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HUMAN CAPITAL AND INCOME LEVEL IN ANDEAN FAMILY FARMING FOR SUSTAINABLE DEVELOPMENT: EMPIRICAL EVIDENCE IN A RURAL PARISH OF SAN LUIS, ECUADOR

Carla Sofía Arguello Guadalupe^{1*}, Mike Joffre Coral Erazo², Jorge Daniel Cordova Lliquin³, José Abelardo Paucar Camacho⁴, Adriana Catalina Guzmán Guaraca⁵, Iván Alfredo Ríos García⁶, Andrea Patricia Guapi Auquilla⁷, Adrián Dios-Vicente⁸

¹Ingeniera En Ecoturismo-Magister En Economía Agraria- Diploma Superior En Docencia Con El Empleo De Las Tecnologías De La Información Y La Comunicación. ORCID iD: <https://orcid.org/0000-0003-2102-4290>. Facultad de Recursos Naturales de la Escuela Superior Politécnica de Chimborazo (ESPOCH). Email: c_arguello@epoch.edu.ec

²Economista- Diploma Superior En Diseño Gestión Y Evaluación De Proyectos De Desarrollo- Diploma Superior En Currículo Por Competencias- Magister En Diseño Curricular Y Evaluación Educativa- Magister En Economía Agrícola Y Desarrollo Sustentable. ORCID iD: <https://orcid.org/0000-0002-7980-7442>. Universidad Politécnica Estatal del Carchi. Email: mike.coral@upec.edu.ec

³Guía Profesional De Turismo- Ingeniero En Ecoturismo- Master Of Science In Geographical Information Science & Systems (UNIGIS MSc). ORCID iD: <https://orcid.org/0000-0002-9827-9657>. Escuela Superior Politécnica de Chimborazo. Email: jorged.cordova@epoch.edu.ec

⁴Asistente Pedagógico Con Mención En Educación De La Niñez Y Juventud En Riesgo- Licenciado En Administración De Desastres- Ingeniero En Administración Para Desastres Y Gestión Del Riesgo- Master Universitario En Planificación Y Gestión De Riesgos Naturales- Doctorado Dentro Del Programa Oficial En Desarrollo Local Y Territorio- Magister En Gerencia En Salud- Diploma Superior En Sistemas De Educación Superior Modular Basados En Créditos Acumulables Y Transferibles. ORCID iD: <https://orcid.org/0000-0003-2722-1850>. Universidad Estatal de Bolívar, carrera de Ingeniería en Riesgos de Desastres. Email: apaucar@ueb.edu.ec

⁵Ingeniera En Biotecnología Ambiental- Doctora De La Facultad De Ciencias Agrarias Y Forestales- Especialización En Teledetección Y Sistemas De Información Geográfica Aplicados Al Estudio De Los Recursos Naturales Y La Producción Agropecuaria- Magister En Manejo Integral De Cuencas Hidrográficas Con Orientación En Manejo Sustentable De Los Recursos Naturales En Cuencas De Montaña. ORCID iD: <https://orcid.org/0000-0003-0473-2041>. Investigadora Independiente Email: adryguz91@gmail.com

⁶Ingeniero Civil- Doctor En El Programa De Doctorado En Ingeniería Del Agua Y Medioambiental- Especialista En Sistemas De Información Geográfica Aplicados A La Gestión Territorial Y Ambiental- Especialista Superior En Gestión Local- Diploma Superior En Diseño Gestión Y Evaluación De Proyectos De Desarrollo- Magister En Gerencia Publica. ORCID iD: <https://orcid.org/0000-0003-0858-4365>. Investigadora Independiente. Email: riosivan33@yahoo.es

⁷Ingeniera Agrónoma- Magister En Suelos Y Nutrición De Plantas. ORCID iD: <https://orcid.org/0000-0003-0711-6391>. Investigadora Independiente. Email: gaaplibra@yahoo.es

⁸Licenciado en Economía- Master en Desenvolvimento Económico e Inovação- Diploma en Docencia Universitaria- Ferramentas informáticas de análise de dados: SPSS (Inicial). ORCID iD: <https://orcid.org/0000-0002-5192-4129> Institución o universidad a la que está afiliada el autor: Universidade de Santiago de Compostela. Email: adrian.dios@usc.gal

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Corresponding Author: Carla Sofía Arguello Guadalupe

c_arguello@epoch.edu.ec

ABSTRACT

The aim of this thesis is to study the socio-economic characterization of small farmers in rural areas through a case study for the parish of San Luis, in the province of Chimborazo (Ecuador). The theoretical framework used allowed us to establish the importance of this activity in the economic, social, cultural, technological and institutional spheres of Ecuador and Latin America, and then to concentrate on the particularities of the parish of San Luis. The methodology used is characterized by a mixed, qualitative and quantitative method: firstly, through a bibliographical review, the geographical area of interest was analyzed and related to the theoretical framework linked to family farming; Secondly, data was collected through a survey to 254 farmers in the parish. The results made it possible to analyze 67 qualitative and quantitative variables, which offer highly relevant data on the productive, social and economic characteristics of small farmers in the parish. In addition, an estimate was made of the income, production costs and rent or gross margin for the four main crops in the parish of San Luis.

KEYWORDS: Family Farming, Small-Scale Farmers, Case Study, Ecuador, Chimborazo.

1. INTRODUCTION

Agriculture is of great importance to Latin American countries. This activity sustains the world's food systems and, when practiced sustainably, contributes to achieving the Sustainable Development Goals (SDGs), which aim to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture (CEPAL, 2023). Through these goals, it is hoped that 10 billion people will be fed by 2050, and agricultural productivity will be increased to improve the economic income of small and medium-sized farmers. It is important to note that agriculture represents a very different proportion of GDP across countries: while in developed countries it accounts for, on average, 4% of gross domestic product (GDP), in developing countries it can exceed 50% of GDP.

This study aims to analyze family farming production in the San Luis parish, a specific area of Ecuador, a Latin American country with a small land area (257,204 km²) but a high diversity of soils, climates, and topographies. The country can be divided into four regions: Coast, Highlands, Amazon, and the Galápagos Islands. In the first three regions, agriculture is practiced for both self-consumption and commercialization, while in the Galápagos Islands, only subsistence farming is practiced, yielding few products due to the islands' agroecological characteristics, which do not allow for optimal production or the capacity to meet local demand.

This small country recorded an agricultural area of 2,192,699 hectares in 2023, an increase in production compared to the previous year, demonstrating the growth and importance of this activity for small farmers (INEC, 2024a). Thus, 40% of Ecuador's rural workforce is engaged in agricultural activities, and the total number of people employed in the sector is close to two and a half million.

We can identify three types of family farming in Ecuador: 1) subsistence family farming (SFF), which does not hire labor; 2) transitional family farming (TFF), which occasionally hires labor; and 3) consolidated family farming (CFF), which hires permanent labor. Family farming represents 84.5% of Agricultural Production Units (APUs), with a concentration of 20% of the land and is primarily dedicated to production for basic needs. The work of small farmers also sustains 64% of agricultural production nationwide. Similarly, CFF contributes to the export supply of various products such as bananas, coffee, and cacao. Therefore, policies have been implemented to strengthen the sector, facilitating access to technology, training, credit,

transportation, and agricultural insurance, while also paying attention to marketing policies (Argüello Guadalupe et al.), to, 2022).

Chimborazo is one of the provinces in the central highlands of Ecuador, with a population of 471,933, 65% of whom live in urban areas and 35% in rural areas. The province's total agricultural land area is 36,670 hectares, employing 81,467 people (MAG, 2021). The capital of Chimborazo is Riobamba, the province's most important commercial center. Its strategic location allows it to maintain trade links with the provinces of Tungurahua, Pastaza, Pichincha, Guayas, Azuay, and Cañar.

The diverse agricultural production enhances commercial opportunities, and the harvested products are varied, ranging from tubers and vegetables to grains and fruits. Riobamba's agricultural production is concentrated in its eleven rural parishes, each exhibiting a varied output based on its altitude, soil type, climate, access to water, and other productive resources. San Luis, the most productive rural parish in Riobamba, will be the focus of our research. While not the largest rural area in the Riobamba canton, San Luis is the most productive per square meter in terms of both quantity and agricultural diversity, making it an important area of study for evaluating the agricultural landscape of the canton and the province.

To date, studies have been conducted measuring specific aspects of the socioeconomic reality of this parish, such as employment, food sovereignty, and poverty levels, but there is no comprehensive research on agricultural production in the San Luis parish. Therefore, it is necessary to delve deeper into the characteristics of family farmers. Furthermore, many of the conditions faced by agricultural producers are similar throughout Ecuador, so research in a region (San Luis) with such diverse agricultural practices could serve as a model for implementing economic and social policies that have a real impact on family farming in the country.

This analysis is particularly relevant because problems in agricultural production management lead to severe problems for the local population, such as food insecurity, poverty, malnutrition, and child malnutrition. Specifically, Riobamba is one of the cities in the country with the highest rates of these issues. However, the agricultural potential of the region would allow it to meet local demand and even market its production outside the province, helping to alleviate poverty and malnutrition. This analysis aims to contribute to sound decision-making regarding the management of production units and the agricultural policies implemented in the region.

These agricultural policies must be coordinated

between local, regional and national authorities, seeking to take advantage of local wealth for secure self-sufficiency, which improves the conditions of the population and the quality of life of our children, youth and senior citizens in the province.

2. METHODOLOGY

This section is divided into two parts. The first explains the process of generating the survey used, while the second details the methodology applied to test the hypotheses.

Methodology used in the survey of farmers in the parish

Our empirical research has focused on the rural parish of San Luis, located in the Riobamba canton, capital of the Chimborazo province. This parish was selected based on the following criteria: 1) the parish has high agricultural productivity due to its agroecological characteristics, which include suitable soil, access to irrigation water, and a temperate climate; 2) it is located approximately 15 minutes from the city of Riobamba, the most important agricultural and livestock marketing center in the province; 3) it has road infrastructure connecting it to the provincial capital and is also connected to access routes to the Coast, Amazon, and central highlands; 4) its population is primarily indigenous and has historically relied on agriculture, a tradition passed down through generations that has sustained families; 5) there is no prior research characterizing the farmers of this parish and identifying their main problems, which may be of broader interest to similar territories in the Andean region of Ecuador.

According to the latest Population and Housing Census of 2022, the San Luis parish has 19,510 inhabitants, of whom 47.5% are men and 52.5% are women; a female predominance that is common in rural areas of Ecuador, due in part to migration patterns in recent decades. According to the parish's Development

and Land Use Plan, the economically active population represents 60.3% of the total population. The sectoral structure of employment is characterized by a strong presence in the agricultural sector, with 42.1% of employed individuals working in agriculture and livestock farming. (GADPa San Luis, 2015).

Our empirical research was based on a survey of a representative sample of farmers in the parish, with questions related to both quantitative and qualitative variables. To determine the sample size, we applied the formula proposed by Saraí Aguilar (Aguilar Barojas, 2005):

$$n = \frac{N * Z^2 * p * q}{d^2 * (N - 1) + Z^2 * p * q}$$

Where:

N = is the total population, in our case the population of the parish of San Luis with agricultural production.

Z² = if the security Z were 99.04%, the coefficient would be 2.59

p = expected proportion (if the confidence level is 95%)

q = 1-p (in this case 1-0.05= 0.95)

d = precision; in this research 3.5% was used

Since the survey was conducted before the availability of data from the latest population census, the sample size was calculated using the population recorded in the 2010 census (12,055 inhabitants). We also considered information from the Ministry of Agriculture, which indicates that 90% of the parish's population cultivates some type of crop. Therefore, the population figure used for the sample calculation was 10,850 inhabitants (MAG, 2019d).

Applying the formula described above, a figure of 254 surveys was obtained. Once the total sample size was determined, it was distributed among the 10 human settlements that make up the parish based on the potential agricultural production area of each settlement, according to the figures collected in **Error! Reference source not found.**

Table 1 Territorial division of the San Luis parish; determination of the number of surveys to be carried out in each sector or settlement.

Sector or human settlement	Area (ha)	90% of agricultural production area (ha)	Sample stratification (%)	Number of surveys to be applied
Parish seat	659.22	593.30	22.5	57
Candelaria	317.45	285.71	10.8	28
Sacred Heart of Jesus	117.45	105.71	4.0	10
The Granary	295.64	266.08	10.1	26
Guaslan	469.98	422.98	16.1	41
Freedom	177.16	159.44	6.1	15
The Immaculate Conception	462.79	416.51	15.8	40
Tunshi Nuns	139.48	125.53	4.8	12
Saint Anthony	169.73	152.76	5.8	15
San Vicente de Tiazo	118.35	106.52	4.0	10
Total	2,927.25	2,634.53	100.00	254

Note: Prepared by the author using data from the PDOT of the San Luis Parish Council 2015.

As a result of these calculations, the 254 surveys were distributed as follows: 57 surveys were administered in the parish seat, 28 in Candelaria, 10 each in Corazón de Jesús and San Vicente de Tiazo, 26 in El Troje, 41 in Guaslán, 15 each in La Libertad and San Antonio, 40 in La Inmaculada, and 12 in Monjas Tunshi. It is worth mentioning that, by visiting the different villages, an initial assessment of the variety of crops present in the area was obtained. Furthermore, it should be noted that communities or settlements such as the parish seat, Corazón de Jesús, Candelaria, and Guaslán are traversed by the main road that connects the city of Riobamba with the cantons of Guamote and Chambo, as well as with Morona Santiago and the central region of the country, which opens up opportunities for marketing the parish's products.

Before beginning the surveys, it was necessary to approach the parish authorities, especially the political lieutenant, Engineer Juan Carlos Pérez, who convened the presidents of the parish's 10 communities to discuss the research to be conducted in the area. With their authorization, each community was visited. Following these preliminary steps, the surveys were administered in two successive phases. Initially, in July 2020, 50 pre-surveys were conducted. These were heavily influenced by the lockdown resulting from the COVID-19 pandemic, but they allowed for an assessment of the survey's applicability and comprehension by the target population. Subsequently, based on this experience and incorporating new variables into the questionnaire, the actual survey was carried out with the 254 farmers in our sample. Data collection was conducted directly by the author of this doctoral thesis between August and December 2021.

To select the specific people to survey, given that the research focuses on family farming, with the help of the presidents of each of the ten communities we identified families that work in this activity, applying the survey to a family member who was working on their plots, considering this as representative of their family production unit.

Regarding the questionnaire used, its development was based on a review of various studies conducted in the country, as well as the models applied in some statistical analyses. Among these models, the questionnaire from the Continuous Agricultural Area and Production Survey (ESPAC), which is conducted annually in Ecuador and collects detailed information on land area, crop characteristics, and other production variables,

proved particularly useful. Furthermore, the author's experience in field data collection and her direct knowledge of the parish and the population under investigation were other fundamental elements considered when deciding on the specific wording of the questions, in order to ensure their comprehension and the willingness of the respondents to answer.

The questionnaire was developed taking into account all these aspects, starting from the variables on which the research was intended to focus. As a result, a questionnaire was designed, structured in 9 sections and a total of 67 questions, of closed, open, and combined types (Appendix I).

The first section includes various questions about the characteristics of the respondents, such as their age, sex, marital status, educational level, and ethnicity. The second section aims to gather information on the main socioeconomic characteristics of the family unit and the workforce employed on the farm: the volume and source of the family's income, the relative importance of agriculture, the number of people working on the farm, the payment methods for hired labor, and membership in associations.

The third section focuses on the size of the farm and its main crops, with questions about the species cultivated, the area sown, the yield obtained, and the land tenure system. The fourth section seeks to understand how the family unit uses the income generated from its agricultural activity, as well as its access to basic services. The fifth section addresses the inputs and access to technology available to farmers in the parish, including questions about the types of seeds used, irrigation systems, different chemical or organic inputs employed in the production process, and other technological aspects. The sixth section gathers information on animal husbandry and livestock production on the parish's farms, clarifying the importance of the different livestock species and the destination of this production (the proportion used for family consumption versus the sale of the animals).

The seventh section addresses the destination of these family farms' production, the different marketing channels for their products, as well as their ability to negotiate prices and their level of satisfaction with current markets. The eighth section seeks to determine whether the family farms have access to technical assistance, financing, and other support from public and private entities and NGOs. Finally, the ninth and final section investigates the main environmental problems that may be affecting crop productivity in the parish, such as floods,

landslides, droughts, pests, or diseases.

Through this study, we aim to provide original information on the socioeconomic, productive, and environmental variables of small-scale farmers in the San Luis parish. This case study may also be of broader interest to other rural areas with similar characteristics in the Sierra region of Ecuador.

Specific methodology for testing research hypotheses

The survey results served as the basis for testing the research hypotheses. The data used and the statistical instruments applied for this testing are described below.

a) First hypothesis: less than 40% of farmers use any type of organic product in their crops

To test this hypothesis, data was obtained from three survey questions regarding the type of inputs used in fertilization, weed control, and pest and disease control processes. These were categorized as chemical or organic: chemical inputs include all those with a chemical component as an active ingredient, while organic inputs are those derived from natural products, as well as biological ones.

To verify the data obtained, a Z-test for proportions was applied to compare the observed proportion with the expected proportion (less than 40%). Since the sample distribution is normal, we consider this statistic appropriate for the analysis. The result allows us to determine the proportion of farmers using some organic product, the standard deviation, and the confidence level.

b) Second hypothesis: most female farmers work with hired labor

The data were obtained from two survey questions: the variable of sex and the farmer's relationship to the type of labor used (family or hired). A Z-test for proportions was applied to this data, as in the previous hypothesis, given the normal distribution and the sufficient number of observations to obtain statistically significant results.

c) Third hypothesis: most farmers in the parish own three or more varieties of crops

This hypothesis is analyzed using data obtained from the survey question regarding the five priority crops on each farm. To test the hypothesis in this case, we have limited ourselves to a descriptive analysis of the responses regarding the number of different crops grown by each farmer; from this, we calculated the percentage of those who have three or more crops.

d) Fourth hypothesis: the educational level influences the income level of the farmers in the parish

To test this hypothesis, it was first necessary to construct an income variable from the data obtained in the survey (quantities produced of the different crops and market prices in effect at the time of harvest). Based on this information, farmers were classified into two groups: those with monthly incomes above \$400 and those below that amount. This threshold was established using Ecuador's Unified Basic Salary (SBU) for 2021 as a reference, defined as the legal minimum monthly income for a full work week (40 hours), the objective of which is to guarantee access to the basic consumption basket for a typical family.

Once the dichotomous dependent variable (monthly income above or below \$400) was defined, a binary logistic regression model was applied to analyze its relationship with educational level, the independent variable. This variable was ordinally coded: primary education (1), secondary education (2), and higher education (3). The model estimates the probability that a farmer belongs to the high-income group based on their educational level. One of the advantages of this model is the possibility of interpreting the results using *odds ratios*, as these allow the relative impact of each explanatory variable to be expressed in terms of probability multipliers. This makes it possible to quantify the relative impact of education on income.

The general formula of the model is:

$$P(Y=1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)}}$$

Where:

- $P(Y=1)$ is the probability that the event of interest will occur
- β_0 is the intercept
- $\beta_1, \beta_2, \dots, \beta_k$ are the estimated coefficients
- X_1, X_2, \dots, X_k are the independent variables

3. RESULTS

Data from the people surveyed

The surveys were conducted in the field, visiting plots of land where individuals could be identified performing agricultural work. The first question posed to these individuals was: "Are you a farmer from this parish?" to which 100% responded affirmatively. Based on this affirmation, the questionnaire began with general questions about the characteristics of the respondents, starting with their gender, age, and ethnicity.

The results show that, of the 254 people surveyed, 104 (40.9%) were female and 150 were male. Among the women, 63.5% identified as Indigenous and the remaining 36.5% as mestizo; the distribution among the men was somewhat different: 46.7% Indigenous and

53.3% mestizo. Regarding age, the vast majority of the farmers interviewed (198, 78% of the total) were between 31 and 60 years old, with the remainder distributed as follows: 16.5% were over 60 years old and 5.5% were 30 years old or younger. The predominance of the central age group (31-60 years) was similar for both women (75%) and men (80%) (**Error! Reference source not found.**).

The percentage of women among the surveyed farmers (40.9%) is significantly lower than their proportion of the parish's total population, which, as previously mentioned, reached 52.5% according to the 2022 Population and Housing Census. However, compared to previous decades, these data reveal a significant shift in the distribution of agricultural labor: in recent decades, the role of women in farming has increased due to the migration of many men to nearby cities in search of work in construction and industry. Although this process of feminization of the agricultural workforce was interrupted in the two years prior to our survey as a consequence of the impact of the COVID-19 pandemic, which led to the dismissal of many workers in the construction and industrial sectors, forcing them to return to their rural homes and to farm work.

Table 2 *Distribution by sex, ethnicity and age of the people surveyed.*

Sex and ethnic self-identification	Age range of respondents			Total
	0-30 years	31 to 60 Years	>60 years	
Female	12	78	14	104
Indigenous	9	52	5	66
Mestizo	3	26	9	38
Male	2	120	28	150
Indigenous	0	58	12	70
Mestizo	2	62	16	80
Total	14	198	42	254

Note: Prepared by the author based on the surveys.

The return of many men to rural areas has exacerbated the problem of gender inequality, as women are relegated once again to domestic activities and childcare, diminishing their opportunities for socioeconomic development and increasing abuse and domestic violence stemming from machismo. Machismo constitutes a structural problem in rural Ecuador and other Latin American countries, manifesting itself most extremely in physical, psychological, and sexual violence. More generally, it has limited women's participation in economic, social, and political activities, completely discriminating against them, as reflected, for example, in the book *Participation and Policies of Indigenous Women in Latin American Contexts**, published a few years ago. (FLACSO, 2009).

Regarding age distribution, one of the

characteristics of farmers is working in the fields well into old age. Studies across Latin America show that the average age of farmers is 55. In Ecuador, recent data from the National Institute of Statistics and Censuses (INEC) indicate that the largest percentage of farmers falls within the 45-64 age range (45.9%), signifying an aging population (INEC, 2022a). The results of our survey for the San Luis parish are consistent with this national trend, registering only 5.5% of farmers aged 30 or younger, while three times as many are over 30 (**Error! Reference source not found.**).

Another important variable is the level of education, the results of which are presented in **Error! Reference source not found.**. The vast majority of those surveyed (86.6%) have only a primary education, which undoubtedly impacts their poverty rates and makes them more vulnerable to errors, such as financial losses in the marketing of their products due to a lack of income and expense tracking during the production process. 8.6% of the farmers surveyed have a secondary education, and only 4.8% have a higher education. Although this is a very small group, the latter have made a positive contribution to agricultural productivity and provided technical support to neighbors and family members in the parish who cultivate the same crops, especially vegetables, legumes, and fruit.

Table 3 *Educational level of the surveyed population*

Level of education	Number of people	.
Primary	220	
Secondary	22	
Superior	12	
Total	254	

Note: Prepared by the author based on the surveys.

Area and main crops of the production units

The table shows the distribution of the surveyed farmers according to the total area cultivated by each of them. In total, the 254 farmers reported cultivating an area of 205.9 hectares, resulting in an average of 0.81 hectares per farm. 76 farmers cultivate between 1,000 and 5,000 square meters (0.1 to 0.5 hectares), 126 between 5,001 and 10,000 square meters, only 10 between 10,001 and 15,000 square meters, and finally, 42 farmers cultivate more than 15,000 square meters (1.5 hectares), with the largest area reported by a single farmer being 2.8 hectares.

The data confirms that we are dealing with small and very small producers, although with significant differences among them. The largest group consists of those cultivating between 0.5 and 1 hectare, representing approximately half of the farmers in the parish and of the cultivated area. The second largest group works an area of 0.5 hectares or less,

comprising 30% of the total, but they only account for 12% of the cultivated area. At the other end of the spectrum are those with more than 1.5 hectares, representing 16.5% of the total number of farmers,

but accounting for 35.1% of the cultivated area. The average size of this last group (1.7 hectares) is double the parish average.

Table 4 of surveyed farmers according to total cultivated area.

Cultivated area (m ²)	Number of farmers	Total cultivated area (m ²)	Average area/Farmer (m ²)	Distribution in %	
				Number of farmers	Cultivated area
1,000 to 5,000	76	244,800	3.221	29.9%	11.9%
5,001 to 10,000	126	976.732	7,752	49.6%	47.4%
10,001 to 15,000	10	114,000	11,400	3.9%	5.5%
more than 15,000	42	723,520	17.227	16.5%	35.1%
Total	254	2,059,052	8.107	100.0%	100.0%
Total cultivated area in hectares		205.9			

Note: Prepared by the author based on the surveys.

In total, considering the crops indicated by each farmer at the five priority levels, we find that the five most frequent crops, and those occupying the largest area in the parish, are those listed in **Error! Reference source not found.**: lettuce, cilantro, Roma tomatoes, alfalfa, and cabbage. Lettuce ranks first, planted by 111 of the 254 farmers, each

dedicating an average area of 2,524 square meters to it. Next are cilantro, cultivated by 82 farmers with an average area of 2,168 square meters, Roma tomatoes (75 farmers with an average of 2,043 m²), and alfalfa (75 farmers with an average of 2,452 m²). Cabbage completes the list, planted by 62 farmers with an average area of 1,961 m².

Table 5 Most frequent crops prioritized at the 5 levels by the farmers of the parish.

Crop	Number of farmers	Total cultivated area (m ²)	Average area per farmer (m ²)
Lettuce	111	280,200	2,524.3
Cilantro	82	177,800	2,168.3
Kidney Tomato	75	153,200	2,042.7
Alfalfa	75	183,900	2,452.0
Cabbage	62	121,600	1,961.3

Note: Prepared by the author based on the surveys.

On the other hand, when asked about what they had planted in the last six months, we identified a total of 26 different crops cultivated by the farmers in the parish. Figure **Error! Reference source not found.** highlights the 10 most frequent crops. Lettuce stands out, cultivated by 42.5% of respondents, followed by alfalfa, grown by 40.2%. These are followed by cilantro (31.1%), cauliflower (26.7%),

cabbage (25.6%), Roma tomatoes (20.5%), corn (16.9%), and finally, onions, broccoli, and beans, each at 12.9%. Additionally, the presence of turnips, radishes, beets, peas, chamomile, strawberries, blackberries, and other crops was identified in smaller proportions, bringing the total to the aforementioned 26 different varieties.

Table 6 Comparison of the average gross margin or income of lettuce, alfalfa, cilantro and kidney tomato production, by size ranges (\$).

Crop area (m ²)	Lettuce	Alfalfa	Cilantro	Kidney tomato
0 - 500	301.6	-76.8	-83.1	1,856.0
501 - 1,000	1,080.3	9.0	-91.0	4,678.0
1,001 - 2,000	1,762.6	110.0	-39.5	6,997.0
2001 - 4000	3,499.0	683.0	37.0	6,554.0
4,001 - 7,600	9,111.0	2,382.6	639.2	-

Note: Prepared by the author based on the surveys.

Results obtained in the comparison of the research hypotheses

The following section presents the results of the analysis carried out to test the four hypotheses put forward at the beginning, based on the information collected in the fieldwork.

Less than 40% of farmers use any type of organic product in their crops

The growing concern for environmental sustainability and human health has driven a significant increase in the use of organic inputs in agriculture worldwide. This phenomenon not only

has implications for soil quality, ecological balance, and the reduction of environmental impact, but also responds to a growing social demand for healthier and more sustainable food. Studying this trend is essential to understanding the changes in the agricultural sector, assessing its environmental effects, and contributing to the design of public policies that promote more responsible and resilient agriculture.

The hypothesis that less than 40% of farmers use any type of organic input in their crops was intended to highlight the limitations of the San Luis parish in

the aforementioned trend. Initial observation of the area confirmed that the penetration of organic inputs is low. Therefore, the hypothesis is inherently conservative: it aims to identify farmers who use some organic inputs, not those who exclusively use them.

Based on the available data, there is statistically significant evidence confirming the hypothesis: less than 40% of farmers use organic inputs in their crops. The observed proportion is notably lower (26.8%) and the difference is highly significant ($p < 0.0001$).

Table 7- Test: Less than 40% of farmers use any type of organic product in their crops.

Sample size	254	Number of farmers who use some type of organic product (x):	68
Observed proportion (p):	0,268	Proportion under null hypothesis (p_0)	0.40
Confidence level	0.05	Critical Z value ($\alpha = 0.05$, left tail):	-1,645
Z calculated	-13.01	p-value	< 0.0001
Standard deviation	± 0.037		

Note: Prepared by the author based on the surveys.

The analysis was conducted on three input groups (fertilizers, weed control, and pest and disease control), with disparate results among them. Thus, the use of organic products is a minority but relevant use for both fertilizers (34.3% of respondents indicated their use) and weed control (where the percentage increases to 38.5%). However, the use of organic products for pest and disease control is negligible (only 1.2% of farmers), in a category where the use of chemical products is very widespread (more than 91% acknowledge their use and 7% do not take any action for this control) (**Error! Reference source not found.**).

4. DISCUSSION

We complete this chapter by delving deeper into the discussion of some of the results obtained in the survey and trying to draw certain implications for public policy.

The role of women in family farming

As previously mentioned, of the 254 people who responded to the survey, 104 (40.9%) were women. However, it should be noted that in many cases, both a man and a woman were observed working on the plot of land, and in these situations, it was usually the man who responded—a very common reaction in rural areas and one that reflects the machismo that persists in Ecuador, especially in rural communities. Thus, although women frequently undertake a significant portion of agricultural tasks and sometimes also act as family representatives in community work projects, assemblies, and other community activities, their primary role in the public sphere continues to be associated with caring for

family members and performing domestic chores. In other words, although women play a key role in farming, their participation remains subject to the traditional gender division, where they tend to focus more on domestic tasks and childcare, while men have greater access to resources, land, and decision-making power.

The majority of the women surveyed self-identified as Indigenous (66 out of 104) and were between 30 and 60 years old. This group of young women has high hopes for the future and proudly expresses their identity. Most wear traditional clothing from their ethnic group (colorful blouses, shawls, skirts, and hats) and communicate with their families in Quechua. Furthermore, 18 of these women were single, a significant number that reflects the younger generation (under 25) who prioritize personal development, whether through education or economic activity, over marriage. This could be leveraged to implement inclusion and professional development programs where women learn to make decisions and become involved in productive activities.

The vast majority of the women interviewed (86) had only completed primary education. However, six women reported having higher education, which has given them access to technical knowledge about production management and modern technologies. These women often lead agricultural transformation processes, creating small businesses that serve as examples in San Luis. For instance, some of them use livestock production to make cheeses, yogurts, and other dairy products that are sold in local markets. Nevertheless, this group represents only a small minority. Overall, while education has led to progress in gender equality in rural areas in recent

decades, women continue to face structural barriers in accessing training, technical resources, inputs, and financing.

On the positive side, the women of San Luis are more inclined to form merchants' associations, which has undoubtedly benefited them by providing access to training and government support programs. These associations are generally led by younger, more educated women who approach public institutions seeking assistance for their community. The women of the parish also demonstrate greater responsibility in managing their expenses: 54% prioritize spending on food, housing, education, and health, and use their resources for replanting before anything else. Furthermore, they are more environmentally responsible. 79% understand the importance of planting trees on their land and take advantage of the environmental services they provide. Additionally, their use of agrochemicals is more controlled; however, according to our survey, this is primarily influenced by their level of education rather than gender.

Based on the results of our study, an interesting public policy could be to encourage the creation of women's groups in each rural parish. These groups would allow farmers with shared interests to come together, without requiring them to be part of formal associations, to exchange knowledge, experiences, and strategies. The formation of these networks would strengthen collaboration among farmers, promoting leadership, collective organization, and environmental awareness as pillars for development. This approach would not only improve women's working conditions but also enhance their economic autonomy and their ability to remain in rural areas. By reducing their workload through access to appropriate technology and fostering peer support networks, greater equity in the agricultural sector would be achieved.

Overall, the results we have obtained on the role of women in agricultural production in the San Luis parish generally confirm some conclusions from previous studies for rural parishes in the Riobamba canton (Ati Cutiupala *et al.*, 2023; Arguello Guadalupe *et al.*, 2022), allowing us to expand and update these conclusions. Among them, we can highlight two: the low level of compliance with gender equity in the San Luis parish; which implies the need for actions that strengthen women's participation in decision-making and the revaluation of their role in agriculture, starting by improving their capacities through specific training measures.

In this regard, it is worth mentioning that the Ministry of Agriculture and Livestock launched a

campaign in 2020 to promote the creation of family gardens. The San Luis parish was one of the beneficiaries, receiving more than 7,500 vegetable plants that were distributed to over 100 organized women in the parish. These women also had access to technical assistance and training in cultivating these crops. However, this is a modest initiative focused on improving the situation of the parish's most vulnerable families. Additionally, there is the (MAG, 2020e) *National Agricultural Strategy for Rural Women (ENAMR)* program, which has three fundamental objectives: to recognize and highlight the work of rural women; to promote their access to productive resources such as land, credit, technology, and training; and to strengthen their participation in decision-making processes at the family and community levels. This Strategy can represent a significant advance in the development of skills and capabilities of rural women, as it provides them with concrete tools to improve their autonomy, productivity and leadership in the agricultural sector.

This research focused on the socioeconomic and productive characteristics of small-scale farmers in rural areas of Ecuador, using the San Luis parish in the Riobamba canton as a case study. When analyzing the variables to be included in the study, priority was given to information related to production processes, while social and environmental aspects, such as migration, gender equality, climate change, child exploitation and violence, malnutrition, unsafe pregnancies, and environmental mitigation measures, were given less importance.

5. CONCLUSIONS

Family farming plays a crucial role in Latin America and the Caribbean (LAC), accounting for a significant portion of food production and employment in rural areas. Data indicate that family farms produce between 27% and 67% of the food consumed in the region's countries, occupying between 12% and 67% of agricultural land and generating between 57% and 77% of agricultural employment. This agricultural model is essential for the livelihoods of millions of families and for ensuring food security in rural communities.

However, family farming in the region continues to face numerous challenges, such as limited access to land, difficulties accessing technology and financing, a weak position in market integration, and shortcomings in implemented public policies. Agricultural development in Latin American and Caribbean (LAC) countries over the last few decades

has generally benefited large producers with greater resources and better market access, exacerbating social and economic inequalities in rural areas and leaving small farmers highly vulnerable. To address these challenges, it is essential to strengthen public policies that support family farming, especially small farmers, by promoting their integration into markets and production chains under more favorable conditions. This requires improving their access to new technologies, inputs, and technical assistance, as well as developing infrastructure that better connects rural areas with urban centers. These actions would contribute to increasing the productivity and income of small family farmers, thereby reducing poverty in rural communities.

In Latin America, over the last few decades, poverty has forced a significant portion of the rural population to migrate, both to urban centers within the country and internationally. This alternative helped improve the economic situation of their families through remittances, but it also carried high risks and other negative impacts in their places of origin. In particular, this was exacerbated by the implementation of neoliberal policies beginning in the 1970s, which created market opportunities but offered little benefit to small farmers. These farmers lacked the technology, knowledge, and inputs necessary to be competitive, as they were unable to mass-produce at market prices.

Within Latin America, Ecuador is a privileged country due to its agroecological conditions, which have allowed it to have agricultural operations throughout its territory that produce a wide variety of products for both domestic consumption and export. The main agricultural exports are bananas, coffee, and cacao. As in most Latin American countries, the land ownership structure inherited from the colonial period, marked by high concentration and the presence of large estates, has been a significant constraint on agricultural development. Four agrarian reforms, at different times during the 20th century, were necessary to achieve some improvements in the conditions of small farmers, granting them ownership rights to their land and access to irrigation water. Furthermore, in recent decades, some public policies have been implemented to facilitate small farmers' access to technical training, financing, technology, and quality inputs; however, their effects have been limited to date.

Within the broader context of Ecuador, our research aimed to study in detail the productive and socioeconomic characteristics of small-scale farmers in the parish of San Luis, located in the canton of

Riobamba, the capital of the province of Chimborazo. This is one of the 24 provinces into which the country is divided and forms part of the Sierra region, one of Ecuador's four major natural regions (the other three being the Coast, the Amazon, and the Galápagos Islands). The province of Chimborazo covers an area of 6,500 km² · has a population of approximately 400,000 inhabitants, and is divided into 10 cantons (municipalities). The provincial capital is the canton and city of Riobamba, which is itself organized into 5 urban and 11 rural parishes.

The rural parish of San Luis is one of the 11 parishes that make up the Riobamba canton and is an important source of agricultural supply for the city's markets. In 2022, the parish had 177,213 inhabitants (out of a total canton population of 260,882). The parish was selected due to its high agricultural productivity, its proximity to the city of Riobamba, and the lack of previous studies on the characteristics of its farmers. In 2010, the parish had approximately 12,000 inhabitants, of whom 5,500 were economically active. The primary sector is the most prominent in the employment structure, accounting for 42% of total employment. Previous data and studies indicate that this parish faces significant structural problems in agricultural production, such as the lack of formal technical training for farmers, which leads to difficulties in pest management, planting planning, and marketing. Most farming families combine subsistence farming with selling their produce in local and national markets, especially in the city of Riobamba. Many also raise livestock, although this is much less significant and largely for their own consumption.

Based on a review of the literature and available data and documents, we developed a questionnaire to further analyze the productive and socioeconomic characteristics of small-scale farmers in the San Luis parish. This questionnaire consisted of 67 questions divided into nine sections, covering topics such as the socioeconomic variables of the families, labor, predominant crops, irrigation systems, other production inputs, and marketing systems. The questions included both closed and open-ended responses and addressed both qualitative and, for the most part, quantitative variables.

The questionnaire was administered to a representative sample of local farmers. To determine the sample size, a statistical formula was used that considered the total population of the parish, resulting in 254 surveys. The distribution of the surveys was based on the potential agricultural production area of the different settlements within the parish. The data collection process was carried

out in two phases. Initially, 50 pre-surveys were administered in July 2020, which served to refine the questionnaire and assess its applicability. Subsequently, between August and December 2021, the final 254 surveys were conducted. The responses obtained were then subjected to the corresponding statistical processing and analysis. Furthermore, based on this information, we calculated or estimated income, production costs, and gross profit or margin for the four most common crops in the parish. Thus, the study provided a detailed and original characterization of the socioeconomic and productive situation of farmers in this rural parish of Ecuador.

The results indicate that 100% of those surveyed are farmers, of whom 40.9% are women and 59.1% are men. This figure reflects a significant participation of women in agricultural work, although their relative share has decreased since the COVID-19 pandemic, driven by the lack of employment for men, who returned to the fields during lockdowns. It should also be noted that a large proportion of the men were working on the plot with their partner; in these cases, the woman generally declined to answer, and the man stepped in to answer the questions.

Regarding ethnic classification, 63.5% of the women identify as Indigenous and the remaining 36.5% as mestizo. This distribution is somewhat different for the men surveyed: 46.7% identify as Indigenous and 53.3% as mestizo. This is a relevant aspect, since Indigenous people have generally lived and worked in agriculture, learning their skills from generation to generation. As for age, the vast majority of respondents (198 out of 254) are between 31 and 60 years old.

The results regarding educational attainment are consistent with the general situation in rural areas of Ecuador. The vast majority of farmers in the parish (86.6%) have only primary education, which limits their ability to access other professional activities and restricts their technical knowledge in agriculture. This also makes them more vulnerable to exploitation by traders and distributors of agricultural inputs and products. It should be noted, however, that 4.7% have higher education. This small minority represents a significant contribution to their families and neighbors, enabling greater agricultural productivity and the production of higher-quality products, which translates into better incomes. Therefore, it would be relevant to design public policies focused on providing more education and training for the parish's rural population, with the aim of increasing agricultural productivity.

Ninety-five percent of those surveyed consider agricultural activity very important to their family's economy. Therefore, although some households combine this with other activities undertaken by some members, agriculture holds fundamental importance for them. Their agricultural activity focuses primarily on crops and plant production, with livestock playing only a complementary role: three out of four respondents report raising some type of animal, either for sale or for the family's own consumption.

The information gathered on income levels confirms the poverty that generally characterizes small farmers in Ecuador. According to the National Institute of Statistics and Censuses (INEC), in June 2023, 27.0% of the Ecuadorian population was below the poverty line and 10.8% in extreme poverty, primarily affecting rural areas. In San Luis, 60% of respondents reported earning less than \$200 per month, which is less than half the unified basic salary in the country in 2021 (the year of the survey). Thirty percent reported incomes between \$200 and \$400, while only 10% earned more than the basic salary, with the majority falling within the \$400 to \$600 range. Only nine farmers (3.5% of the total) reported earning more than \$600 per month, which can be considered a good income for the rural area, as evidenced by the visible assets (vehicle, housing) they possess. In short, then, the income poverty that generally characterizes the farmers of the parish also hides notable inequalities.

Turning to variables related to agricultural activity, despite being small-scale farmers, it was evident that most of them need to hire external labor for various tasks during peak work periods, especially for planting and harvesting. Specifically, for planting, the vast majority (81%) hire between 2 and 4 people, and the remaining 19% hire between 5 and 8. These figures rise even further for harvesting: 64% hire between 2 and 4 people for this task, and 36% hire between 5 and 8. Obviously, the specific volume of labor required varies depending on the cultivated area and the crops; thus, kidney tomatoes, strawberries, and blackberries are the ones that require the most workers during harvest.

Payment methods for hired workers vary, sometimes combining cash, in-kind compensation (a share of the harvest), and food. In most cases (53%), wages are not paid exclusively in cash, so payment (full or partial) in the form of food and/or in-kind compensation remains widespread. The daily wage ranges from \$12 to \$13, and it is common practice to also provide food to the worker, an additional cost estimated at \$2 to \$3.

The vast majority of farmers (94%) are not affiliated with any producers' association; the few who are members report receiving training, supplies, and access to machinery or equipment through these associations. The farmers surveyed generally express little trust in and significant dissatisfaction with existing associations, believing they only benefit the leaders. This is a major problem because, while there are strong bonds of solidarity among the farmers in the parish, their level of organization is low. This hinders joint negotiations for both the purchase of supplies and the sale of finished products, as well as improved access to training or the undertaking of investments that are more costly to make individually.

The respondents are almost all small or very small farmers: 80% cultivate less than 1 hectare, with the average cultivated area being 0.81 ha. The vast majority (83%) grow two to four crops simultaneously, generally prioritizing one crop and supplementing it with two others. The number of crops does not differ significantly based on the size of the farm. In total, we identified 26 different crops in the parish, although the number of farmers cultivating them and the area sown vary considerably. The five most common crops are, in this order: lettuce, alfalfa, cilantro, Roma tomatoes, and cabbage. The average area sown by each farmer ranges between 0.20 and 0.25 hectares (2,524 m² for lettuce, 2,452 m² for alfalfa, 2,162 m² for cilantro, 2,043 m² for Roma tomatoes, and 1,961 m² for cabbage). Regarding land tenure, 68.5% of the farmers surveyed stated that they own the land they cultivate, 20.5% lease it, and 11.0% have a combination of both types of land tenure.

The predominant agricultural production model in the San Luis parish is conventional, employing chemical products for soil fertilization and pest and disease control; this is the model reported by 86.2% of respondents. However, 7.9% claim to produce organically and 5.9% using an agroecological system; relatively high percentages in the national context. This situation is conditioned by two factors: the market for organic agricultural production in Ecuador is still very small; furthermore, the transition to these types of production systems requires knowledge and technical support that small farmers generally lack. In this regard, it would be important to provide greater support for organic and agroecological agricultural production through public policies, considering not only the national market but also the existence of export markets to higher-income countries; this could substantially increase the income of small producers. To achieve

this, it is essential to consolidate marketing and distribution channels for these products.

As a nuance to the previous overview (the general use of agrochemicals by farmers in the San Luis parish), it's worth mentioning an agroecological practice carried out by 78% of those surveyed: incorporating crop residues to enrich the soil. Others use these residues as animal feed or to produce organic fertilizers. These practices can serve as a foundation for the dissemination of agroecology, a more conscious production model that helps prevent problems such as soil erosion and contamination, thus avoiding harm to microfauna and the consequent decrease in biodiversity. Furthermore, this model promotes water conservation through more sustainable irrigation systems that minimize waste of this resource. As a result, farmers could obtain higher-quality crops, allowing them to access higher prices in the market, even through direct sales to consumers.

One of the strengths of the San Luis parish for agricultural production stems from its access to water. All of the farmers surveyed reported having irrigation water for their crops; the vast majority (97.2%) obtained it through the Chambo-Guano-Chingazos irrigation canal, with the remainder using water from drilled wells or the Chibunga River. Both the canal water and the well water are of acceptable quality; the only problem in this regard is for the three farmers who draw their water from the Chibunga River, whose water is significantly polluted.

Almost all respondents (96%) prepare the soil using machinery (tractors), which they generally hire other residents of the parish to operate, a practice that also sometimes extends to transporting the harvest. In contrast, clearing, weeding, planting, and harvesting are carried out with traditional tools such as hoes, picks, rakes, and forks. In this respect, public policies and cooperative organizations could help reduce costs by facilitating access to shared machinery. Furthermore, all farmers in San Luis work with certified (68%), selected (21%), improved (7%), or a combination of these types of seed. Only a small group occasionally reuses their seed production for certain crops (cilantro, alfalfa, corn, peas, potatoes, beans), especially when market prices for these products are very low.

Soil fertilization is carried out using chemical products (59%), organic products (34%), or a combination of both (7%). A large proportion of those surveyed stated they were unaware of the toxicity level of the fertilizers they use, and therefore their effects on the population, the soil, and the crops are

largely ignored. The potential risks from chemical inputs are even greater with herbicides and pesticides, given their widespread use for weed control and the management of plant pests and diseases. To address these problems, which are significant for their crops, farmers in the parish use chemical products because they are cheaper than alternative methods (organic or biological). However, in making this decision, they are not analyzing the consequences for their own health or that of consumers. In this regard, it would be important to improve the training and education of producers on the effects of the inputs used, in terms of productivity, but also in terms of both workplace and food safety.

Related in part to the above, only a minority of those surveyed reported receiving or having received any type of technical support (in any area). For 18%, this support has consisted of advisory services, while between 8% and 9% receive assistance with supplies, marketing, or machinery. Therefore, there is significant room for improvement in public policies, in collaboration with associative entities, to advance training and technical support for farmers in the parish.

From a financial perspective, the majority (68%) of respondents use only their own capital to develop their activity. However, 94% would like to increase the size of their farm, indicating a significant disconnect between the capital needs of these farmers and the financial institutions operating in the region. Several factors may contribute to this problem: farmers' reluctance to take on debt; and the limited willingness of banks to grant loans to these types of producers. In any case, it seems clear that the financial system in the region is limited, which calls for the development of public policies that facilitate access to credit, with guarantee systems and favorable interest rates, to support the growth of these agricultural production units.

Regarding marketing channels, almost all of the farmers surveyed in the San Luis parish (95%) stated that they sell their products at the wholesale market in the city of Riobamba, but 66% of them are dissatisfied with the conditions. The reasons for this dissatisfaction are low prices, pressure from intermediaries, and the influx of products from other markets, which drives prices down. Consequently, a

large majority (82%) expressed interest in accessing new markets. In our view, however, this is very difficult or impossible for each farmer individually, given the small volume and irregularity of their production. The decisive factor for improving their integration into the Riobamba wholesale market and accessing other markets (such as supplying supermarkets in the city of Riobamba or selling directly to retail markets) lies in the organization of farmers within the parish (or with those from other nearby parishes) for the joint marketing of their produce. This is something that can be supported through public policies, but it requires, first and foremost, a change in the mindset of the farmers themselves.

In the research we finally offer a detailed calculation or estimate of the income, production costs and resulting gross margin for the four main crops of the parish (lettuce, alfalfa, cilantro and kidney tomato), based on the information provided by the farmers in the survey; considering for each crop different ranges of size (cultivated area).

Our calculations indicate that, regardless of the planted area, the crop that offers the best economic returns (in terms of income per farmer) is the Roma tomato, followed at a considerable distance by lettuce. The difference in income generated by these two crops is especially significant for plots smaller than 2,000 m² with this gap narrowing (though still substantial) above that size threshold. Alfalfa, on the other hand, generates a much lower income than the two previous crops, only reaching significant volumes on large plots for the parish context; however, these economic results should be interpreted considering that it is a crop primarily used to feed family livestock (thus avoiding the purchase of animal feed at the market). Finally, for cilantro, the figures indicate a negative return (estimated costs exceed income) in almost all plot sizes. However, these results are heavily influenced by the sales prices reported in the survey, which are much lower than the market prices indicated by statistical sources for the current year, 2024-2025. In this respect, it is important to bear in mind (in general) that our calculations are based on the information provided by farmers in the survey; therefore, they should be interpreted with some caution.

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