JPB REVIEW
INTERNATIONAL JOURNAL OF PROFESSIONAL BUSINESS REVIEW
ISSN: 2525-3654
OPEN ACCESS

CHARACTERIZATION OF COFFEE PRODUCTION AND THE LEVEL OF INCOME OF THE FARMER IN THE AMAZONAS REGION

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ARTICLE INFO

Article history:

Received 05 June 2023

Accepted 29 August 2023

Keywords:

Characterization of Coffee;
Coffee Production;
Income;
Socioeconomic Level.

ABSTRACT

Purpose: The objective of this research was to characterize coffee production and its impact on the income of farmers in the Amazonas Region.

heoretical framework: Recent literature has identified that coffee production is an agriculturally significant activity in the local economy, being the main generator of employment and family income. This activity is influenced by various factors, such as soil quality and climate change (Arzubi, 2003). However, there are still many factors that require further research regarding coffee production, in order to increase both crop productivity and the incomes of the families involved.

Design/methodology/approach: We analyzed the profile of international research on the characterization of coffee production from 2018 to 2022. The subject and authors found in journals indexed in Scielo, Scopus were identified. The research was basic with a quantitative approach and a non-experimental design of a descriptive cross-sectional type, with a sample of 126 farmers, it was carried out through the survey as an information collection instrument.

Findings: The volume of research on the characterization of coffee production and its impact on farmers' incomes has increased in recent years. However, it has been identified that only a few authors and journals have contributed to this specific topic. In the survey sample, it was found that 71% of the respondents are male producers, and 32% fall within the age range of 38 to 47 years. Furthermore, 32% of the farmers have two hectares of cultivation, with an average production of 30.6 quintals. 75% of the farmers sold their coffee to traders or intermediaries at a price of S/. 867 per quintal. Regarding associativity, it was found that 39% of the producers have an associativity degree between 0.78 and 0.88. On the other hand, 92% of the farmers use technology below 0.5, indicating a high level of associativity but low technology employed in the production process.

Research, Practical & Social implications: It is suggested to conduct more in-depth research on the level of technology and associativity among farmers in the Amazon region. This is because, despite having a high degree of associativity and low technology employed, it does not necessarily reflect in the producers incomes.

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Originality/value: The information provided is original. The findings do not indicate any shortcomings in coffee agricultural activity, as it remains one of the primary activities in generating employment and income for many families.

Doi: https://doi.org/10.26668/businessreview/2023.v8i9.3692

CARACTERIZAÇÃO DA PRODUÇÃO DE CAFÉ E DO NÍVEL DE RENDA DO AGRICULTOR NA REGIÃO DO AMAZONAS

RESUMO

Objetivo: O objetivo desta pesquisa foi caracterizar a produção cafeeira e seu impacto na renda dos agricultores da Região do Amazonas.

Quadro teórico: A literatura recente identificou que a produção de café é uma atividade agrícola significativa na economia local, sendo o principal gerador de emprego e renda familiar. Esta atividade é influenciada por vários fatores, tais como a qualidade do solo e as alterações climáticas (Arzubi, 2003). Mas ainda há muitos fatores que requerem mais pesquisas em relação à produção cafeeira, para aumentar tanto a produtividade das lavouras quanto a renda das famílias envolvidas.

Projeto/metodologia/abordagem: Analisamos o perfil da pesquisa internacional sobre a caracterização da produção cafeeira de 2018 a 2022. Foram identificados o assunto e os autores encontrados em revistas indexadas na Scielo, Scopus. A pesquisa foi básica com uma abordagem quantitativa e um desenho não experimental de um tipo transversal descritivo, com uma amostra de 126 agricultores, foi realizada através da pesquisa como um instrumento de coleta de informações.

Constatações: O volume de pesquisas sobre a caracterização da produção cafeeira e seu impacto sobre a renda dos agricultores aumentou nos últimos anos. No entanto, identificou-se que apenas alguns autores e periódicos contribuíram para este tópico específico. Na amostra da pesquisa, constatou-se que 71% dos entrevistados são produtores do sexo masculino e 32% estão na faixa etária de 38 a 47 anos. Além disso, 32% dos agricultores têm dois hectares de cultivo, com uma produção média de 30,6 quintais. 75% dos agricultores venderam seu café a comerciantes ou intermediários a um preço de S/. 867 por quintal. No que diz respeito à associatividade, verificou-se que 39 % dos produtores têm um grau de associatividade entre 0,78 e 0,88. Por outro lado, 92% dos agricultores usam tecnologia abaixo de 0,5, indicando alto nível de associatividade, mas baixa tecnologia empregada no processo produtivo.

Investigação, implicações práticas e sociais: Sugere-se a realização de uma investigação mais aprofundada sobre o nível de tecnologia e associatividade dos agricultores na região amazônica. Isso porque, apesar de ter alto grau de associatividade e baixa tecnologia empregada, não necessariamente reflete nos rendimentos dos produtores.

Originalidade/valor: A informação fornecida é original. Os resultados não apontam deficiências na atividade agrícola do café, uma vez que continua a ser uma das atividades primárias na geração de emprego e renda para muitas famílias.

Palavras-chave: Caracterização do Café, Produção de Café, Renda, Nível Socioeconômico.

CARACTERIZACIÓN DE LA PRODUCCIÓN DE CAFÉ Y EL NIVEL DE INGRESO DEL CAMPESINO EN LA REGIÓN AMAZONAS

RESUMEN

Objetivo: El objetivo de esta investigación fue caracterizar la producción de café y su impacto en el ingreso de los productores de la región Amazonas.

Marco teórico: La literatura reciente ha identificado que la producción de café es una actividad agronómicamente significativa en la economía local, siendo el principal generador de empleo e ingreso familiar. Esta actividad está influenciada por diversos factores, como la calidad del suelo y el cambio climático (Arzubi, 2003). Sin embargo, aún existen muchos factores que requieren mayor investigación en la producción de café, con el fin de incrementar tanto la productividad de los cultivos como los ingresos de las familias involucradas.

Diseño/metodología/enfoque: Se analizó el perfil de la investigación internacional sobre la caracterización de la producción de café de 2018 a 2022. Se identificaron los sujetos y autores encontrados en revistas indexadas en Scielo, Scopus. La investigación fue básica con un enfoque cuantitativo y un diseño no experimental de tipo descriptivo transversal, con una muestra de 126 productores, se realizó a través de la encuesta como instrumento de recolección de información.

Hallazgos: El volumen de investigación sobre la caracterización de la producción de café y su impacto en los ingresos de los agricultores se ha incrementado en los últimos años. Sin embargo, se ha identificado que sólo unos pocos autores y revistas han contribuido a este tema específico. En la muestra de la encuesta se encontró que el

71% de los encuestados son productores de sexo masculino, y el 32% se encuentra en el rango de edad de 38 a 47 años. Además, el 32% de los agricultores tienen dos hectáreas de cultivo, con una producción media de 30,6 quintales. El 75% de los productores vendió su café a comerciantes o intermediarios a un precio de S/. 867 por quintal. En cuanto a la asociatividad, se encontró que el 39% de los productores tienen un grado de asociatividad entre 0,78 y 0,88. Por otro lado, el 92% de los productores utiliza tecnología por debajo de 0,5, lo que indica un alto nivel de asociatividad pero baja tecnología empleada en el proceso de producción.
Investigación, implicaciones prácticas y sociales: Se sugiere llevar a cabo una investigación más profunda sobre el nivel de tecnología y asociatividad entre los agricultores de la región amazónica. Esto se debe a que, a pesar de tener un alto grado de asociatividad y baja tecnología empleada, no necesariamente se refleja en los ingresos de los productores.
Originalidad/valor: La información proporcionada es original. Los hallazgos no indican deficiencias en la actividad cafetalera, ya que sigue siendo una de las principales actividades en la generación de empleo e ingresos para muchas familias.

Palabras clave: Caracterización del Café, Producción de Café, Ingreso, Nivel Socioeconómico.

INTRODUCTION

Coffee production in Latin America is one of the largest worldwide and plays a crucial role as an economic engine in many countries. Great importance is placed on value addition to increase family incomes and contribute to the GDP of regions and the country. Since the 19th century, coffee has played a substantial role in the global economy and has established itself as a primary agricultural activity in generating employment and income (Sereia et. al, 2008). It has endured in global markets over the years, experiencing three distinct waves. The first and second waves focused on commercial coffee, transitioning to a focus on whole beans and higher quality. The third wave has emphasized direct engagement between producers and end consumers (Da Silva y Salazar, 2022), generating impacts on production processes, prices, and coffee demand (González-Freire y Martínez-Hernández, 2022). Currently, there are various classifications of coffee, such as Catimor, Caturra, and other varieties, which influence the quality and yield of production. An example of highly marketable coffee is Kapitan coffee, appreciated for its flavor and special appeal to consumers (Yusuf et. al, 2022).

At the same time, in recent years, a large part of agricultural systems has suffered from land degradation, water scarcity, and climate change. Coffee production, in particular, has been consistently affected by pests and diseases, as well as biological, economic, and social issues (Castellanos-Galdámez et. al, 2022; Delgado-Oramas, 2020). Climate change is a factor that impacts coffee farmers as it significantly reduces suitable cultivation areas and increases the spread of various diseases, such as coffee leaf rust. This generates multiple causes and consequences for both the regional economy and the ecosystem (Libert-Amico y Paz-Pellat, 2018). It is estimated that weed competition can cause yield losses of up to 40% (Alvarado-Huamán et. al, 2022). This transformation jeopardizes the production of organic and high-

quality coffee by small-scale producers and the future of their organizations (Henderson, P., 2019). Furthermore, it affects the quality of the coffee cup due to drying and processing methods, cultivation type, growth time, maturity stage, and grain storage capacity, limiting the quality and production of coffee (Binotto et. al, 2011).

Thus, it shows that organic coffee production involves different forms of treatment and agricultural management compared to conventional coffee. However, both traditional and technified agriculture have not reflected the expected results in terms of production yield and economic benefits for farmers (Rojas-Ruiz et. al, 2020). This highlights the complexity of coffee production, as farmers heavily depend on their crops, have limited cultivation areas, and often lack technological advancements in their agricultural practices (Méndez et. al, 2014). On the other hand, Benítez-García et. al (2015) argue that technological level directly relates to farmers' income and production yield, emphasizing the importance of technified interventions in agriculture. Additionally, Machado et. al (2015) indicate that production yield and economic risk are factors that contribute to the limitation of a sustainable production system, mentioning the need to implement an agroecological approach and achieve agroecosystem stability to increase coffee productivity.

In summary, the production of organic coffee is managed differently in terms of treatment and agricultural practices compared to conventional coffee. However, traditional and technified agriculture have not yielded the expected results in terms of production yield and economic benefits for farmers (Rojas-Ruiz et. al, 2020). This highlights the complexity of coffee production, as farmers heavily rely on their crops, have limited cultivation areas, and often lack technological advancements in their agricultural practices (Méndez et. al, 2014). Furthermore, Benítez-García et. al (2015) assert that the technological level has a direct relationship with farmers' income and production yield, emphasizing the importance of technified interventions in agriculture. Moreover, Machado et. al (2015) indicate that production yield and economic risk are factors that contribute to the limitations of a sustainable production system. Hence, they mention the need to implement an agroecological approach and achieve agroecosystem stability to increase coffee productivity.

LITERATURE REVIEW

Coffee production is an agricultural activity that requires considerable physical effort from farmers. In many cases, the coffee production process is primarily carried out by the family unit, without employing additional workers. This activity is a self-generating source of

employment for producers and constitutes one of the main sources of income for families, contributing to the socio-economic development of rural areas. Family farming sustains thousands of people in these areas, achieving a balance in the production system that allows for environmental conservation. Additionally, it stimulates the regional economy and plays an important role in supplying food to urban areas. Coffee production is a heterogeneous family agricultural activity in terms of financial, human, and social resources. It is characterized as a subsistence agricultural activity, where the first production is destined for the market, and the second production is intended for self-consumption.

Coffee Production

Production is generated through the combination and transformation of resources to obtain products that satisfy the needs of a population. It allows analyzing the choices made by a producer in combining productive factors based on their target production level. In the case of coffee production, it involves the transformation of raw coffee into a final product, ranging from the planting of the crop to the drying of the coffee. This production depends on multiple factors, such as soil quality potential, the farmers economic resources, and climate change (Arzubi, 2003).

Coffee production encompasses a production process that starts from seed selection to planting, involving a series of agricultural activities that ensure the success of the plantations. These activities include weed and pest control, as well as fertilization, which enable sustainable agricultural practices and improve the quality and increase the coffee production. Characterizing production involves identifying the development potential based on the current situation of the agricultural activity, providing a clear understanding of its positive and negative aspects. This helps address internal issues and diagnose key aspects for the functioning of a coffee farm (Ministry of Agriculture and Livestock, 2020).

Conventional coffee production relies on fertilization and pest control, often utilizing chemical products. However, most farmers do not analyze the soil type, which can hinder proper crop management and harm the soil. Moreover, the lack of technified agriculture in traditional farming practices is reflected in the quantity and quality of coffee production (Escobar et. al, 2016). On the other hand, this characterization allows understanding the type of coffee that is marketed in the main markets and its socio-economic impact on producing families, being one of the primary agricultural activities nationwide and an important source of employment and income (Calderón and Rodríguez, 2018).

Income Level

Income refers to the amount of money that economic agents receive from the sale of activities or the leasing of productive factors, also known as aggregate income. Additionally, income can be associated with goods and services. According to the Ministry of Economy and Finance (MEF, 2003), income represents the increase in economic benefits generated over a period of time, whether in the form of inflows, increase in asset value, or reduction of obligations resulting in an increase in net worth, and it is not related to owners' contributions to that net worth.

When we talk about income, we are referring to an economic inequality where the distribution is not equitable and often linked to need versus merit (Salvador, 2014). Aggregate income is the total income received by farmers through the production process, calculated as the value of production minus the value of intermediate goods. In a circular flow economy, aggregate income is equal to aggregate expenditure (Solis and Cruz, 2020).

Income is an important factor for families as it comes from their own efforts in work or the sales of their agricultural products. It allows them to sustain their agricultural activities and determines the quality of life for farming families. There are several tools to determine the economic income of families, such as wages, per capita income, educational level, available area for cultivation, and the productive capacity obtained from coffee production in relation to the selling price of their products (Galeas and Álvaro, 2014).

DATA AND METHODOLOGY

The research was conducted in the Ñunya Jalca Village Center, located in the district of Bagua Grande, Utcubamba Province, Peru. This village center consists of 13 hamlets and covers a land area of 12,708 m2. It is situated at an altitude of 1556 meters above sea level and experiences climatic variability due to continuous and intense rainfall throughout the year. Six of the hamlets are engaged in coffee production, and the local economy heavily depends on this activity. The boundaries of the village center are as follows: to the north, it borders the districts of Bagua Grande and Cajaruro; to the south, it borders the district of Lonya Grande and the Progreso San Antonio Village Center; to the east, it borders the district of Jamalca and the San Martín de Porras Village Center; and to the west, it borders the Miraflores and Pueblo Libre Village Centers.

The study was carried out in the six coffee-producing hamlets of the Ñunya Jalca Village Center, which are home to approximately 675 families. The research adopted a basic

quantitative approach and a non-experimental cross-sectional design. Data collection was done at a single point in time, and the study was descriptive, observational, and correlational in nature, as it aimed to analyze variables based on the obtained relevant characteristics. A quantitative approach was used to quantify data collection and analyze the data without manipulation, obtained at a specific moment in time. Additionally, a descriptive approach was employed to characterize the population studied based on observation.

The research collection instruments were key for the collection of information and the application of a structured questionnaire, based on a sample of the finite population that allows the collection of information from the following equation:

$$n = \frac{Z^2 * P * Q * N}{Z^2 * P * Q + (N-1)e^2}$$

Where:

n= sample number;
N= total population;
Zα= 1.96 al; p and q is the expected ratio of 50% to each;
e = is the precision error (5%).

$$n = \frac{1.96^2 * 0.5 * 0.5 * 675}{1.96^2 * 0.5 * 0.5 + (675-1)0.05^2}$$

The obtained sample consisted of 256 coffee producers. For data analysis, statistical programs such as SPSS version 26 and EViews were used, as well as tools like Microsoft Word and Microsoft Excel 365 to write the data analysis and present it in the form of graphs and tables. Additionally, a correlation analysis was conducted using the box and whisker plot method to evaluate the association between the service quality variables and customer satisfaction.

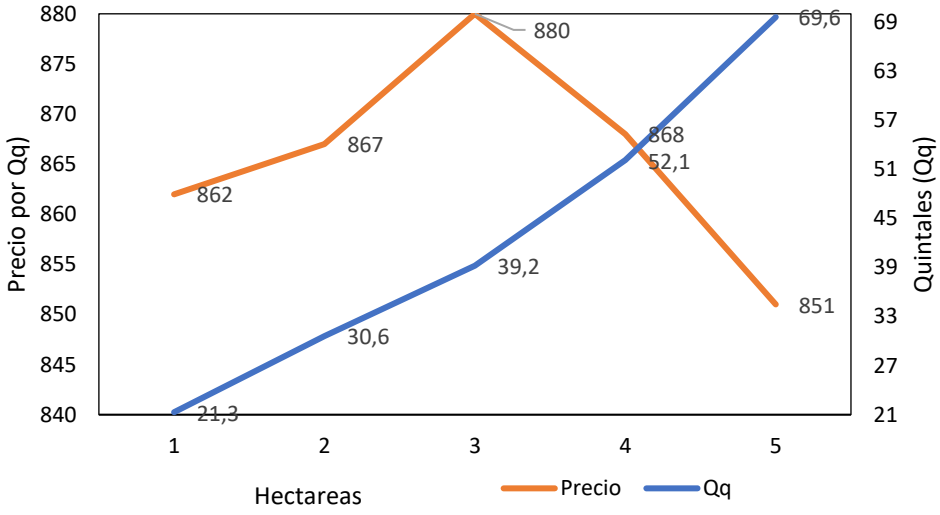
For the analysis of statistical tests, the serial correlation Breusch-Godfrey LM method was used to examine the correlation between the coffee production variable and the variables of cultivation area (AC), association (A), technology (T), yield (R), and price (P). A sampling was performed in which all elements of the population had an equal probability of being selected for the research. The instruments were applied through a mapping analysis of the location of coffee-producing areas, and the information was analyzed using Microsoft Excel, SPSS, and EViews programs to address the complex data.

RESULTS AND DISCUSSION

On a global level, Peru ranks as the second-largest exporter of organic coffee and the seventh-largest exporter of coffee overall, being one of the main agricultural products exported by the country. In the Amazonas region, coffee plays an important role in the agricultural sector, with Amazonas being the fourth coffee-producing region (Central Reserve Bank of Peru, Piura Branch, 2021). This research specifically focuses on the Utcubamba Province, in the district of Bagua Grande in the center of the town of Ñunya Jalca.

According to the obtained results, it was found that 71% of the farmers are men, while 29% are women. In terms of age, 18% fall within the range of 18 to 27 years, 21% within 28 to 37 years, 32% within 38 to 47 years, 15% within 48 to 57 years, and 12% are over 58 years old. Regarding the size of their crops, 27% of the producers work with less than one hectare, 32% with two hectares, 23% with three hectares, 9% with four hectares, and 8% with more than four hectares. In terms of marketing, 75% of the farmers sell their coffee through intermediaries, while 25% do so through coffee cooperatives. In terms of coffee-producing hamlets, four were identified in descending order of production: Ñunya Jalca Village Center, Palmo, Cruz Roja, and Galeras.

Figure 1. Coffee production and sale price per hectare.



Source: Own elaboration with data from the 2022 survey.

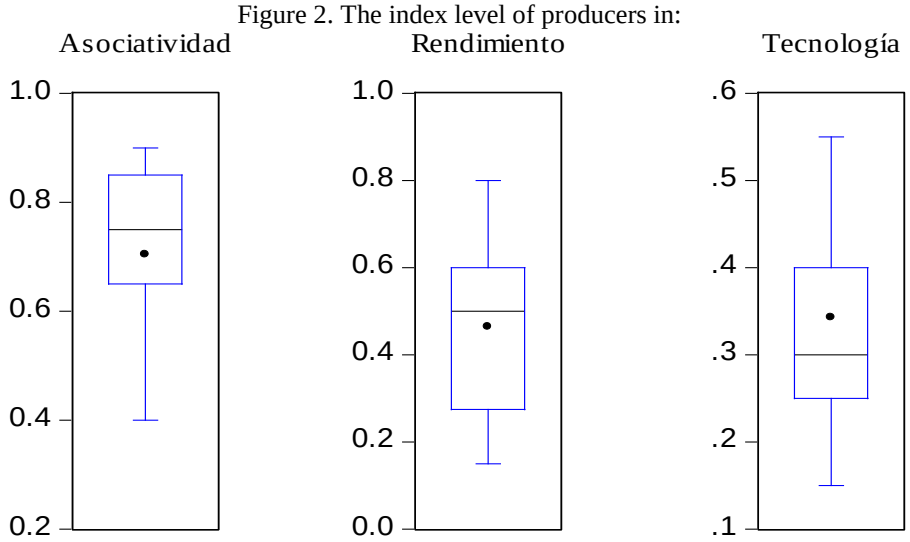
Coffee production in the Ñunya Jalca Village Center is an important agricultural activity that also drives other agricultural activities, such as plantain and fruit tree (agroforestry) production in the community. These activities are efficient in crop management and land use. Additionally, the quantity of coffee production has an inverse relationship with product exports

and a relationship with prices (Figueroa-Hernández et al., 2019), aiming to contribute to the sustainability of agricultural processes in the short and long term.

In Figure 1, the coffee production and selling price per hectare can be observed. Farming families engaged in coffee cultivation in areas of one, two, three, four, and five hectares produce 21.3, 30.6, 39.2, 52.1, and 69.6 quintals of coffee, respectively. Furthermore, the average selling price per hectare for these same areas is 862, 867, 880, and 868 soles. The yield of parchment coffee per hectare decreased from 19 to 15 quintals between the years 2011 and 2014, while the selling price per quintal decreased from 141 to 134 soles (Rojas-Ruiz, Alvarado-Huamán, Borjas-Ventura, & Carbonell Torres, 2020).

Of all the respondents, 80% of the farmers mentioned that the price of coffee is an important factor for boosting productive factors and improving the technology used. The producers are attentive and up-to-date regarding their crops to enhance production yield. They also stated that the best price and yield are achieved when families dedicate 80% of their time and effort to caring for one to three hectares of cultivation. They affirmed that coffee production is an activity that generates employment and income for families. This aligns with the author Vázquez-López et. al (2022), who mention that coffee cultivation is significant in the local economy due to its contribution to employment, family income, and national currency.

Figure 2. The index level of producers in:



Source: Own elaboration of the 2022 survey data

Within the agricultural activities of coffee farmers, the box and whisker plot show that a high percentage of farmers are associated with cooperatives or associations, while a low percentage does not use appropriate technology in their production process.

Out of the total surveyed farmers, 24% have an association level between 0.69 and 0.77, and 39% have an association level between 0.78 and 0.88. This indicates that farmers are associated with cooperatives or associations, which allows them to improve their production process and market their products. According to authors Juan Manuel and Andrea (2021) and Arboleda et al. (2019), associated producers have a high level of production, practice agricultural and environmental sustainability, and contribute to local development. On the other hand, non-associated farmers do not experience improvements in their productivity.

According to the opinions of farmers, 52% of the families are satisfied with the yield of their coffee production, with a range from 0.44 to 0.63. Additionally, 26% claim to have very low production. Analyzing the box and whisker plot, it can be observed that a high percentage of farmers are satisfied with the yield of their coffee crops. This aligns with the research of Muñoz-Belalcazar et. al (2021) and Julca-Otiniano et. al (2018), who mention that proper agricultural management, association, and fertilization type influence yield and product quality.

In Figure 2, it is evident that 57% of the farmers fall below the technological index of 0.30, while 34% fall between 0.31 and 0.45, and only 8% have a technological index greater than 0.50. This allows us to understand that in the Ñunya Jalca Village Center, 92% of families are below the technological index of 0.5 and aim to generate coffee production under a traditional agricultural management approach. According to authors Osorio Velásquez and Pombo (2019), technology seeks to offer advantages in the production process to increase productivity and simplify work. They also mention that traditional crop management is due to lack of knowledge and cultural roots, while management based on appropriate technology is associated with implementing a production system that allows for increased family income. On the other hand, Franco et. al (2018) emphasize the importance of competitiveness in marketing markets.

Table 1. Specification of the producers before an increase and decrease of the technological level and associativity.

Hectare (Has)	Perfom ance	Income	Technoligica l index	Price	Income	Ssociativity index	Prece	Income
1	21.3	3885	<0.5	861	18374	<0.5	862	18415
			>0.5	862	18415	>0.5	862	18416
2	30.6	3600	<0.5	867	26546	<0.5	867	26546
			>0.5	867	26546	>0.5	867	26546
3	39.2	3480	<0.5	880	34623	<0.5	880	34623
			>0.5	880	34623	>0.5	880	34623
4	52.1	2960	<0.5	869	47587	<0.5	867	44185
			>0.5	-	-	>0.5	867	44185
5	69.6	1760	<0.5	851	63988	<0.5	897	65140
			>0.5	-	-	>0.5	897	65140

Source: Own elaboration of the 2022 survey data

Table 1 shows the level of technology possessed by farmers, which is related to the coffee production area, pruning, pest control, weed control, and fertilization of the crop. These practices strengthen productive capacity and increase farmers' income. It can be observed that in the production of one hectare, when the level of technology and associativity is below the technological index of 0.5, the incomes are $18374 and $18415 respectively. In contrast, when the technological index is above 0.5, the producers' incomes differ by $100 soles compared to the level of associativity. It is concluded that an increase in technology and associativity does not generate a significant difference in the income and prices of producers who have one, two, three, four, and five hectares of coffee production. However, it is observed that farmers with larger production areas obtain higher incomes through coffee production. According to Osorio and Pombo (2019), the technification of agricultural activity improves production against pests but can affect quality of life. Additionally, Gómez et. al (2018) argue that a technological strategy of information and services must be aligned and coordinated to generate development.

Furthermore, it is observed that families with one, two, and three hectares of coffee production seek other sources of income in addition to employment in coffee production. Farmers with less than one hectare earn an annual income of 3885 soles, while those with three hectares earn 3480 soles. On the other hand, farmers with four hectares have an income of 2960 soles. As families possess more hectares of production, they do not seek other sources of income. Coffee farming is one of the most important activities as it provides economic income, employment, and an ecosystem service to the community (Rojas et. al, 2021). Loaiza and Granda (2015) and Chavez (2020) also argue that coffee production has a significant value in family incomes. For example, producers cultivating one hectare earn an income of S/ 403, while those cultivating three hectares earn S/ 919. Additionally, the production costs of one quintal of coffee are 142 soles, and the producers' yield is 0.15 quintals of coffee per hectare.

By analyzing the correlation of coffee production, the relationships between two or more quantifiable variables can be identified. It is important to understand the correlation of variables, whether positive or negative, to comprehend how they vary together. In this study, independent variables such as cultivation area (CA), associativity (A), technology (T), yield (Y), and price (P) were analyzed to measure the degree of correlation with the dependent variable.

Table 2. Breusch-Godfrey Serial Correlation LM Test

F-statistic	2.976070	Prob. F(1,249)	0.0857
Obs*R-squared	3.023596	Prob. Chi-Square(1)	0.0821

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 06/01/23 Time: 09:23
Sample: 1 256
Included observations: 256
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AC	-0.001408	0.427372	-0.003294	0.9974
A	-0.361218	3.017021	-0.119727	0.9048
R	0.511284	2.944523	0.173639	0.8623
T	-0.431192	3.632514	-0.118704	0.9056
PR	-0.002008	0.019029	-0.105505	0.9161
C	1.917447	16.55273	0.115839	0.9079
RESID(-1)	-0.109912	0.063712	-1.725129	0.0857

R-squared	0.011811	Mean dependent var	-5.63E-15
Adjusted R-squared	-0.012001	S.D. dependent var	7.574141
S.E. of regression	7.619453	Akaike info criterion	6.926249
Sum squared resid	14455.96	Schwarz criterion	7.023188
Log likelihood	-879.5599	Hannan-Quinn criter.	6.965238
F-statistic	0.496012	Durbin-Watson stat	1.976928
Prob(F-statistic)	0.811090		

Source: Elaboración propia de los datos de la encuesta 2022

The specifications of a correlation model through "Breusch-Godfrey Serial Correlation", it is observed that the model exists a correlation in the variables with a probability greater than 0.5 and the greater than 0.5 of Square Chip, both allow us to accept 99% null hypothesis that there is a correlation in the variables and also in the analysis of the error lags in a period it is maintained that there is a correlation. Table 2 shows that associativity, technology has a moderate negative correlation and cultivation area, price has a zero negative correlation and only the performance variable has a moderate positive correlation.

CONCLUSION

Coffee farming in the Ñunya Jalca Village is predominantly led by male farmers, representing 72% of the population and ranging in age from 38 to 47 years old. This activity stands out as an important generator of employment and family income in the area. Additionally, it operates as an organic production system that benefits from the presence of natural vegetation and fruit varieties, which allows for other sources of income and promotes local economic development.

It was found that farmers with higher cultivation density and a high level of associativity do not necessarily experience an improvement in coffee production. In fact, a higher cultivation density is associated with a decrease in production per hectare. Furthermore, both low and high

levels of associativity do not have a significant impact on increasing coffee production. Additionally, it was identified that farmers employ low levels of technology in their agricultural practices. These variables, such as cultivation density, associativity, and technological level, exhibit a negative correlation with coffee production, while yield shows a positive correlation.

In the Ñunya Jalca Village, farmers have a high degree of associativity, but this does not translate into a significant increase in production. This may be due to various reasons, such as the lack of implementation of appropriate agricultural technologies or the failure to implement the guidance provided by cooperatives. Further research is needed to determine the underlying causes that explain why, despite high associativity, the low technology used is negatively affecting production and, ultimately, family income.

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