

## BASELINE INFORMATION ANALYSIS FOR AN INTEGRATED AGROFORESTRY SYSTEMS IN BENGUET, CORDILLERA ADMINISTRATIVE REGION (car)<sup>1</sup>

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### ABSTRACT

A baseline information analysis for Agroforestry farming systems was done in the 13 municipalities of Benguet Province. A total of 41 barangays from the different municipalities were surveyed and 95 actual Agroforestry practitioners were interviewed.

There are four Agroforestry systems being practiced in all three Agroforestry Ecological Zones (AFEZ) in Benguet Province. These are: Agrisilvicultural (combination of annual crops particularly squash, *gabi*, sweet potato, rice, or corn plus forest trees specifically Benguet Pine or Alnus), Agrisilvipastoral (combination of rice, corn, *gabi* or sweet potato including fruit trees and coffee plus domestic animals typically native pigs, native chickens, and cattle integrated under Benguet Pine or Alnus), Silvipastoral (combination of domestic animals particularly cattle under Benguet Pine or Alnus), and; Agrisilviculture plus Sericulture, (combination of *gabi*, sweetpotato, or rice planted in open areas with coffee planted under Benguet Pine or Alnus plus mulberry cultivated in the open areas for Sericulture). Among these Agroforestry systems, Agrisilviculture was the most practiced. These Agroforestry systems are situated in areas having greater than 100% slope (which is deemed very strong to very steep slope), have sandy loam soil, experience the Type 1 climate, with temperature range of 18–28.95°C and mainly rainfed. Coffee, sweet potato, *gabi*, cassava, corn, and chayote are the common crops cultivated while cattle, native pigs, and native chickens are the domestic animals found in most of these Agroforestry systems. On the other hand, Alnus (*Alnus spp.*), and native *Ipil-ipil* (*Leucaena leucocephala L*) are the dominant Nitrogen fixing trees integrated while Benguet Pine (*Pinus kesiya Royle ex Grodon*) is the most prominent forest tree cover. Meanwhile, the identified Non-Timber Forest Species (NTFS) are different bamboo species and “rono” (*Miscanthus sinensis*) which are sold as pole or trellis, respectively. These are also used for fuel wood and fencing. The respondents perceived Agroforestry as a wide tract of land with large trees growing, unaware that they are practicing Agroforestry. For forest conservation measures, the respondents plant trees and strictly follow forest protection ordinances like not practicing the old “*kaingin*” system.

**KEYWORDS:** Agroforestry farming systems, Agroforestry, Baseline Information, Agroforestry Ecological Zones, Agrisilviculture, Agrisilvipastoral, Silvipastoral and Sericulture

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### INTRODUCTION

Agroforestry is the sustainable management of land which increases overall production by harmoniously combining agricultural crops, trees, and other forest plants and/or animals simultaneously or sequentially and applies management practices that are compatible with the cultural practices of local population (Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, 1983).

Agroforestry systems may be classified into Agrisilviculture, Agrisilvipastoral and Silvipastoral systems. Vergara and Briones (1987), as cited by Buhong (2000), stated that Agrisilviculture involves the combination of agronomic crops such as rice and vegetables with horticultural crops, and/or forest trees. The combination may be achieved in terms of spatial arrangements of the crop components i.e. trees planted as field border or at farm boundaries, alternative rows of food and tree crops, alternative strips of food crops and trees, and random mixture of food crops and trees. Meanwhile, Agrisilvipastoral is defined as the combination of agricultural crops, forest crops and livestock in a given site. Silvipastoral on the other hand involves the combination of trees and livestock in a given area as contrasted to a wide expanse grasslands for traditional livestock grazing.

Del Castillo (2000) added that the combined production of food crops with trees, animals and other resources in an area is being practiced at present. Agroforestry has become a by word among change agents, and considered one of the sustainable technologies in attaining increased economic gain, resource preservation and ecological stability.

Agroforestry farming system is being vigorously promoted as an important tool in the development of the uplands like the Cordillera Administrative Region (CAR). However, Agroforestry Development Program in CAR should start with baseline survey to provide background information in climate, topography, soils and socio-economic environment within the target area. This initial stage includes description and diagnosis of farm situations. The design stage follows during which a range of alternative interventions are eventually tested under actual farm conditions. Whatever interventions that successfully meet the evaluation criteria will be made available to other farmers (Macanes, 2009).

Agroforestry is an old practice. This is evident in the many forms of Agroforestry farming systems existing in CAR. However, in order to increase understanding about existing Agro-

forestry systems in the region, documentation, assessment, and characterization of these agroforestry systems are very important. This would provide information on whether a particular agroforestry system is functioning effectively or have reached its maximum operating potential. Moreover, documentation can provide ideas for innovations which can make existing Agroforestry systems more productive, sustainable and adoptable to other areas.

## Objectives

The project primarily aimed to establish a database information by documenting the existing Agroforestry farming practices in Benguet Province based on the biophysical ecosystems.

Specifically, this project aimed to:

1. Document the existing agroforestry farming systems practiced in Benguet Province,
2. Characterize the biophysical environment affecting the agroforestry systems,
3. Identify nitrogen-fixing plants integrated in the existing Agroforestry systems of Benguet,
4. Know the Non-timber Forest Species (NTFS) existing in the agroforestry farms, and
5. Document the perceptions, attitudes and knowledge systems of farmers practicing agroforestry in Benguet.

## MATERIALS AND METHODS

The project was implemented by Benguet State University (BSU) through the Institute of Highland Farming Systems and Agroforestry (IHFS) from December 2008 to May 2009 as part of the Cordillera Administrative Region Agroforestry Program funded by the initiative of Sen. Edgardo J. Angara. Pre-identification of areas with existing Agroforestry systems was done in coordination with the respective Municipal Agriculture Offices (MAO) before the actual reconnaissance survey. Per-



mission from the Local Government Unit (LGU) was sought prior to the conduct of the survey and interviews. Formal and informal interview using structured questionnaires were employed to elicit information from key informants and respondents. Meanwhile, secondary data and referrals were acquired from the offices of the different municipalities.

The survey was done in all the 13 municipalities of Benguet namely; Atok, Bakun, Bokod, Buguias, Itogon, Kabayan, Kapangan, Kibungan, La Trinidad, Mankayan, Sablan, Tuba and Tublay. A total of 41 barangays from the different municipalities were surveyed where 95 actual agroforestry practitioners were randomly identified and interviewed.

**RESULTS AND DISCUSSION**

**Documentation of Agroforestry Farming Systems in Benguet**

**Profile of the respondents**

Thirty-one percent of the respondents fall under the age bracket of 41-50 years old. This implies that most of the respondents are middle aged and are experienced farmers. It shows that out of the 95 respondents, 63% were male while 37% were female. The greater number of male respondents is attributed to the time and location where they were interviewed because most of the interviews were done in the field. Furthermore, females were reluctant to give information and said that their spouse instead be interviewed considering that it is mostly the males that manage the farm. Nevertheless, this study recognizes the important involvement of females in the operation of the Agroforestry farms (Table 1).

Majority of the respondents had formal education thus, they have no difficulty in understanding this study and in responding to questions during the inter-views. This implies that most of them are literate

enough to accept inno-

ventions on agroforestry

management practices. Regarding the civil status, 79% were married; 14% single and only seven percent were widow/ers.

Most of the respondents owned the land they are cultivating; 17% were tenants and only five percent of them were renting the land. This shows that most of the respondents have flexibility in applying viable agroforestry farming technologies, and in enhancing their farms to maximize productivity (Table 1).

Meanwhile, Majority of the respondents bring their products directly to the public markets. Other market channels were through middlemen (35%), consumers (5%), and retailers (3%). This signifies that the respondents have direct access to markets (Figure 2).

**Identified agroforestry farming systems**

The distribution of the identified agro-



**Fig. 1. Benguet map showing the thirteen municipalities where the study was conducted**

Table 1. Distribution by age, sex, civil status, and educational attainment of the respondents

AGE	TOTAL	PERCENT (%)
20-30	13	14
31-40	11	12
41-50	29	31
51-60	18	19
61-70	16	17
71-80	5	5
81-90	3	3
Total	95	100

SEX	TOTAL	PERCENT (%)
Male	60	63
Female	35	37
Total	95	100

CIVIL STATUS	TOTAL	PERCENT (%)
Single	13	14
Married	75	79
Widow/er	7	7
Total	95	100

EDUCATIONAL ATTAINMENT	TOTAL	PERCENT (%)
Elementary	36	38
High School	33	35
College	20	21
Vocational	1	1
Non-formal	2	2
No Formal Education	3	3
Total	95	100

LAND TENURE STATUS	TOTAL	PERCENT (%)
Tenant	74	78
Owned	16	17
Rented	5	5
Total	95	100

forestry systems in Benguet. Four agroforestry farming systems were identified namely: Agrisilviculture (agricultural crops + forest trees or woody perennials), is practiced by majority of the respondents. This is followed by Agrisilvipas-toral (agricultural crops + forest trees or woody perennials + domestic animals) which is done by 35% of the farmers. Meanwhile, Silvipastoral (domestic animals + forest trees or woody perennials), and Agrisilviculture + Sericulture were adopted by 4% of the respondents (Figure 3). Most of these agroforestry farms were located near the respondents' homes i.e. back-yard gardens. These various Agroforestry farming systems are found in all the municipalities of Benguet except for Agrisilviculture + Sericulture that it is only observed in La Trinidad, Kapanagan, and Sablan. The Agroforestry Ecological Zones (AFEZ), elevation, municipalities and the agroforestry farming systems practiced are presented in Table 2.

**Plants and animals integrated in the agroforestry systems**

There were some similarities of the crops and domestic animals integrated in the agroforestry systems in the different AFEZ of Benguet. However, some plants grown from low to mid mountain zone (AFEZ 1&2) such as mango, coconut, pineapple and other fruit-bearing trees are not found in high mountain zone (AFEZ 3). These differences are attributed from crop adaptation in the different altitudes.

Common plant species and livestock found in the different agroforestry systems were classified under the three AFEZ are shown in Table 3.

**Farm management practices**

Table 4 shows the farm management practices adopted by the respondents. Most of them apply both organic and synthetic fertilizers. Meanwhile, 24% use organic fertilizers only while





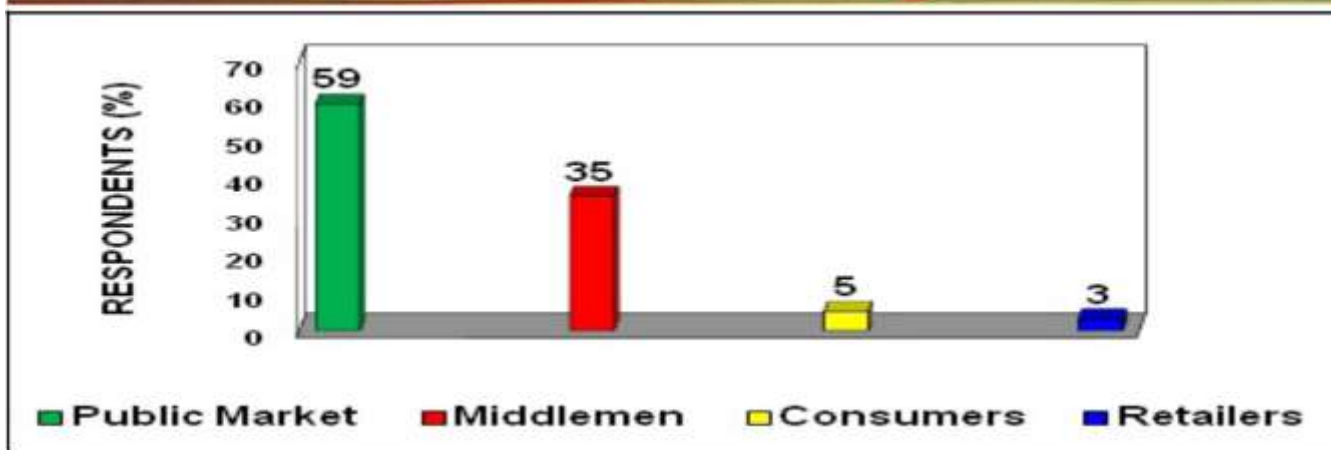


Figure 2. Market channels of the respondents

20% apply synthetic fertilizers. Differences of preference on the use of organic or inorganic fertilizer are due to the various crops integrated in these Agroforestry farms and plant nutrient requirements.

For pest and disease management practices, 66% of the respondents do physical method of controlling pests and diseases by hand picking the pests while pruning the disease infected plant part or uprooting the whole plant, 48% use chemical control, and 24% employ biological means like maintaining natural enemies of pests on their farms. The respondents claimed that chemical pesticides are just applied to control pests and diseases of specific crops such as rice, pineapple and other vegetables integrated in the agroforestry farms.

### Biophysical Characteristics of Agroforestry Systems in Benguet

#### A. Physical Characteristics

##### Land areas of respondents for agroforestry

Table 5 presents the total land area used for agroforestry farms by the respondents. Forty-one *barangays* from the 13 different municipalities of Benguet with a total of 267.73 hectares were assessed. Results showed that the municipality of Bakun had the largest total land area of 115 hectares devoted for agroforestry by respondents while Atok had the lowest total land area of 2.9ha. The differences in the land areas are attributed to the respondents' varied size of farm, the type of agroforestry farming systems practiced and the number of respondents.

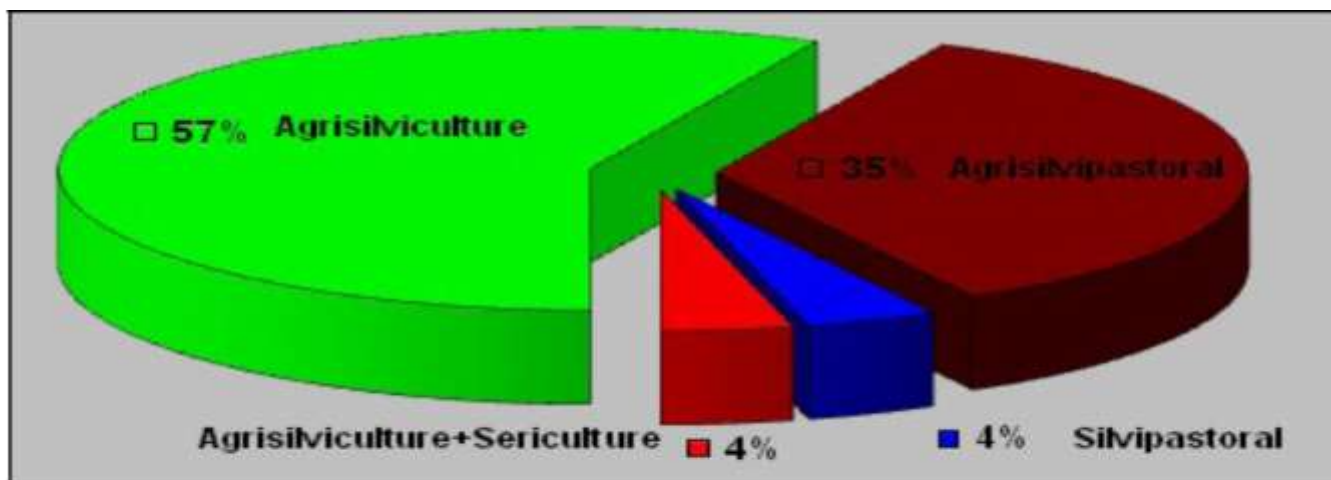


Figure 3. Distribution of different agroforestry farming systems

Table 2. Agroforestry Ecological Zones (AFEZ) of Benguet

AFEZ	ELEVATION	MUNICIPALITIES	AGROFORESTRY SYSTEMS PRACTICED
1 (Low Mountain Zone)	500 -1000 meters above sea level (masl)	Itogon	Agrisilviculture Agrisilvipastoral Silvipastoral
		Tuba	Agrisilviculture Agrisilvipastoral Silvipastoral
		Sablan	Agrisilviculture Agrisilvipastoral Silvipastoral Agrisilviculture + Sericulture
2 (Mid Mountain Zone)	1,100 – 1,500 masl	Mankayan	Agrisilviculture Agrisilvipastoral Silvipastoral
		Kapangan	Agrisilviculture Agrisilvipastoral Silvipastoral Agrisilviculture + Sericulture
		Bokod	Agrisilviculture Agrisilvipastoral Silvipastoral
		La Trinidad	Agrisilviculture Agrisilvipastoral Silvipastoral Agrisilviculture + Sericulture
3 (High Mountain Zone)	1,600 -2,000 masl	Atok	Agrisilviculture Agrisilvipastoral Silvipastoral
		Bakun	Agrisilviculture Agrisilvipastoral Silvipastoral
		Buguias	Agrisilviculture Agrisilvipastoral Silvipastoral
		Kabayan	Agrisilviculture Agrisilvipastoral Silvipastoral
		Kibungan	Agrisilviculture Agrisilvipastoral Silvipastoral
		Tublay	Agrisilviculture Agrisilvipastoral Silvipastoral

Table 3. Common plant species and livestock found in each Agroforestry system

AFEZ	AGOROFRESTRY SYSTEM	PLANTS AND ANIMAL SPECIES	
		Common Name	Scientific Name
AFEZ 1 (Low Mountain Zone) 500-1,000 masl	Agrisilvicultural	Annual Crops	
		Corn	<i>Zea mays L.</i>
		Gabi	<i>Colocasia esculenta L.</i>
		Sweet potato	<i>Ipomea batatas L.</i>
		Rice	<i>Oryza sativa L.</i>
		Squash	<i>Cucurbita maxima L.</i>
AFEZ 1 (Low Mountain Zone) 500-1,000 masl	Agrisilvicultural	Fruit Trees /Plantation Crops	
		Mango	<i>Mangifera indica L.</i>
		Avocado	<i>Persea americana Mill.</i>
		Jack fruit	<i>Artocarpus heterophyllus Lamk.</i>
		Guava	<i>Psidium guajava L.</i>
		Santol	<i>Sandoricum koetjapi Merr.</i>
		Coffee Arabica	<i>Coffea arabica L.</i>
		Coffee Liberica	<i>Coffea liberica W.Bull ex Heirn</i>
		Coffee Robusta	<i>Coffea canephora Pierre ex Froehner</i>
		Coconut	<i>Cocos nucifera L.</i>
		Pineapple	<i>Ananas comosus L.</i>
		Banana	<i>Musa spp. L.</i>
		Tiger grass	<i>Thysanolaena maxima Roxb.</i>
AFEZ 1 (Low Mountain Zone) 500-1,000 masl	Agrisilvicultural	Forest Trees/Woody Perennials	
		Ipil-ipil	<i>Leucaena leucocephala L.</i>
		Alnus	<i>A.japonica Steud., A. maritima Muhl ex Nutt</i>
		Benguet pine	<i>Pinus kesiya Royle ex Grodon</i>
		Gmelina	<i>Gmelina arborea Roxb.</i>
		Mulberry	<i>Muros alba L</i>
AFEZ 1 (Low Mountain Zone) 500-1,000 masl	Agrisilvipastoral	Annual Crops	
		Corn	<i>Zea mays L.</i>
		Gabi	<i>Colocasia esculenta L.</i>
		Sweet potato	<i>Ipomea batatas L.</i>
		Rice	<i>Oryza sativa L.</i>
AFEZ 1 (Low Mountain Zone) 500-1,000 masl	Agrisilvipastoral	Fruit Trees / Plantation Crops	
		Mango	<i>Mangifera indica L.</i>
		Avocado	<i>Persea Americana Mill.</i>
		Jack fruit	<i>Artocarpus heterophyllus Lamk.</i>
		Guava	<i>Psidium guajava L.</i>
		Santol	<i>Sandoricum koetjapi Merr.</i>
		Coconut	<i>Cocos nucifera L.</i>
		Coffee Arabica	<i>Coffea arabica L.</i>
		Coffee Robusta	<i>Coffea canephora Pierre ex Froehner</i>

Table 3. Continued...

AFEZ	AGOROFRESTRY SYSTEM	PLANTS AND ANIMAL SPECIES	
		Common Name	Scientific Name
AFEZ 1		Forest Trees / Woody Perennials	
(Low Mountain Zone)	Agrisilvipastoral	Alnus	<i>A.japonica Steud., A. maritima Muhl ex Nutt</i>
		Ipil-ipil	<i>Leucaena leucocephala L.</i>
500-1,000 masl		Benguet pine	<i>Pinus kesiya Royle ex Grodon</i>
		Gmelina	<i>Gmelina arborea Roxb.</i>
AFEZ 1	Agrisilvipastoral	Domestic Animals	
Low Mountain Zone)		Pig	<i>Sus scrofa L.</i>
		Native pig	<i>Sus domesticus L.</i>
500-1,000 masl		Cattle	<i>Bos Taurus L.</i>
		Native chicken	<i>Gallus domesticus L.</i>
AFEZ 2	Agrisilvicultural	Annual Crops	
(Mid Mountain Zone)		Chayote	<i>Sechium edule Sw.</i>
		Corn	<i>Zea mays L.</i>
		Sweet potato	<i>Ipomea batatas L.</i>
1,100-1,500 masl		Rice	<i>Oryza sativa L.</i>
AFEZ 2	Agrisilvicultural	Fruit Trees / Plantation Crops	
		Lima bean	<i>Phaseolus lunatus L.</i>
		Pigeon pea	<i>Cajanus cajan L.</i>
		Mung bean	<i>Vigna radiata L.</i>
(Mid Mountain Zone)		Pineapple	<i>Ananas comosus L.</i>
		Banana	<i>Musa spp.</i>
		Avocado	<i>Persea Americana Mill.</i>
1,100-1,500 masl		Arabica Coffee	<i>Coffea Arabica L.</i>
		Citrus Lemon	<i>Citrus limon</i>
		Citrus Pomelo	<i>Citrus maxima</i>
		Tiger grass	<i>Thysanolaena maxima Roxb.</i>
AFEZ 2	Agrisilvicultural	Forest Trees / Woody Perennials	
		Alnus	<i>A.japonica Steud., A. maritima Muhl ex Nutt</i>
(Mid Mountain Zone)		Ipil-ipil	<i>Leucaena leucocephala L.</i>
		Benguet pine	<i>Pinus kesiya Royle ex Grodon</i>
		Bamboo	<i>Bambusa spp.</i>
1,100-1,500 masl		Tree fern	<i>Cyathea spp.</i>
AFEZ 2	Agrisilvipastoral	Annual Crops	
(Mid Mountain Zone)		Rice	<i>Oryza sativa L.</i>
		Cassava	<i>Manihot esculentum Crantz.</i>
1,100-1,500 masl		Chayote	<i>Sechium edule</i>
		Sweetpotato	<i>Ipomea batatas L.</i>



Table 3. Continued...

AFEZ	AGOROFRESTRY SYSTEM	PLANTS AND ANIMAL SPECIES	
		Common Name	Scientific Name
AFEZ 2  (Mid Mountain Zone)  1,100-1,500 masl	Agrisilvipastoral	Fruit Trees / Plantation Crops	
		Banana	<i>Musa spp.</i>
		Guava	<i>Psidium guajava L.</i>
		Arabica Coffee	<i>Coffea Arabica L.</i>
		Citrus – Lemon	<i>Citrus limon</i>
AFEZ 2  (Mid Mountain Zone)  1,100-1,500 masl	Agrisilvipastoral	Forest Trees / Woody Perennials	
		Benguet Pine	<i>Pinus kesiya Royle ex Grodon</i>
		Alnus	<i>A.japonica Steud., A. maritima Muhl ex Nutt</i>
		Ipil-ipil	<i>Leucaena leucocephala L.</i>
		Bamboo	<i>Bambusa spp.</i>
		Mulberry	<i>Muros alba L.</i>
		Tree fern	<i>Cyathea spp.</i>
AFEZ 2  (Mid Mountain Zone)  1,100-1,500 masl	Agrisilvipastoral	Domestic Animals	
		Pig	<i>Sus scrofa L.</i>
		Native pig	<i>Sus domesticus L.</i>
		Cattle	<i>Bos Taurus L.</i>
		Native chicken	<i>Gallus domesticus L.</i>
AFEZ 3  (High Mountain Zone)  1,600-2,000 masl	Agrisilvicultural	Annual Crops	
		Chayote	<i>Sechium edule</i>
		Sweet potato	<i>Ipomea batatas L.</i>
		Gabi	<i>Colocasia esculenta L.</i>
		Cassava	<i>Manihot esculentum Crantz.</i>
		Passion fruit	<i>Passiflora spp.</i>
AFEZ 3  (High Mountain Zone)  1,600-2,000 masl	Agrisilvicultural	Plantation / Agroforestry Crops	
		Arabica Coffee	<i>Coffea arabica L.</i>
		Citrus-Lemon	<i>Citrus limon</i>
		Guava	<i>Psidium guajava L.</i>
		Banana	<i>Musa spp.</i>
AFEZ 3  (High Mountain Zone)  1,600-2,000 masl	Agrisilvicultural	Trees / Woody Perennials	
		Benguet Pine	<i>Pinus kesiya Royle ex Grodon</i>
		Alnus	<i>A.japonica Steud., A. maritima Muhl ex Nutt</i>
		Rono	<i>Miscanthus sinensis Anders.</i>
		Tree fern	<i>Cyathea spp.</i>
AFEZ 3  (High Mountain Zone)  1,600-2,000 masl	Agrisilvipastoral	Annual Crops	
		Chayote	<i>Sechium edule</i>
		Sweetpotato	<i>Ipomea batatas L.</i>

Table 3. Continued...

AFEZ	AGOROFRESTRY SYSTEM	PLANTS AND ANIMAL SPECIES	
		Common Name	Scientific Name
AFEZ 3 (High Mountain Zone) 1,600-2,000 masl	Agrisilvipastoral	Annual Crops	
		Gabi	<i>Colocasia esculenta L.</i>
		Cassava	<i>Manihot esculentum Crantz.</i>
		Passion fruit	<i>Passiflora spp.</i>
AFEZ 3 (High Mountain Zone) 1,600-2,000 masl	Agrisilvipastoral	Fruit Trees / Plantation Crops	
		Arabica Coffee	<i>Coffea arabica L.</i>
		Citrus-Lemon	<i>Citrus limon</i>
		Guava	<i>Psidium guajava L.</i>
		Banana	<i>Musa spp.</i>
AFEZ 3 (High Mountain Zone) 1,600-2,000 masl	Agrisilvipastoral	Forest Trees / Woody Perennials	
		Alnus	<i>A.japonica Steud., A. maritima Muhl ex Nutt</i>
		Benguet Pine	<i>Pinus kesiya Royle ex Grodon</i>
		Rono	<i>Miscanthus sinensis Anders.</i>
		Tree fern	<i>Cyathea spp</i>
AFEZ 3 (High Mountain Zone) 1,600-2,000 masl	Agrisilvipastoral	Domestic Animals	
		Pig	<i>Sus scrofa L.</i>
		Native pig	<i>Sus domesticus L.</i>
		Cattle	<i>Bos taurus L.</i>
		Native chicken	<i>Gallus domesticus L.</i>
AFEZ 3 (High Mountain Zone) 1,600-2,000 masl	Silvipastoral	Forest Trees / Woody Perennials	
		Alnus	<i>A.japonica Steud., A. maritima Muhl ex Nutt</i>
		Benguet Pine	<i>Pinus kesiya Royle ex Grodon</i>
		Rono	<i>Miscanthus sinensis Anders.</i>
		Tree fern	<i>Cyathea spp</i>
AFEZ 3 1,600-2,000 masl	Silvipastoral	Domestic Animals	
		Cattle	<i>Bos taurus L.</i>
AFEZ 3 (High Mountain Zone) 1,600-2,000 masl	Agrisilvicultural + Sericulture	Fruit Trees / Plantation Crops	
		Citrus Lemon	<i>Citrus limon</i>
		Satsuma Orange	<i>Citrus unshiu Marcovitch</i>
		Coffee- Arabica	<i>Coffea Arabica L.</i>
AFEZ 3 (High Mountain Zone) 1,600-2,000 masl	Agrisilvicultural + Sericulture	Forest Trees / Woody Perennials	
		Alnus	<i>A.japonica Steud., A. maritima Muhl ex Nutt</i>
		Benguet Pine	<i>Pinus kesiya Royle ex Grodon</i>
		Mulberry	<i>Muros alba L.</i>
		Rono	<i>Miscanthus sinensis Anders.</i>
		Silkworm	<i>Bombyx mori L.</i>

Table 4. Farm management practices of agroforestry farmers in Benguet

MANAGEMENT PRACTICES	NO. OF RESPONDENTS	PERCENT (%)
<b>On Fertilizer</b>		
Organic	23	24
Inorganic	19	20
Both	46	48
<b>Pest and Disease Management</b>		
Chemical	46	48
Physical	63	66
Biological	23	24

\*Multiple response

### Topography

Table 6 shows the soil type, elevation and average temperature of the agroforestry farms surveyed. Temperatures were recorded using a hand-held electronic device having an altimeter, barometer and temperature reading capability. Figure 4 shows the slope of the agroforestry farms. Most areas (42%) have slope of more than 100% which is considered strong slope to very steep slope while only 1% have a slope of 0-0.5%.

### Climate

Benguet province experiences the Type 1 of the Corona System of climate classification that is characterized by two pronounced seasons, dry from November to April, and wet during the rest of the year. Maximum rain period is from June to September.

### Farm Water Sources

Most (83%) of the farms cultivated by the respondents are rainfed. Other water sources for irrigation include brooks/springs, river, streams and man-made deep wells. Thus, selection of crops to be grown is critical and the planting activities were timed at the onset or during the

Table 5. Total land area utilized for agroforestry in Benguet

MUNICIPALITY	BARANGAY	TOTAL LAND AREA (Ha)
1. ATOK	Topdac Caliking	2.9
2. BAKUN	Amposongan	115
3. BOKOD	Bila Boboc-Bisal Daclan Tikey	3.27
4. BUGUIAS	Loo Poblacion	4
5. ITOGON	Dalupirip Poblacion Tuding Tinongdan	14.25
6. KABAYAN	Adaoay Ballay Doakan Gusaran Pacso	5.75
7. KAPANGAN	Central Labueg Paykek Sagubo	21.35
8. KIBUNGAN	Poblacion Sagpat	3.3
9. LA TRINIDAD	Ambiong Beckel Puguis Wangal	47.15
10. MANKAYAN	Cabiten Culalo Guinawang Paco	9.25
11. SABLAN	Banangan Central	7.71
12. TUBA	Central Tuba Nangalisan San Pascual	4
13. TUBLAY	Ambassador Basil Daclan Central	29.8
<b>TOTAL</b>		<b>267.73 Ha</b>



rainy season. It was observed that agroforestry farms with a steady source of water for irrigation have diverse crops planted.

**B. Farm Characterization**

Table 7 presents the plant and animal species integrated in the various Agroforestry farms in Benguet. Most of the farms particularly

those which fall under the low and mid-mountain zones (AFEZ 1&2) have fruit trees and other woody perennials which serve as the upper canopies for the under-storey crops as further shown in the Transect Maps of the different AFEZ (Figures 5&6). Temperate vegetables like chayote and snap bean were the common crops found in the agroforestry farms in the high mountain zones (Fig 7). However, coffee and sweetpotato

Table 6. Physical characteristics of the different locations of the agroforestry farms in Benguet

MUNICIPALITIES	SOIL TYPE	AFEZ	ELEVATION (meters above sea level)	TEMPERATURE °C
Itogon	Sandy Loam, Clay loam	1 Low Mountain Zone	500 -1,000 masl	28.95-32.3 °C
Sablan	Clay			
Tuba	Clay loam, Gravelly Loam			
Bokod	Clay	2 Mid Mountain Zone	1,100 – 1,500 masl	25.43-28 °C
La Trinidad	Loam, Clay loam, Gravelly loam			
Mankayan	Sandy loam, Silt loam			
Kapangan	Sandy loam, Gravelly loam			
Atok	Sandy loam	3 High Mountain Zone	1,600 -2,000 masl	18-24 °C
Bakun	Clay loam			
Buguias	Sandy loam			
Kabayan	Clay			
Kibungan	Gravelly loam			
Tublay	Loam, Silt loam			

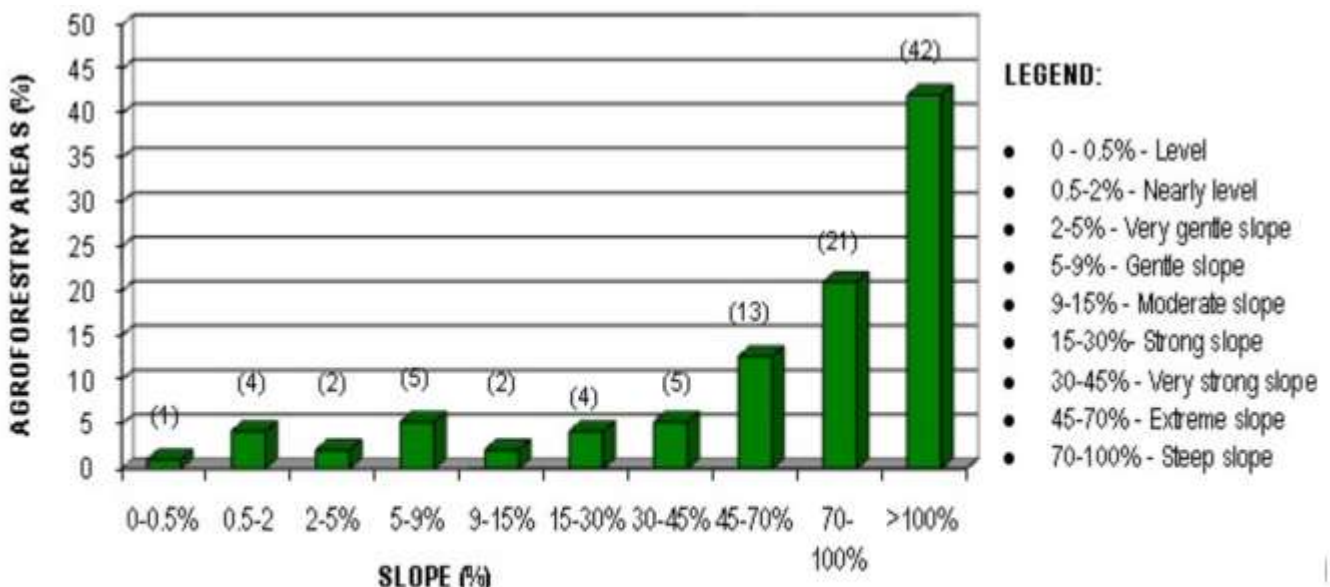


Figure 4. Slope distribution of agroforestry areas in Benguet

Table 7. Elevation and temperatures of the Agroforestry farms of Benguet

AFEZ	Municipalities	Elevation (meters above sea level)	Average Temperature	Agroforestry Farming System
AFEZ 1	Itogon Sablan Tuba	500 – 1,000 masl	28.95 – 32.3oC	<p><b><i>Agrisilvicultural</i></b></p> <hr/> <p><i>Grains:</i> Rice, Corn</p> <hr/> <p><i>Vegetables:</i> Sweet potato, Squash, Gabi</p> <hr/> <p><i>Fruits/Plantation crops:</i> Coffee (Arabica, Robusta, Liberica), Coconut, Pineapple, Banana, Avocado, Jack fruit, Guava, Mango, Santol</p> <hr/> <p><i>Other Forest Species:</i> Tiger grass, Alnus, Bamboo, <i>Ipil-ipil</i>, Benguet pine, Gmelina, Mul- berry, “Rono”, Indigenous Tree Species</p>
AFEZ 1	Itogon Sablan Tuba	500 – 1,000 masl	28.95 – 32.3oC	<p><b><i>Agrisilvipastoral</i></b></p> <hr/> <p><i>Grains:</i> Corn, Rice</p> <hr/> <p><i>Vegetables:</i> Gabi, Sweet potato</p> <hr/> <p><i>Fruits/Plantation crops:</i> Coffee, Avocado, Jack fruit, Guava, Santol, Mango</p> <hr/> <p><i>Other Forest Species:</i> Tiger grass, Alnus, Bamboo, <i>Ipil- ipil</i>, Benguet pine, Gmelina, Mulberry, “Rono”, Indigenous Tree Species</p> <hr/> <p><i>Livestock/Poultry:</i> Swine, Cattle, Native chicken</p>
AFEZ 2	Bokod Kapangan Mankayan La Trinidad	1,000 – 1,500 masl	25.43 – 28oC	<p><b><i>Agrisilvicultural</i></b></p> <hr/> <p><i>Grains:</i> Rice, Corn</p> <hr/> <p><i>Vegetables:</i> Chayote, Sweet potato, Gabi</p> <hr/> <p><i>Fruits/Plantation crops:</i> Pineapple, Banana, Coffee (Arabica, Robusta), Citrus, Avocado</p> <hr/> <p><i>Forest Species:</i> Alnus, Bamboo, Benguet pine, Tiger grass, “Rono”, Tree fern, Indigenous Tree Species</p>



Table 7. Continued...

AFEZ	Municipalities	Elevation (meters above sea level)	Average Temperature	Agroforestry Farming System
AFEZ 2	Bokod Kapangan Mankayan La Trinidad	1,000 – 1,500 masl	25.43 – 28°C	<b><i>Agrisilvipastoral</i></b> <i>Grains:</i> Rice <i>Vegetables:</i> Chayote, Cassava, Sweet potato <i>Fruits/Plantation crops:</i> Banana, Coffee, Citrus, Guava <i>Other Forest Species:</i> Alnus, Benguet Pine, Bamboo, Mulberry, <i>Ipil-ipil</i> , “ <i>Rono</i> ”, Tree fern, Indigenous Tree Species <i>Livestock/Poultry:</i> Swine, Cattle, Carabao, Goat, Native chicken
AFEZ 3	Atok Bakun Buguias Kabayan Kibungan Tublay	1,600 – 2,000 masl	18 – 24°C	<b><i>Agrisilvicultural</i></b> <i>Grains:</i> Rice, Corn <i>Vegetables:</i> Chayote, Sweet potato, <i>Gabi</i> , Cassava <i>Fruits/Plantation crops:</i> Passion fruit, Guava, Arabica Coffee, Citrus-Lemon, Banana
AFEZ 3	Atok Bakun Buguias Kabayan Kibungan Tublay	1,600 – 2,000 masl	18 – 24°C	<b><i>Agrisilvicultural</i></b> <i>Forest Species:</i> Alnus, Benguet Pine, “ <i>Rono</i> ”, Tree fern, Indigenous Tree Species <i>Livestock/Poultry:</i> Swine, Cattle, Native chicken
AFEZ 3	Atok Bakun Buguias Kabayan Kibungan Tublay	1,600 – 2,000 masl	18 – 24°C	<b><i>Silvipastoral</i></b> <i>Other Forest Species:</i> Alnus, Benguet Pine, “ <i>Rono</i> ”, Tree fern <i>Livestock:</i> Cattle <b><i>Agrisilviculture plus Sericulture</i></b> <i>Fruits/Plantation crops:</i> Lemon, Coffee, Banana <i>Other Forest Species:</i> Alnus, Benguet Pine, “ <i>Rono</i> ”, Tree fern, Mulberry <i>Others:</i> Silkworm

were observed to be the most common crops under the fruit trees and other woody perennials. Finally, domestic animals like native pigs, chicken, and cattle were the animals commonly integrated.

**Nitrogen-fixing plants of Agroforestry Farms in Benguet Province**

**Identified N-fixing plant species**

The n-fixing tree species that were observed to abound in the different Agroforestry farms under the three AFEZ were *Alnus* (*A.japonica steud*, *A.maritima muhl ex nutt*) and native *Ipil-ipil* (*Leucaena leucocephala L.*). Other N-fixing crop species found were Pigeon pea, Lima bean and Mungbean as shown in Table 8.

**Distribution of Nitrogen-Fixing Plant Species**

Table 9 presents the distribution of different N-fixing plants at the various AFEZ. Dominance of *Alnus* and *Ipil-ipil* among the N-fixing plants were noted in the farms surveyed.

**Other uses of N-fixing plants**

Aside from being the source of Nitrogen-rich biomass for fertilizers, the respondents claimed that the N-fixing plants also serve as boundary markers, used as shade for understorey crops, fence, firewood and hedgerow for soil erosion control. Moreover, *Ipil-ipil* is also used as fodder for animal ruminants.

**Identified NTFS and their Uses**

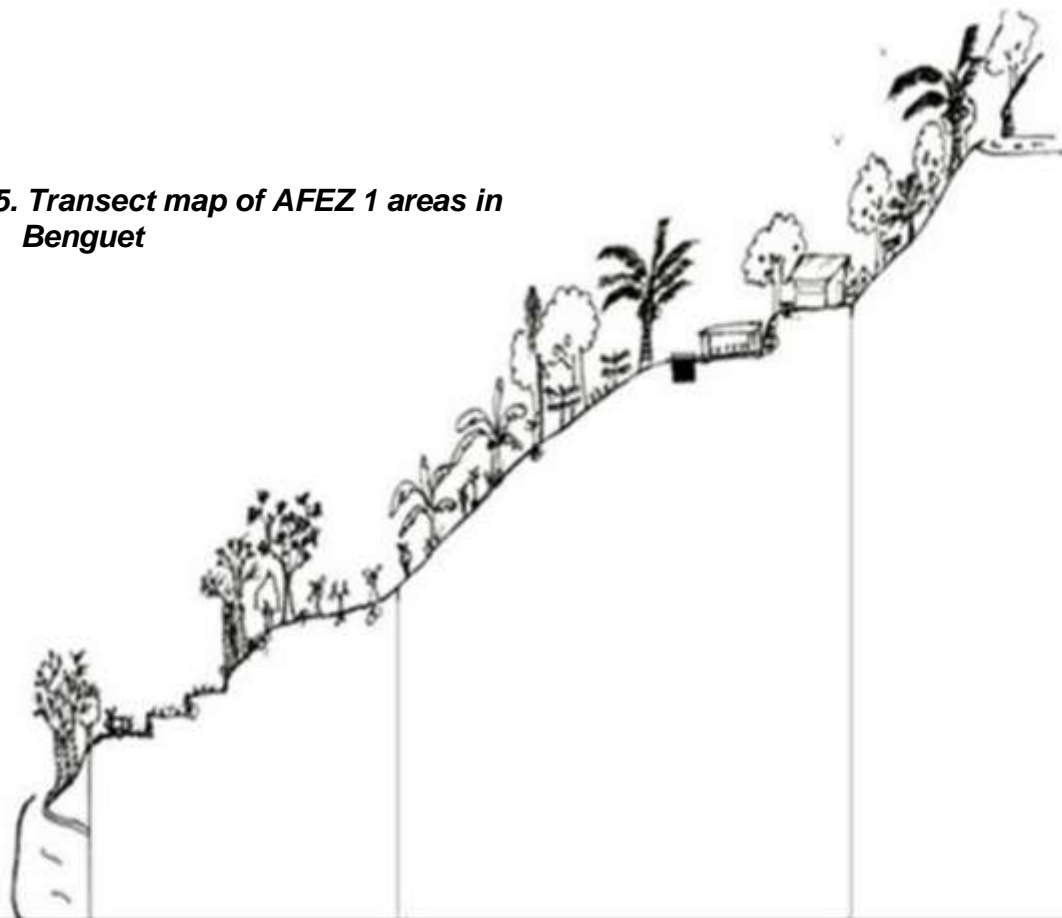
Table 10 presents the identified NTFS found in the Agroforestry farms under the various AFEZ. *Alnus* trees, *Ipil-ipil* trees, bamboo and “rono” (*Miscanthus sinensis Anders.*) are dominant in all of the farms.

The respondents stated that they integrate NTFS in their agroforestry farms for domestic use particularly fuelwood, fences, shade for under-storey crops, and planted as soil and water conservation (SWC) measures. Others said they utilized NTFS for economic purposes such as bamboo traded as poles and “rono” sold as trellis for leguminous crops. *Ipil-ipil* is used as fodder for livestock and mulberry as source of mulberry leaves for silkworm (Sericulture).

Table 8. Common nitrogen-fixing species found in the agroforestry farms in Benguet

AFEZ	MUNICIPALITY	NITROGEN-FIXING PLANTS	SCIENTIFIC NAME	LIFECYCLE
AFEZ 1 (500-1,000 masl)	ITOGON	<i>Alnus</i>	<i>A.japonica Steud.</i> ,	Perennial
	SABLAN		<i>A. maritima Muhl ex Nutt</i>	
	TUBA	Native <i>Ipil-ipil</i>	<i>Leucaena Leucocephala L.</i>	Perennial
AFEZ 2 (1,100-1,500 masl)	LA TRINIDAD	<i>Alnus</i>	<i>A.japonica Steud.</i> ,	Perennial
	MANKAYAN		<i>A. maritima Muhl ex Nutt</i>	
	KAPANGAN	Native <i>Ipil-ipil</i>	<i>Leucaena leucocephala L.</i>	Perennial
	BOKOD	Lima bean	<i>Phaseolus lunatus L</i>	Annual
		Pigeon pea	<i>Cajanus cajan L.</i>	Annual
		Mung bean	<i>Vigna radiate L.</i>	Annual
AFEZ 3 (1,600-2,000 masl)	ATOK	<i>Alnus</i>	<i>A.japonica Steud.</i> ,	Perennial
	BAKUN		<i>A. maritima Muhl ex Nutt</i>	
	BUGUIAS	Native <i>Ipil-ipil</i>	<i>Leucaena leucocephala L.</i>	Perennial
	KABAYAN	Pigeon pea	<i>Cajanus cajan L.</i>	Annual
	KIBUNGAN TUBLAY			

**Figure 5. Transect map of AFEZ 1 areas in Benguet**



<b>Crops, Shrubs, Trees</b>	<b>Rice, Sweet Potato, Ube, Gabi, Pigeon Pea, Alnus, Bamboo, Ipil-tpil, Indigenous Tree Species</b>	<b>Banana, Pineapple, Cassava, Coffee, Coconut, Rattan, Rambutan, Mango, Jackfruit, Samol, Star apple, Corn, Tamarind, Tiger Grass, Indigenous Tree Species</b>	<b>Coconut, Tiger Grass, Mahogany, Gmelina, Indigenous Tree Species</b>
<b>Animals</b>	<b>Carabao</b>	<b>Native Chicken</b>	<b>Indigenous Tree Species</b>
<b>Infrastructure Components</b>	<b>Rice Terraces, Creek</b>	<b>Compost Pit, Seedling Nursery, Rockwall</b>	<b>Road</b>
<b>Soil Type</b>	<b>Clay Loam</b>	<b>Sandy Loam</b>	<b>Sandy Loam</b>
<b>Slope</b>	<b>9-15%</b>	<b>30-45%</b>	<b>70-100%</b>
<b>Average Temperature</b>	<b>28.95-32.30°C</b>		
<b>Elevation</b>	<b>500-1,000 meters above sea level</b>		
<b>Agroforestry Ecological Zone (AFEZ) 1</b>			

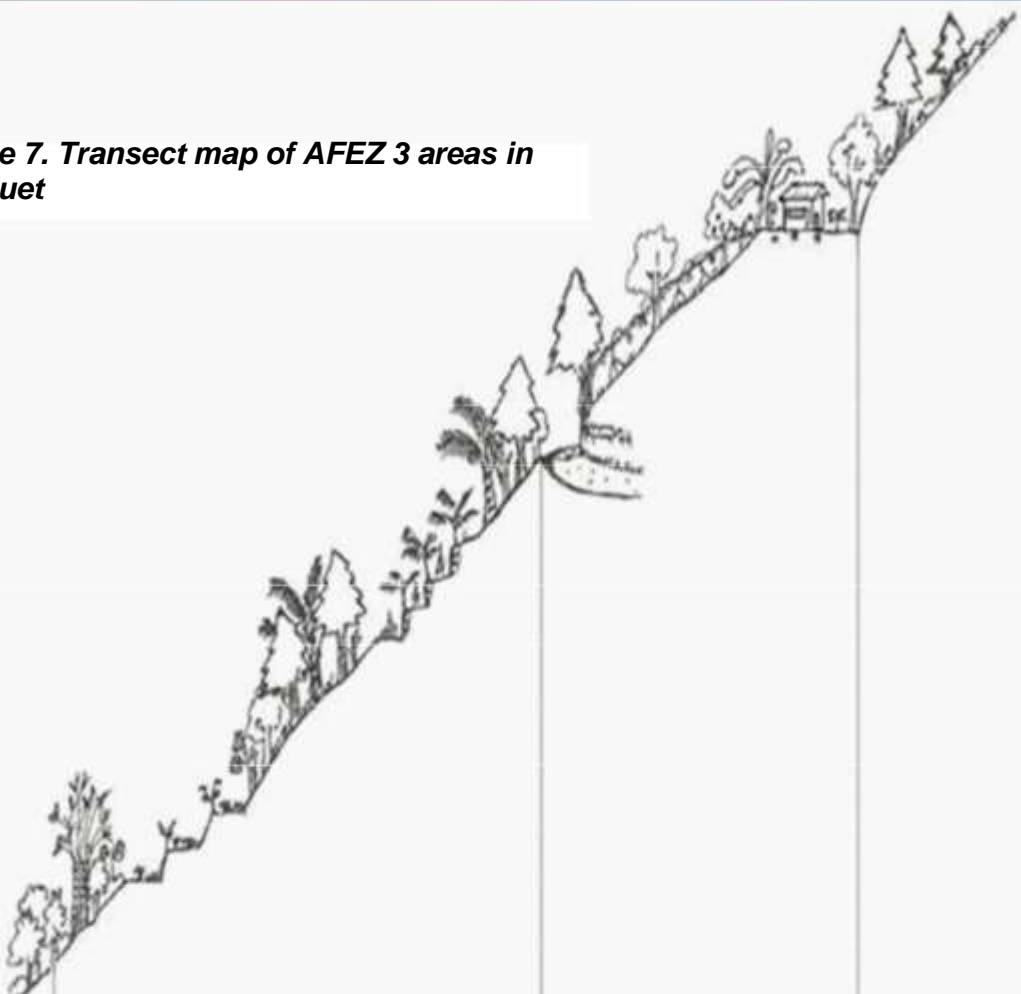
**Figure 6. Transect map of AFEZ 2 areas in Benguet**



Crops, Shrubs, Trees	Benguet Pine, Pasture grass, Bamboo, Ipil-IPIL, Indigenous Tree Species	Sweet Potato, Cassava, Gabi, Coffee, Banana, Squash, Mango, Jackfruit, Santol, Lemon, Coconut, Mulberry, Pineapple, Corn	Bamboo, Gmelina, Benguet Pine, Alnus, Tree Fern, Indigenous Tree Species
Animals	Cattle	Swine, Native Chicken	
Infrastructure Components			Road
Soil Type	Clay Loam	Sandy Loam	Sandy Loam
Slope	2-5%	9-15%	>100%
Average Temperature	25.43-28°C		
Elevation	1,100-1,500 meters above sea level		
	1,000-1,500 meters above sea level		
Agroforestry Ecological Zone (AFEZ) 2			



**Figure 7. Transect map of AFEZ 3 areas in Benguet**



Crops, Shrubs, Trees	<b>Snap Bean, Peachay, Cassava, Tiger Grass, 'Rono', Tree Fern, Alnus, Benguet Pine, Bamboo, Indigenous Tree species</b>	<b>Chayote, Coffee, Banana, Avocado, Lemon, Alnus, Benguet Pine</b>	Benguet Pine, Benguet Pine, Indigenous Tree Species
Animals	Indigenous Tree Species	Benguet Pine, Native Chicken	
Infrastructure Components		Road	
Soil Type	Sandy Loam	Sandy Loam	Sandy Loam
Soil Type	Sandy Loam	Sandy Loam	Sandy Loam
Slope	>100%	>100%	>100%
Average Temperature	18-24°C		
Elevation	1,600-2,000 meters above sea level		
<b>Agroforestry Ecological Zone (AFEZ) 3</b>			



## Perceptions, Attitudes and Knowledge Systems of Benguet Farmers on Agroforestry

### Perceptions of the respondents on agroforestry

Figure 8 shows that most of the respondents perceived agroforestry as a wide tract of land with large trees growing (P1); while 34% perceived it as land with trees, crops and animals (P2); and 25% said agroforestry is just a group of trees (P3).

Table 9. Percentage distribution of nitrogen-fixing plants in the AFEZ of Benguet

AFEZ	ALNUS	IPIL-IPIL	PIGEON PEA	LIMA BEAN	MUNGBEAN
1 (500-1,000 masl)	7%	7%	2.3%	-	-
2 (1,100-1,500 masl)	28%	8%	9.3%	1%	2.3%
3 (1,600-2,000 masl)	36%	14%	4.6%	3.5%	-
TOTAL	71%	29%	16%	4.5%	2.3%

Table 10. Identified non-timber forest species and their uses in the agroforestry systems of Benguet

AFEZ/ MUNICIPALITY	AGROFORESTRY SYSTEM	NON-TIMBER FOREST SPECIES	USES
1 (Low Mountain Zone 500-1,000 masl)  Itogon Sablan Tuba	Agrisilvicultural	Alnus	Boundary marker, Shade, Fence, SWC*
		Bamboo	Sold as poles
		<i>Ipil-ipil</i>	Boundary marker, Shade, Fence, SWC* Fodder, SWC*
		"Rono"	Sold as trellis, SCW*
2 (Mid Mountain Zone 1,100-1,500 masl)  Bokod, Mankayan, Sablan, Kapangan	Agrisilvicultural	Alnus	Boundary marker, SWC*
		Bamboo	
	Agrisilvipastoral Silvipastoral	<i>Ipil-ipil</i>	
		"Rono"	
3 (High Mountain Zone 1,600-2,000 masl)  Atok, Bakun, Kabayan, Kibungan, La Trinidad Tublay	Agrisilvicultural Agrisilvipastoral Silvipastoral	Bamboo	Food for silkworm, SWC*
		"Rono"	
		Tree fern	
	Agrisilvicultural + Sericulture	Bamboo	
		Mulberry	
		"Rono"	
		Tree fern	
		Bamboo	
		Mulberry	

\*SWC-soil and water conservation

**Awareness of the respondents on their role to protect the forest and on the function of a forest**

The respondents were also asked about the importance of a forest in their area. The respondents asserted that forests are beneficial. They are aware that forests provide plenty of products. These products include firewood, lumber, charcoal and other raw materials for industries. They also value forests for its role in the preservation of biodiversity, water supply and the deterrence of soil erosion. Thus, when asked on their awareness to protect the forests, 98% of the respondents know and understood that it is their duty to protect the forest while 99% are aware on the valuable contribution of the forests (Table 11). In the case of forest protection, Table 12 shows that 66% of the respondents stated that they do reforestation while 52% strictly avoid "kaingin" practice and 49% strictly follow existing forest ordinances.

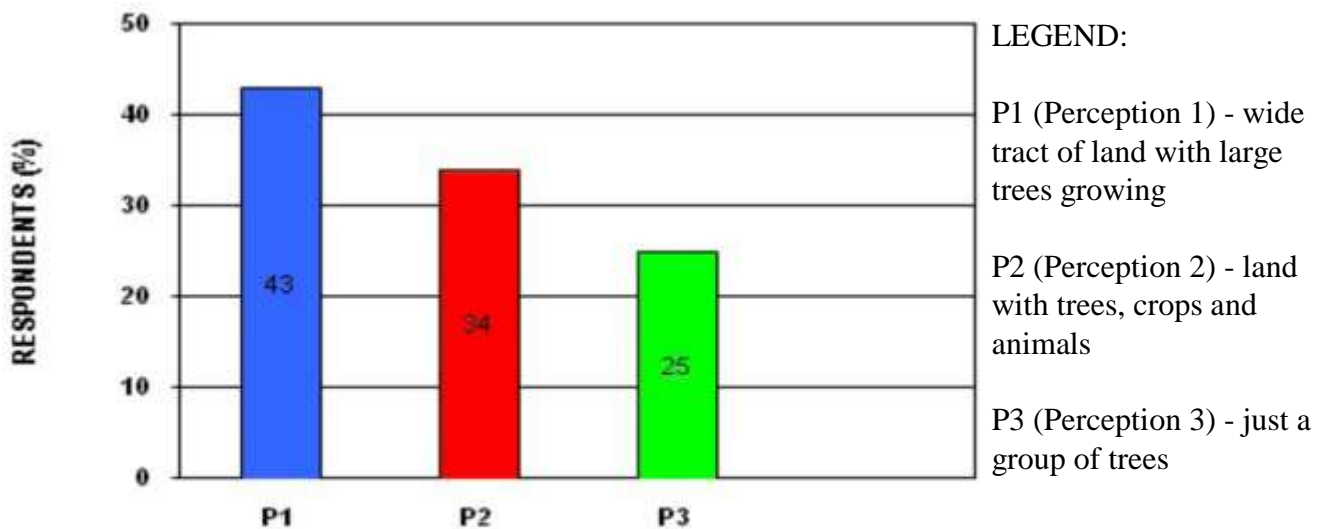
Agrisilvipastoral, Silvipastoral, and Agrisilvicultural with Sericulture. Agrisilvicultural system is exemplified by farms planted to under-storey crops like corn, rice, and vegetables with fruit trees and forest trees serving as the upper canopy. Agrisilvipastoral system is characterized by farms planted with crops similar to Agrisilviculture but integrated with any domestic animals like cattle, native pigs and poultry or a combination of the three. Meanwhile, a farm with live-stock, mainly cattle, grazing under forest trees or fruit trees typifies the Silvipastoral system. On the other hand, Agrisilvicultural with Sericulture features a farm with similar crops combination of an Agrisilvicultural system but includes mulberry plants for leaf production for silkworms. These agroforestry farming systems were found in all three AFEZ in Benguet except for Agrisilviculture with Sericulture which was found only in La Trinidad, Kapangan and Sablan. Interestingly, this study also found out that all the respondents were unaware that they are practicing the agroforestry farming system.

**CONCLUSIONS AND**

**RECOMMENDATIONS Conclusions**

Results of this study revealed that there are four existing Agroforestry farming systems practiced in Benguet namely: Agrisilvicultural,

Most of the areas devoted by the respondents for agroforestry farming have sandy loam soil type, have a very steep slope and falls within temperature ranges of 18-28.95°C. Moreover, these agroforestry farms experience the Type 1 climate of the Coronas Classification system and largely depend on rain for irrigation.



**Figure 8. Respondents' perceptions towards agroforestry in Benguet**

**Table 11. Awareness of respondents on their roles to protect the forest and on the function of the forest**

AWARENESS ON ROLES	NUMBER OF RESPONDENTS	PERCENT (%)
Yes	93	98
No	2	2
TOTAL	95	100
AWARENESS ON THE FUNCTION OF FOREST	NUMBER OF RESPONDENTS	PERCENT (%)
Yes	94	99
No	1	1
TOTAL	95	100

**Table 12. Respondents' activities to safeguard the forests**

ACTIVITIES	NUMBER OF RESPONDENTS	PERCENT (%)
Tree planting	63	66
Strictly follow existing ordinances in forest conservation	49	52
Avoid "kaingin" System	47	49

*\*Multiple response*

Coffee, sweet potato, gabi, cassava, corn, and chayote are the common crops found in most of the agroforestry farms. Meanwhile, cattle, native pig and native poultry were the domestic animals integrated in these agroforestry farms.

Furthermore, two identified N-fixing trees found in the agroforestry farms were *Alnus* (*Alnus spp*) and native Ipil-ipil. *Alnus* was the dominant between the two known n-fixing trees. Meanwhile, pigeon pea, lima bean and mungbean were the leguminous crops commonly integrated in the respondents agroforestry farms.

This study also found that the common NTFS in the Agroforestry farms were bamboo (*Bambusa spp*), tree fern (*Cyathea spp*), and "rono". Bamboo and "rono" are primarily sold as pole and trellis respectively. It is also used for fuelwood and fences. These NTFS also serves as boundary markers, shade for other crops and as live fence.



Finally, most of the respondents perceived agroforestry as a wide

tract of land with large trees growing. They are aware of the benefits derived from the forests and are willing to take care and protect it. In protecting the forests, the respondents plant trees, strictly follow existing ordinances on forest conservation and avoid the practice of the "kaingin".

**Recommendations**

1. The existing agroforestry farming systems should be further enhanced by diversifying the crops and further increase the raising of livestock to maximize farm productivity. Enhancement activities such as but not limited to adopting soil and water conservation measures like the installation of check dams and proper contour farming practices to reduce soil erosion in view of the fact that most of the Agroforestry farms have very steep slope. Full utilization of biomass from the farms through composting to serve as organic fertilizers is also encouraged.

2. Conduct trainings and seminars on new technologies of agroforestry such as; the use of Agroforestry Land Capability and

Mapping Schemes (ALCAMS) to determine the site/area's capability to support an agroforestry system and potentials for development. Other improved agroforestry technologies appropriate for upland farming such as but not limited to cover cropping, strip cropping, mulching, contour hedgerows, contour canals, contour rock walls and balabag or babag system.

3. Promote agroforestry as an alternative and sustainable source of livelihood, environment protection, climate change mitigation and balance biodiversity through production of Information Education Communication (IEC) materials, scientific forums and conferences.

4. Provide continuous technical assistance to Agroforestry farmers.

5. Conduct follow up researches on Agroforestry systems and practices using the generated information from this research to further determine important facts and knowledge systems that were not covered in this study.

### ACRONYMS

Acronyms used in the study:

AFEZ - Agroforestry Ecological Zones

ALCAMS - Agroforestry Land Capability and Mapping Schemes

BSU - Benguet State University

CAR - Cordillera Administrative Region

IEC - Information Education Communication

IHFSA - Institute of Highland Farming Systems and Agroforestry

LGU - Local Government Unit

MAO - Municipal Agriculture Office

NTFS - Non-timber Forest Species

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