Agroforestry systems and practices in hilly uplands of Misamis Oriental, Philippines

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Abstract. A total 140 agroforestry farmers were randomly identified. The data were collected using survey questionnaires, formal interviews and reconnaissance surveys. Generally, the farmers were mature (51 yr and over), male, married, and had not finished a college degree. In spite of this, adoption of Falcata-based agroforestry practices was high as exemplified by the number of adopters, presence of various tree, agricultural crops, and animals. The study also revealed that tenurial status and farm size were the main factors hindering agroforestry adoption. Land owners with a large area are most likely to adopt different agroforestry practices. Tenants preferred to plant cash crops due to the issues on the right to choose what to plant, privacy of land and security of products and uncertainty on the length of time to cultivate the land. Most respondents practiced multitree, intercropping, alley/ hedgerow intercropping to maximize land utilization, and thereby produced a diversity of crops.

Keywords: Agroforestry, falcata, upland, intercropping, tenure

1. Introduction
Falcata (Paraserianthes falcataria (L.) Nielsen) is a potential plant for wood industry because it has high economic and ecological values [1][2][3][4][5]. Many agroforestry farmers are embarking on an expensive, risky and laborious endeavor of establishing falcata-based agroforestry system relying on the belief that by planting falcata they can gain financial benefits. Driven by the current demand and price situation and government program (i.e. National Greening Program), these tree farmers must be protected by providing them with new technologies they can use that is specific to their site.
The economic benefits of integrating fast-growing trees on farm prompted many farmers to change their farming systems. Falcata along with fruit trees and other high value agricultural crops were planted together forming different agroforestry systems with different components, nature and purpose.

Tree farmers have little knowledge on the agroforestry systems and practices they are implementing. These farmers should be empowered with the knowledge so they can choose best management practices and protection from pest and diseases. This study was conducted in six municipalities and a city, with the following objectives: 1) determine the agroforestry systems and practices adopted by the upland farmers; and, 2) determine the factors influencing agroforestry adoption in the studied areas.

2. Materials and Methods

2.1 Study site

Figure 1. Locations of the study sites.

2.2 Selection of participants
An approximately 140 Falcata – based agroforestry farms (20 farms per municipality/ city) were visited for the collection of primary data required determining agroforestry systems and practices. The minimum area considered a site is 0.25 ha or 2,500 m$^2$. Farms owned by one farmer but located in different places was considered separate sites.

2.3 Data Collection
Ensuring the presence of trees farmers, a scheduled validation or site visits was conducted. A communication letter asking permission for the conduct of the study, with tentative date, was sent. As suggested by the farmer, the team scheduled validation to maximize time of the farmer and the team.
Selected local government units (LGUs) where the sites are located were notified of the purpose of the project. The team conducted courtesy call to respective local leaders. The team asked their consent and support to the project. The support sought from LGUs includes digitized maps of their municipality, records of falcata plantation from their Municipal Agriculture Office or Municipal Environment and Natural Resources Officer (MENRO) or CENRO assigned Forester.

Primary data were collected using survey questionnaires, individual farmer interviews and reconnaissance surveys. All farmer participants were interviewed regarding their farms and their agroforestry practices.

Figure 2. Interview with the falcata farmers in the Municipalities of Claveria and Talisayan, Philippines.

2.4. Data analysis
Descriptive statistics like frequency, percentages and mean were conducted using the statistical package of the STATA v. 10.

3. Results and Discussion

3.1. Typology of falcata-based agroforestry farmers
Generally, the farmers were mature (51 yr and over), male, married and had not finished a college degree. Some researchers found that education is especially important on the rate at which farmers are willing to adopt new technologies [6].

3.2. Agroforestry systems and practices adopted
In spite of their maturity and level of education, adoption of falcata-based agroforestry practices was high (Table 1) as exemplified by the number of adopters, length of time of practice (Table 4) presence of various tree (Table 2), agricultural crops (Table 3) and animals. Majority of smallholders Falcata-based farmers in these research sites practice different agroforestry (Figure 3), but with different forest tree crops, agricultural crops and animals. It was perceived that growing different crops at the farm provides income stability and increase self-sufficiency. Many farmers in Mindanao transformed their farming system from monocropping to agroforestry producing a variety of annual and perennial crops [9]. The agroforestry systems practiced in Northern Mindanao is somewhat similar to that of Nueva Vizcaya, Benguet and Quezon where alley cropping and multistory systems dominates [7]. In Southern Philippines, parkland system, natural vegetative strips, block planting, and border planting were commonly adopted [8].
Table 1. Type of agroforestry systems adopted by agroforestry farmers in Misamis Oriental, Philippines.

| AGROFORESTRY SYSTEM | BALKINGASAG (N = 20) | GINGOOG CITY (N = 20) | LAGONG LONG (N = 20) | MEDINA (N = 20) | SALAY (N = 20) | SUGBONGCO GON (N = 20) | CLAVERIA (N = 20) |
|---------------------|----------------------|-----------------------|----------------------|----------------|----------------|------------------------|------------------|
| Multistorey System  | 14                   | 16                    | 11                   | 7              | 10             | 5                      | 12               |
| Hedgerow            | 1                    | 2                     | 7                    | 13             | 7              | 14                     | 3                |
| Intercropping       |                      |                       |                      |                |                |                        |                  |
| Woodlot             | 5                    | -                     | 1                    | -              | -              | 1                      | 5                |
| Boundary            | -                    | 1                     | 1                    | -              | 2              | -                      | -                |
| Taungya             | -                    | 1                     | -                    | -              | 1              | -                      | -                |

Figure 3. a. Falcata – abaca (Musa textilis) agroforestry system. b. Falcata – cacao – banana – fruit trees agroforestry system. c. Falcata – coconut agroforestry system.

Table 2. Forest tree crops intercropped with falcata in falcata-based agroforestry system in Philippines.

| TREE CROPS                     | BALINGASAG (N = 2) | GINGOOG CITY (N = 50) | LAGONG LONG (N = 23) | MEDINA (N = 35) | SALAY (N = 17) | SUGBONGCO GON (N = 96) | CLAVERIA (N = 49) |
|--------------------------------|--------------------|-----------------------|----------------------|----------------|----------------|------------------------|------------------|
| Coffea spp. (Coffee)           | -                  | 2                     | 2                    | 1              | 2              | 6                      | 7                |
| Mangifera indica (Mango)       | -                  | 2                     | 2                    | 5              | 1              | 11                     | 2                |
| Lansium domesticicum (Lanzones)| 2                  | 11                    | 10                   | 12             | 8              | 12                     | 4                |
| Durio zibithemus (Durian)      | -                  | 9                     | 1                    | 3              | -              | 10                     | 6                |
| Garcinia mangostana (Mangosteen)| -                 | 9                     | 1                    | 1              | -              | -                      | 4                |
| Artocarpus odoratissimus (Marang)| -                 | -                     | 2                    | 3              | 2              | 5                      | 5                |
| Artocarpus heterophyllus (Nangka)| -                 | 5                     | 1                    | 3              | 2              | 14                     | 4                |
| Swietenia macrophylla (Mahogany)| -                 | -                     | 2                    | 3              | -              | 12                     | -                |
**Table 3.** Agricultural crops integrated with falcata in falcata-based agroforestry system in Philippines.

| Crop Name                  | Balingasag (N = 26) | Gingoog City (N = 38) | Lagonglong (N = 33) | Medina (N = 27) | Salay (N = 27) | Sugbongcogon (N = 45) | Claveria |
|----------------------------|---------------------|-----------------------|---------------------|----------------|----------------|-----------------------|----------|
| *Manihot esculenta*        | 3                   | 1                     |                     |                |                |                       |          |
| (Cassava)                  |                     |                       |                     |                |                |                       |          |
| *Musa* spp. (Banana)       | 12                  | 11                    | 13                  | 11             | 15             |                       |          |
| *Cocos nucifera*           | 14                  | 14                    | 18                  | 15             | 19             |                       |          |
| (Coconut)                  |                     |                       |                     |                |                |                       |          |
| *Phaseolus vulgaris*       |                     |                       | 1                   |                |                |                       |          |
| (Baguio Beans)             |                     |                       |                     |                |                |                       |          |
| *Sechium edule*            |                     |                       |                     |                |                | 2                     |          |
| (Chayote)                  |                     |                       |                     |                |                |                       |          |
| *Brassica rapa* (Pechay)   |                     |                       |                     | 1              |                |                       |          |
| (Eggplant)                 |                     |                       |                     |                |                |                       |          |
| *Solanum melongana*        |                     |                       |                     |                | 2              |                       |          |
| (Eggplant)                 |                     |                       |                     |                |                |                       |          |
| *Zingiber officinale*      |                     |                       |                     |                |                | 2                     |          |
| (Ginger)                   |                     |                       |                     |                |                |                       |          |
| *Colocasia esculenta*      | 2                   | 2                     | 2                   |                |                |                       |          |
| (Taro)                     |                     |                       |                     |                |                |                       |          |
| *Zea mays* (Corn)          |                     |                       |                     | 3              |                |                       |          |
| *Ipomea batatas* (Sweet potato) |                 |                       |                     | 1              |                |                       |          |
| *Cucurbita maxima*         |                     |                       |                     | 1              |                |                       |          |
| (Squash)                   |                     |                       |                     |                |                |                       |          |
| *Citrus aurantium*         | 3                   |                       |                     |                |                |                       |          |
| (Citrus)                   |                     |                       |                     |                |                |                       |          |
Table 4. Length of time farmers were practicing agroforestry in Misamis Oriental, Philippines.

| LENGTH (YR) | BALINGASA (N = 20) | GINGOOG CITY (N = 20) | LAGONGLON (N = 20) | MEDINA (N = 20) | SALAY (N = 20) | SUGBONGCOGON (N = 20) | CLAVERIA (N = 20) |
|-------------|---------------------|------------------------|--------------------|-----------------|---------------|----------------------|------------------|
| < 1         | 1                   | -                      | -                  | -               | -             | -                    | -                |
| 1 – 2       | 3                   | 3                      | 1                  | 2               | -             | -                    | 4                |
| 3 – 4       | 8                   | 4                      | 1                  | 5               | 1             | 7                    | 5                |
| 5 – 6       | 6                   | 4                      | 1                  | 6               | -             | 7                    | 3                |
| 7 – 8       | 2                   | 1                      | 2                  | 3               | -             | -                    | 3                |
| 9 and over  | -                   | 8                      | 15                 | 4               | 19            | 6                    | 4                |

3.3. Factors influencing agroforestry adoption

The study revealed that tenurial status (Table 6) and farm size (Table 5) were the main factors hindering agroforestry adoption. Land owners with a large area are most likely to adopt different agroforestry practices. Tenants preferred to plant cash crops due to the issues on the right to choose what to plant, privacy of land and security of products and uncertainty on the length of time to cultivate the land. In some part of Misamis Oriental and Bukidnon, farmers plant trees for domestic consumption like repair or construction of their houses [3]. Most respondents practiced multistorey, intercropping, alley/ hedgerow intercropping (Table 1) to maximize land utilization, and thereby produced a diversity of crops.

Table 5. Area devoted to agroforestry.

| AREA (HA) | BALINGASAG (N = 20) | GINGOOG CITY (N = 20) | LAGONGLONG (N = 20) | MEDINA (N = 20) | SALAY (N = 20) | SUGBONGCOGON (N = 20) | CLAVERIA (N = 20) |
|-----------|----------------------|-----------------------|---------------------|-----------------|---------------|----------------------|------------------|
| < 0.50    | 6                    | 2                     | -                   | 2               | 1             | 5                    | 4                |
| 0.50 to   | 4                    | 2                     | 4                   | 9               | 3             | 3                    | 8                |
| 1.00      |                      |                       |                     | 4               | 4             | 5                    | 2                |
| 1.50      | 1                    | 3                     | 4                   | 2               | 0             | 5                    | -                |
| 2.00      | 2                    | 3                     | 4                   | 3               | 2             | 1                    | 3                |
| 3.00      | 1                    | 4                     | 3                   | -               | 3             | -                    | -                |
| 4.00      | -                    | 1                     | 2                   | -               | 2             | 2                    | -                |
| > 5.00    | 3                    | 2                     | 1                   | -               | 5             | 1                    | 3                |

Table 6. Tenurial status of falcata – based agroforestry farmers in Misamis Oriental, Philippines.

|                     | BALINGASAG (N = 20) | GINGOOG CITY (N = 20) | LAGONGLONG (N = 20) | MEDINA (N = 20) | SALAY (N = 20) | SUGBONGCOGON (N = 20) | CLAVERIA (N = 20) |
|---------------------|----------------------|-----------------------|---------------------|-----------------|---------------|----------------------|------------------|
| Owner               | 12                   | 11                    | 17                  | 11              | 13            | 5                    |                  |
| Joint               | 2                    | 6                     | 1                   | 0               | 2             | 9                    |                  |
| Ownership           |                      |                       |                     |                 |               |                      |                  |
| Tenant              | 4                    | 3                     | 1                   | 7               | 5             | 6                    |                  |
| Rented              | 2                    | 0                     | 1                   | 2               | 0             | 0                    |                  |
4. Conclusion
Majority of Falcata-based farmers practised multistorey, intercropping, alley/ hedgerow intercropping to maximize land utilization, and thereby produced a diversity of crops. However, the number and type of agroforestry systems practiced varies across sites. Education, age, area, tenurial instruments, financing were the factors that may influence the diversity of agroforestry system, component crops and/ or animals.

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