching treatments have been applied. Annual growth rate was 2.12 cm/year, while the annual height growth was 1.23 m/year for all treatments and no significant differences between all treatments. Papaya and taro were planted to test the possibility of growing crops under the mahogany trees. Based on visual observation, papaya can thrive under shade with acceptable yield. However, plants were tall and weak and the fruits were small compared with those grown under full sunlight. On the other hand, taro has produced good quality tubers and has a higher yield.

Experiment 3. Effect of coconut frond pruning treatments on the growth and yield of interplanted mahogany

The annual growth rate of mahogany was 0.88 cm/year with frond pruning while 0.95 cm/year with the unprunned treatment. Diameter change between mahogany trees under pruned or unprunned coconut trees showed no significant difference. Also, coconut yield between plots with frond pruning and that of control showed no difference. However, many mahogany trees have damaged top in the control because coconut fronds hit the top of mahogany during windy days while no damaged top were observed with pruning of fronds.

7. Local timber market survey

Survey of the local timber market was done in order to understand the problems in timber marketing. In 2003, timber products from mahogany shared only 8% of the total amount of timber found in Sitio Jordan, San Vicente where as coconut timber and others share 89% and 3%, respectively. Coconut trees were utilized as construction materials while timber from mahogany was used for paneling of houses and materials for furnitures.

Table 4. Profit share of timber products in San Vicente.

		Mahogany	Coconut	Others
Value of Standing Log (Margin for farmer)		10 peso/b.f. (40.0%)	1 peso/b.f. (16.7%)	1 peso/b.f. (12.5%)
Harvest Cost	Chainsaw labor	2 peso/b.f.	1 peso/b.f.	1 peso/b.f.
	Assistant Labor	0.4 peso/b.f.	0.4 peso/b.f.	0.4 peso/b.f.
	Hauling to road by Horse	1.5 peso/b.f.	0.5 peso/b.f.	0.5 peso/b.f.
	Deliver to shop by Jeep	0.45 peso/b.f.	0.45 peso/b.f.	0.45 peso/b.f.
	Sub-total	4.35 peso/b.f. (17.4%)	2.35 peso/b.f. (39.1%)	2.35 peso/b.f. (29.4%)
Margin for Wholesaler		10.65 peso/b.f. (42.6%)	2.65 peso/b.f. (44.2%)	4.65 peso/b.f. (58.1%)
Wholesale Price (or Dealer Price)		25 peso/b.f. (100%)	6 peso/b.f. (100%)	8 peso/b.f. (100%)

Table 5. Profitability analysis of agroforestry system in San Vicente.

Financial Indicators	Values at Different Interest Rates			
A. Coconut and Lanzones	8%	12%	18%	20%
Net Present Value (NPV) (in Pesos)	54,947	26,184	8,350	5,468
Benefit Cost Ratio (BCR)	1.87	1.66	1.38	1.30
Internal Rate of Return (IRR) (in %)		28		
B. Coconut and Coffee				
Net Present Value (NPV) (in Pesos)	94,990	52,532	21,719	15,960
Benefit Cost Ratio (BCR)	1.62	1.54	1.40	1.35
Internal Rate of Return (IRR) (in %)		33		
C. Coffee Only				
Net Present Value (NPV) (in Pesos)	88,789	50,853	19,758	13,347
Benefit Cost Ratio (BCR)	2.02	1.76	1.39	1.29
Internal Rate of Return (IRR) (in %)		26		
D. Mahogany + Avocado + Lanzones + Coconut				
Net Present Value (NPV) (in Pesos)	650,104	258,386	61,647	35,920
Benefit Cost Ratio (BCR)	4.73	3.73	2.25	1.85
Internal Rate of Return (IRR) (in %)		27		
E. Mahogany Only				
Net Present Value (NPV) (in Pesos)	285,039	99,076	10,670	136
Benefit Cost Ratio (BCR)	2.76	2.22	1.23	1.00
Internal Rate of Return (IRR) (in %)		20		

(Sources: Camacho, 2003 and DENR-ERDB, 1998)

Table 4 shows the profit share for timber products. Results in 2003 show that mahogany is most profitable to the farmers compared with other tree species.

8. Profitability analysis of different agroforestry farms

The profitability of the dominant cropping systems was evaluated by using three criteria namely: Net Present Value (NPV); Benefit-Cost Ratio (BCR); Internal Rate of Return (IRR). These values were annualized using 8, 12, 18, and 20 percent discount rates (MCME, 2001). Results show IRR is highest in coconut and coffee combination while mahogany mono-culture has the lowest. However, NPV is highest in mahogany and fruit trees combination followed by mahogany monoculture.

Conclusion

Characterization of the land use system in the area was done for a period of five years to investigate problems and constraints. And, we proposed development strategies, performed field experiments, and analyzed for economic profitability. The results of diagnostic research show that a shift from agriculture-based land use system to forestry-based land use system. The shift is caused by

industry development, lack of labor force, comparatively dry condition, and less benefit from the old system.

Factors affecting adoption of mahogany-based land use system include capital for planting materials and fertilizer, attitude of farmers, information, labor force, and technology. The current shift to planting of mahogany can be facilitated if there is enough information on the planting technique and management including supply of quality planting materials. This result is very useful for the formulation of restoration policies and its campaign.

Farmers are planting mahogany trees for supplying the raw materials needed for housing and environmental protection. Based on the profitability analysis and local timber market survey, mahogany plantation or mahogany based agroforestry system allows farmers to get higher income. Therefore, the mahogany based land use system is perceived as the adoptable land use system providing reasonable income and better environmental protection.

The results of the three field experiments are helpful for improving production technology for mahogany plantation and can also help in the formulation of future farm plans for small-scale farmers, even though there were no significant results from the field experiments after 3 years of measurement. The short duration of the field experiments necessitates its continuity with farmer's participation as partners, record keepers, and local scientists. As a result, development strategy promoting people's self-restoration program and Clean Development Mechanism is proposed for further research. Among others, this will tackle issues on policies, support mechanisms, timber harvesting technology, financial and economic analysis.

Literature Cited

1. ASEAN-Korea Environmental Cooperation Unit. 2002. Restoration of degraded forest ecosystem in the Southeast Asian tropical region: Annual report, AKECU, Seoul. pp. 78-80.
2. Bagadion, B.C. 1999. Bending the wind: lessons from Mt. Makiling. Center for Development Management. pp. 18-19
3. Camacho, L. D. 2003. Economic Evaluation of the different farming systems within the Makiling Forest Reserve: An Evaluation Report.
4. Department of Environment and Natural Resources-Ecosystems Research and Development Bureau (DENR-ERDB). 1998. Development and management of forest plantations: A guide book. DENR-ERDB.
5. Lee, J. M. 2002. Factors affecting adoption of mahogany-based agroforestry system in the Philippines: Case study in Sitio Jordan, San Vicente, Santo Tomas, Batangas, Philippines. M.S. Thsis, Konkuk Univ. Seoul, Korea.
6. Makiling Center for Mountain Ecosystems (MCME). 2001. The Mt. Makiling forest reserve-Development initiatives and management experiences. MCME.
7. Makiling Center for Mountain Ecosystems (MCME). 1999. Towards the accreditation of qualified Mt. Makiling forest reserve occupants: An action research. MCME.
8. Municipality of Sto. Tomas. Sto. Tomas comprehensive land-use and development plan. Municipality of Sto. Tomas. 3-1-3-84.
9. Nair, P.K.R. 1993. Introduction to Agroforestry. Kluwer Acdemic Publisher. The Netherlands. pp. 347-351.

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