On-farm Evaluation of an Improved Fallow System in the Philippines

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Abstract

Although agroforestry is a new field of study, many forms of indigenous agroforestry systems have existed for generations. These systems have to be documented and evaluated so that factors responsible for their sustainability could be identified. The objective of the study is to document and evaluate the Naalad improved fallow system in central Philippines. Six farms at different stages of fallow and cultivation were identified. The activities of the farmers are being documented and selected soil properties are being analyzed. The Naalad system has two basic modifications : introduction of a tree legume to hasten fallow period and the constrution of a fascine-like structure made of tree branches to conserve soil. Preliminary results of soil analysis are presented. There seem to be no significant differences of soil properties at different stages of cultivation and fallow.

Introduction

After more than a decade and a half, agroforestry is viewed by many as the most appropriate land use system in cultivated upland or hillyland areas. Agroforestry can be described as the raising of woody perennials in conjunction with agricultural crops and/or livestock in a sustainable manner. In the Philippines, agroforestry is the pillar technology of the country's social forestry program which in 1987 already covered 500,000 hectares with 200,000 family beneficiaries (FMB, 1987).

Although agroforestry is a new field of studey, it is actually a very old practice. Many forms have existed in various parts of the Philippines for thousands of years (Lasco and Lasco, 1989). They have evolved through hundreds of years of testing and fine-tuning. As such, they are a virtual mine of information for agroforestry systems development. For example, they can give an idea of the suitable species and species combinations for a certain area. This information could enable poverty-stricken countries to save valuable reseach money and more importantly, time. It is therefore imperative that indigenous agroforestry systems be documented and analyzed.

Swidden farming (traditional shifting cultivation or fallow system) is considered to be the oldest form of agroforestry (Vergara, 1982). It is characterized by a rotation of fields between short periods of cropping and longer fallow periods (Waters, 1964, cited by Peters and Neuenschwander, 1988). The sustainability of the system lies primarily in the maintenance of a sufficiently lenghty fallow period to rejuvenate the fertility of the soil.

Several types of fallow systems are being practiced by indigenous cultural communities (ICCs) in the mountains of the Philippines (Rice and Dulnuan, 1980 ; Celestino and Elliot, 1986 ; Olofson, 1983).

One of these systems in the Naalad improved fallow system. It is probably the only kind in the world. Its uniqueness lies in significant modifications over the traditional fallow system. It has been existing for nearly a hundred years and yet very little is known about it. Thus this study was designed to learn more

Presented at the International Symposium on "the Rehabilitation of Degraded Forest Lands in the Tropics"-Technical Approach, Tsukuba, Ibaraki, Japan, 17 September 1992, held by Tropical Agriculture Research Center (TARC)

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about how the system works. This paper presents the preliminary results of the study.

Objectives

The objectives of the study are as follow :

1 To document and analyze the agroforestry production system in Naalad.

2 To monitor the effect of the farming system on the following soil properties : soil organic matter, total nitrogen content, available phosphorus content, exchangeable potassium content and soil pH.

Methodology

1 Location and time of study

The study is being conducted in Naalad, one of the mountainous "barangays" (the smallest political unit in the Philippines) of the municipality of Naga in the Province/island of Cebu. It is located approximately 23km southeast of Cebu City at 10° 12′ latitude and 123° 45′ longitude with an elevation ranging from 100-300m asl.

The study started in October 1990 and is continuing up to the present.

2 Climate

The area falls under the third Philippines climatic type which is characterized by the absence of a pronounced maximum rain period but with a short dry season lasting from one to three months. The dry season lasts from January to June and the rainy season from July to December. March to April is the driest period of the year while the heaviest rains usually occur in October. Annual rainfall in central Cebu ranges from 1,600 to 2,000mm.

3 Topography and soils

The "barangay" has a very mountainous terrain. The farms are located on slopes of up to 100%. Soils in the area belong to the Faraon clay type which is well drained.

4 Documentation procedures

1) Basic strategy

The basic strategy of the study is to enlist the assistance of farmer cooperators in the conduct of a holistic documentation and evaluation of the Naalad system. Farmers were trained in keeping diary type farm records so that the activities in their respective farms could be documented.

2) Selection of farms and farmer cooperators

Four farmer cooperators were selected through the aid of the local officials in the village. The main criterion for the selection of farmer cooperators is ownership of a farm that meets the requirements of the study. Six farms were chosen with the following characteristics :

Farm 1 : One year under fallow
Farm 2 : Three years under fallow
Farm 3 : Five years under fallow
Farm 4 : One year under cultivation
Farm 5 : Three years under cultivation
Farm 6 : Five years under cultivation

The purpose of choosing farms with cultivation during different years is to identify the biophysical, economic and technical changes that occur in each stage of the cycle.

As a token of gratitude for the use of the farms, each farmer cooperator is being given a small subsidy to buy farm inputs, primaily fertilizers.

3) Soil properties

Soil samples were taken at the beginning to the study and after every cropping thereafter to monitor changes in selected soil properties. Three composite samples were taken from the upper, middle and lower portions of each farm. Soil sampling was performed in October 1990, October 1991 and May 1992.

4) Production system

The cultural practices and cropping systems are also being documented through the farm records.

From the data gathered, the system will be evaluated. The strength and weakness will be identified and recommendations will be made. Practices with potential for extrapolation will be identified.

Results and discussion

1 The agroforestry production system

The Naalad system is basically an improved fallow system with two modifications from the traditional system. First, the fallow period is hastened by the introduction of native *Leucaena leucocephala.* If the farmers were to rely on nature, it would probably take 10 to 20 years to rejuvenate the fertility of the soil. Instead, they plant native leucaena along strips, which reduces the fallow period to only 5 to 6 years, presumably, due to the nitorgen-fixing ability of leucaena.

Secondly, after the fallow period, the leucaena strips are cut and the branches are piled along the contours to form a fascine-like structure which they call "balabag" or "babag". These structures have a spacing of 1 to 2 meter and the agricultural crops are planted in the alley formed by two "babags". The function of the "babag" is primarily to control erosion. It has also been observed by the farmers that crops close to the "babag" grew more vigorously.

The structure of the system is very similar to alley cropping except that the "babags" are composed of dead branches which decay after some time. When asked why they did not use live hedgerows, one farmer answered that by the time the "babag" decays, it is time to fallow the area again. In addition, dead branches do not need maintenance as mach as live hedgerows.

One advantage of the Naalad system over the traditional fallow period is that the farmers need only two parcels of land since both the fallow and the cultivation periods last for 5 to 6 years. In the traditional fallow, more land is needed because the fallow period lasts for more than 10 years while cultivation is performed only from 2 to 3 years. It could then be suggested that the Naalad system is an adaptation to a decreasing land-to-people ratio.

The cropping system in Naalad usually consists of planting corn during the wet season (around May) and tobacco during the dry period (October to December). Corn is planted for subsistence while tobacco is a cash crop. Usually, there are 1 to 2 rows of crops in the alleys formed by the "babags". It has also been observed that onions are being interplanted with tobacco by some farmers.

There are variations among the practices of the farmers. For example, one farmer continues to cultivate his land even after 6 years. Some farmers also use rock walls.

2 Changes in soil properties

Table 1 shows the values of selected soil properties during the past 19 months. The main hypothesis is that in areas under fallow, soil fertility will improve over time while in areas under cultivation, soil fertility will decline over time. To test this hypothesis, a regression analysis was performed with time (in months) as the independent variable and the soil property as the dependent variable. Two cases were used. In the first case, each farm was analyzed independently of each other. In the second case, farms under fallow were combined together in the analysis to approximate the 6-year fallow cycle.

Thus, in the first measurement for the farm in the first year fallow the cycle was designated as month 1, for the farm in the third year of fallow was assigned month 25 and the farm in the fifth year of fallow was assigned month 49.

In the succeeding measurements the age of the farms was adjusted accordingly (plus 12 months in the second measurement and plus 19 months in the third measurement). The same procedure was adopted for farms under cultivation.

Results of the regression analysis of each farm (Table 2) showed that there was a very low linear relationship between the soil properties and time during the 19-month period of the study.

If all the farms under fallow were treated as one and the same would apply to farms under cultivation, a similarly low correlation between time and soil properties would be obtained (Table 3). However, it is noteworthy that all the regression equations in the farms under fallow showed a ascending slope indi-

Table 1 Soil property values for each farm

Soil property	Date of measurement		
	October 1990	October 1991	May 1992
1 First year fallow			
Soil organic matter (%)	1.95	1.6	1.7
Total N (%)	0.17	0.15	0.17
Available P (ppm)	8.3	8.3	9.0
Exchangeable K (ppm)	53.3	34.3	54.0
pH	7.9	8.1	8.3
2 Third year fallow			
Soil organic matter (%)	1.81	1.6	1.2
Total N (%)	0.18	0.17	0.13
Available P (ppm)	9.0	9.0	7.0
Exchangeable K (ppm)	50.7	72.3	38.3
pH	7.9	7.8	8.1
3 Fifth year fallow			
Soil organic matter (%)	3.47	2.3	2.3
Total N (%)	0.25	0.19	0.17
Available P (ppm)	16.7	9.0	10.3
Exchangeable K (ppm)	93.3	45.3	58.0
pH	7.8	8.1	7.9
4 First year cultivation			
Soil organic matter (%)	2.84	2.1	2.1
Total N (%)	0.20	0.18	0.20
Available P (ppm)	14.0	9.3	13.3
Exchangeable K (ppm)	144.00	93.3	111.3
pH	7.8	8.0	7.8
5 Third year cultivation			
Soil organic matter (%)	1.60	1.2	0.93
Total N(%)	0.13	0.10	0.11
Available P (ppm)	10.3	6.3	10.7
Exchangeable K (ppm)	66.7	36.0	46.0
pH	7.9	8.1	7.9
6 Fifth year cultivtaion			
Soil organic matter (%)	2.10	1.8*	1.7*
Total N (%)	0.19	0.17	0.16
Available P (ppm)	30.0	8.7	10.0
Exchangeable K (ppm)	82.7	100.7	83.3
pH	8.0	8.1	8.0

*Farm has been converted to fallow
Note: All the values are average of 3 measurements.

cating the increase in the levels of the soil properties measured. In contrast, most of the regression equations of farms under cultivation showed a descending slope suggesting a decline in the contents of soil organic matter, total nitrogen and exchangeable potassium.

It appears therefore that the hypothesis is not validated by the results obtained so far. There seemed

Teble 2 Regression equations for each farm

Farm	Soil property	Equation	r^2
One-year fallow	Soil o.m.	o.m. = 0.1314−0.0016 (Months)	0.3277
	Total N	N = 0.1617−0.00016 (Months)	0.0022
	Available P	P = 8.1957+0.0337 (Months)	0.0550
	Exch. K	K = 48.5034−0.1201 (Months)	0.0053
	pH	pH = 7.9136+0.0081 (Months)	0.4049
Three-year fallow	Soil o.m.	o.m. = 1.8955−0.0325 (Months)	0.4694
	Total N	N = 0.1877−0.0028 (Months)	0.3256
	Available P	P = 9.4130−0.1012 (Months)	0.0451
	Exch. K	K = 58.5641−0.4487 (Months)	0.0068
	pH	pH = 7.8171+0.0099 (Months)	0.1101
Five-year fallow	Soil o.m.	o.m. = 3.4112−0.0688 (Months)	0.7401
	Total N	N = 0.2534−0.0046 (Months)	0.8372
	Available P	P = 16.3125−0.3750 (Months)	0.5168
	Exch. K	K = 88.7746−2.1768 (Months)	0.2545
	pH	pH = 7.8548+0.0094 (Months)	0.2419
One-year cultivation	Soil o.m.	o.m. = 2.8082−0.0413 (Months)	0.4095
	Total N	N = 8.8788+9.0909 (Months)	0.018
	Available P	P = 12.9852−0.0715 (Months)	0.0326
	Exch. K	K = 138.2321−2.0634 (Months)	0.1408
	pH	pH = 7.8343+0.0030 (Months)	0.0455
Three-year cultivation	Soil o.m.	o.m. = 1.6338−0.0374 (Months)	0.6525
	Total N	N = 0.1314−0.0016 (Months)	0.3277
	Available P	P = 9.2767−0.0155 (Months)	0.0012
	Exch. K	K = 63.3603−1.2942 (Months)	0.3873
	pH	pH = 7.9814−0.0003 (Months)	0.0007

Teble 3 Regression equations for combined analysis

Soil property	Equation	r^2
Under fallow		
Soil o.m.	o.m. = 1.6291+0.0138 (Months)	0.2336
Total N	N = 0.1575+0.0005 (Months)	0.0616
Available P	P = 8.0703+0.0461 (Months)	0.0685
Exch. K	K = 48.1425+0.2088 (Months)	0.0196
pH	pH = 7.9450+0.0004 (Months)	0.0027
Under cultivation		
Soil o.m.	o.m. = 2.4038−0.0329 (Months)	0.2640
Total N	N = 0.1971−0.0014 (Months)	0.2192
Available P	P = 8.9836+0.1646 (Months)	0.0368
Exch. K	K = 127.9472−1.6700 (Months)	0.3981
pH	pH = 7.8392+0.0035 (Months)	0.5154

to be no detectable change in the fertility of the soil through time. If this observation was to be confirmed by suceeding measurements, it could indicate that the farming technology is so efficient that there is no significant nutrient loss from the agroecosystem, which could account for the sustainability of the system for the past 100 years. However, this explanation is contradicted by the common observation of the farmers that yields decline over time so that the farms have to be followed after 6 years. Presumably, there is a limiting amount of one or more nutrients that makes farming unprofitable from the point of view of farmers.

The inability of soil testing procedures to detect significant changes in the soil properties corresponding to the experienced yield decline in shifting cultivation farms is a fairy common occurrence in similar studies especially in high-base status soils (Sanchez, 1976).

Closing remarks

The Naalad system has shown that farmers who have lived for many years in a mountainous environment could evolve sustainable agroforestry systems. These systems should be documented and analyzed. Possible applications to the design of other agroforestry systems should also be explored.

Acknowledgement

The study is being conducted through a grant from the International Foundation for Science (IFS), Sweden.

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