GROWING AREAS AND TRADITIONAL PRODUCTION PRACTICES OF ARABICA COFFEE IN BENGUET

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ABSTRACT

The research was conducted to identify the specific growing areas and traditional production and conservation practices on Arabica coffee in the different municipalities of Benguet.

Locations of Arabica coffee production areas were obtained using a handheld Global Positioning System (GPS) navigation device and processed through ArcView software to generate maps. A survey instrument was pre-tested then formal and informal interviews were conducted with 106 coffee growers in the 13 municipalities of Benguet. Secondary data were obtained from the local government units and other government agencies.

Arabica coffee in Benguet thrives at elevations ranging from 531 to 1,800 m asl classified under three agro-ecological zones; the high hills, low mountain and mid-mountain zones. The high hills zone with elevations from 500-1,000 m asl had temperatures ranging from 28.95-32.30C; areas under low mountain zones had elevations from 1,001 to 1,500 m with temperature range of 25.43-28.0 0C and the mid-mountain zone (1,501-2,000 m asl) has temperature range of 18.0-24.00C.

The common cropping pattern practiced among the coffee growers was the combination Arabica coffee with agricultural crops and woody perennials. Production and conservation practices of Arabica coffee growers such as raising seedlings in a nursery or in shaded areas, transplanting of wildlings growing under coffee plants to a new growing site, and rejuvenation through tapping or capping and pruning of old Arabica coffee trees were noted. Production practices observed by Arabica coffee growers was mainly organic. There was non-application of synthetic fertilizers and pesticides among Arabica coffee growers.

INTRODUCTION

Coffee is one of the top priority crops in Benguet. Coffee has existed for centuries in the Cordillera Administrative Region (CAR) and has been a part of the culture and lifestyle of the Cordillerans. Among the cultivated species, Arabica coffee is the most popular although other species exists (DA, 2010). Arabica coffee is also regarded as one of the promising industrial crops in the Cordillera highlands.

The economic importance of Arabica coffee growing had motivated the farmers to increase areas of production as a major livelihood and income earner. Relatedly, the growing number of coffee shops has increased the demand for coffee products. At present, organic farming of Arabica coffee is being promoted since it has a special flavor and aroma sought by coffee drinkers and processors. The production system of coffee in Benguet is mostly organic (Tad-awan and Pablo, 2010). This is significant considering the importance of coffee as one of the banner crops of the CAR region. Organic coffee production or growing coffee without the use of harmful pesticides or chemicals using processes such as recycling and composting has a natural impact on the environment. An organic coffee production system replenishes and maintains soil fertility, and encourages biodiversity. In order to have a sustainable organic Arabica coffee production, there is a need to have a holistic view of the production system, therefore the need for database. Presently, data on growing areas and organic production of Arabica coffee in Benguet which is a vital input in the planning of responsive and proactive interventions is scarce.

This research was also the first in the country to identify Arabica coffee growing areas in Benguet through GPS. The information generated are significant to various stakeholders in order to attain sustainable Arabica coffee production in the province as well as in the region and the country as a whole.

MATERIALS AND METHODS

At the initial stages of the project, a training workshop was conducted with the project leaders, research assistants and research aides as participants. At this workshop, a draft survey instrument and appropriate interviewing technique were discussed. The workshop was followed by a pre-test of the instrument in which researchers conducted interviews with

coffee growers in La Trinidad, Benguet. After the pre-test, the instrument was shortened, questions rephrased, and a final questionnaire was reproduced and used during the actual survey.

The names of Arabica coffee growers and other important information on the production areas were obtained from the different LGUs and farmer's organizations. Secondary data were obtained from the LGUs and other government agencies. Percentages, means and rankings were used to analyze responses. Photo-documentation of the different growing areas including the production and conservation practices of coffee growers were done.

During the survey, data on the production sites such as elevation and soil characters were gathered. Locations of Arabica coffee production areas were obtained using a handheld Global Positioning System (GPS) navigation device (GARMIN GPSMAP60 CSx) and processed through ArcView software to generate maps. Soil chemical properties were analyzed using rapid soil test kits (STK) acquired from the Bureau of Soils and Water Management.

RESULTS AND DISCUSSION

Coffee growing areas

Elevation and temperature

All the 13 municipalities of Benguet were surveyed. Coffee growing areas in Benguet can be classified under three agro-ecological zones; the high hills, low mountain and mid-mountain zones. Although, Arabica coffee was grown productively at 1,200 to 1,800 m asl (Macanes, 2011), it was observed during the survey that Arabica coffee thrives at elevations ranging from 531 to about 1,800 m asl. The high hills zone with elevations from 500-1,000 m asl had temperatures ranging from 28.95-32.3 0C where most parts of Tuba, Sablan and some barangays of Bokod and Itogon are classified (Table 1 and Fig. 1).

Areas under low mountain zones had elevations from 1,001 to 1,500 m asl which include most parts of Bokod, Itogon, Kabayan, Kapangan, Kibungan, Kapangan, La Trinidad and Tublay with temperature range of

25.43-28.0 0C. The mid-mountain zone (1,501-2,000 m asl) covers most of the barangays of Atok, Bakun, Buguias, and Mankayan and some parts of Kabayan and Tublay with temperature range of 18.0-24.0 0C (Fig. 2). According to various reports of DA-CAR and Benguet State University, Arabica coffee performs well at elevations ranging from 1000 m to 1500 m asl and these elevations are characteristics of the low and mid-mountain zones of Benguet. Winston et al., (2005) found that areas above 1000 meters are preferred for the production of superior quality coffee since high elevation improves the quality of the bean and best cupping quality. In addition the cool weather associated with high altitudes delays ripening and the inherent characteristics of acidity and aroma are fully developed. On the other hand, Arabica coffee grown in the low elevation may not have the same quality as those grown in the high elevations. Clarke and Macrae (1985) reported that the upper limit elevation for Arabica coffee could be 1600 m asl and beyond which, low temperature could be a limiting factor. At lower elevations, the plants suffer from serious infection of leaf rust disease and white stem borer incidence, thus, production becomes uneconomical.

Land area surveyed devoted to Arabica coffee
and Number of coffee trees grown

Table 2 shows the production areas of organic Arabica coffee. A total of 47.92 hectares belonging to 106 coffee growers in the three agro-ecological zones was devoted to organic Arabica coffee. High hills zone had a total of 3.16 hectares planted with 3,632 trees. Low mountain zones areas have15.56 hectares and grows 17,652 coffee trees. Mid-mountain zones had the largest area devoted to organic Arabica coffee with 29.2 hectares planted with 30,280 trees. High number of Arabica coffee trees was observed in the farms due to the dense planting system. Arabica coffee growers claimed observing proper planting distance, however, they do not prune the coffee trees, and do not remove wildlings which led to the very dense plantation. The recommended number of trees per hectare is 1,200 following the Agroforestry farming system (Macanes, 2011). In some countries Arabica coffee trees were planted at higher densities such as in Kenya at 1,329 trees/ha and Brazil at 1,400-1,900 trees/ha. However, most plantations in these areas are not shaded (Harding, 2006).

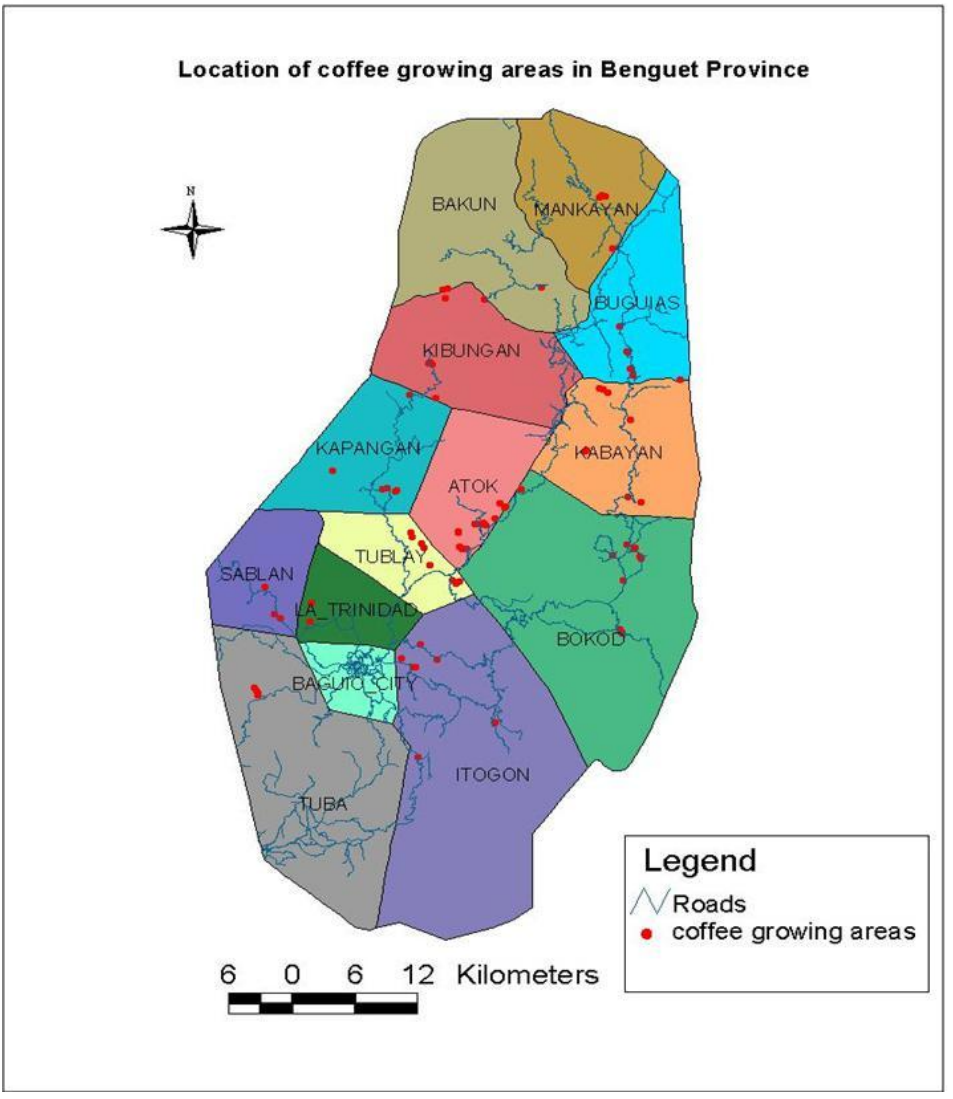

Figure 1.Map of Benguet showing the Organic Arabica coffee growing areas

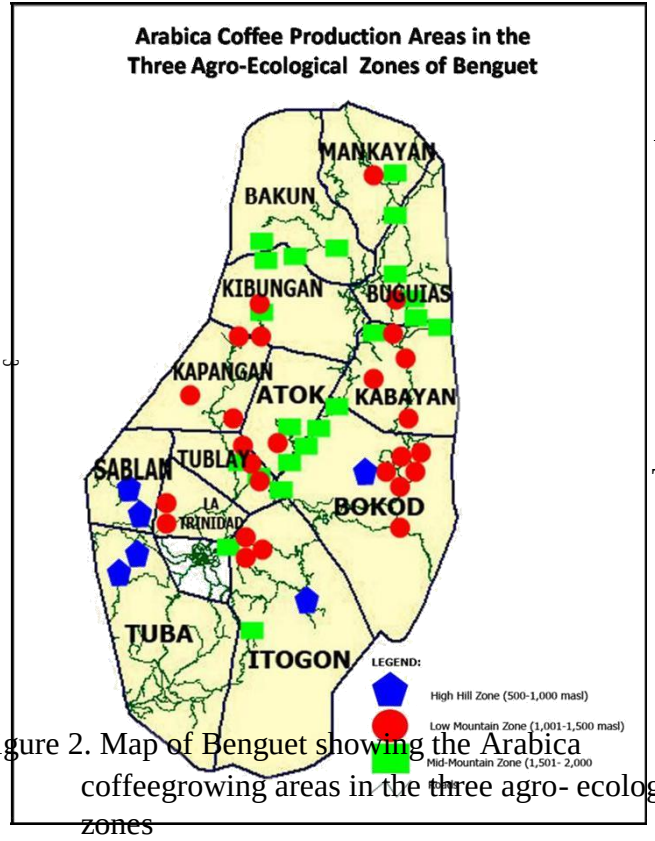

Figure 2. Map of Benguet showing the Arabica coffeegrowing areas in the three agro- ecological zones

AGRO-ECOLOGICAL ZONE	ELEVATION (m asl)	TEMPERATURE (^{0}C)	AREA PLANTED TO ARABICA COFFEE (has)	NO. OF COFFEE GROWERS	NO. OF TREES	CROPPING SYSTEMS	MUNICIPALITIES
High hill zone	500-1,000	28.95-32.3	3.16	12	3,632	Arabica coffee (Monocrop) Arabica coffee + *Alnus* Arabica coffee + Robusta Arabica coffee + Mulberry	Bakun Itogon Sablan Tuba
Low mountain zone	1,001-1,500	25.43-28.0	15.56	53	17,652	Arabica coffee (Monocrop) Arabica coffee + *Alnus* Arabica coffee + Chayote + *Alnus* Arabica Coffee + Chayote Arabica coffee + Benguet Pine + *Alnus* + Chayote	Atok Bakun Bokod Itogon Kabayan Kapangan Kibungan La Trinidad Sablan Tublay
Mid-mountain zone	1,501-2,000	18.0-24.0	29.20	41	30,280	Arabica coffee (Monocrop) Arabica coffee + *Alnus* Arabica coffee + Chayote + *Alnus* Arabica Coffee + Chayote Arabica coffee + Benguet Pine + *Alnus* + Chayote	Atok Bakun Buguias Itogon Kabayan Kibungan Mankayan Tublay

Table 1. Characteristics of Arabica coffee growing areas in Benguet

Cropping system

Majority (90%) of the Arabica coffee farmers practice Agroforestry particularly the agrisilvicultural system in their backyards (Fig. 3) and involve combination of agricultural crops with woody perennials. Other variants of this system include alley cropping, multistorey, boundary planting, windbreaks, improved fallow, and the taungya (PCAARRD, 2003).

Multistorey system in Benguet was exemplified by Arabica coffee integrated with banana, fruit trees such as citrus, guava, avocado and mango, and Alnus. These plants serve as shade for Arabica coffee and understory crops like sweet potato, gabi and ginger are also planted.

Arabica coffee production under Benguet pine, a technology developed by Benguet State University, is a common practice of integrating chayote particularly in Atok (Fig. 4). Arabica coffee grown under Alnus is commonly practiced in Bakun, Bokod, Kapangan, Mankayan and Tublay. Arabica coffee with chayote cropping system is a common practice in Kibungan and Tuba (Fig 5).

Other cropping systems in Benguet are Arabica coffee + chayote + Alnus (La Trinidad); Arabica coffee with Robusta coffee (Itogon); and Arabica coffee integrated with mulberry (Sablan). Arabica coffee as monocrop was observed in Buguias and Kabayan.

Other cropping systems were reported in Arabica coffee growing countries. Erbaugh (2006) cited that growing coffee in Uganda under a canopy of trees shade cultivation systems is a traditional way practice with farmers claiming that shade-grown coffee is of better quality, more sustainable, promotes biodiversity, has fewer pests problems, and requires fewer chemical inputs.

In Southwestern Ethiopia, the primary center of origin and center of genetic diversity of Coffea arabica, vast areas of forests coffee were observed (MelakuWerede, 1984). Semi-forest coffee production system is commonly found with considerable sizes located near the main roads, rural towns or peasant villages in scattered manner managed with little cultural practices such as weeding and shade regulation.

It was estimated that semi-forest coffee occupies nearly 136,000 hectares (34%) of the total area of coffee land in the country and represents about 24% of the total land (Dubale and Teketay, 2000). Other coffee production system is garden type, located near the residence houses and with an area of less than 0.5 hectares

Soil chemical properties of farms for Arabica coffee production Growing areas under high hills zone had medium soil nitrogen and high phosphorous content (Table 2). Potassium was deficient while soil pH range is <4.5 (extremely acidic). Low mountain zone areas exhibited medium soil nitrogen and phosphorous content with sufficient potassium and soil pH is very strongly acidic. Mid-mountain zones had soils with high nitrogen, medium phosphorous but deficient in potassium and soil pH of 4.5-5.0 (very strongly acidic).

It was noted that all the growing areas have soil pH ranging from 4.5-5.0 which is strongly acidic. This is quite alarming since Arabica coffee has to be grown in slightly acidic soil. According to Wrigley (1995) and Willson (1985), Arabica coffee thrives in regions with deep, well drained loamy soils, with a slightly acidic pH and a good supply of humus and exchangeable bases, especially potassium. This condition of Benguet soils for Arabica coffee production is an urgent concern for organic practitioners and soils scientists to do research and recommend soil amendments and appropriate soil management practices.

Table 2. Soil chemical properties of organic farms for Arabica coffee production in Benguet

ECOLOGICAL ZONE	NITROGEN	PHOSPHOROUS	POTASSIUM	pH
High hill zones (500-1,000 m asl)	Medium	High	Deficient	<4.5
Low mountain zones (1,001-1,500 m asl)	Medium	Medium	Sufficient	4.5-5.0
Mid-mountain zones (1,501- 2,000 m asl)	High	Medium	Sufficient	4.5-5.0

Soil pH description: <4.5 (extremely acid), 4.5-5.0 (very strongly acid), 5.1-5.5 (strongly acid), 5.6-6.0 (moderately acid)

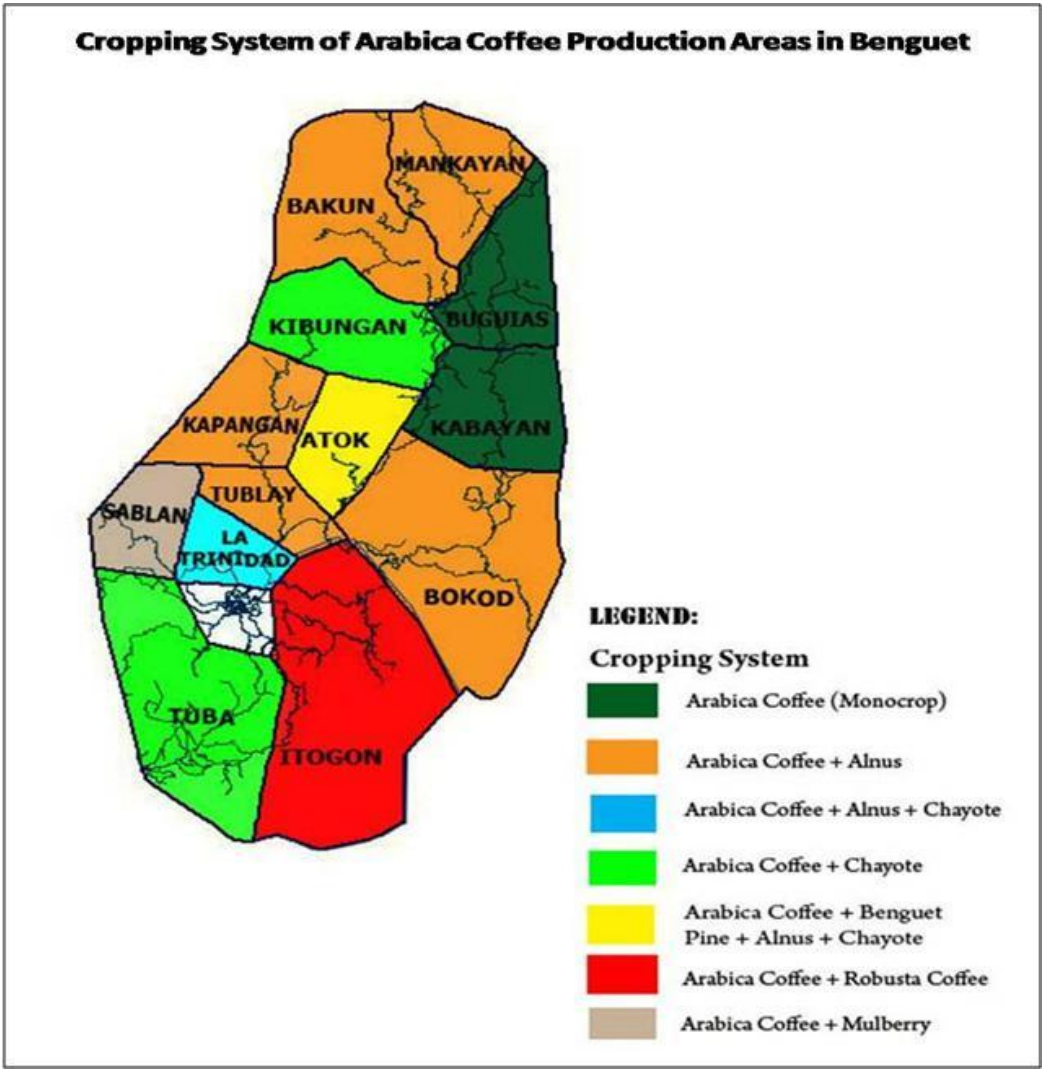

Figure 3. Map of Benguet showing cropping systems of Arabica coffee growing areas

Figure 4. Arabica coffee trees in backyards

Figure 5.Arabica coffee growing alongside with chayote

Yield potential of Arabica coffee cultivars in the growing areas

Yield of Arabica coffee ranged from 500g to 2,500g fresh berries per tree. The fresh berries when processed using wet method had a dry weight of 250-500g green beans. Arabica coffee yields an average of 1,820g fresh berries per tree and 352g green beans. The yield per tree of Arabica coffee cultivars varies in each agro-ecological zone. Highest yield of Granica, Red Bourbon and Typica was recorded from the mid-mountain zone. Except for San Ramon, lowest green bean yield was recorded in the high hills zone (Table 3).

Table 3. Potential yield of Arabica coffee cultivars in the three agro-ecological zones of Benguet

AGRO-ECOLOGICAL ZONE	GREEN BEAN YIELD (g/tree)			
	GRANICA	RED BOURBON	SAN RAMON	TYPICA
High hill zone (500-1,000 m asl)	250	220	330	130
Low mountain zone (1,001-1,500 m asl)	370	310	260	160
Mid-mountain zone (1,501- 2,000 m asl)	370	680	320	160

Production Practices of Organic Arabica Coffee Growers in Benguet The Respondents

A total of 106 organic Arabica coffee growers from the 13 municipalities of Benguet were the respondents of this study. Table 4 shows the Arabica coffee farmer-respondents' landholding size, age, educational attainment, ethnic origin and organizations affiliated. Most of the respondents were past their prime age or 29% belongs to the age bracket of 51-60 years old while 23% are 41-50 years old. This indicates that the respondents had vast experience as coffee farmers since majority (75%) had been engaged in Arabica coffee production for 21-30 years. Only a few (4%) had large area (more than 2 hectares) devoted to organic Arabica coffee production.

Most coffee growers have less than 500 m2 planted to Arabica coffee. The other areas of the farm were planted with other horticultural crops. Most of the respondents had formal education in which 31% of them had finished high school. This may imply that majority of these growers are literate to understand technologies and practices on organic Arabica coffee production. Majority belongs to the ethnic group of Ibaloi (52%) and few of them are active members of farmer organizations such as, BOCAELI, PAPROCOA-Kabayan, Kibungan Arabica Coffee Growers MPC, TOCAGMA-La Trinidad, BACOGA-La Trinidad, Atok Coffee Growers Association and Baayan Farmers Association-Tublay.

Table 4. Distribution by number of years into coffee production, land holdings, age, education, ethnic origin and organizational membership of the respondents

ITEM	FREQUENCY (N=106)	PERCENTAGE
Number of Years into Coffee Production		
1-10	6	6
11-20	10	9
21-30	80	75
31-40	5	5
41-50	5	5
Age		
20-30	3	3
31-40	15	14
41-50	24	23
51-60	31	29
61-70	17	16
71-80	14	13
81-90	2	2
Land holdings devoted to Arabica coffee (has)		
<0.05	42	40
0.051-0.5	39	37
0.51-1.0	10	9
1.01-2.0	11	10
2>	4	4

Table 4. Distribution by number of years into coffee production, land holdings, age, education, ethnic origin and organizational membership of the respondents

EducationalAttainment		
Elementary Level	8	8
Elementary Graduate	17	16
High School Level	12	11
High School Graduate	33	31
College Level	13	12
College Graduate	12	11
Vocational	7	7
Illiterate	4	4
Ethnic Origin		
Ibaloi	55	52
Kankanaey	44	42
Ilokano	4	4
Kalanguya	3	3
Membership in Organization		
BOCAEL	16	15
Other Farmers Org	26	25
None	64	60

Nature and source of planting materials. Majority (79%) of the farmer-respondents transplant uprooted wildlings (fallen seeds that germinated beneath existing Arabica coffee trees) either from their own coffee trees or from their neighbors (Table 5 and Fig.6).

Other sources of seedlings are BSU and the Department of Agriculture through the nurseries of their respective Municipal Agriculture Offices. Interestingly, the respondents claimed that the existing old Arabica coffee trees were acquired from the seedling dispersal of the livelihood program, KKK (Kilusang Kabuhayan at Kaunlaran) Program, of the then President Ferdinand E. Marcos in the ‘1970s.

Table 5. Organic Arabica coffee production and postharvest practices in Benguet

PRACTICE	FREQUENCY (n=106)	PERCENTAGE
Planting Materials		
Wildlings	84	79
Potted seedlings	16	21
Planting Distance		
Random	73	69
1m x 1m	22	21
3m x 3m	11	10
Soil Fertility Management		
Application of fertilizer	20	19
Non-application of fertilizer	86	81
Harvesting Period		
October-March	14	13
November-March	92	87
Harvesting Method (Hand picking)		
Priming	96	91
Stripping	10	9
Postharvest Processing		
Wet Method	64	60
Dry Method	42	40

Figure 6. Wildlings growing under old Arabica coffee trees (above) and potted wildlings as planting material

Planting method. Noted in most (69%) of the Arabica coffee farms were the random or no uniform planting distance resulting in densely populated coffee trees. This practice of coffee growers is not favorable for optimum coffee production since according to Macanes (2011), the standard planting distance of Arabica coffee is 3m x 3m or 4m x 4m for the Arabica coffee strains which had spreading branches like Typica, Red Bourbon, Granica, Kenya, Mondo Nuvo, Yellow or Red Caturra, and Moka while 1.5m X 1.5m or 1m X 1m for San Ramon and Improved San Ramon which had compact branches. This recommended planting distance allows for easier weeding, fertilizer application and harvesting and favors more growth of lateral branches as compared with the farmers' practice of dense planting which has many drawbacks.

Soil fertility management. Majority (81%) of the farmer-respondents do not apply any fertilizer on their coffee trees. Some applied limited amount of fertilizers particularly chicken dung which was usually an excess from their vegetable gardens (Table 5). Eight percent of the farmer-respondents, whose coffee trees were integrated with nitrogen-fixing tree species like Alnus, Ipil-ipil or Calliandra spp., claimed they need not to put fertilizers since the decomposed litter falling from these N-fixing trees serve as fertilizer and mulch to control weeds and are presumed to increase yield. Nutrients released annually from the organic matter from shade tree litter are assumed to be 40 kg N, 10 kg P and 35 kg K at coffee yields of 1 ton/ha green beans (Van Der Vossen, 2005).

Sondahl et al. (2005) reported that small coffee farms in Brazil, Colombia and Kenya with no access to external inputs often produce less than 300 kg/ha/year green coffee beans, while intensively managed plantations of Arabica coffee at conventional spacing may yield 2 t/ha annually averaged over several years.

Yields of 5 t/ha and higher have been obtained in some close-spaced and unshaded coffee planted with compact-type Arabica cultivars. Berry et al., (2002) reported that organic farming systems have the potential to supply large amounts of N to growing crops through the incorporation of crop residues, manures and composts.

Source of Irrigation. Organic Arabica coffee production areas in Benguet are rainfed.

Crop Protection

Control of Arabica Coffee Diseases. Anthracnose (*Colletotrichum coffeanum*) on leaf, stem and fruit was observed in all the Arabica coffee farms (Fig. 7). Anthracnose infestation observed on Arabica coffee leaves was rated 26-50% severe while 51-75% more severe on the berries. Other diseases like coffee leaf rust and leaf spot were also noted but of low incidence. All of the farmer-respondents are not employing any control measures against anthracnose, leaf rust and spot and sooty mold.

Figure 7. Anthracnose/Coffee Blight (*Colletotrichum coffeanum*) disease on fruit and leaf of Arabica coffee

Insect Pests. The most common insect pest observed in all the farms was the coffee berry borer. Farmers reported that the attack of stem borer was mild. Black sooty mold, technically not a disease but is caused by sucking insects (scale insects, aphid, mealy bugs), was prevalent on Arabica coffee trees in the open plantation. Scale insects severely infested coffee trees in the municipalities of Buguias, Kabayan, Kapangan, Kibungan, and Tublay (Fig. 8). Except for a few growers who remove scale insects manually, most of the coffee growers do not apply any control measure against these insects.

Figure 8. Insect pests of Arabica coffee in Benguet (clockwise from left) coffee berry stem borer, scale and mealy bugs and sooty mold infested Arabica coffee in non-shaded plantation

Harvesting

Harvesting Period. Arabica coffee harvest season in Benguet usually starts from November until late March. About 13% of the farmer respondents particularly those in the high hills zone start harvesting as early as October until March. Non-synchronized harvesting period was attributed to the varied agro-ecological zones which these Arabica coffee plantations are grown. High hills zone is characterized with higher temperature (28.95 -32.30C), thus, faster ripening of coffee berries may occur. Camargo (1985) cited that above 230C may cause accelerated ripening of fruits, often leading to loss of quality.

Harvesting Methods. All of the farmer-respondents manually harvest coffee berries and majority (91%) follow the priming method while 9% practice stripping (harvesting of both ripe and unripe berries). Stripping was done to minimize labor and saves time as claimed by the farmers. Ladders and bamboo poles were used in harvesting ripe coffee berries due to tall trees (Fig. 9). Nylon sacks were the common containers for the harvested coffee berries.

Figure 9. Harvesting ripe Arabica coffee berries using wooden poles, bamboo ladders and hooks

Postharvest Practices

A great number (60%) of the respondents practice the wet method which involves depulping, fermentation, washing, sun-drying and dehulling to extract quality green beans (Fig. 10 and Table 5).

Depulping and Fermentation. The use of mortar and pestle was a common practice by the farmers in Benguet to remove the pulp of ripe berries (Fig. 10).

It was noted however, that 21% of the coffee growers use improvised wooden and fabricated metal depulpers (Fig. 11) claimed as more efficient while the other farmers either stomp or squeeze the ripe berries by hand. The depulped coffee beans were soaked overnight in containers (Fig. 12) or until the slippery substance (mucilage) are removed then the floaters are discarded.

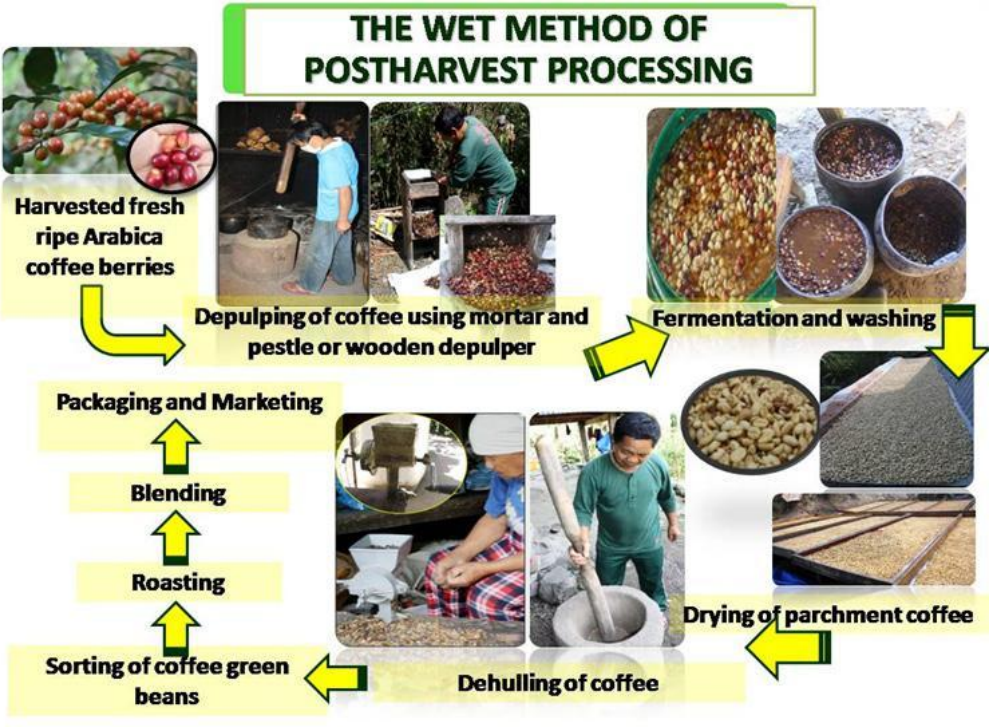

Figure. 10. Flow chart of the wet method of processing coffee beans

Figure 11. Mortar and pestle, a common equipment used both for depulping and dehulling Arabica coffee in Benguet

Figure 12 . Improvised wooden coffee depulpers (above) and locally fabricated metal depulpers

Figure 13.Depulped coffee berries soaked in clean water in drums and pails

Drying. Drying was done to lessen the moisture content before dehulling. Washed parchment coffee was sundried on sacks laid over pavements, rock surfaces, winnowers, gutters and GI roofs. For the dry method, the harvested ripe berries are dried under the sun by placing in basin, winnowers or sacks laid on cemented pavement or open areas near the homes (Fig. 14). It was also noted that a few dry their coffee berries by using rafter or roof beam of their houses. The heat from the sun absorbed by the GI sheet roof hastens the drying of the coffee berries. These also serve as the storage area for the coffee. Dry method was usually done for small harvest and for home consumption.

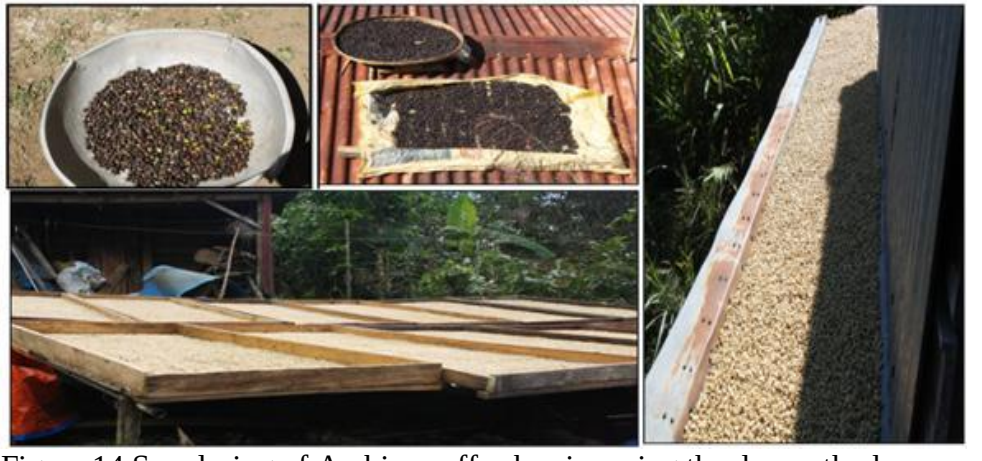

Figure 14.Sun drying of Arabica coffee berries using the dry method (top) and parchment coffee processed with the wet method (foreground, right)

Dehulling. Arabica coffee green beans are extracted from the dried parchment coffee using the mortar and pestle. This practice produces more rejects as breakage of the green beans happens during the pounding. On the other hand, few farmers use corn/rice grinding machines while farmers who had a large volume of harvest rent dehulling machines (Fig. 15) from coffee processors such as the BSU-IHFSA. The use of dehulling machines limits the amount of defects from the processed parchment coffee, thus, lessens losses incurred.

Figure 15. Extracting Arabica coffee green beans using portable rice/corn mill (left, inset) and renting of dehulling machine

Marketing Practices

Majority (90%) of the farmer-respondents sell their Arabica coffee products as green beans. Parchment coffee, dried berries (from the dry method) and ground roasted coffee are also sold. Buyers of organically produced Arabica coffee products are mostly their neighbors, local coffee processors like Umali or Garcia in Baguio City and Rocky Mountain Company (Table 6). Recently, fresh ripe berries are being bought at PhP 60.00/kg by some companies. Green beans are priced from PhP 35.00(?) to PhP 200.00. Some of the respondents use other non-conventional unit of measurement in selling their products, e.g. 1 ganta of green bean was sold at PhP 300.00 (a ganta is equivalent to 2.2 kg). This implies the demand for organically grown Arabica coffee products in Benguet. However, inappropriate packaging especially for roasted ground coffee was noted. Nylon sacks were re-used as containers for green beans, parchment coffee and dried berries. Polyethylene bags were used for packaging roasted and ground coffee (Fig. 16).

Table 6. Arabica coffee products, average buying price and market outlets of Arabica coffee in Benguet

Arabica coffee Products	Frequency (n=106)	Buying Price/Kg (PhP)	Market Outlet	Frequency
Green beans	80	30.00-200.00	Neighbors	18
			Umali's/Gourmet	17
			Local Public Market/Cooperative	14
			Garcia's	10
Parchment	15	30.00-180.00	Rocky Mountain Coffee	10
			Middlemen	8
			Cordillera Coffee	3
			Figaro	1
			Neighbors	7
			Local Public Market/Cooperative	7
			Middlemen	5
Dried Berries	15	45.00-80.00	Neighbors	7
			Local Public Market/Cooperative	5
			Middlemen	3
Roasted Ground Coffee	11	140-300.00	Local Public Market/Cooperative	11
Fresh Berries	2	60.00	Companies	2

**Multiple response*

Figure 16.Storage containers and packaging of Arabica coffee products. Nylon sack for green beans (left) polyethylene bags for roasted beans and ground coffee (right)

Conservation Practices of Arabica Coffee in Benguet

Conservation activities of the farmer-respondents like nursery establishment, topping/capping, pruning and rejuvenation of Arabica coffee were noted during the survey (Table 7).

Nursery establishment. Majority (96%) do not have established nurseries. In case of expansion or replacement of dead Arabica coffee trees, the farmer-respondents cited that vigorous wildlings found under old coffee trees were planted. This coincides with the findings of Tad-awan and Pablo (2010) that wildlings or volunteer seedlings are the planting materials commonly used in Benguet.

Tapping or capping. This practice involves the removal of shoot tips of Arabica coffee trees from desired height or about 1 meter (Fig. 17). Tapping or capping enhances the growth of lateral branches which eventually will bear more fruits. Out of the 106 respondents, 22 practiced topping or capping young Arabica coffee trees. The low number of farmers practicing this technique was attributed to the limited information dissemination drive on organic Arabica coffee production practices from the concerned agencies as claimed by the farmers.

Pruning. Pruning is a practice of removing infested and infected plant parts and unwanted branches, thus, improving the productivity of Arabica coffee trees. Only 14% of the farmer-respondents practice pruning.

Rejuvenation. Two distinct methods of rejuvenation practiced by the farmer-respondents were noted, dehorning and bending. Sixteen farmer-respondents practice rejuvenation, 11% by dehorning (complete/single stem) and 4% through bending method (Fig 18 and 19). The rejuvenation of old Arabica coffee trees could bring back 100% yield and reduce 50% labor cost (Macanes, 2011). Dehorning involves the cutting of the old Arabica coffee tree wherein only about one foot stump was left for sprouts to grow. Bending is done by having the whole trunk of the Arabica coffee tree bent parallel and close to the ground. Sprouts from the bent trunk are maintained while the old branches are cut.

Table 7. Conservation practices of Arabica coffee in Benguet

CONSERVATIONPRACTICES	FREQUENCY (N=106)	PERCENTAGE
Nursery establishment	4	4
Topping/Capping	22	21
Pruning	15	14
Rejuvenation		
Dehorning	12	11
Bending	4	4
Total	57	15

Figure 17.Unpruned Arabica coffee tree (above) and topped/capped Arabica coffees (trees grown under Alnus (below right) and Benguet Pine trees (below left)

Figure 18. Rejuvenation of old Arabica coffee trees by complete dehorning method

Figure 19. Rejuvenation of old Arabica coffee trees bybending method

SUMMARY AND CONCLUSION

The Arabica coffee growing areas practicing organic production are classified under the high hills zone with elevations from 500-1,000 m asl in the municipalities Tuba, Sablan, Bokod and Itogon; low mountain zones with an elevations from 1,001 to 1,500 m asl which include most parts of Bokod, Itogon, Kabayan, Kapangan, Kibungan, Kapangan, La Trinidad and Tublay; and the mid-mountain zone (1,501-2,000 m asl) covers most of the barangays of Atok, Bakun, Buguias, and Mankayan and some parts of Kabayan and Tublay. A total of 47.92 hectares surveyed were devoted to Arabica coffee organic production. Arabica coffee performs well at elevations ranging from 1000 m to 1500 m asl and these elevations are characteristics of the low and mid-mountain zones of Benguet. The favorable climate and natural conditions in the low and mid-mountain zones of Benguet has high potential for organic Arabica coffee production which will have positive impact on environmental and natural resource conservation.

Arabica coffee farmers practice Agroforestry in their backyards and involve combination of agricultural crops with woody perennials. Coffee farmers transplant uprooted wildlings as planting materials and plant at random or non-uniform planting distance resulting in densely populated coffee trees. Organic production was mainly practiced in Arabica coffee. Coffee growers do not apply any synthetic fertilizer and pesticide on their coffee trees.

Arabica coffee harvest season in Benguet usually starts from November until late March. But farmers particularly those in the high hills zone start harvesting as early as October until March. Non-synchronized harvesting period was attributed to the varied agro-ecological zones where these Arabica coffee plantations are grown. All of the farmers manually harvest coffee berries through priming method. As to postharvest practices, majority practice the wet method which involves depulping, fermentation, washing, sun-drying and dehulling to extract quality green beans.

Conservation activities like nursery establishment, topping/capping, pruning and rejuvenation of Arabica coffee are being practiced by some of the coffee growers.

RECOMMENDATIONS

Specific information generated in this study are recommended to be considered by other Arabica coffee researchers and growers in planning and implementing management practices for organic Arabica coffee production.

Low mountain zones (1,001 to 1,500 m asl) and the mid-mountain zones (1,501-2,000 m asl) of Benguet are the best environment for organic Arabica coffee production. Arabica coffee as component in Agroforestry is encouraged.

Uprooted wildlings as planting materials and planting at random may not be good practices in organic Arabica coffee production. Conservation activities of the farmers like nursery establishment, topping/ capping, pruning and rejuvenation of Arabica coffee are encouraged.

Though organic production is being practiced on Arabica coffee, there are some factors to consider for successful organic coffee production in the highlands. These include training of coffee farmers on concept and organic agricultural practices; prices of organic coffee must be competitive; and certification of produce should be done.

Future researches should be directed towards appropriate cultural management practices to improve the soil, deter the development of pests and increase of coffee yields under shaded conditions.

This research may be a commencement of collaborative and synergistic studies on Arabica coffee improvement in the region and the country as a whole. These collaborative efforts are expected to get impetus that will result in the development of new coffee varieties and production and postproduction technologies, which may improve and sustain the Arabica coffee industry.

Further, the Arabica coffee industry will be helpful in providing livelihood and economic sustenance of the farmers as well as satisfaction to the coffee drinkers by having a good brew in their cup.

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