

## Characterization of banana farms (*Musa spp.*) in Cuyani Microbasin, Pichanaki District, Chanchamayo Province (Junín, Perú)

### Caracterización de fincas bananeras (*Musa spp.*) En la microcuenca de Cuyani, distrito de Pichanaki, provincia de Chanchamayo (Junín, Perú)

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#### Abstract

The objective of this study was to characterize banana farms in the Cuyani Microbasin in the district of Pichanaki, Chanchamayo province (Junín, Peru). We worked with a producer organization that has 400 partners, of which a sample was taken (n = 80) using the proportions method. It was found that the banana farms are very diverse, the person in charge is mostly a man, but there is an interesting percentage of the female gender in the administration of the farms. In general, producers have a basic educational level. The production system is traditional, the banana is grown alone or associated with other crops, such as coffee. Most producers consider that pests and diseases are the main factors limiting production, since they reduce yields and increase production costs. The farms were classified in five groups, the most important of which was 45% of the farms whose owner is a male, between 44 and 56 years old, with secondary education, who lives on the same farm. They do not have a property title, the house does not have basic services, and they have poultry and guinea pigs. They have 2 to 3 hectares of banana (cultivars: Island and Palillo, 600 to 1000 plants/ha). Its production costs are between 2000 and 3600 soles and a yield of 6.5 to 7.5 t/ha. The cultivar Isla is the most common but also the cultivars Palillo, Morado and Biscocho are planted.

**Keywords:** Banana; characterization; cluster; farms; survey.

#### Resumen

Este estudio se realizó con el objetivo de caracterizar fincas productoras de plátano en la Microcuenca Cuyani en el distrito de Pichanaki, provincia de Chanchamayo (Junín, Perú). Se trabajó con una organización de productores que cuenta con 400 socios, de los cuales se tomó una muestra (n = 80) usando el método de proporciones. Se encontró que las fincas productoras de plátano son muy diversas, el responsable es mayoritariamente un hombre, pero hay un porcentaje interesante del género femenino en la administración de los fundos. En general, los productores tienen un nivel educativo básico. El sistema de producción es tradicional, el plátano se cultiva solo o asociado con otros cultivos, como el café. La mayoría de los productores consideran que las plagas y enfermedades son los principales factores limitantes de la producción, ya que reducen los rendimientos y aumentan los costos de producción. Las fincas se clasificaron en cinco grupos, el más importante reunió al 45% de las fincas y se caracterizó por tener como responsable de la finca a hombres de 44 a 56 años, con educación secundaria, que viven en la misma finca. No tienen título de propiedad, la vivienda no tiene los servicios básicos y crían aves y cuyes. Tienen de 2 a 3 ha de plátano (cultivares: Isla y Palillo, 600 a 1000 plantas/ha). Sus costos de producción están entre 2000 y 3600 soles y un rendimiento de 6.5 a 7.5 t/ha. El plátano Isla es el más cultivado; pero también se siembran los cultivares Palillo, Morado y Biscocho.

**Palabras claves:** Plátano, caracterización, conglomerado, fincas, encuesta.

#### Introduction

Banana (*Musa spp.*) is native to Southeast Asia, from where it passed to India and Africa. The Europeans introduced it to America and the Antilles and today it is a widely distributed crop, both in the tropics and subtropics. However, the largest commercial plantations are found in the humid tropics (Rodríguez and Guerrero, 2002). According to the Special Project Huallaga Central and Bajo Mayo-PEHCBM (2016), banana production is

concentrated in Africa, Latin America and the Caribbean with a world production in 2011 of 145 million MT. In Peru, banana cultivation is expanding rapidly in the jungle and the north of the country and, according to the Ministry of Agriculture (MINAGRI), in 2016, reached 169,646 ha harvested (Agencia Agraria Noticias, 2018). In the central forest there were about 19,000 ha in 2015 (Agencia Agraria Noticias, 2015) and in the district of Pichanaki, 1,595 ha (INEI, 2012).

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Banana has generated a significant and growing interest in the consumer and is one of the freshest and most widely marketed products locally and nationally. It is a basic food for the population, especially in the diet of the inhabitants of the jungle. The production systems are mostly traditional, both in monoculture, and associated mostly with coffee and cocoa (PEHCBM, 2016).

On the other hand, agriculture in Pichanaki, as in most of the country, is an activity of small producers, that is, the agricultural units or farms are small. But the farms are very diverse and complex so it is necessary to make a characterization as a previous step for any subsequent project (Santistevan *et al.*, 2014). For Malagon and Prager (2001) the characterization is a determining stage for the development of research in production systems. It consists of determining a set of variables that distinguish a particular production area or unit and that makes it different from others. Among other things, it seeks to distinguish the outstanding aspects for research in the selected area, identify the prevailing systems and identify the limiting factors.

In this sense, by grouping the farms according to their main differences and relationships, the aim is to maximize homogeneity within the group and heterogeneity among them (Cabrera *et al.*, 2004). Therefore, this work was carried out with the objective of characterizing the banana farms (*Musa* spp.) in the Cuyani microbasin, Pichanaki district (Chanchamayo, Junín, Peru).

### Materials and methods

The investigation was carried out in the Junín region, Chanchamayo province, Pichanaki district, in the Cuyani microbasin. It limits on the west with Bella Vista; on the east with Pichiquari and on the southeast with Alto Pichanaki (Figure 1).

For this particular investigation, we worked with the most representative organization of the study area, which has 400 banana producers from which a sample of 80

producers was selected. The “Method of Proportions”, already used in other similar researches, was used (Merma and Julca, 2012); the method has the following formula:

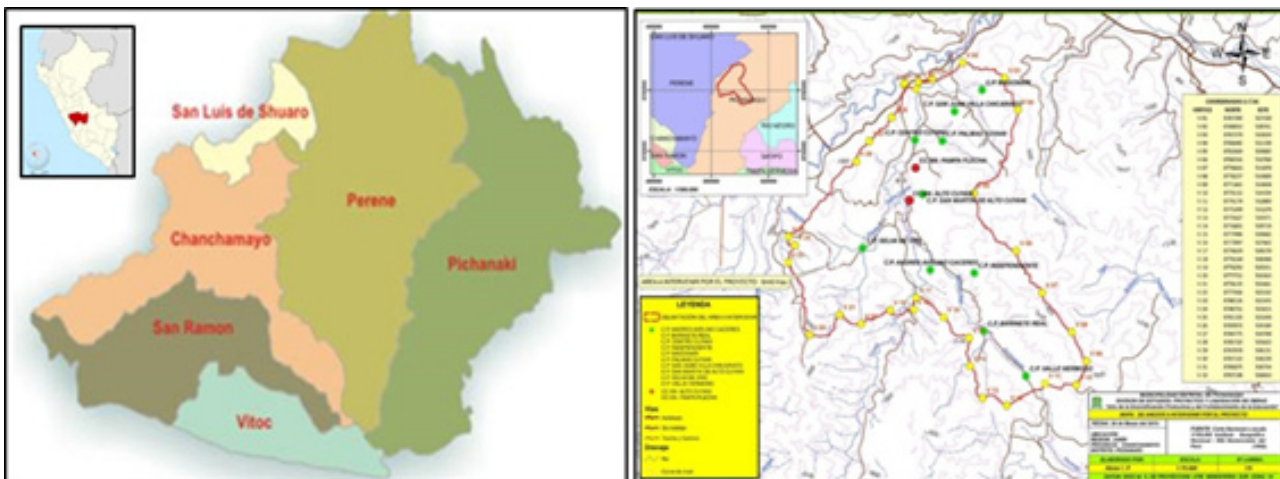
$$n = \frac{\frac{4PQ}{d^2} - 1}{\frac{4PQ}{d^2} - 1} + 1$$

Where:  
 n: Sample size  
 N: Target population (Universe)  
 P: Success probability 0.5 (value assumed)  
 Q: Error probability 0.5  
 d: % error

The data collection was carried out through semi-structured surveys, related to economic, social, environmental and technical management aspects for agricultural production. The surveys were carried out in the field, taking advantage of the meetings held by the community members, and to complete the information, they were surveyed on their own farms. Finally, a clustering analysis was performed by the Ward Method, with a Euclidean Square distance of 1200.

### Results and discussion

**Characteristics of the banana producer:** Figure 2 shows that the person responsible for the farm is mostly male (77%) and 23% of the farms are managed by women. These results corroborate data from the National Agricultural Census (INEI, 2012), which showed that of every 10 farmers, about 8 are men and 2 are women in the Selva region. The participation of women in the administration of agricultural farms is important for the financing of future projects, due to the gender approach. The most frequent age ranges of producers are from 31 to 43 years (40%), 44 to 56 years (26%), showing the presence of a young sector, which would indicate the sustainability in the management of the crop in the following decades.



**Figure 1.** Map of the Pichanaki district and the Cuyani Micro-basin study area, Chanchamayo province, Junín region, Peru (Adapted from: MDP, 2015). The study did not consider the town of Valle Hermoso

The educational level of banana farmers shows that 51% of them have completed elementary education, 44% have high school education, 3% have not had any educational formation, 1% have a technical career and 1% have university education (Figure 2). Compared to the data of the 2007 National Census, there is a similarity, where 40% of the total population of the Pichanaki district are people who have completed elementary education, 32% are people who have high school education and 16% do not have any educational level (Pichanaki District Municipality, 2016). According to these data, the educative level of the producers is basic, aspect that has an effect in the technified handling of the crop, as well as the access to projects or programs of technological improvement.

The coverage of basic services for farmers, such as water supply, drainage and electricity, is incomplete and inadequate in most rural areas, unlike in the urban sector. Forty-nine percent of the producers who live in the towns and communities have water supplied by rivers and irrigation ditches, as well as electricity. Farmers who live in Pichanaki or Centro Cuyani, have full basic services (45%) and a group of less than 6% have only water, but it is not from a potable source (Figure 2).

According to the research carried out in the Cuyani microbasin by the Pichanaki District Municipality (2015), the main economic activity is agriculture. In the study area, it was found that 72% of the farmers depend on this activity and 28% have other incomes, as they work in state institutions and in the commercial and transport sectors.

Most of banana producers raise animals, 65% have poultry and 19% poultry + guinea pigs; only 13% do not raise animals, since they are farmers residing in Pichanaki (Figure 2). The possession of animals promotes that the producer resides in the same farm and not in the city. This is important because it is an indicator of the degree of control that the producer has with respect to his agricultural unit (Caballero, 2002).

During the investigation of the banana farms, it was found that the producers have their own fields (95%), rented (2.5%) and both own and rented fields (2.5%). Of the producers who have their own fields, 42% have a land title and 54% have a certificate of ownership. In the group of those with own and rented fields, 3% have land title and lease contracts, and 1% have lease contracts. Land tenure is one of the main problems of Peruvian agriculture; according to the National Agricultural Census of 2012, of every 100 producers, 45.4% have a land title, that is, the property is registered in public registries or in the process of registration; the remaining 54.6% of producers do not have a land title. In the case of banana producers, most have a certificate of ownership, which puts agricultural activity at risk, as the legalization of the land is an important step towards improving its management.

In Figure 2, it is shown that 60% of the producers do not belong to any organization and 25% belong to a coffee cooperative. But most producers indicated that this organization is just being formed and is in the process

of legalization. This aspect is important, because only legally constituted organizations can access state support programs.

**Characteristics of the banana farm:** Of the farmers surveyed, 55% have between 1 and 5 ha of total land, 26% between 6 and 10 ha, 8% between 16 and 20 ha, 7% between 11 and 15 ha and 4% between 21 and 40 ha (Figure 3). Banana producers also manage other agricultural crops, such as coffee (71%), cocoa (7%), pineapple (9%), corn (6%), fruit trees and kion (4%).

In the Cuyani Microbasin, the area of the farm planted with bananas is small, since 62% of those surveyed have between 0.75 and 1.5 ha, 29% have between 2 and 3 ha and only 9% have between 4 and 6 ha (Figure 3). The producers who manage more than 2 ha were mainly found in Cumbre Barinetti, where bananas are the main crop and therefore the basis of their economy. In other population centers and assessed communities, banana cultivation is managed in small agricultural areas, so farmers depend on other crops.

Production systems are mostly traditional and often occur in associations with other types of agricultural products, such as coffee, cocoa, among others, and in some countries are managed under a monoculture system (PEHCBM, 2016). Figure 3 shows that 64% of the producers surveyed associate bananas with other crops, 22% manage them as monocultures and 14% have agricultural land where they work with both production systems.

The producers who associate the crop with coffee are 76%; in the Cuyani Microbasin, the association of coffee with bananas is common, as a temporary shade for the coffee tree to manage the luminous intensity. Likewise, 13% associate it with corn, 6% with fruit trees and 5% with cocoa.

The number of banana cultivars handled is approximately 300, of which half are primary clones and half are somatic mutants. The existing banana cultivars in Peru and America have originated from *Musa acuminata* and through the formation of hybrids with *Musa balbisiana* (Figuerola and Wilson, 1992). This has resulted in fruits that are grouped into: plantain type and banana type. The Plantain type (AAB group) is the one that can be eaten cooked, fried, green or ripe. The main commercial varieties include 'Bellaco' and 'Inguiri'. The Banana type (AAA group) is the one that is consumed as table fruit, and here the commercial varieties 'Seda' (Gros Michell), 'Cavendish', 'Isla', 'Moquicho or Biscochito' and 'Capirona' stand out (PEHCBM, 2016). The main cultivars managed by the producer are Isla, Palillo, Bellaco, Bizcocho, Morado and Largo, in order of importance. The 'Isla' cultivar is the most used by the producer with 71%.

In the case of 'Isla' cultivar, 50% of producers received a sales price of 0.6 soles per kg, 16% received 0.7 soles per kg and another 16% received a price of 0.7 to 1.0 soles per kg. The remaining 18% have just installed the crop. In

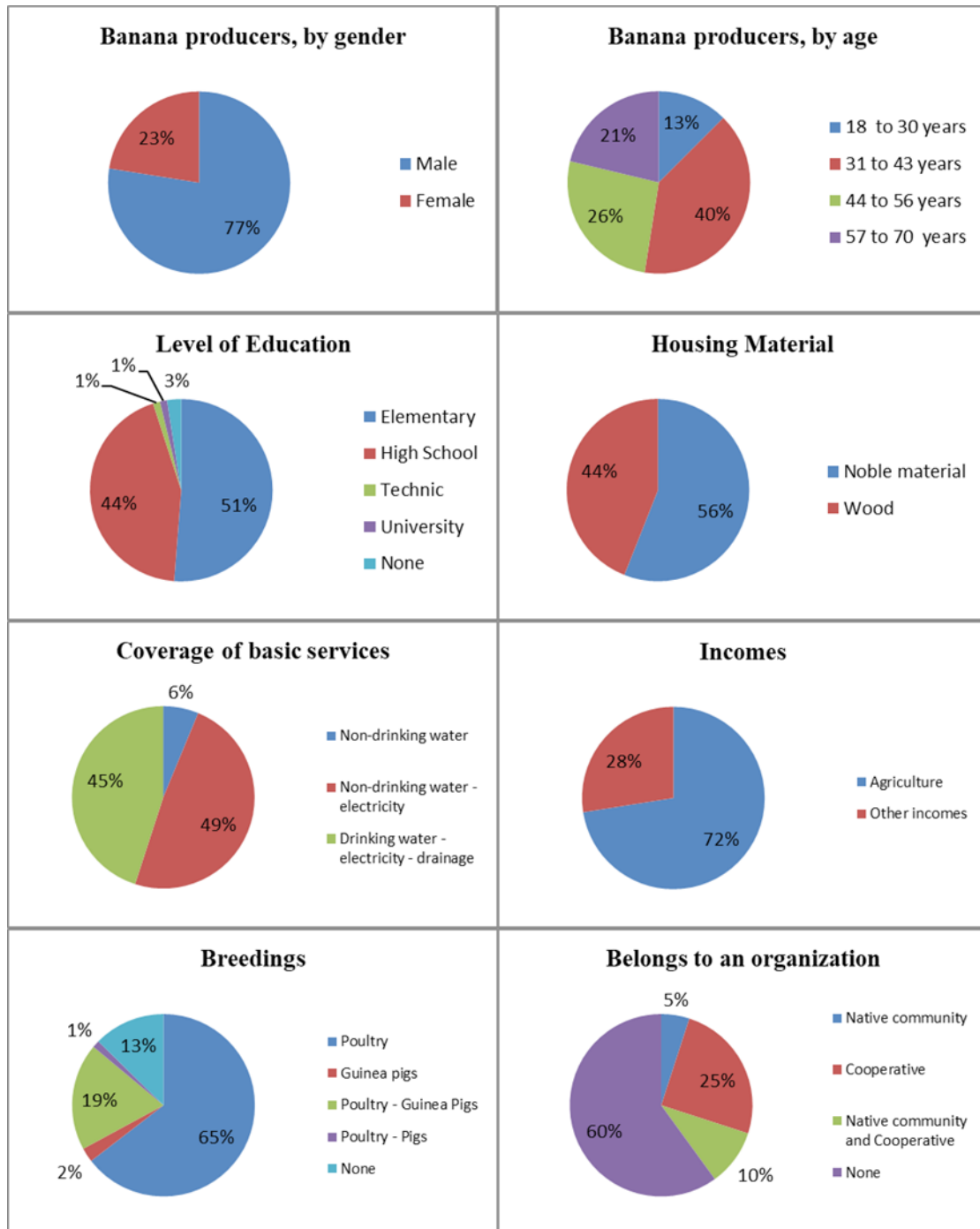


Figure 2. Socio-economic status of banana producers in the Cuyani Microbasin, Pichanaki district, Chanchamayo province, Peru

the case of the ‘Palillo’ cultivar, 70% of farmers received a price of 0.7 to 0.9 soles per kg and 7% received between 1.0 and 1.5 soles per kg; the remaining 23% have recently been installed. According to these data, the price of ‘Palillo’ cultivar is higher than that of ‘Isla’. [Figueroa and Wilson \(1992\)](#), mention that one of the disadvantages of Isla cultivar is that it is very susceptible to banana weevils. In 2000, bananas reached a price of 0.32 soles per kg, while in 2016 it reached 0.58 soles per kg ([DGESEP, 2017](#)).

The highest banana yield in Peru was reported in the Piura region in 2013, with 22.7 t/ha, followed by the San Martín region with 13.1 t/ha and Junín with 11.4 t/ha.

In this study ([Figure 3](#)), a yield of 6.5 to 7.5 t/ha (43% of producers), 7.6 to 8.6 t/ha (30%), 5 to 6 t/ha (21%) and between 9.7 to 12 t/ha (6%) was reported. The low yields are explained by a traditional management of the farm, most of the producers that allow a high incidence of phytosanitary problems such as the “Panama disease” and the “banana weevil”.

Ninety-five percent of those surveyed indicated that they sell their product in the Pichanaki market because they manage small agricultural plots and are not competitive to enter the Lima market. Four percent indicated that their production was only for self-consumption, due to their low

production and 1% do not know which market they will sell their production to. The low prices in the local market, is explained by a lower demand in the quality of the product, in addition that the farmers do not have a harvest plan and therefore do not make an adequate management of the fruit to offer.

Regarding the cost of production, 47% of farmers have a production cost per hectare ranging from 2000 to 3600 soles, 14% invest from 3700 to 5000 soles and these are producers who invest a little more in phytosanitary management, fertilization; finally, 39% invest from 1500 to 2000 soles, are producers who manage bananas at low planting densities and work in a traditional way (Figure 3).

According to the National Agricultural Census (2012), the lack of water is one of the major problems for the development of the agricultural sector in Peru. Ninety-nine percent of the banana producers surveyed do not have irrigation water and are dependent on rainfall. This is confirmed by census data indicating that 64.8% of the country's agricultural land is not irrigated and is cultivated using only rainfall. In the jungle region, 94.7% is rainfed agriculture. Only 1% of the water is available for irrigation through the sprinkler system with the help of a motor pump that is supplied by streams.

About diseases, 50% of banana producers mentioned that "Panama disease", "yellow Sigatoka" and "black Sigatoka" are the diseases that most affect production. Nineteen percent indicated only "Panama disease" and 7% to "yellow Sigatoka" and "black Sigatoka". About 10% of producers reported other unknown diseases (Figure 3). But the "Panama disease" caused by *Fusarium oxysporum* f. sp. *cubense* is the disease that generates the greatest economic losses in this crop (Figueroa and Wilson, 1992).

On the other hand, 64% of the producers indicated that the most important pest is the "banana weevil" (*Cosmopolites sordidus*); this pest drills the base of the pseudo stem and the plant bulb, causing the progressive decay of the bud and shoots. In the study, 19% of the producers reported weevil damage and unknown pests, 6% indicated that they had recently installed their field, so there are no pests present, another 6% have no pests present in their plantation and 5% indicated the presence of unknown pests (Figure 3).

Regarding crop rotation, producers indicated that at the end of the season they would grow coffee and those who had associated coffee with bananas would only keep the coffee (40%); others (Cumbre Barinetti) mentioned that they would continue growing bananas (20%); another group indicated that they did not know whether they would rotate or continue growing bananas (14%). Also, 10% indicated that they will plant fruit trees, achiote (5%), cassava (4%) and pineapple (1%).

Agricultural production is influenced by factors that directly affect the efficiency of production. For 44% of producers, the presence of diseases is the biggest problem for production, especially due to the incidence of "Panama disease". For 28% of producers, pests and diseases are

the main problem; 15% consider that the main problem is the presence of weeds, as they consider that if they do not remove the weeds in time there is a delay in the growth of the crop. A smaller group of 6% reported only pest damage and 5% lack of fertilizer (Figure 3).

According to the National Agricultural Census (2012), of the total number of farmers who received training or technical advice, 72.2% were trained in agricultural crops, 32.2% in livestock and 11% in management, conservation and processing. In the jungle region, 88.9% of agricultural producers received training in agricultural crops. Figure 3 shows that 80% of the producers indicate that they have not received training, 9% of producers indicate that they have received training, which was provided by the Pichis Palcazú Project and the main topic was cultural work; 6% of producers indicated that they were trained by Servicio Nacional de Sanidad Agraria (SENASA). The producers indicated that the institutions come to carry out training, but there is no follow-up to the talks given by the specialists.

The use of conglomerates has been reported in Ecuador to group coffee farms (Santistevan *et al.*, 2014) and cattle farms (Vargas *et al.*, 2012). In Peru, for the analysis of farms with prevalent crops in Cusco (Merma and Julca, 2012), also mandarin farms in Cañete (Collantes *et al.*, 2015) and cocoa farms in San Martín (Tuesta *et al.*, 2014). In Colombia, for typification studies in citrus and guava production systems (Cleves & Jarma, 2014). In Mexico, also to classify guava producers (Borja *et al.*, 2018) and in Costa Rica to classify dairy herds (Vargas *et al.*, 2013). The grouping of farms is important because future actions could be carried out for each group and no longer individually (Criollo *et al.*, 2016), given that groups are formed by similarity between the elements that compose it and it could be assumed that those farms that are grouped, alone present significant differences with the rest (Castro *et al.*, 2012). In this study, conglomerate analysis determined the presence of five groups of farms, groups 1 and 2, were the most numerous with 45 and 31. 2% of the farms, respectively (Figure 4).

There are important differences between groups of farms (Table 1); for example, Group 1 is characterized by having men between the ages of 44 and 56, with secondary education, who live on the same farm. They do not have property titles, the house does not have basic services, and they have poultry and guinea pigs. They have 2 to 3 ha of banana with the cultivars Isla and Palillo with a density of 600 to 1000 plants/ha. Their production costs are between 2000 and 3600 soles (1US\$ = 3.30 soles) and they have an average yield of 6.5 to 7.5 t/ha. Group 5 has the youngest farm managers residing in the town of Pichanaki and their housing is of noble material with basic services. They have from 4 to 6 ha of banana cv. Palillo, the density of plantation and the costs of production are similar to the first group; but its yield of banana is greater and is between 7.6 to 8.6 t/ha. Table 1 also shows that, in all groups, diseases are the main limiting factor in production and the cultivar Isla banana is the most used but the other cultivars such as Palillo, Morado and Biscocho are also planted.

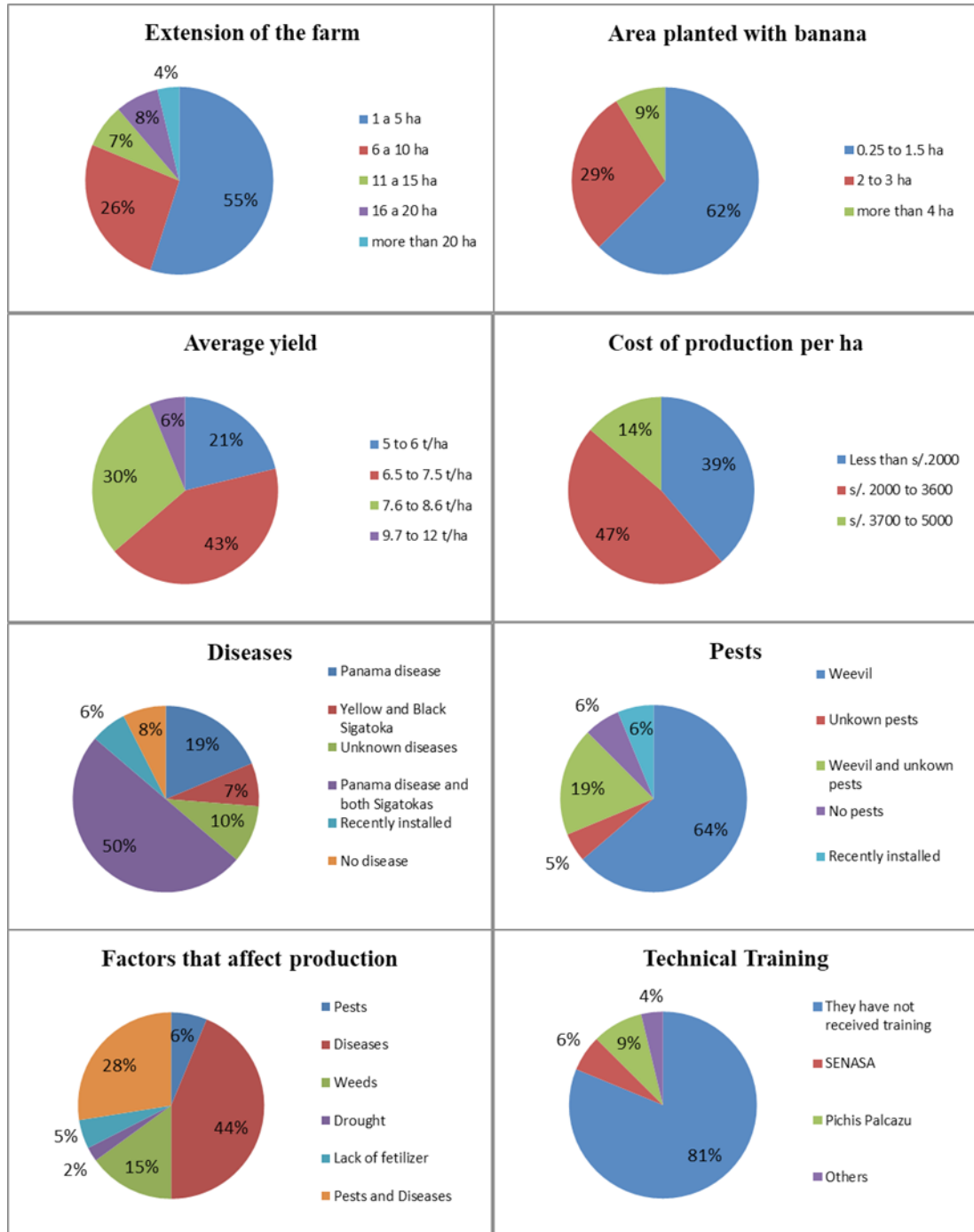
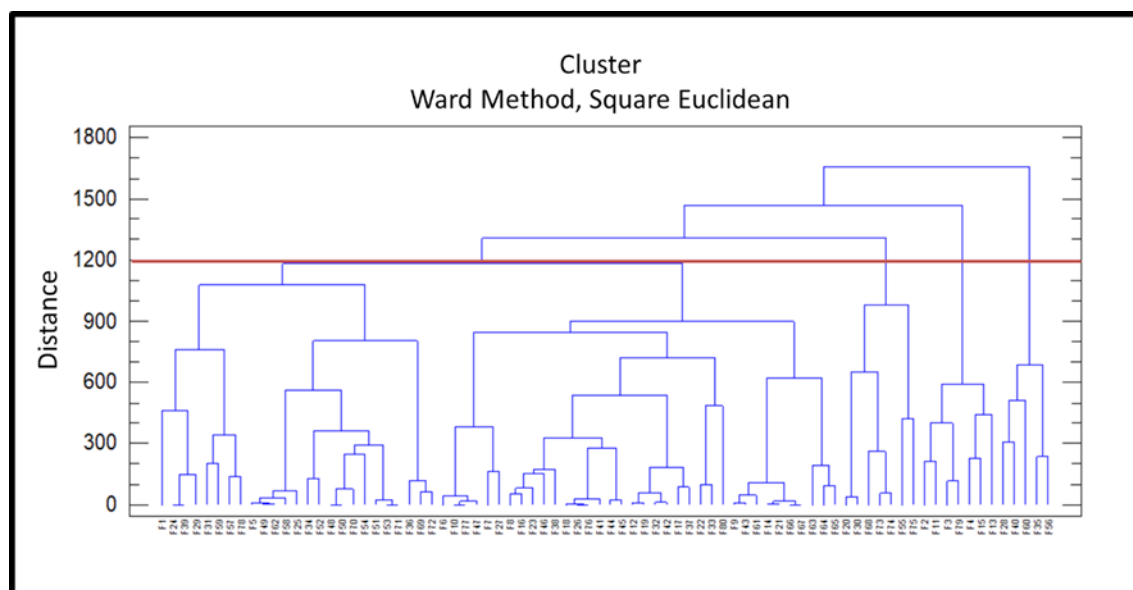


Figure 3. Characteristics of the production of the banana farm in the Cuyani Microbasin, Pichanaki district, Chanchamayo province, Peru

### Conclusions

In the Cuyani microbasin, the banana farms are very diverse. The person responsible for the farm is mostly male, but there is an interesting percentage of the female gender in the administration of the farms. In general, the producers have a basic level of education, the production system is traditional, the banana is grown alone or in association with other crops. Most producers consider pests and diseases to be the main limiting factors of production, as they reduce yields and increase production costs. Animal husbandry encourages the producer to reside on the farm and not in

the city and this is important because it is an indicator of the degree of control that the producer has over his agricultural unit. The farms were classified into five groups, the most important being 45% of the farms and is characterized by having men between the ages of 44 and 56, with secondary education and who lives on the same farm. They do not have a property title, the house does not have basic services, and they have poultry and guinea pigs. They have 2 to 3 ha of banana with the cultivars Isla and Palillo with a density of 600 to 1000 plants/ha. Their production costs are between 2000 and 3600 soles (1US\$ = 3.30 soles) and



**Figure 4.** Dendrogram of the banana farms in the Cuyani Microbasin, district of Pichanaki, Chanchamayo Province

Variables	Group 1	Group 2	Group 3	Group 4	Group 5
Age of the farm responsible (years)	44 to 56	31 to 43	31 to 43	44 to 56	18 to 30
Level of education	High School	Basic School	High School	Basic School	Basic School
Residency	Farm	Farm	Farm	Farm	Pichanaki
Housing material	Wood	Wood	Noble	Wood	Noble
Animals	Poultry/Guinea Pigs	Poultry	Poultry	Poultry	None
Basic Services	Non drinking water	Non drinking water	Non drinking water	Non drinking water	All
Property of the land	Certificate of ownership	Property title	Certificate of ownership	Certificate of ownership	Property title
Area with banana (ha)	2.0 – 3.0	0.25 - 1.5	0.25 - 1.5	0.25 - 1.5	4.0 – 6.0
Cultivars	Isla/ Palillo	Isla	Bizcocho	Isla/Morado	Palillo
Density (plants /ha)	600 - 1000	600 - 1000	200 - 600	200 - 600	600 - 1000
Factors that limit production	Diseases	Diseases/Pests	Diseases	Diseases	Diseases
Market	Pichanaki	Pichanaki	Pichanaki	Pichanaki	Pichanaki
Production system	Tradicional	Tradicional	Tradicional	Tradicional	Tradicional
Production costs (S/. x ha)	2000 - 3600	2000 - 3600	1000 - 2000	2000 - 3600	2000 - 3600
Yield (t/ ha)	6.5 - 7.5	7.6 - 8.6	5.0 – 6.0	5.0 - 6.0	7.6 - 8.6

**Table 1.** Main characteristics of the groups of banana farms in the Cuyani microbasin, district of Pichanaki, province of Chanchamayo, Peru

have an average yield of 6.5 to 7.5 t/ha. All groups consider that diseases are the main limiting factor of production and the cultivar Isla is the most common, in three of the five groups. All the groups consider that diseases are the main limitation of production. Other cultivars such as Palillo, Morado and Biscocho are also used.

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