Socioeconomic and Environmental Benefits of Agroforestry Practices in a Community-based Forest Management Site in the Philippines

Leonida A. Bugayong

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INTRODUCTION

The Philippines has more than 7,100 islands with an aggregate land area of about 30 million hectares (M ha). Forestlands comprise 53% (15.855 M ha) of the total land area while 47% are certified alienable and disposable lands. By land use, the estimated total forest area is 5.4 M ha or 18% of the country's aggregate land area (Philippine Forestry Statistics 2001).

There are more than 70 million people in the Philippines and an estimated 18 to 20 million are found cultivating or occupying more than 8 M ha of the uplands \(^1\) (Guiang 1998). Continued deforestation of about 100,000 ha per year has been blamed largely on indiscriminate logging and harvesting of non-timber forest resources coupled with extensive land conversion for upland agriculture by shifting/slash-and-burn cultivators. Intensive cultivation and burning contribute largely to declining land productivity in the uplands through accelerated soil erosion and diminishing soil fertility.

To address the problems of environmental degradation and poverty in the uplands, the government implemented the Integrated Social Forestry Program (ISFP) that started in 1982. The Program sought to establish long-term partnership between the government and forest occupants in promoting sustainable use of public forestlands. Forest occupants are Filipino citizens actually and directly occupying and/or cultivating forestland as of December 31, 1981 (Ministry Administrative Order No. 46, S-1982).

Qualified participants (forest occupants and landless farmers, tillers and rural workers dependent on public forestlands for their livelihood) to the ISFP were given a 25-year tenure through the Certificate of Stewardship Contract (CSC) awarded to individual families or communally. CSC holders were allowed to develop their allocated lands (3 to 7 ha per family) into productive farms to make their families economically viable and self-reliant while protecting and conserving the environment through non-destructive farming practices. They were required to plant a portion of their farms to suitable forest tree species and at least five fruit-bearing trees per hectare (Ministry Administrative Order No. 46, S-1982).

Political and constitutional changes in the late 1980s to mid-1990s led to the presidential pronouncement in 1995 that Community-Based Forest Management (CBFM) is the National Strategy to ensure the sustainable development of the country's forestland resources (Executive Order No. 263). This led to the integration of people-oriented forestry programs and projects that have been implemented since the 1980s into the CBFM Program. The ISFP is one of the programs that are to be integrated into the CBFM program (DENR Administrative Order No. 96-29).

Agroforestry is one of the soil and water technologies that were transferred to farmer participants in the CBFM-ISFP as a means of improving their economic conditions.

\(^1\) Uplands are areas with 18 percent slope or higher that are declared as forestlands under Philippine Forestry Laws
while rehabilitating the degraded uplands. It allows farmers to plant agricultural crops (economic livelihood) in tandem with tree crops (reforestation aspect).

Agroforestry has been used as a major strategy to enjoin forest occupants to become partners in rehabilitating degraded forestlands. As an alternative to the destructive kaingin-making or slash-and-burn farming of most upland farmers, agroforestry was expected to reduce soil erosion, improve soil quality, vegetative cover, land productivity and uplift the farmers' level of living through sustained farm productivity.

Today, agroforestry continues to be an important component of upland development policies and projects implemented by both government and non-government organizations. After more than two decades of being practiced by upland farmers, it is worthwhile to determine whether agroforestry as a policy and program strategy to rehabilitate degraded forestlands has achieved its goal -- that of improving the environment and uplifting the well-being of its farmer-practitioners and beneficiaries.

For effective implementation of agroforestry as key component of community-based policies and programs, the study found the need to determine whether the socioeconomic and environmental benefits encourage further adoption or practice by upland farmers. To make the study more useful, the researcher also thought it necessary to come up with recommendations on how to make it more viable and sustainable technically and policy-wise.

OBJECTIVES

The study aimed to analyze the agroforestry practices of the upland farmers, assess the socioeconomic and environmental benefits, and draw up lessons and recommendations for sustainable agroforestry development in community-based forestry projects.

METHODOLOGY AND SCOPE

Selection of study site was made in consultation with the staff members of the Department of Environment and Natural Resources (DENR). The study site is in Barangay Fernando in the municipality of Santo Tomas, province of La Union. It forms part of a CBFM project site that started out as a site for the Forest Occupancy Management in the 1970s, then became an ISFP site in 1983, a model ISFP site in 1990 and later on a Center for People's Empowerment Unit (CPEU) in 1993. The DENR retained only the CPEU sites when management of ISFP sites was devolved to the Local Government Units under the Local Government Code. The project site is one of those retained by the DENR.

The site is located in the province of La Union, Northern Philippines between 120°16' and 120°35' longitude and 160°15' latitude. Barangay Fernando is situated at the southeastern portion of the municipality of Santo Tomas, approximately 230 km north of Manila, the country's capital.

An ocular survey of the project site was initially undertaken to determine the extent and type of agroforestry practices of the farmers in the area. Transect mapping of the
project site was conducted to determine the biophysical components within the
landscape. Results of the transects and consultations with the DENR project staff and
farmers led to the selection of three farms where erosion plots were established and
soil samples were collected. Farm selection was based on the similarity of
agroforestry practices of the farmers and their willingness that their farms be part of
the study.

Secondary data on both socio-demographics (population, sources and amount of
income, education, etc.) and biophysical (edaphic, climatic, physiographic and biotic
components) characteristics of the site were gathered. Baseline data before the start of
the project was not available so the researcher used secondary information from key
informant interviews, recent reports and other documents to have an idea of what
transpired before and during project implementation in the site.

Primary socioeconomic data was gathered through key informant and individual
farmer interviews. All farmer participants to the CBFM-ISFP were interviewed
regarding their farms and their perceived benefits (socioeconomic and environmental)
from agroforestry. Non-participants similarly cultivating upland and lowland farms in
the barangay were randomly selected for interview. Differences in responses between
participants and non-participants were compared using t-test and Chi-square tests.
Respondents' rating of perceived changes in specific socioeconomic and
environmental parameters were analyzed using Mann-Whitney sum rank test.

For the biophysical aspect, soil fertility and soil erosion rates are some of the
parameters measured during the rainy season cropping. Soil erosion plots were
established in three farms by laying out 2x4 m plots constructed of galvanized iron
sheets on three sides with the lower end of the rectangular plot left open. In each farm,
three plots each were laid out in the farm forest (upper slope=25-30 degrees), grass
fallow (middle slope=10-15 degrees) and vegetable/rice terraces (lower slope=0-10
degrees). Sheet erosion was measured in the plots using an erosion bar patterned after
those used by Ramirez (1988) and Visco (1997). Data were then converted into their
equivalent weight per hectare using mathematical calculations and conversion figures
developed by the Ecosystems and Research Development Bureau in 1986 (cited by
Visco 1997).

Soil samples were collected from the three representative farms where the erosion
plots were laid out, using standard sampling procedures. Soil and physical analyses
(organic matter, nitrogen, pH, available phosphorous, exchangeable potassium and
CEC, and soil texture) were subjected to t-tests to determine significant differences
between the agroforestry practices.

The study was confined to only one site and for only one cropping season due to time
and resource constraints. A longer duration of study would certainly generate more
data. Also, generalizations may not be applicable in other CBFM-ISFP areas since the
conditions in the study site do not reflect conditions in other areas of the country and
respondents form a very small percentage of the total number of farmers cultivating
the degraded uplands. However, it is hoped that the findings of the study can serve as
inputs in the formulation or improvement of general policies and programs geared
towards empowering upland communities in rehabilitating degraded uplands. Data on
the biophysical characteristics of the site can serve as baseline information for the
project.
DISCUSSION OF RESULTS

The dominant agroforestry practices of the farmers in the study site are comprised of planting of woody perennials (farm forest) along the upper slopes (25-30 degrees), grass species allowed to grow in fallow areas along the middle slopes (10-15 degrees), and planting of rice and vegetables along the terraces (0-10 degrees). These practices interact with each other through their protective and productive functions that benefit the farmers as well as the land (Figure 1).

Woody perennials in the farm forests above interact with the terraces below through their protective function by preventing massive soil erosion and landslides that would otherwise adversely affect the agricultural crops. Other protective services of trees include restoring or maintaining soil fertility through nutrient cycling; soil and water conservation; modifying microclimate and providing shade; and as live fence and wind breaks. The trees also provide timber, fuelwood, and food both for the farmer's home consumption and for future commercial purposes (Lasco 1992).

Figure 1. Schematic diagram of the functional interactions among the major components of the agroforestry system in Fernando, Santo Tomas, La Union, Philippines (Bugayong 2002)

In turn, the terrace farms provide short-term economic services to the farm forests/tree farms through the cash income and food (from rice and vegetables grown) that allows the farmers to continue maintaining the forests instead of cultivating the upper slopes for agricultural crops as they used to do. In the long-term, the farm forests are expected to contribute additional cash income for the farmers to improve terrace farm productivity.

The terrace farms also interact with the fallow areas (some terraces along the middle slopes are left to fallow mainly because of inadequate farm labor and capital
resources) through the short-term economic benefits that allow the farmers to leave the fallow areas to regain soil fertility. Grass fallows, in turn, provide ecological benefits in terms of improved soil fertility in the long run that would increase farm productivity once they are again cultivated. Grass in these areas also prevent excessive movement of the soil down to the lower terraces.

**Socioeconomic Benefits**

This paper highlights some of the benefits derived by farmers from the practice of agroforestry in the project site. Comparisons are made between CBFM-ISFP participants' and non-participants' perceived changes in their socioeconomic conditions since the start of the project to the time the survey was conducted. These are validated by survey results of their income, level of living and net returns from various cropping systems.

Rank sum tests (Table 1) show no significant differences between respondents' perceived changes in their socioeconomic conditions except for farm income.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>PARTICIPANTS</th>
<th>TOTAL</th>
<th>NON-PARTICIPANTS</th>
<th>TOTAL</th>
<th>M-W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>No.</td>
</tr>
<tr>
<td>Income from farm</td>
<td>8.57</td>
<td>11.43</td>
<td>45.71</td>
<td>34.29</td>
<td>35</td>
</tr>
<tr>
<td>Income from off-farm sources</td>
<td>15.15</td>
<td>21.21</td>
<td>42.42</td>
<td>21.21</td>
<td>33</td>
</tr>
<tr>
<td>Type of house</td>
<td>16.67</td>
<td>30.55</td>
<td>30.55</td>
<td>22.22</td>
<td>36</td>
</tr>
<tr>
<td>Household appliances</td>
<td>25.00</td>
<td>22.22</td>
<td>36.11</td>
<td>16.67</td>
<td>36</td>
</tr>
<tr>
<td>Time spent in the farm</td>
<td>14.29</td>
<td>11.42</td>
<td>37.14</td>
<td>37.14</td>
<td>35</td>
</tr>
<tr>
<td>Leisure time</td>
<td>16.67</td>
<td>25.00</td>
<td>44.44</td>
<td>13.88</td>
<td>36</td>
</tr>
</tbody>
</table>

O = none, L = low, M = moderate, H = high; * significant at 5% confidence level; ns - not significant

**Farm and off-farm income.** About 45.71 and 34.29 % of participants rated the change in farm income as moderate and high, respectively. A relatively higher percentage (64.52 %) of non-participants observed that farm income increased moderately while only 6.45% gave the change a high rating. Although majority of both respondents perceived the changes to be moderate, the farmers attribute the slight increase in farm income to better farming techniques that they learned from government technicians and other farmers through cross-farm visits.

Survey results indicate a slight increase in farm income from 1994 to 2000. Mean farm income of participants in 2000 (deflated to 1994 values using consumer price index) was ₱37,891 and that of non-participants was ₱41,335. These are slightly higher than the values generated by Tadeo in 1994 from the same project site where mean farm income of participants was ₱20,833.43 while that of non-participants was ₱27,256.45. Figure 2a shows a relative increase in mean farm income of both respondents from 1994 to 2000 and a slightly higher mean farm income of non-
participants than those of participants. However, no statistical differences were observed between them. The farmers attribute the increase in farm income mostly to improved soil and water conservation technology and higher farm inputs such as irrigation, fertilizer and pesticides. Increased off-farm income enabled most of the farmers to afford such higher inputs.

An analysis of the total household income in year 2000 shows that participants had ₱96,419.17 while non-participants had ₱58,831.04 (also deflated to 1994 values using consumer price index). Participants' farm income (₱37,891) makes up only about 39.3% of total household income while non-participants' farm income (₱41,335) makes up about 70% of their total household income. The remaining 59% of the participants' and 30% of the non-participants' total income were from off-farm sources such as local and overseas (e.g. nurses, seamen, domestic helpers, etc.) employment of household members and other livelihood sources (e.g. small stores, buy-and-sell, jeepney/tricycle driving, other services). The study reveals that more household members of the participant respondents (90%) had off-farm sources of livelihood than those of non-participants (50%).
On a per capita income basis, participants and non-participants had per capita (real farm) income in 2000 of ₱11,043.06 and ₱8,843.45 for mean household sizes of 5 and 6, respectively. In the 1994 study, participants had ₱6,422.23 while non-participants had ₱4,411.08 per capita income with mean household sizes of 4 and 5, respectively. The 1994 per capita incomes of farmers were way below the annual national and regional per capita income\(^2\) or poverty threshold values of ₱8,885 and ₱10,022, respectively (Figure 2b).

\(^2\) The annual per capita income is the income required or amount to be spent to satisfy nutritional requirements (2000 calories) and other basic needs (PIDS 2001).
The 2000 national and regional poverty thresholds were ₱13,916 and ₱12,488, respectively. Per capita farm incomes of respondents in 2000 are still below the national and regional poverty thresholds. However, participants' per capita household income of ₱24,507 is higher than national and regional per capita incomes while that of non-participants (₽12,430) remains a little below national and regional poverty thresholds. Off-farm income accounts for the improvement of the participants' per capita household income.

Although reported mean farm incomes of both respondents remain at subsistence level, results of farm cost and return analysis indicate slightly higher mean values. Average net cash and non-cash revenues per hectare are ₱54,687.23 and ₱61,115.94 for participants and non-participants, respectively. Mean net cash revenues per hectare are ₱43,624.18 and ₱44,381.48, respectively. Highest net revenues per hectare are observed for the vegetable-tobacco-mango combination at ₱112,763 (cash and non-cash) and ₱124,350 (cash) for participants and for the rice-tobacco-mango combination at ₱130,333 (cash and non-cash) and ₱93,306 (cash) for non-participants. Non-cash income refers to the amount consumed by the household.

The revenues, however, do not include income from farm forests yet since the trees have not been harvested. The future income from harvesting the mature timber would definitely increase farm revenues.

**Level of living.** Survey results show that the respondents have a generally low to medium level of living based on the reported number and type of household and farm facilities. In terms of type of house, almost equal percentages of participants and non-participants have permanent or temporary houses. About 30.55 and 45.16 percent of participants and non-participants, respectively, have temporary houses. About 30.55 and 25.81 percent of participants and 30.55 percent of non-participants rated the change in type of house as moderate. A close 30.55 percent of participants and 25.81 percent of non-participants gave it a low rating. This indicates that farmers have other priorities on which to spend any additional income such as on the children's education or investment in farm and other income-generating activities.

The study also shows that farmers' level of living was low to moderate in terms of ownership of facilities and appliances for seating, dining, cooking, sleeping and other needs. About 36.11% of the participants and 38.71% of non-participants gave moderate rating for change in household appliances while a low rating was given by 22.22% and 41.93% of participants and non-participants, respectively. Again, these reflect the farmers giving low priority to the addition of household appliances.

Equal numbers of participants (37.14 % each) gave ratings of moderate and high to the time spent in the farm meaning that they spend considerably less time in the farm because the farm forests need less maintenance now than in the early years of establishment. On the other hand, 51.61 and 22.58 percent of non-participants gave moderate to low rating to this item. They spend equal or slightly less time on the farm now than before. Majority of both participants (44.44%) and non-participants (60%) gave a moderate rating to change in leisure time, indicating that there was not much change in time spent for leisurely activities between then and now.

Although survey results do not indicate much difference between perceptions of agroforestry practitioners and non-practitioners, the respondents generally observed
that they are slightly better off now than before the project started when the upland farms had lower productivity due to purely slash-and-burn farming practices.

**Utilization of forest products.** One objective of social forestry is to reduce the farmers' dependence on the forests for their livelihood. Survey results show that since the implementation of the CBFM-ISFP in the site, more non-participants (82.35%) than participants (55%) continue to depend on the nearby forests for their fuelwood, timber and other forest-based needs. The primary product collected by 85% of participants and all of the non-participants (100%) is fuelwood. Other products collected are timber for house construction, leaf fodder for livestock, fruit tree crops, and materials for handicraft. Participants mainly gather the forest products they need from their own farm forests leaving the non-participants to continue collecting from nearby natural forest stands. Most of these are mainly for home consumption while a few sell them for badly needed cash.

The farmer-participants' attributed the decrease in their dependence on the natural forests mostly to their realization of the importance to protect the nearby forests for the environmental and economic services these provide. Also, the farmer-participants can get dead branches or wood from their own tree farms for their fuelwood and lumber needs thereby decreasing their dependence on the nearby natural forests. Most farmers look forward to harvesting the timber in their farm forests in a few years time and a considerable increase in their cash income from these.

Both participants and non-participants listed some problems in collecting and utilizing forest products from the nearby forestlands. Respondents listed such problems as: scarcity of forest products, distant and steep sources, difficulty in getting permits to collect/harvest forest products, uncontrolled or accidental burning in forestlands, lack of machines to cut and carry logs, and high risk in collecting/harvesting timber products because it is prohibited by law.

Most of these problems are faced due to the heavily deforested nature of the forestlands in the project site caused by indiscriminate logging and slash and burn cultivation that prevailed long before the ISF project was implemented in the area. Harvestable timber has become very scarce. It was only during the last two decades that portions of the area have been replanted and the remaining patches of natural forests protected from further deforestation through the CBFM-ISFP.

**Other socioeconomic benefits.** Results reveal that majority of the respondents rated the changes in community capability (in terms of planning, decision making, project implementation, monitoring and evaluation, training, linkaging, and self-reliance) to be moderate to high. This was mainly due to the technical and social assistance that participant-farmers received from government to help make them more self-reliant as a community. Because of the close relationships (by blood or marriage) of the respondents, DENR project staff reported an easier and faster transfer of information and technology from participants to non-participants. This could explain the lack of significant differences in the responses of participants and non-participants.

Other benefits include security of tenure through the CSC provided by the DENR to the project participants. Having secure tenure over the land they cultivate stimulates the farmers' commitment to protect and develop the area contracted to them. Being able to harvest, utilize and market the products derived from the development of their
tenured land are incentives for them to continue doing so not only for their individual benefit in the long term but also to the community and nation in general. Tadeo reported in 1994 that expansion of cultivated uplands were observed in the site due in most part to the parcellation of forestlands through the CSCs awarded to ISFP participants.

DENR staff also had similar observations with upland farms occupied by non-participants who have since become sedentary farmers due to decreasing area available for kaingin making. Hence, shifting cultivation is no longer widespread in the area as an indirect effect of parcellation of forestlands and occupants staking their claims on uplands under cultivation with the hope that they too would be granted tenure over such lands by government in the future.

Environmental Benefits

From the perspective of both CBFM-ISFP participants and non-participants, there were generally moderate to high changes in biophysical and environmental conditions with the introduction of agroforestry in the area. Results did not vary significantly between participants and non-participants except for perceptions on climate and rainfall (Table 2).

**Climate and rainfall.** Half the participants or 50% said that climate improved highly since agroforestry was practiced in the area, 36.11 percent gave it a moderate rating and the rest gave a low rating (5.56%) or observed no change (8.33%). On the other hand, most (43.75%) of the non-participants gave a moderate rating to change in climate, 28.12% gave a low rating, 18.75% gave a high rating and 9.38% saw no change.

The respondents explained that there was a noticeable lowering of dry season temperature due to the presence of more trees as compared to when only grass and shrubs covered the deforested uplands. Trees along the pathways and farm boundaries also provide shade from the sun's heat.

Most of both participants (52.78%) and non-participants (53.12%) gave a moderate rating to change in rainfall amount or pattern. Their responses were significantly different at 1% level of significance (Mann-Whitney test). About 30% of participants gave a high rating while none of the non-participants gave a high rating for change in rainfall. Although they expect similar rainfall annually, the respondents felt that the increased forest vegetation resulted to more rains as compared to when the forestlands were relatively bare.

<table>
<thead>
<tr>
<th>TABLE 2. Farmers' perceived changes in biophysical and environmental conditions since agroforestry was practiced in the area (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATEGORY</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Climate</td>
</tr>
<tr>
<td>Rainfall</td>
</tr>
<tr>
<td>Soil type and</td>
</tr>
</tbody>
</table>
Soil type, fertility and erosion. The importance of forest cover, soil type and soil erosion is not lost on the participants (50%) and non-participants (48.28%) who gave these items a moderate rating. Farmers' experience and observation showed the previous practice of kaingin or slash and burn farming of the uplands caused the lightening of soil color that also indicated low soil fertility. This served as a signal for them in the past to leave the kaingin plot to recover its fertility by opening or moving on to other areas for cultivation, returning to the previous area only when the soil has improved through non-cultivation. When the degraded grasslands were planted to trees, the farmers observed that soil improved in quality over time.

Results of soil analysis for farm forest (FF), grass fallow (GF), rice (RT) and vegetable (VT) terraces, are summarized in Table 3 (before planting and after harvesting) and Table 4 (depth1 = 0-15 cm and depth2 = 16-30 cm). The farms have sandy clay loam (FF and RT) and clay loam (GF and VT) soil types. Fertility of the soil samples are all within acceptable standards (except for soil nitrogen which was very low) although some variations are observed among the four agroforestry practices.

Soil pH ranges from 5.82 (medium acidic) to 6.07 (slightly acidic). OM is relatively high (3.71 to 4.29%) while available P ranges from 14.32 ppm (RT) to 26.24 ppm (GF). Exchangeable K at the GF (0.32 me/100g soil) and VT (0.41 me/100g soil) are lower than at the FF (0.60 me/100g soil) and RT (0.58 me/100g soil). CEC ranges from 33.46 (FF) to 36.96 (VT) me/100g soil.

Slight changes in soil characteristics were observed in all practices before planting and after harvesting. Overall, soil pH became slightly more acidic (6.1 to 5.82), OM (3.53 to 4.21%) and N (0.18 to 0.23%) increased, available P decreased (23.62 to 18.6 ppm), exchangeable K decreased (0.54 to 0.42 me/110g soil), and CEC increased (33.98 to 36.99 me/100g soil). In terms of depth, mean soil pH increased (5.95 to 5.98), OM (4.19 to 3.55%) and N (0.23 to 0.18%) decreased, P increased (20.21 to 22.01 ppm), K decreased (0.55 to 0.41 me/100g soil).

The movement of soil (or erosion) during the rainy season was also observed by farmers to have visibly lessened with the growing forest vegetation in the uplands. The farmers attribute this to the deeper roots of trees holding on to the soil and preventing massive landslides or extensive soil erosion during rainy days.
Table 3. Mean values of soil properties before planting (BP) and after harvesting (AH) by AF practice (samples collected from Brgy. Fernando, Sto. Tomas, La Union, May - October, 2000)

<table>
<thead>
<tr>
<th>SOIL PROPERTY</th>
<th>FARM FOREST</th>
<th>GRASS FALLOW</th>
<th>VEG. TERRACE</th>
<th>RICE TERRACE</th>
<th>OVERALL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BP</td>
<td>AH</td>
<td>Mean</td>
<td>BP</td>
<td>AH</td>
</tr>
<tr>
<td>pH</td>
<td>6.12</td>
<td>5.86</td>
<td>5.99</td>
<td>6.15</td>
<td>5.80</td>
</tr>
<tr>
<td>% OM</td>
<td>3.82</td>
<td>4.77</td>
<td>4.29</td>
<td>3.35</td>
<td>4.08</td>
</tr>
<tr>
<td>% N</td>
<td>0.20</td>
<td>0.24</td>
<td>0.22</td>
<td>0.17</td>
<td>0.26</td>
</tr>
<tr>
<td>K (me/100g soil)</td>
<td>0.70</td>
<td>0.50</td>
<td>0.60</td>
<td>0.34</td>
<td>0.30</td>
</tr>
<tr>
<td>CEC (me/100g soil)</td>
<td>29.38</td>
<td>37.55</td>
<td>33.46</td>
<td>35.27</td>
<td>37.20</td>
</tr>
<tr>
<td>% Clay</td>
<td>25.44</td>
<td>23.44</td>
<td>24.44</td>
<td>29.33</td>
<td>25.56</td>
</tr>
<tr>
<td>% Sand</td>
<td>50.67</td>
<td>48.22</td>
<td>49.44</td>
<td>42.33</td>
<td>43.94</td>
</tr>
<tr>
<td>Soil textural class</td>
<td>Sandy clay loam</td>
<td>Clay loam</td>
<td>Clay loam</td>
<td>Sandy clay loam</td>
<td>-</td>
</tr>
<tr>
<td>Bulk density *</td>
<td>1.37</td>
<td>1.26</td>
<td>1.32</td>
<td>1.26</td>
<td>1.32</td>
</tr>
<tr>
<td>Porosity (%) *</td>
<td>50.59</td>
<td>54.24</td>
<td>52.26</td>
<td>50.59</td>
<td>54.24</td>
</tr>
</tbody>
</table>

* Only one set of data for bulk density and porosity was taken (no data from RT) during the study period
Table 4. Mean values of soil properties at depths 0-15 cm (D1) and 15-30 cm (D2) by AF practice (samples collected from Brgy. Fernando, Sto. Tomas, La Union, May-October, 2000)

<table>
<thead>
<tr>
<th>SOIL PROPERTY</th>
<th>FARM FOREST</th>
<th>GRASS FALLOW</th>
<th>VEG. TERRACE</th>
<th>RICE TERRACE</th>
<th>OVERALL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D1</td>
<td>D2</td>
<td>D1</td>
<td>D2</td>
<td>D1</td>
</tr>
<tr>
<td>pH</td>
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<td>5.96</td>
<td>5.98</td>
<td>5.97</td>
<td>5.78</td>
</tr>
<tr>
<td>% OM</td>
<td>4.64</td>
<td>3.95</td>
<td>4.26</td>
<td>3.17</td>
<td>4.19</td>
</tr>
<tr>
<td>% N</td>
<td>0.23</td>
<td>0.20</td>
<td>0.27</td>
<td>0.16</td>
<td>0.22</td>
</tr>
<tr>
<td>P (ppm)</td>
<td>21.24</td>
<td>15.73</td>
<td>25.00</td>
<td>27.47</td>
<td>21.11</td>
</tr>
<tr>
<td>K (me/100g soil)</td>
<td>0.71</td>
<td>0.49</td>
<td>0.39</td>
<td>0.25</td>
<td>0.43</td>
</tr>
<tr>
<td>CEC (me/100g soil)</td>
<td>31.86</td>
<td>35.06</td>
<td>36.98</td>
<td>35.49</td>
<td>37.74</td>
</tr>
<tr>
<td>% Clay</td>
<td>22.33</td>
<td>26.56</td>
<td>28.99</td>
<td>25.59</td>
<td>30.06</td>
</tr>
<tr>
<td>% Sand</td>
<td>52.50</td>
<td>46.39</td>
<td>41.56</td>
<td>44.72</td>
<td>41.06</td>
</tr>
<tr>
<td>% Silt</td>
<td>25.17</td>
<td>27.06</td>
<td>29.44</td>
<td>29.39</td>
<td>28.89</td>
</tr>
</tbody>
</table>
Figure 3 shows that mean sheet erosion was highest in the farm forests (26.62 tons/ha) followed by vegetable terraces (15.66 tons/ha) and grass fallow areas (15.40 tons/ha). Only farm forests and grass fallows significantly differed in terms of average depth of erosion and mean sheet erosion. The high erosion rates in farm forests are attributed to the slightly steeper slope of these areas and the gaps in the canopy because the most trees are too young to have closed crowns.

Figure 3. Mean soil erosion rates (average depth of soil erosion in mm and sheet erosion in tons/ha) in the farm forests, grass fallow, and vegetable terraces

However, the erosion rates in the site are a lot less than those reported in many upland farms nationwide. Lasco (1992) cites the following soil losses: 100 tons/ha in Magat Watershed (David, 1984), 15.40 to 52.75 tons/ha in Palawan (Banlawe, 1985), or 90 tons/ha in Negros (Sajise, 1982). Likewise, David and Collado (1984) reported that sheet and rill erosion rates (t/ha/yr) in the Magat Watershed could reach as high as 239 in savanna, 264 in open grasslands, and 587 in kaingin areas.

**Vegetative cover, land productivity and production.** The ratings given by most participants for change in vegetative cover are high (47.22 %) and moderate (47.22 %) with only 2.78% each giving low rating and no change observed. Fifty percent of non-participants gave a moderate rating and the rest gave high (31.25 %) and low (18.75%) ratings. Evidently, the farmers observed that the planting of trees and perennials made a visual difference on the landscape over the last decade. They said that the hills used to be brown with only grasses as vegetation before they were reforested through the CBFM-ISF project. More trees and fruit species are also grown on the lower elevations today than before.
Participants rated change in land productivity to be moderate (47.22%) to high (38.89%) while most non-participants gave it a moderate (71.88%) to high (12.5%) rating. Similar ratings were given to change in production (44.44% moderate and 33.33% high) by participants and non-participants (70.96% moderate and 12.9% high). The farmers attribute the change in productivity and production to the improvement in soil fertility and decrease in soil erosion.

**Flora and fauna.** Change in flora and fauna was given moderate ratings by majority of participants (45.71%) and non-participants (55.17). The increase in forest cover has also resulted in the increase in undergrowth species and in microbiological activity due to decaying organic matter on the forest floor. The added vegetative cover also provides habitat and food for other flora and fauna.

Vegetation analysis in farm forests of selected farms in the site indicate a total diversity index of 0.77, which is relatively higher when compared to monoculture tree farms and plantations in other areas of the country. This diversity index is comparable to those found in Palawan by Navasero-Gascon (1998) where the multistory farms of the Hanunuos had a diversity index of 0.7335 while the natural forests had 1.229.

The relatively high diversity index for farm forests in this study indicates positive changes in vegetative cover from the prevalence of grassland species at the start of the project to a growing mixture of forest tree species today. Although choice of species planted by the farmers was mainly dictated by the availability of planting materials (mostly exotic fast growing species) provided by the DENR, there was a mixture of species. The planting of other indigenous tree species found in the vicinity is expected to further increase species diversity both in flora and fauna.

**Incidence of pests, diseases and fire.** The farmers say that the incidence of pests, diseases and fire has decreased moderately (44.11% of participants and 46.43% of non-participants). The shift from kaingin-making as an upland activity to tree farming has significantly reduced the occurrence of fires during summer particularly in the project site. Protection of the forestlands covered by the participants as a requisite in their CSCs also contributed to the decreased incidence of fires and other illegal activities in the nearby forests. However, the farmers observe the continued burning of grasslands in other areas not yet covered with forest species and where farmers still practice kaingin-making.

**Soil and water conservation.** The study also tested some factors of agroforestry adoption. Among the perceived benefits derived from practicing agroforestry, soil and water conservation was found to be statistically significant as a factor of adoption. The results indicate that the higher the farmers perceive soil and water conservation as a benefit from agroforestry, the more likely they would adopt or continue adopting the technology. Some agroforestry/soil and water conservation technologies adopted by the farmers include vegetative measures (farm forest, enrichment planting, alley cropping, boundary planting and composting) and structural measures (terrace farming, drainage canals, contour canals, riprap, and rockwalling). The farmers' sources of knowledge about these technologies are government trainors/extension workers, older generation farmers, and personal observations during cross-farm visits.
CONCLUSIONS

Results of the study indicate that agroforestry as a strategy to uplift the socioeconomic conditions of the farmers while rehabilitating the degraded uplands has made inroads in the project site. Though the socioeconomic benefits discussed are still modest, the future returns from the harvesting of mature trees in the farm forests are expected to further improve the farmers' income and well-being. Although difficult to measure the changes in environmental conditions from the project's start to the present, improvements (soil fertility, erosion, microclimate, vegetation, etc.) are already felt by the farmers, which they are already starting to benefit from.

However, the farmers need more assistance in terms of technical and social preparation as they approach the time when the trees they planted are ready for harvesting. Specifically needed are appropriate technology for harvesting, processing and marketing of forest products. Changes are expected in their socioeconomic conditions as well as issues on the sustainability of the farm forest component of their agroforestry practices.

Among other issues that have to be addressed for farmers is the need for more environment-friendly technologies and know-how for the farmers. Among these are the promotion of biotechnology (use of bio-organic versus inorganic fertilizers) and integrated pest management instead of pesticides, use of indigenous tree species for farm forests and nitrogen-fixing species to improve soil fertility, and other soil and water conservation technologies to sustain farm productivity.
REFERENCES


