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ANALYSIS OF PRODUCTIVE, SOCIAL AND ECONOMIC DIVERSITY IN THE COTTON SECTOR OF PARAGUAY, PERU AND BOLIVIA

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ABSTRACT

This article examines the dynamics of family farming in the context of cotton production in Latin America in Paraguay, Bolivia and Peru. It proposes a typology methodology to understand its diversity. The article results from the +Cotton project, an initiative of FAO, the Government of Brazil and seven Latin American countries to strengthen the cotton sector through trilateral South-South cooperation. The typology is based on the analysis of three baseline studies carried out in Bolivia, Peru and Paraguay between 2012 and 2016, using a proposal for the typification of family cotton farming based on its gross production value. The results confirm the diversity present in the family farming segment. In Paraguay, 50.16% of farmers are specialized, 3.16% are diversified and 11.15% are rural households; in Peru, 17.40% are specialized, 28.33% diversified and 54.27% are rural households; in the case of Bolivia, the categorization changed from family farmer to business farmer, resulting in 26.92% specialized, 19.23% diversified and 53.85% rural households. For the development of inclusive and effective policies, the study allows identifying and promoting elements that define the diversity of family farming. The typology is positioned as an effective tool to identify, analyze and understand diversity in the context of family farming, facilitating the promotion of sustainable and resilient practices in the region.

Keywords: cotton, family farming, public policies, rural development, typology

INTRODUCTION

Family farming is the majority group in rural areas of Latin America. According to Leporati *et al.* (2018), family farming represents around 77% of agricultural establishments, between 27 and 67% of total food production, it occupies between 12 and 67% of the agricultural surface and generates between 57 and 77% of agricultural employment in the region (FAO and IDB, 2007; FAO, 2012). Family farming plays an indisputable role in food security, overcoming poverty and eradicating hunger, in the economic development for the construction of a sustainable agrifood future, achieving a more balanced planet and the 2030 SDGs (FAO and IFAD, 2019). Studies such as those by Wiggins (2009), Pretty *et al.* (2011), Larson *et al.* (2013), and Schutter (2014) highlight that small-scale agriculture is strategic in the search for production capable of maintaining and

increasing productivity without compromising sustainability. FAO estimates that, of the total of 570 million production units worldwide, no less than 500 million are family farms (Lowder *et al*., 2014; Gladek *et al*., 2017).

In Latin America, cotton growing stands out, characterized by a productive structure with different types of producers and technological levels. The cotton value chain involves around 350 million people and is one of the 20 most important commodities on the market (ICAC, 2016).

According to FAO, in 2019, there were 131,500 cotton producers in the region, of which around 77% are family farmers[1]. For these families, cotton is a crop that, along with food crops, ensures food security and strengthens their resilience. The importance of cotton in Latin America also lies in the local textile industry linked to crafts, mainly in Colombia, Peru, Ecuador, Bolivia and Paraguay, where this activity represents the main family and community livelihood in cotton-growing areas (FAO, 2019).

Trilateral South-South Cooperation Brazil – FAO

This article and the methodology to classify family cotton farming emerges within the framework of the Trilateral South-South Cooperation initiative between Brazil, FAO and seven countries in Latin America and the Caribbean, +Cotton, which aims to strengthen the technical, managerial and organizational capacities of institutions in the cotton sector in the region.

Its South-South approach, based on the exchange of knowledge and experiences, has made it possible to strengthen the capacities of partner countries in areas such as food security, family farming and natural resource management, addressing rural development in a comprehensive manner, considering economic, social and environmental aspects (FAO and ABC/MRE, 2022). In this sense, the Brazil-FAO Cooperation stands as a tool for the exchange and generation of knowledge and for support in the establishment of public policies aimed at family farmers who produce cotton.

This article presents the main results of an analysis of the diversity of family cotton producers in three countries in the region: Peru, Paraguay and Bolivia, within the framework of the +Cotton project, in addition to reflecting on the relevance of typologies as a tool for the development of inclusive and effective public policies for the sustainable transformation of the rural sector.

THEORETICAL FRAMEWORK

The diversity of family farming: theoretical and conceptual elements

Family farming is a recent political category in Latin America, but it has gained projection, especially since the International Year of Family Farming (Salcedo *et al*., 2014; Schneider, 2016) and the United Nations Decade of Family Farming (2019-2028). FAO (2012) defines family farming as a form of agriculture and

livestock activities managed and operated by a family and dependent on family labor.

This social category has its origins in the peasantry and indigenous communities from 1940 to 1960 (Warman, 1988; Bengoa, 2003). During this period, the discussion focused on the integration of specific social groups, such as indigenous people and peasants, into modern societies. From 1960 to 1970, discussions returned to economic and productive aspects, emphasizing technologies and agricultural modernization (Schultz, 1964; CEPAL, 1989). On the other hand, the role of the peasantry in the most radical processes of agrarian transformation via agrarian reform was discussed, as occurred in Chile, Bolivia and Peru (CIDA, 1966; Gómez, 1992; Kay, 2000).

But, what can we understand by family farming? Do we refer to the same concept and variables to define a diversity of realities? The concept of "family farming" has a multitude of variables and aspects that deserve to be studied and framed. The conventional assumption that agricultural development is mainly driven by large-scale agriculture has been questioned for years, based on various research and studies that demonstrate the opposite (van der Ploeg, 2017).

It is necessary to distinguish the concept of family farming from other concepts used. The use of one terminology or another has theoretical, political and social identity implications. The use of the term "family farmer" instead of small-scale farmer has the advantage of broadening the scope and coverage of the definition, since it exceeds the criterion of land area and adds the variable of work (Schneider, 2016). Thus, a family farmer can be defined as an agricultural producer who lives in a rural environment and predominantly uses family labor for his activities, thus constituting an enterprise in which the business management is carried out based on the family economy. The common elements in the definition of family farming focus on production, farm size, workforce and management of the enterprise. The combination of these elements according to regions, countries and social groups generates an enormous diversity of forms of family farming.

Family cotton farming in Latin America

So, what characterizes the region's cotton farmers? Are these characteristics similar between farmers from different regions? What motivations do farmers have to continue in this sector? Do cotton production systems in family farming include sustainable practices?

A family farmer is characterized by being an economic enterprise that operates under a regime of family economy (Schneider, 2016). These enterprises: (a) make predominant use of family labor in the production process, (b) the management of the enterprise and the activity is family-owned, (c) the results

of production and other forms of resource input belong to the domestic group, (d) investment or savings decisions are made by the family, and e) in general, access to the means of production happens through inheritance.

When it comes to characterizing the cotton sector in Latin America, initially, similarities and differences are observed between countries and groups. In Brazil and Argentina, cotton predominantly represents a production chain with medium and large producers, focused on export. In Colombia, Peru, Paraguay, Ecuador and Bolivia, the cotton production chain is mainly made up of small-scale producers, many of them tenants, for whom the destination of production, in recent decades, has been the domestic market (FAO, 2015).

Therefore, working in the cotton family farming segment requires understanding the diversity among producers, and it is through the construction of criteria and indicators that it is possible to establish distinctions to guide public policies and programs that work with this sector. In this sense, the objective of this study is to define the heterogeneity of cotton family farming in the countries of Bolivia, Peru and Paraguay, using their gross production value as a determining factor in their level of specialization and dependence on cotton, in order to direct and develop public policies in accordance with each group of farmers.

METHODOLOGY

This typology, for family cotton farming, seeks to combine the origin and type of labor of the production unit with the value obtained by the productive activity, measured through the gross value of total production. Based on this percentage information, a cut-off criterion is used to form the classes and types of farmers.

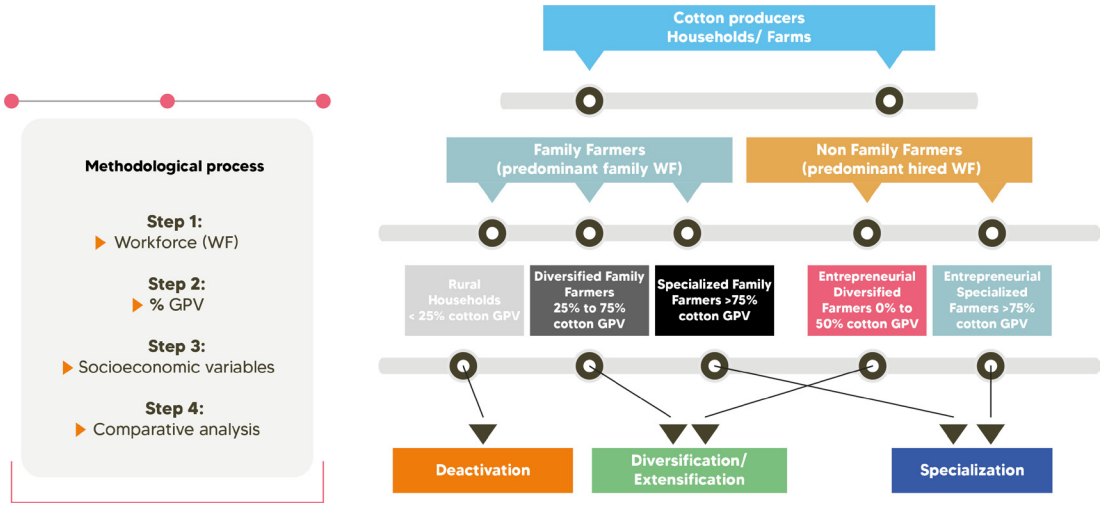
The hypothesis is that family farmers that produce cotton may be immersed in three differentiation processes, which are generating: (1) the disabling of production in a certain stratum of producers, (2) the diversification/extension of production in another stratum, and (3) the specialization/concentration in a smaller group.

The deactivation process means that this crop is being reduced or replaced by another, representing a very small proportion (less than 20%) of the production value (Schneider, 2016).

Regarding the specialization process, the opposite can occur in relation to the deactivation process. In this case, cotton comes to represent an increasing proportion of the total production value.

The process of diversification or extension represents a more complex trajectory, because it is undefined, as it can lead producers towards deactivation or specialization, as well as keeping them in their current stage.

The methodology consists of 4 phases (Figure 1): (i) separating the agricultural



Source: Schneider, 2016.
Figure 1. Methodological proposal for the categorization of family cotton farming.

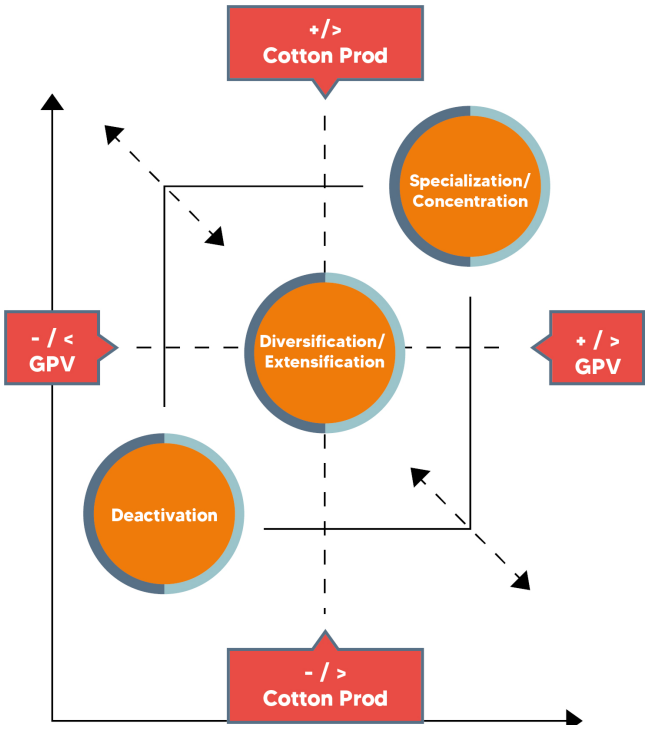
establishments by the type of work used on the farm (family – family farmer or hired – non-family farmer), (ii) classifying the family and non-family establishments into five types, using the percentage (%) which cotton represents in the gross value of production as criterion, (iii) selecting the economic and social indicators to develop a socioeconomic profile of each type, (iv) comparing the different types by variable or within the same type, but between different regions (Schneider, 2016).

There are diverse development trajectories, which can coexist in the same region or country (Figures 2 and 3) and, therefore, can change according to territorial contexts, or related to the application of public policies.

The information allows cotton producers to be classified into three types (Schneider, 2016):

1. Rural households in deactivation phase (percentage of cotton equal to or less than 25% of the total).
2. Diversified Family Farmers (percentage of cotton grown between 25 and 75% of the total).
3. Specialized Family Farmers (percentage of cotton equal to or greater than 75% of the total).

It is not enough to classify agricultural establishments according to the area or economic activity, such as the production value or income, but rather the



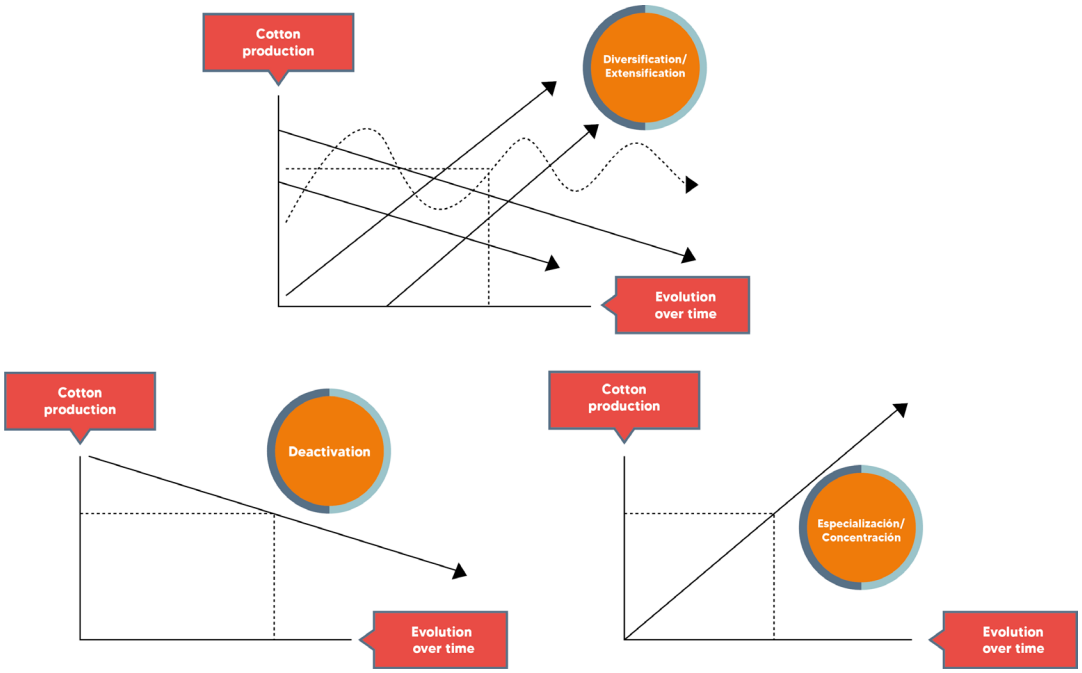
Source: Schneider, 2016.
Figure 2. Production transformation trajectories of family cotton farmers.

social context, economic environment and characteristics of the biophysical resources must be considered, since they are not isolated in relation to the markets and the more general dynamics of the economy and society where they are located (Berdegué and Fuentealba, 2011).

General considerations in the application of the methodology.

The methodology was applied between 2017 and 2019 and incorporated the information available in the "Baseline and sector characterization studies" carried out in Peru, Paraguay and Bolivia by the +Cotton project. These were elaborated based on primary information collected from socioeconomic surveys applied to a statistically representative number of family cotton producers, and a complementary review of national secondary sectoral information, obtained from official sources.

The information was collected using official figures from the Ministry of Agriculture of each country. The number of registered producers was obtained from the latest agricultural censuses and, based on this information, a simple stratified sampling (CI: 95%) was carried out for the representative cotton production departments. In the case of Peru, a total of 293 producers



Source: Schneider, 2016.
Figure 3. Socioeconomic differentiation trajectories of family cotton farmers.

was obtained, for Bolivia 26 producers, and for Paraguay 305 producers. Subsequently, primary data were generated through a survey directed to the producers identified through statistical sampling. The surveys carried out in the countries had the same structure and incorporated data into their methodology to build sustainability indicators (SEEP) of cotton production systems, based on the global methodology promoted by GIZ, ICAC and FAO (2006).

The methodology used to classify family cotton farming consists of several steps: (1) disaggregating the producers using the variable "permanent labor" (PL) in relation to family labor, considered family labor when the PL is less than 50%, or else business labor when the PL is more than 50%, (2) applying the independent variable "Gross Production Value" (GPV), which allowed a categorization of 3 types among family farmers: Rural Households (RH) with cotton GPV equal to or less than 25%, Diversified Family Farmers (DFF) with cotton GPV between 25 and 75%, and Specialized Family Farmers (SFF) with cotton GPV greater than 75%, (3) selecting social, market and technical indicators that allow for the development of a more detailed socioeconomic profile (Table 1), and (4) comparing groups or between regions or other crossings of variables relevant to the analysis (Schneider, 2016).

The methodology allows the construction of thematic indicators, grouping a set of dependent variables obtained through statistical treatments of frequency

Table 1. Categorization of socioeconomic, social, market and technical variables selected for the categorization.

Institutional indicators	Technical assistance
	Credit assistance
Social indicators	Value of financial aid
	Woman with leadership role
	Receives economic help
	Some members participate in an organization
	Some members participate in seminar
Market indicators	Price information
	Forecast of changes in cotton activity
Technical indicators	Pest management
	Soil analysis / Direct sowing
	Irrigation
	Crop rotation
	Loss of soil fertility
	Degraded / compacted soils
	Technology: organic, traditional or transgenic
	Training in the use of inputs
	Performs subsoiling / Level curve

Source: prepared by authors.

and arithmetic measures. The independent variable that allowed classifying family farmers that produce cotton into three types was the proportion of income from cotton, in relation to the total Gross Production Value of the units.

RESULTS

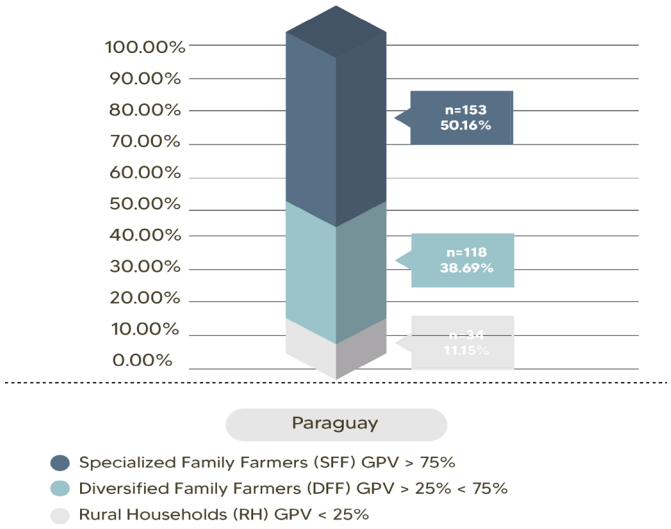
Categorization of family cotton farming in Paraguay

The baseline study in Paraguay was conducted in 2015 (Instituto Desarrollo, 2015) and included field data collection based on a semi-structured survey of 305 cotton-growing families from six departments in the country. Of the total number of survey respondents, 117 were from Caaguazú, 91 from Caazapá, 15 from Concepción, 2 from Ñeembucú, 70 from Paraguarí and 10 from San Pedro.

The producers are characterized by being family farmers, including farms no larger than 10 ha. The Western Region has been expanding cotton production with differentiated technologies and production systems (surfaces from 10 ha to 1,000 ha), mechanized sowing and harvesting, without the use of family labor, which is why it was not included in the definition of the sample.

Analysis by groups in Paraguay

Of the cotton farms, 11.15% are classified as Rural Households (RH), 38.69% as Diversified Family Farmers (DFF) and 50.16% as Specialized Family Farmers (SFF) (Figure 4). Therefore, the majority group belongs to the "specialized" type.



Source: prepared by the authors.
Figure 4. Categorization of family farmers, based on the percentage of cotton GPV in Paraguay.

Based on this categorization, the analysis of dependent variables is applied for the descriptive analysis of statistical data. The variable profitability of cotton production shows that for 44% of producers the relationship is negative. This information must be analyzed, since families continue to grow cotton despite the negative profitability.

The RH group stands out with the lowest productivity, occupying 53% of the farm for cotton cultivation, higher than the SFF or DFF. On the other hand, DFF is the group that receives the best cotton sales price, has higher productivity rates (1,237 kg/ha) and presents medium size (5.50 ha).

In relation to land ownership, there are no major differences between groups. The results from the analysis of social, technical and market variables show that SFF is the group with the greatest access to credit (64%), participation in organizations (63%), and the least access to technical assistance (12%); however, it is the most susceptible group to changing economic activity (45%), compared to 20% in the RH group or 10% in the DFF group. Similarities are seen between groups in terms of the lack of use of irrigation systems and the type of seed used, with the majority using seeds with biotechnology.

Differences between groups stand out in other variables, such as the greater loss of soil fertility by RH (83%), or SFF practicing lower pest management (22%), soil analysis (5%), crop rotation (78%) or subsoiling practices (50%), despite having more degraded soils (64%).

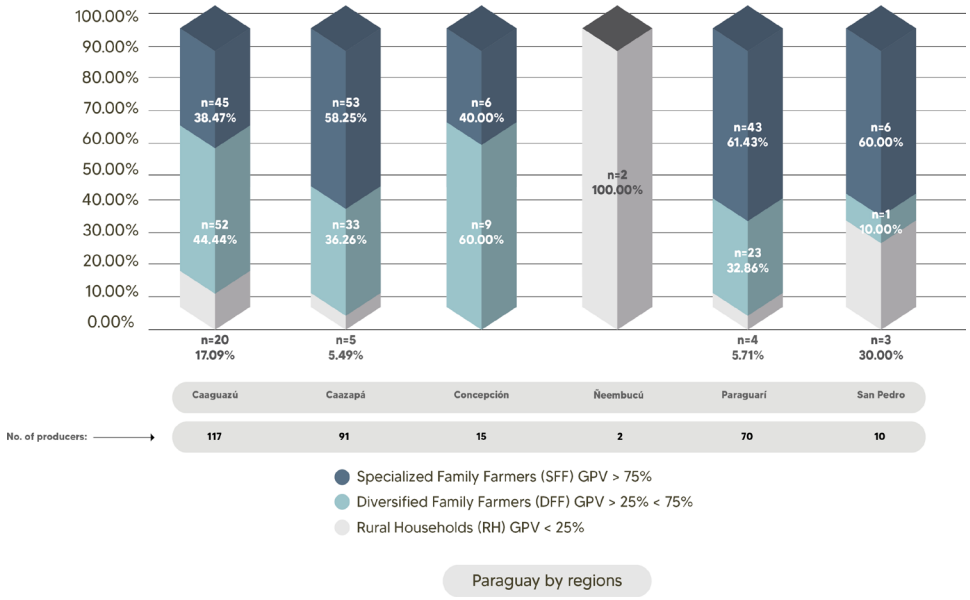
In relation to risk perception, the consequences of climate change and droughts are the greatest perceived risks for every group. In general, SFF show the highest risk index (4%), compared to RH or DFF (less than 3%).

Characteristics of family farmers in Paraguay by regions

Below are the results of applying the methodology in each of the 6 departments analyzed in Paraguay (Figure 5).

The results of the analysis based on the variable GPV show some differences between regions, which confirm trends already described: the cotton deactivation process is majority in the Ñeembucú region (the sample was made up of only two producers, so it may be due to a sampling error); in Paraguarí, San Pedro and Caazapá, SFF are the majority (60%). Paraguarí presents the best profitability indices in the three groups, better productivity and prices obtained by DFF, and the lowest indices of SFF in change of activity. RH in this region shows greater vulnerability, greater perception of risks and high soil compaction.

The deactivation process that tends to occur among SFF stands out, since it is the group with the lowest use of sustainable practices, the lowest rate of access to technical assistance, in addition to being the most vulnerable group, mainly in Caaguazú and Caazapá. DFF presents higher productivity rates in all regions and proves to be the most "sustainable" group, in terms of the contribution of cotton activity as family livelihood.



Source: prepared by the authors.

Figure 5. Distribution of categories of family cotton farmers by percentage of cotton GPV by region in Paraguay.

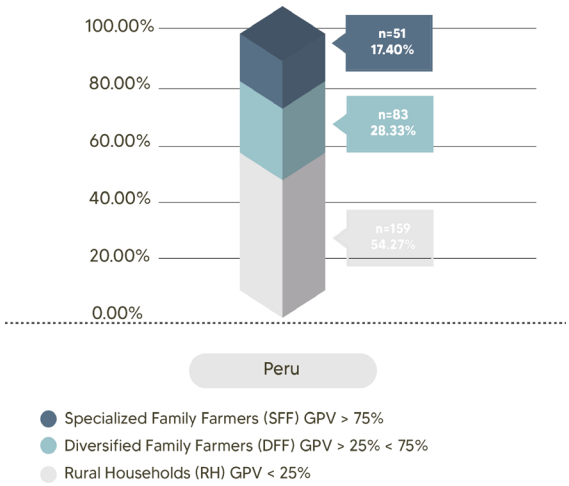
Out of the family farmers, 44% show negative profitability rates. There are 25% of farmers who use a conventional system with negative profitability, and the percentage is 46% among those who use a transgenic system.

Categorization of family cotton farming in Peru

Data from the 2012 Agricultural Census (INEI, 2013) identify 8,425 cotton production units throughout the country, with an average size of less than 4 ha. Three profiles of cotton producers in Peru can be defined: (i) small family farmers in coastal valleys, representing more than 90% of the country's production units, (ii) medium and large farms, with areas greater than 10 ha, and (iii) small-scale cotton producers for artisanal purposes.

Analysis by groups in Peru

The application of the methodology in Peru was carried out based on the information collected in Peru by Apoyo Consultoría (2016), "Baseline survey and analysis of cotton production systems and value chain". The study consists of a sample of 293 family cotton farmers, distributed as follows: 97 in Piura, 98 in Lambayeque and 98 in Ica. The first categorization based on the analysis of the GPV (Figure 6) shows that Rural Households (RH) represent 54.27%, Diversified Family Farmers (DFF) represent 28.33% and Specialized Family Farmers (SFF) represent only 17.40% of the family establishments. This structure differs from that analyzed in Paraguay, where SFF was majority, whereas in Peru, more than 50% belong to the RH group.



Source: prepared by the authors.
Figure 6. Categorization of family farmers, according to the percentage of cotton GPV in Peru.

Regarding the profitability variable, the first analysis shows that there is a high number of producers who present negative profitability, the largest group being the SFF with 27.45%. The RH produces a small amount of cotton, taking into account the high percentage that income from agricultural activities represents for this group (67.30%) and maintaining the percentage of income from non-agricultural activities, as in the DFF (32%). Considering the perception of risks, SFF have a lower perception of risks (2.95 on average), compared to DFF (3.02) and HR (3.09).

The analyses show significant differences in the destination of cotton sales between the three groups, with the main destination for the SFF being cotton gins (54%), although for the other groups it is the industry and intermediaries. The technical variables show few differences between groups, highlighting that RH is the one that uses the most irrigation; most irrigation in Peru is done by gravity. Lastly, the DFF is the one that receives the most aid from the government, including training. In relation to access to credit, there are no significant differences between the three groups and, in terms of association, DFF and RH show the highest percentages (50%) compared to SFF (20%).

Characteristics of family farmers in Peru by regions

The disaggregation by farmer group in each of the three regions (Figure 7) allows to visualize the structure by region, which is key to understanding reality and which, with the general analysis, would not be perceived.

Source: prepared by the authors.

Figure 7. Distribution of categories of family cotton farmers by percentage of cotton GPV by region in Peru.

The results by region show that Piura is the region where there is a more pronounced deactivation process, with 40% of RH and 40% of DFF. This region has the lowest productivity rates. In Lambayeque, the three groups of farmers are equally represented and in Ica, SFF has a higher percentage (64%). In Lambayeque, 31.48% of RH and in Piura, 35.48% of DFF have negative profitability (<0%).

RH represents the group with the highest non-agricultural income indices. These producers are the largest in the Piura region and they show lower average productivity indices, although the average cotton sale price is higher than in the other regions. Piura shows lower average productivity indices compared to the other two regions. Producers from Piura tend to organize themselves more in associations (67%), compared to Ica (41.46%) or Lambayeque (38.89%). On the contrary, the SFF is the majority group in the Ica region, and the data seem to indicate that they are the most vulnerable group for the three regions, as in the case of Paraguay, since, despite presenting a high agricultural income in Ica, this region is where there is a higher percentage of producers with negative profitability. This could indicate the fragility of the SFF production system. Regarding the DFF, it is the group with the highest profitability, above 100%, and with smaller differences between regions, showing similarities with RH in the three regions. Finally, the DFF has the highest risk perception indices and the highest frequency in terms of receiving government aid. In the three regions, the DFF group has the largest farm sizes.

Categorization of family cotton farming in Bolivia

The National Registry of Cotton Producers (*Registro Nacional de Productores de Algodón*, RENPA), prepared with data from the 2015 Agricultural Survey (INE, 2015), presented only 106 producers in the department of Santa Cruz, considering medium and small-scale producers and enterprises. The origin of the data for the analysis comes from the Study "Baseline survey and analysis of cotton production systems and production complex" (CEP, 2016), where (i) the universe of producers used to calculate the sample is very low compared to the other two countries (ii) the average farm size is quite large (>50 ha), based on the established criteria of small-scale or family farming, and (iii) the labor force (LF) variable used in Paraguay and Peru as a categorization criterion is not met. Therefore, in the case of Bolivia, it was decided to adopt an area criterion and compare it with the profile of farmers in Peru and Paraguay, reaching the conclusion, in principle, that all farmers surveyed in Bolivia belong to the group of "corporate farmers" (CF).

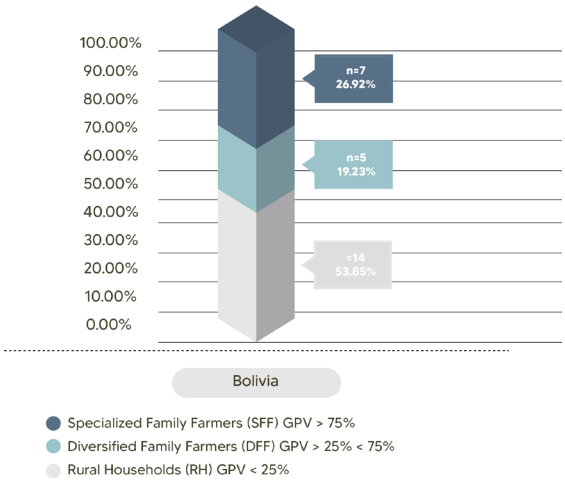
Analysis by groups in Bolivia

The sample considered consists of 26 entrepreneurial farmers who produce cotton in the Department of Santa Cruz, in the municipalities of Andrés Ibáñez, Chiquitos and Cordillera. The first categorization (Figure 8), based on the analysis of the variable GPV, shows that rural households (RH) represent 53.85%; diversified entrepreneurial farmers (DEF) represent 19.23%; and specialized entrepreneurial farmers (SEF) represent 26.92% of the establishments that produce cotton in Bolivia.

Most of the farmers surveyed belonged to the RH group, but with an average area of 475 ha. In the defined categories, there are no rural households composed of entrepreneurial farmers, but data seem to show a category of rural cotton entrepreneurs in the process of deactivation. It is the SEF that shows the largest area occupied with cotton (72%) compared to the RH (26%), and higher sales prices for the DEF and lower among the RH.

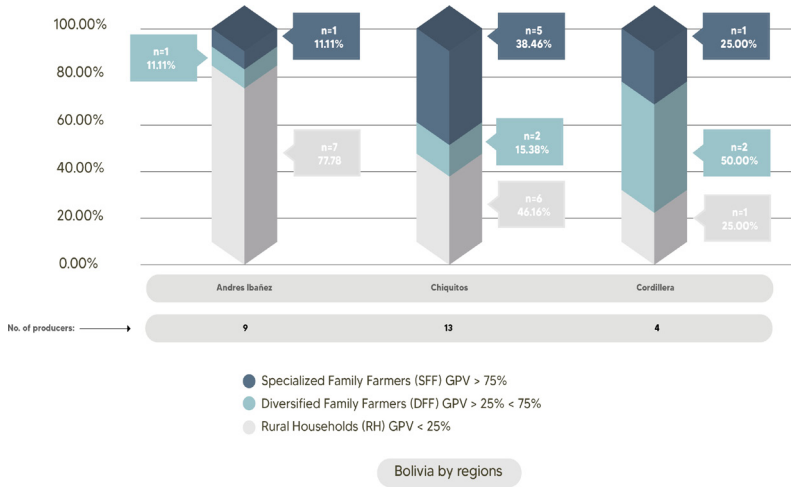
Characteristics of farmers in Bolivia by regions

In terms of technical assistance, it is considered low among the SEF. There is a high index of negative profitability of RH, compared to the other groups. The data by region allow for further analysis (Figure 9). The Andrés Ibáñez province has the highest number of RH (77%), where cases of negative profitability are concentrated among the RH (50%) and low access to credit assistance among the SEF.



Source: prepared by the authors.

Figure 8. Categorization of family farmers, according to the percentage of cotton GPV in Bolivia.



Source: prepared by the authors.
Figure 9. Distribution of categories of family cotton farmers by percentage of cotton GPV by region in Bolivia.

DISCUSSION

To conduct a more solid categorization and description of family farming, a representative survey is necessary, which contains information on access to land, time spent by household members and by people hired to work on the farm, and household income and its composition (Berdegué and Rojas, 2014). If the typology has more than one category, it would be possible to combine them and make a more enriched analysis of the cases or to elaborate on the relationships between them. Disaggregations function as levels of detail of data, that is, it is possible to build increasingly specific indicators, to observe reality in a more complex way, formulating new research hypotheses, which help in subsequent induction processes. In this sense, typologies can contribute to the process of explaining reality, and not just to its mere description. According to Nogueira and Zylbersztajn (2017), to reflect this reality, it is necessary to consider various common factors; in their case, they used as categorization criteria the scale of production, type of land, labor, management, and ownership. For their part, Fasiaben *et al.* (2013) used criteria of area, work, productivity, gross production value, and percentage of sugarcane sold. Both models proved to be suitable to define typologies adjusted to the reality where they were applied.

In this study, it was possible to reflect new hypotheses such as: transgenic technology in the face of a reality with low technical indices and practically no irrigation. This has had a detrimental impact, mainly on the SFF of Paraguay, whose negative profitability indices and risk indicators, on average, are higher

among the three groups investigated, especially in the regions of Caaguazú and Caazapá; and as the technological level in cotton production in Ica is the most developed in Peru, with possibilities of achieving better prices, which is possible through the organization of cooperatives and/or associations, since in Piura, farmers seem to be more organized around these social structures. On the other hand, this categorization allows to distinguish between those farms that have become specialized looking to improve economic performance but also assuming a greater risk, and those that have chosen to diversify production, accompanied by specific production methods, to improve yields (Bosc *et al.* 2015).

The construction of typologies is a tool to help direct specific actions towards certain groups or strata. When it is perceived that the negative profitability rates are the highest in Caaguazú and Caazapá, and that these two regions have the lowest rates of technical assistance, this points to the importance of thinking about public policies that offer this type of support, to identify the problem and assist family farmers. In this case, with special emphasis on the SFF, which have the lowest rates of technical assistance in Paraguay and are presented as the most vulnerable group. In the case of Peru, when it is perceived that 31.48% of the rural households in Lambayeque and 35.48% of the diversified ones in Piura present a negative profitability, actions can be proposed to identify the causes and to develop public policies of credit and/or technical assistance. Another example could be the one identified in Piura, where productivity rates are very low compared to the other two regions, where it is possible to think of a political agenda that acts in the presence of this reality. As for Bolivia, it was found that 50% of RH in Andrés Ibáñez and 33.33% of RH in Chiquitos present a negative profitability. Faced with this hypothesis, if confirmed by other studies, it would be important to think of public policies that improve productivity rates for the RH group in the Andrés Ibáñez and Chiquitos regions.

Another public policy that comes up as a demand is the financing of irrigation equipment and technologies, which seems to be one of the main factors contributing to the low productivity indices of the activity. According to IFAD (2014), strengthening specialized family agriculture involves policies on access to resources such as land and, above all, water. In many cases, the small size of the property and limited access to water impose strong restrictions on the expansion of production and, therefore, on agricultural yields. On the other hand, it proposes the improvement of activities that generate more added value or expand the stages in the production processes and the reduction of the use of external inputs such as seeds and fertilizers. These can be gradually replaced with organic manure or less intensive techniques for the management of plants and animals, such as agroecology and direct sowing without removing plant

material from the soil. These concepts are essential for the development of a more sustainable, equitable and resilient food system (Apablaza *et al.* 2023).

Social and economic diversity as central elements for the design of inclusive public policies at the productive, commercial and gender levels

The conception of a development model based on the recognition of the differentiation in social and economic diversity is relatively recent, as Schneider (2010) highlights. At the end of the 20th century, the need to look at and analyze reality from more comprehensive approaches, considering the complexity of the environment, became stronger. Amartya Sen's (1989) development capability approach emphasizes that development can be achieved insofar as the decision-making capacity of individuals is broader. Ellis's (2008) capacity development theory proposes the approach of diversification of livelihoods and highlights the need to relate and promote dialogue between these concepts. That is, people are more capable of creating strategies for survival in a specific situation of vulnerability, insofar as their capacity to create a diversified range of activities and forms of economic, productive, social and environmental organization to improve their living conditions is greater. Capacity building can occur through diversification, as a way to promote freedom of choice, given a range of options and uncertainties (Scoones, 2015).

The conception of livelihoods in the rural environment is based on a wide range of strategies, among which agricultural activity is one among many (Perondi and Schneider, 2012).

During the period of agricultural modernization, promoting development was a synonym for increasing productive output. Today, this trend is not enough, as it has been shown that improving production variables is not enough on the path to sustainable development. Some studies point to self-sufficiency, market exchange and community relations as strategies regarding the destination of the product, combined with a set of circumstances and opportunities, internal and external to the agricultural household. The combination of these three paths influences and is influenced by the degree of autonomy and resilience of each farm. Resilience improves when a farmer can depend on a certain level of self-sufficiency, a cohesive local community and a diversified set of market relations (Palmioli *et al*., 2020).

Recent studies by international institutions such as the World Bank (2006) and the IAASTD (International Assessment of Agricultural Knowledge , Science and Technology for Development), show that the future of agriculture in particular and of the rural world will be determined by the way in which humans will be able to manage resources and the diversity of species, soils and ecosystems. Various authors highlight the importance of taking this diversity into account, particularly in agriculture, for the development of effective and inclusive

public policies, recognizing that there are many paths to transformation towards a more sustainable and resilient development (Stringer *et al*., 2019). Diversification is a key approach in enhancing biodiversity, pollination, pest control, nutrient cycling, soil fertility, and water regulation. Practices targeting aboveground biodiversity boost pest control and water regulation, while those targeting belowground biodiversity improve nutrient cycling, soil fertility, and water regulation. Adopting diversification practices seems to be promising to contribute to biodiversity conservation and food security, from the local to the global scales (Tamburini *et al*., 2020).

The ability to make correct decisions in accordance with the interests of individuals and groups must contemplate strengthening livelihoods, diversifying work and income-generating strategies, and stimulating resilience in the presence of crises, shocks or other vulnerabilities. The role played by women and rural youth is also key and must be considered in the development of inclusive public policies.

What can we learn from diversity?

Both for the cotton sector in the countries studied, and for other sectors made up of family farmers, the conception and recognition of diversity is an even greater challenge. The description and the understanding of this diversity are essential to propose research gaps, technology transfer, and appropriate public policies for the sector (Fasiaben *et al*., 2013).

Understanding the context requires the involvement of farmers from the start, in order to better understand their values, motivations and desired outcomes. Good governance will be a key factor in achieving the necessary transformations (Stringer *et al*., 2019). Any attempt to create a typology of groups of farmers shows an attempt to reflect the reality between the diversity of nature and the need to reduce the complexity into meaningful categories (van Averbeke and Mohamed, 2006). Diversity exists and is key to the conception of more effective social and economic intervention tools (Olofsson, 2019).

Therefore, for the development of capacities to improve the security of the means and standards of living, it is essential for public policies and other mechanisms of social and economic intervention and international cooperation to promote the potential for opportunities, based on the recognition of diversity, and to eliminate the obstacles for this (Ellis, 1998).

CONCLUSIONS

The results allow us to reflect the reality of family cotton farmers in the countries studied. In Paraguay, the greatest differences were perceived between regions and not so much between the types classified according to their GPV. The deactivation process that tends to occur among the SFF stands out, as well

as the higher profitability in some departments. In the case of Peru, as in Paraguay, the most significant differences were perceived between regions and not so much between the types classified. The high productivity in Ica, with negative profitability, and the low productivity in Piura, are highlighted. For Bolivia, great differences were perceived between the types of entrepreneurial farmers. The data allowed us to examine these phenomena more precisely, to identify in which regions these processes have occurred more intensely.

The main problem concerns the size of the samples in Bolivia and in Ñeembucú, in the case of Paraguay. This reflects the problem of making generalizations from a small number of cases, especially those that correspond to 100% of one result or another. This highlights the need to be more careful when collecting data, so that the samples, although representative, are larger.

The categorization of family cotton farming in Paraguay, Peru and Bolivia showed that this group is diverse and the recognition of differences between regions and groups is a key input for the development of interventions such as public policies, other promotion mechanisms and areas of study, which could be developed in depth.

This study confirms the hypothesis about the processes of deactivation, diversification and specialization of cotton production in Bolivia, Paraguay and Peru.

NOTES

[1]Calculation conducted by the +Cotton project, based on official records of cotton producers provided by partner countries, including Brazil.

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