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# Determinant aspects of the deciduous fruit production in the province of Tungurahua, Ecuador

## Aspectos determinantes de la producción de frutales caducifolios en la provincia de Tungurahua, Ecuador

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**ABSTRACT**

The province of Tungurahua is well known for the production of deciduous fruit trees in Ecuador, however, its production is impacted by some issues that affect productivity. The purpose of this investigation was to conduct a diagnosis of the production system of deciduous fruit trees in 6 locations in Tungurahua province. Surveys were carried out to obtain information on 117 production units (farms). A regression model was used to determine the relationship between the variables and their incidence in the production system. The results showed that peach (*Prunus persica*) is the fruit crop with highest yield (16.19 t $ha^{-1}$), followed by apple (*Malus domestica*) (13.36 t $ha^{-1}$) and pear (*Pyrus communis*) (13.15 t $ha^{-1}$). Apple cultivars Emilia and Golden Delicious, cv. Uvilla of pear and Conservero Amarillo of peach were the most cultivated in Tungurahua. The main factors that influenced the farmer income were: Land area used for cultivation, reason for growing fruit trees, age of the producer, fruit selection and type of production. It is necessary to advocate to expand the cultivated land area of these fruit crops in order to satisfy local demand and compete with imports of these fruits.

**Keywords:** cultivar; *Malus domestica*; *Prunus pérsica*; *Pyrus communis*; production system.

**RESUMEN**

La provincia de Tungurahua es conocida por la producción de árboles frutales de hoja caduca en Ecuador, sin embargo, su producción se ve afectada por algunos problemas que afectan la productividad. El objetivo de esta investigación fue realizar un diagnóstico del sistema de producción de árboles frutales de hoja caduca en 6 lugares en la provincia de Tungurahua. Se realizaron encuestas para obtener información sobre 117 unidades de producción (granjas). Se utilizó un modelo de regresión para determinar la relación entre las variables y su incidencia en el sistema de producción. Los resultados mostraron que el durazno (*Prunus persica*) es el cultivo con mayor rendimiento (16,19 t $ha^{-1}$), seguido de la manzana (*Malus domestica*) (13,36 t $ha^{-1}$) y la pera (*Pyrus communis*) (13,15 t $ha^{-1}$). Los cultivares de manzana Emilia y Golden Delicious, cv. Uvilla de pera, y el cv. Conservero Amarillo de durazno, fueron los más cultivadas en Tungurahua. Los principales factores que influyeron en los ingresos del agricultor fueron: Área de tierra utilizada para el cultivo, razón para cultivar árboles frutales, edad del productor, selección de fruta y tipo de producción. Es necesario fomentar el incremento del área de tierra cultivada de estos cultivos de frutas para satisfacer la demanda local y competir con las importaciones.

**Palabras clave:** cultivares; *Malus domestica*; *Prunus pérsica*; *Pyrus communis*; sistema productivo.

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## INTRODUCTION

Deciduous fruit production system refers to the management carried out in these type of crop by farmers according to their production area and how fruit is treated to be marketed (Puentes, 2006).

Deciduous fruit crops such as peach (*Prunus persica*), plum (*Prunus sp*.), pear (*Pyrus communis*) and apple (*Malus domestica*) have their origin in temperate zones of Europe and Asia (Fariglio et al., 2020), and respond in various ways to seasonal changes, stimulating certain physiological responses that allow them to survive adverse environmental conditions (Ducuara, 2017), using as a defense mechanism for cessation of all metabolic processes for the visible growth of structures with meristems (Gómez and Malvicini, 2011).

Worldwide, the Asian continent produces almost half of fruit (57%). In terms of deciduous fruit trees, China is the main producer of apple, pear, peach and plum. However, this kind of fruit crops are also disseminated in Latin America and the main producer in Latin America is Chile (FAO, 2018).

In Ecuador, there are 1,385,805 ha dedicated to permanent crops (including fruit crops), where the highlands have the 17.7%, the Littoral region has the 73.0% and the Amazon has the 9.3% (INEC, 2018). Some regions of the highlands of the Andes in Ecuador produce deciduous fruits; in these locations temperatures are relatively constant throughout the year, therefore, these crops present great seasonality (typically January to March) (Poerwanto et al., 2008), although they can also occur twice a year in some highland valleys. Temperature is the most important environmental variable for the growth of deciduous fruit trees (Fadón, 2020; Kuden, A., 2020).

In Ecuador, the production of deciduous fruit trees contributes in 21.7% of the current demand for apples (10,000 tons of 56,000 tons), 40.2% of pears (7,500 tons of 18,650 tons), 55% of peaches (6,900 tons) of 12,400 tons) and 92% of plum (770 tons of 10,300 tons) (INEC, 2018). Furthermore, the peak of local production does not coincide with the constant demand throughout the year, and therefore there is a need to import fruit from other countries, such as Chile. In addition, low prices of imported fruit and the low local yields poses a challenge and limits market competition.

In Ecuador, the province of Tungurahua is the primary location for the production of deciduous fruit crops, mainly apples, pears and peaches. Tungurahua has edaphoclimatic conditions that generally have in the inter-Andean valleys of Ecuador, being these conditions suitable for the production of this type of fruit crops (Viera et al., 2017). However, its production is affected by number of factors that affect yields: the use of seedlings that do not guarantee the quality and uniformity for new plantations, little use of quality germplasm (new varieties), inadequate pre and post-harvest management, lack of technical assistance, scarcity of productive loans and access to land, a decrease in labor work in the agricultural sector in this production area (Viera, A., 2016).

Similarly, the production of deciduous fruit crops in subtropical areas presents a challenge for local farmers, because these species require exposure to certain period of cold hours to increase the amount of fruiting. For this reason, cultivars with less requirement for cold hours and adapted to temperate climates are used in Ecuador (Viteri, 2000). The objective of this research was to carry out a diagnosis of the production systems of deciduous fruit trees in the province of Tungurahua, Ecuador, in order to assess the current situation.

## MATERIALS AND METHODS

### Study area

The province of Tungurahua is located in the center of the country, with the presence of some inter-Andean valleys (0.999º: 1.5º S; 78.15º: 78.92º W). The province has an area of 3,369 km$^2$ and has nine counties (Ambato, Baños de Agua Santa, Cevallos, Mocha, Patate, Pelileo, Píllaro and Tisaleo). Deciduous fruit trees have adapted to high altitude areas showing the best productive behavior where night temperatures are low, alternating with warm and sunny days for much of the year, facilitating fruit ripening and the synthesis of chemical-organoleptic compounds that contribute to good fruit quality. This province has locations at altitudes above 2500 masl and provides suitable climatic conditions for the cultivation of deciduous fruit crops, such as average temperature between 16º and 17ºC, annual precipitation between 400 and 1,000 mm and relative humidity between 50 and 85% (INIAP, 2008). In Tungurahua, the coldest months are in July and August, reaching minimum temperatures of 7.7°C; which is beneficial for the deciduous trees which need chill hours to break dormancy (Fadón *et al*., 2020).

### Sampling

Surveys were carried out in 6 countries of Tungurahua, where deciduous fruit crops (apple, pear and peach) are grown. Surveys included questions related to family composition, agricultural activities, use of technology, post-harvest management, technical assistance, incidence of pests, production costs, marketing and income. Sample size (n) was determined using the formula of Levi and Lemeshow (2008):

$$n = \frac{NZ_\alpha S^2}{\delta^2(N-1)+Z_\alpha S^2} \quad (1)$$

where:

N: Total size of the study population (N = 7000);

$Z_\alpha$: Confidence level according ($\alpha$ = 95%) to the normal distribution ($Z_\alpha$ = 1.96)

$\delta$: Maximum allowable error between point estimate and actual value $\delta$ = 180;

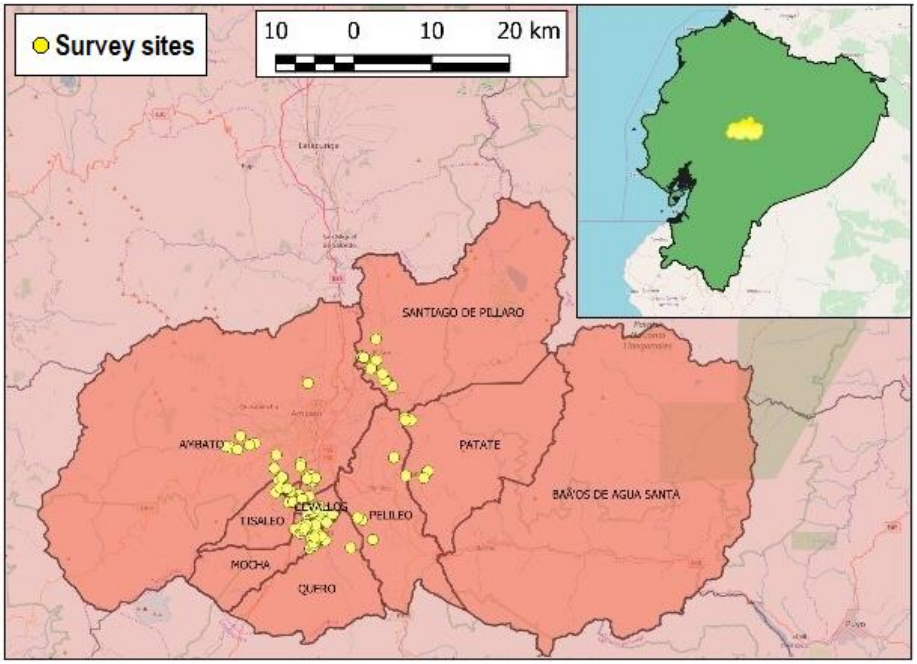


**Figure 1**. Tungurahua Province and sampled deciduous fruit farms.

**Statistical analysis**

$S^2$: Estimated variance of the variable to be analyzed (estimated from the maximum range of the variable under study: R)

$$R=X_{max}-X_{min} \quad (2)$$

If the variable follows a normal distribution, the difference between the maximum and minimum data will be at ± 3σ in such a way that the standard deviation of the variable can be estimated from R = 6000:

$$S = \frac{R}{6} \quad (3)$$

Thus, the number was estimated at n = 117 samples or production units (farms); the surveys carried out in the cantons of Ambato was 26.0%, in Mocha 26.0%, in Píllaro 15.5%, in Cevallos 13.6%, in Tisaleo 10.6%, and in Patate 7.4% (Figure 1). There were some productive units with 2 or 3 deciduous fruit crops, thus survey was done for all the crops found in the farm.

To describe the relationship between income with a set of variables, the regression model proposed by Ramírez and Potes (2019) was used; in this model the output variable Y (income) can be related to "n" input variables (García et al., 2019). The estimators of the coefficients of this model are obtained from the equation:

$$Y = \beta_0 + \beta_0 X_1 + \ldots + \beta_p X_p + \varepsilon \quad (4)$$

Where $X$ is the farmer income, $\beta$ are the regression coefficients, and $X$ are the independent variables that explain the statistical regression model. $\varepsilon$ is a random variable that has a normal with zero mean, constant and uncorrelated variance (Aparicio et al., 2004). A one-way ANOVA was used to determine the statistical significance of the analyzed variables in the model (Biney et al., 2020). The data was analyzed using statistical software R version 3.6.1

## RESULTS AND DISCUSSION

**Main deciduous fruit trees cultivated in Tungurahua**

The average data collected in the 117 productive units is presented in Table 1. Of the three deciduous fruit trees analyzed, it was observed that the highest production was obtained in pear (7.25 t); the highest average area per productive unit corresponded to apple (0.57 ha). In general, it was observed that the cultivation area per farm corresponded to small farms (around 0.5 ha), which have low production per productive unit, that reported by Viera et al. (2017).

Plant density for apple (667.84 plants $ha^{-1}$) and pear (646.60 plants $ha^{-1}$) were similar, as well as their average yields per plant (22.22 and 24.29 kg $plant^{-1}$, respectively). Viteri et al. (1995) observed that there are several factors that influence the planting distance of deciduous fruit trees, such as the rootstock used, cultivar, formation system, machinery to be used and available area; and plant density is positively correlated with the total yield per ha. On the other hand, peach had the highest plantation density (752.34 plants $ha^{-1}$); however, its average yield per plant (21.19 kg) was lower compared to the other deciduous fruit crops, but its yield per ha was the highest (16.19 t $ha^{-1}$) due to its higher planting density. These yields are considered superior in comparison with other countries such as México (Larque et al., 2009) and low in comparison to Colombia (Puentes et al., 2008). The potential yield in deciduous fruit trees can be affected by several climatic factors, such as growing seasons with moderate temperatures, together with relatively cool nights. Conversely, when night temperatures are high,

plant respiration is high, increasing the energy cost and decreasing the daily net carbon balance, directly affecting development (Fischer et al., 2010).

This study allowed us to identify that the farmers mainly have monoculture; however, we also found associated crops. The peach crops were the main monoculture; while, in terms of crop association, the combination of apple and peach obtained the highest percentage (32.76%) (Table 2).

**Table 1**
Production data per productive unit, average farm area, plantation density and yield of the main deciduous fruit trees

| Variable | Average | Confidence interval (95%) |
|---|---|---|
| Apple (n = 81) | | |
| Production (t) | 6.65 | 5.36 - 7.94 |
| Surface (ha) | 0.57 | 0.46 - 0.68 |
| Density (plants ha $^{-1}$) | 667.84 | 567.14 - 768.53 |
| Yield (kg plant $^{-1}$) | 22.22 | 20.39 - 24.05 |
| Yield (t ha $^{-1}$) | 13.36 | 11.53 - 15.19 |
| Pear (n = 22) | | |
| Production (t) | 7.25 | 4.19 - 10.32 |
| Surface (ha) | 0.55 | 0.29 - 0.81 |
| Density (plants ha $^{-1}$) | 646.60 | 519.81 - 773.40 |
| Yield (kg plant $^{-1}$) | 24.39 | 20.84 - 27, 43 |
| Yield (t ha $^{-1}$) | 13.15 | 9.60 - 16.19 |
| Peach (n = 50) | | |
| Production (t) | 5.72 | 4.27 - 7.18 |
| Surface (ha) | 0.41 | 0.30 - 0.52 |
| Density ( plants ha $^{-1}$) | 752.34 | 665.68 - 839.00 |
| Yield (kg plant $^{-1}$) | 21.19 | 18.29 - 24.08 |
| Yield (t ha $^{-1}$) | 16.19 | 13.29 - 19.08 |

**Table 2**
Percentage of monoculture and associated crops

| Fruit Crop (monoculture and associated) | Porcentaje (%) |
|---|---|
| Peach | 36.21 |
| Apple and peach | 32.76 |
| Apple, peach and pear | 13.79 |
| Apple and pear | 12.07 |
| Peach and pear | 5.17 |

## Apple, pear and peach cultivars in Tungurahua

### Apple

It was observed that the cultivar Emilia was the one that predominated in the Tungurahua province (60.20%), followed by Golden Delicious (35.02 %) (Table 3). The Emilia cultivar has a large-sized fruit, the pulp is yellowish-white, juicy, sweet and at the same time acidulated; it was originally from central Europe and introduced to Píllaro (Ecuador) in 1932 (Jaramillo, 2016). Cultivar Golden Delicious was originated in West Virginia, USA, and is one of the cultivars most cultivated worldwide (Salas-Salazar et al., 2011.). Apple production in the province of Tungurahua is not sufficient to satisfy local demand, covering only 10% of the market demand, consequently 90% of the fruit is imported from Chile (80%) and Peru (10%) (Cobo, 2019). Royal Gala is the variety that Ecuador imports mainly from Chile (Bravo, 2013) because ecuadorian´s production is very low. Its positioning in the market has given it the status of being a highly demanded and consumed product due to its good appearance, quality, flavor, texture and consistency, optimum degree of maturation and organoleptic properties (PROCHILE, 2011). In 2019, Ecuador imported 57548.76 t of apple (MAG, 2019), therefore, to compete with imported fruit, it is necessary to expand the land area of cultivation.

### Pear

The cultivar Uvilla is the most cultivated in Tungurahua (56.56%) (Table 4); while cultivar Morada is the least predominant (2.69%). In the counties of Mocha, Patate and Quero no pear crops were registered. The fruit of the cultivar Uvilla is more crisp, sweet, juicy and perfumed, reason why is also highly valued in the Tungurahua market (Martínez, 2013). The cultivar Packham showed a slightly high percentage (14.56%); this cultivar is also imported from Chile for the local market (Lorca, 2018). In 2017, Ecuador imported a total of 13,455 t of pear fruit (MAG, 2019); therefore, it is necessary to increase the cultivated area to satisfy the national demand.

### Peach

Table 5 shows the cultivar Conservero Amarillo predominated in the province of Tungurahua (60.34%); while cultivars with the lowest percentages were Fortuna, Nectarino, INIAP-Diamante and Monarca; these cultivars are limited to specific locations.

The cultivar Conservero Amarillo adapts to altitudes between 2300 and 3000 masl, its fruit is round, with yellow bark and yellow pulp (Flores, 2011). Cultivar INIAP-Diamante has been little adopted in Tungurahua. This cultivar has quality characteristics similar to imported fruit because it has good post-harvest qualities and high productivity (25 kg ha-1), and it is adapted for inter-Andean valley conditions with lower cold requirements (Viteri, 2000). The total amount of peach imported in 2017 was 2,259 t (MAG, 2019), therefore, it is necessary to promote the cultivation and consumption of local varieties with high potential.

**Table 3**
Apple cultivars grown in the province of Tungurahua

| County | Anna | Bell Golden | Emilia | Golden Delicius | Royal Gala | Jonagold | Rome Beauty |
|---|---|---|---|---|---|---|---|
| Ambato | - | - | 62.77% | 35.99% | - | 1.24% | - |
| Cevallos | - | 16.00% | 16.31% | 58.64% | 9.05% | - | - |
| Mocha | - | - | 67.85% | 32.15% | - | - | - |
| Patate | 100.00% | - | - | - | - | - | - |
| Píllaro | - | - | 44.62% | 50.00% | - | 5.38% | - |
| Quero | - | 100.00% | - | - | - | - | - |
| Tisaleo | - | - | 73.61% | 25.46% | - | 0.34% | 0.58% |
| Total | 0.50% | 2.59% | 60.20% | 35.02% | 1.04% | 0.54% | 0.11% |

**Table 4**
Pear cultivars in the province of Tungurahua

| County | Blanca | Ciruela | Morada | Piña | Uvilla | Packham |
|---|---|---|---|---|---|---|
| Ambato | 16.93% | - | 0.39% | 3.91% | 68.36% | 10.42% |
| Cevallos | - | - | - | 26.81% | 64.61% | 8.58% |
| Mocha | - | - | - | - | - | - |
| Patate | - | - | - | - | - | - |
| Píllaro | - | 54.95% | 15.44% | 15.08% | 14.53% | - |
| Quero | - | - | - | - | - | - |
| Tisaleo | - | - | - | - | 50.00% | 50.00% |
| Total | 9.46% | 8.80% | 2.69% | 8.23% | 56.56% | 14.26% |

**Table 5**
Peach cultivars in the province of Tungurahua

| County | Abridor | Conservero Amarillo | Diamante | Fortuna | Nectarino | Zapallo | Monarca |
|---|---|---|---|---|---|---|---|
| Ambato | 14.41% | 43.23% | 1.03% | - | 0.99% | 40.35% | - |
| Cevallos | - | 77.00% | - | - | - | 23.00% | - |
| Mocha | 42.11% | 46.05% | - | 11.84% | - | - | - |
| Patate | 74.45% | 25.55% | - | - | - | - | - |
| Píllaro | 7.38% | 85.01% | - | - | - | 7.24% | 0.37% |
| Quero | - | - | - | - | - | - | - |
| Tisaleo | - | 100.00% | - | - | - | - | - |
| Total | 22.99% | 60.34% | 0.23% | 0.41% | 0.22% | 15.69% | 0.11% |

**Table 6**
Variables analyzed in the linear regression model to determine the factors that influence in the production system of deciduous fruit trees

| Variables | Coefficient | Variables | Coefficient |
|---|---|---|---|
| Site | 3404.50 $^{ns}$ | Fruit storage | 2560.00 $^{ns}$ |
| Altitude | -0.66 $^{ns}$ | Selection of fruit | 1243.50 * |
| Temperature | 381.00 $^{ns}$ | Technical assistance | 2577.70 $^{ns}$ |
| Precipitation | 0.27 $^{ns}$ | Association | 2585.70 $^{ns}$ |
| Age of the producer | -41.60 * | Reason to cultivate | 5222.30 ** |
| Level of education | 2560.00 $^{ns}$ | Tenure of land | 3881.00 $^{ns}$ |
| Members of family | -47.60 $^{ns}$ | Type of grove | 2453.20 $^{ns}$ |
| Cultivated area | 0.06 ** | Type of production | 2407.80 * |
| Parameter of harvest | -2235.60 $^{ns}$ | Irrigation | 2517.90 $^{ns}$ |

* significant; ** highly significant; ns = not significant.

**Factors influencing farmer income**

Production is the result of the transformation of inputs using a technology and depends on the use of inputs such as plants, materials, labor work and land (Galarza and Díaz, 2015); thus the above factors are also going to influence farmer income. In this study, only five variables (age of the producer, cultivated area, selection of fruit, reason to cultivate fruit trees and type of production) showed statistical significance ($p < 0.10$) (Table 6), consequently, they mainly influenced the model.

In the last decades, the research of factors that influence in the production of different fruit trees are focused on generating greater productivity and income, in order to obtain results that allow farmers to continue in the arduous process of cultivating the land, regardless of the quality of the product that will be distributed and consumed by in the market; consequently, technological, economic and tradition factors are relevant in the result of the obtained harvest (Larqué et al. 2009).

**Age of the producer**

In Tungurahua, producers of deciduous fruit crops are between 28 and 87 years old; the workforce of the farmers is 85% over 50 years old, and of them 51% belong to the group called of the third age (more than 60 years old) (Figure 2). This factor influences productivity because there is a decrease in the efficiency of labor resources (field work) in relation to the increase in the age of the producer. This variable negatively affects the income of the producer of deciduous fruit; according to our results, for each year of increase in the age of the producer, the income decreases by an average of 41.60 USD.

A lower efficiency in the development of field work due to the age of the farmer directly affects the yield and profitability of the crop (Larqué et al., 2009; Sangerman-Jarquín et al., 2014; Viera et al., 2017).

Furthermore, Sangerman-Jarquín et al. (2014) point out that technological appropriation is highly correlated with the age of producers. These authors also mentioned that younger farmers are more innovative, and have higher performance of complementary activities and relevance of peasant techniques. In addition, they also have easier access to brochures and technical magazines with agricultural information.

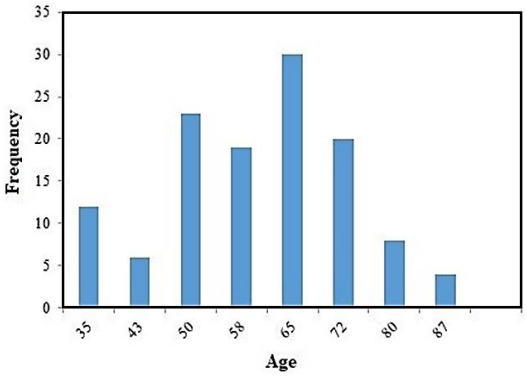


**Figure 2.** Age of the producers of deciduous fruit trees in the province of Tungurahua.

## Cultivated area

The surface of the land dedicated to the cultivation of deciduous trees (apples, pears and peaches) is carried out in small production units which influence productivity and profitability (Puentes et al., 2008; Viera et al., 2017). In Tungurahua, the largest cultivated area of apple was in a range of 0 and 5,000 m2 (Figure 3). In relation to peach, the largest cultivated area was in a range of 0 and 2,500 m2 (Figure 4). The range for pears was from 0 to 1,500 m2 (Figure 5). If the cultivated area is large, the production will be better, and consequently the farmer's income will increase. Viera, et al. (2017) determined that for each square meter that the cultivation area increases, there is an income gain because it increases the number of productive units in terms of plants.

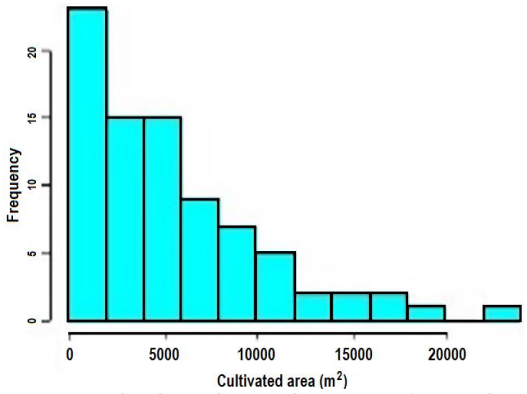


**Figure 3.** Apple cultivated area in the province of Tungurahua.

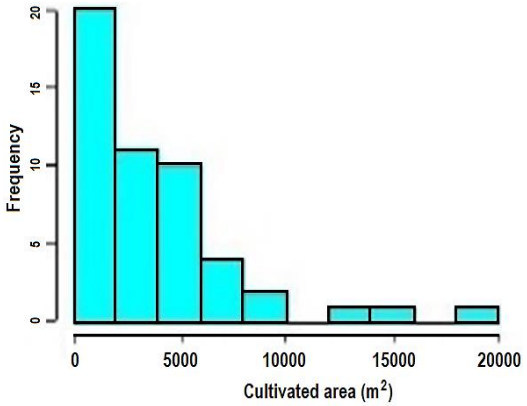


**Figure 4.** Peach cultivated area in the province of Tungurahua.

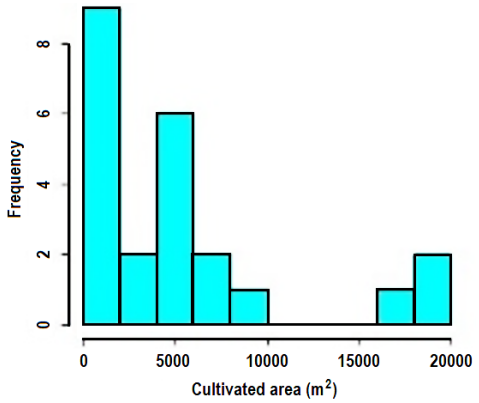


**Figure 5.** Pear cultivated area in the province of Tungurahua.

## Selection of fruit

A factor that influences the profitability of the cultivation of deciduous fruit trees is the selection of the fruit because the product is best appreciated according to its quality. The potential consumer makes the decision to buy based on a product that satisfy their needs (Schiffman y Lazar, 2000). A previous selection of the fruit, mainly according to size, affects the price and increases the income (Larque et al., 2009). According to the results, 85% of the producers carry out this procedure. Those producers who carry out this activity could increase their income by USD 1,243.50 because they obtain better prices. Larqué et al. (2009) and Viera et al. (2017) agree that fruit selection is a technical aspect that affects the commercialization of deciduous fruit crops and that this practice contributes to obtaining a better price in the negotiation.

## Cultivation reason

Farmers that cultivate deciduous fruit trees by tradition (heritage) corresponded to 86%, a 12% did it because they have the knowledge of the cultivation, and a 2% consider that this activity is profitable. According to the results of the survey, producers who dedicate to these crops considered the profitability as main reason, can earn on average USD 992.80 less than farmers who do it for a knowledge of the cultivation; as well as farmers who dedicated to these crops by tradition earn USD 2,980.90 less. Traditional deciduous fruit crops in Tungurahua are apparently forgotten or underused (little technical management and lack of technification) despite this type of fruit has nutritional qualities and has good flavor (Ducuara, 2017), thus they would have potential in the local market and could become an excellent cash crop that generates income for small farmers. The lack of adequate agronomic management, technification and training are the main reasons for fruit orchards not being productive (Aular and Casares, 2011; Viera et al., 2017).

## Production type

Yield is related to the agronomic management that the crop receives (Berdeja-Arbeu et al. 2019). The development or growth of the fruit trees depends on the mineral nutrition, the application of fertilizers in the soil facilitates the plant growth and

influences the fruit quality (Soto-Parra et al., 2016). Three types of production were identified, the predominant was the "clean (biological and chemical-fertilizer)" type with 67%, the "organic" with 12% and the "chemical" with 20%. The type of production used in these crops influences the income of the fruit growers; according to the results of the survey, for producers who use an organic method, their income decreases on average by USD 1,572.70 compared to those who use clean production; and those who apply a chemical production increase their income by USD 363.10 in relation to those who use clean production. This difference in income is due to the lower cost of chemical products compared to the inputs used in clean and organic production types. In addition, some farmers expressed that agrochemicals produce short-term results in cultivation; however, there are greater risks for both the environment and the health of the farmer. For this reason, "clean agriculture" is currently being promoted in Ecuador (Martínez et al., 2019; Viera and Jackson, 2019). Furthermore, it was observed that there is little development of organic production since this type of production requires a more exclusive type of market.

## CONCLUSIONS

Tungurahua province is known for the production of deciduous fruit crops. The main fruit cultivated was the apple; however, the highest yield was observed in the peach crop. Cultivars Emilia and Golden Delicious (apple), Uvilla (pear) and Conservero Amarillo (peach) were the most grown in the province. The key factors that influenced in the farmer income were: land area used for cultivation, reason to cultivate fruit trees, age of the producer, fruit selection and type of production. The main reason why this type of fruit is cultivated in this province is by tradition (inheritance); however, it was observed a low productivity due to a lack of technical management, consequently technical assistance is a fundamental factor for reactivating their production. It is necessary to expand the land area used for cultivation of these fruit crops in order to satisfy local demand and compete with imports effectively in the larger markets.

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