

## Diagnosis of Agricultural Mechanization in Four Communities in Manabí Province, Ecuador

### Diagnóstico de la mecanización agrícola en cuatro comunidades de la provincia de Manabí, Ecuador



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**ABSTRACT:** The objective of this paper is to present the results of diagnosing the current situation of agricultural mechanization in four communities of Manabí Province in Ecuador. The methodology used in this research was based on field work. The main tool was a survey with quantitative and qualitative questions, which was applied to 239 inhabitants of four communities Bonce, El Beldaco, Mapasingue and Santa Martha, located in the Valley of Portoviejo River and that are close to the geographical boundary between the cantons of Santa Ana and Portoviejo. The results showed that agricultural areas are mechanized on an average of 39.8%. Only the soil preparation operation is mechanized, using for this purpose mainly the tractors rented to private companies (more than 60%) and very few to community associations (2%). The average surface indicator used by a tractor is 48.8 ha/tractor, in machining index is on average 2.28 hp/ha, which is high compared to the recommended 1 hp/ha (Gaytán, 2007, quoted by Sánchez-Hernández et al, 2014). High level of mechanization is due to the use of tractors with higher power than necessary, according to the surface worked.

**Keywords:** index of mechanization, family agriculture.

**RESUMEN:** El objetivo del presente trabajo es exponer los resultados del diagnóstico de la situación actual de la mecanización agrícola en cuatro comunidades de la provincia de Manabí del Ecuador. La metodología empleada en esta investigación se basó en el trabajo de campo. La herramienta principal fue una entrevista con preguntas de carácter cuantitativo y cualitativo, la cual se aplicó a 239 habitantes de cuatro comunidades Bonce, El Beldaco, Mapasingue y Santa Martha, ubicadas en valle del río Portoviejo y que están cercanas al límite geográfico entre los cantones Santa Ana y Portoviejo. Los resultados demostraron que de las áreas agrícolas se mecanizan en promedio un 39,8 %. Se mecaniza sólo la operación de preparación de suelos, utilizando con este fin principalmente tractores alquilados a las empresas particulares (más de un 60 %) y muy pocos de asociaciones comunitarias (2%). El indicador de la superficie promedio que utiliza un tractor es de 48,8 ha/tractor, el índice de mecanización es en promedio de 2,28 hp/ha, que es elevado en comparación con lo recomendado de 1 hp/ha (Gaytán, 2007, citado por Sánchez-Hernández et al, 2014). El alto nivel de mecanización se debe al uso de tractores con potencia superior de la necesaria, de acuerdo a la superficie trabajada.

**Palabras clave:** índice de mecanización, agricultura familiar.

### INTRODUCTION

Agriculture is one of the most important activities of Ecuador, employing about 30% of the labor force, presenting a great importance to the livelihoods of rural households. Their participation in the national GDP has constantly fluctuated at levels 8-9%; making the sector one of the main pillars of the national economy (Monteros, 2016).

Up to 85% of all farms in Ecuador are aimed at family farming, with more than 60% of this amount produce almost entirely for self-consumption in subsistence farming (Leporati et al., 2014). According to INEC (2017), more than 93% of rural households own their land with formal titles of land tenure.

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Family farms in Ecuador have on average 3.48 ha of land, totaling more than 2.4 million hectares belonging to this type of agriculture compared to commercial approach that has on average 14.7 hectares of land and adding more than 12.3 million hectares. Furthermore, family farming contributes more than 40% of the value of all agricultural production, supplying 85% of onions, 70% of corn and 64% of potatoes produced in Ecuador ([Leporati et al., 2014](#)).

However, the Ecuadorian countryside is marked by severe inequality of wealth and control over resources. Rural income poverty is 43%, while extreme poverty is 18.10% ([INEC, 2017](#)). Regarding to access to land, concentration is extremely high: 64.4% of the production units have less than five hectares but, in total, occupy only 6.3% of the agricultural area. Meanwhile, larger properties (over 200 hectares) represent only 0.1% of domestic enterprises, but also control 29% of the total area ([Carrión y Herrera, 2012](#); [CEPAL, 2016](#)).

The incorporation of machinery and new technologies in agriculture has significant backlogs, which is characteristic, not only for Ecuador, but for most countries of Latin America and the Caribbean ([CEPAL, FAO, IICA, 2017](#)). The modernization of the Ecuadorian countryside heavily depends among other factors, on the type of production system, the size of the UPA (agricultural production unit), socio-economic situation of producers and topographical conditions of the area. Mainly large farmers, who are the minority, have their own farm machinery and are continuously renewing them with the latest technology available.

Lacking the financial resources to acquire the machines required, small farmers mostly hire the soil preparation services to informal contractors that provide basic and general service for all farmers, which is not a specialized service that takes into account the real needs of each producer. There are shortages in machinery adaptable to ecological and topographical conditions of the country, especially small-scale, hillside and horticulture farms ([Piñeiro, 2018](#)).

In the country, the Ministry of Agriculture and Livestock (MAG) carries out several projects, programs and initiatives intended to help improve productivity and quality of life of small and

medium producers. It highlights the National Project of Technological and Participative Innovation and Agricultural Productivity (PITPPA), which runs the 24 provinces of Ecuador. The beneficiaries are small producers, that is, those with 0 to 10 hectares. The project aims to raise national productivity in items like banana, rice, plantain, potato, hard corn, wheat, barley, soybean, sweet corn, corn, fruits, coffee, cocoa and vegetables, among others, on grounds of small and medium producers. In framework of this project and in the Shoulder to Shoulder Strategy and, in order to mechanize farming, lower costs of labor and increase production of small and medium farmers associations, tractors, motor cultivators, implements and other inputs were given to farmers (<https://www.agricultura.gob.ec>).

Manabí province leads the provinces with the largest area of agricultural work. In 2017, it ranked second nationally by el number of people who were working the land, in agricultural work, with 10.91% of the national total workforce. It reached the same place in the production of dry hard corn, concentrating 24.74% of domestic production. It also excels in producing banana with 40.21% of the national total ([ESPAC, 2017](#)).

The development of "Agricultural Mechanization Community" Program, in Manabí Province since 2014, has contributed to the modernization of the rural sector. The program consisted of delivery to agricultural associations, motor cultivators and tractors with major implements, acquired in 2009 by the National Development Bank (BNF), in order to mechanize the work on the land, lower costs of labor and increase production of small and medium producers in the province ([Cevallos y Shkiliova, 2016](#)).

Understanding the reality of farmers and their motivation in the use of agricultural machinery contributes in a meaningful way to analyze the situation of agricultural mechanization in the country, province, county or a given locality. Inserted in this reality, Manabí Province has little research on the use of agricultural machinery and implements for small and medium farmers.

The aim of this paper is to present the results of diagnosing the current situation of agricultural mechanization in Bonce, El Beldaco, Mapasingue

and Santa Martha communities, which are located in Valley of Portoviejo River, near the geographical boundary between Santa Ana and Portoviejo Cantons, Manabí, Province of Ecuador.

## TOPIC DEVELOPING

### METHODS

The research methodology was based on fieldwork, its main tool was the structured interview to farmers of Bonce, El Beldaco, Mapasingue and Santa Martha Communities, from Santa Ana and Portoviejo Cantons Manabí Province of Ecuador (Olaoye y Rotimi, 2010; da Silva et al., 2018).

In Santa Ana Canton, where El Beldaco and Bonce Communities are located, most soils are moderately deep to superficial, with texture from loamy to loam-clay soil, located on flat slopes, undulating to hill reliefs. The main crop is corn and it is distributed mainly in considerable areas on the east zone, while in the western part are presented in smaller areas spread from north to south. In most cases, it is presented with the pasture in low and high hill reliefs, often in very abrupt slopes like those near the tops. Corn, like

other crops, mostly does not have irrigation and depends on natural provision of water from the rainy season. In Santa Ana, all maize is sowed in favor of the slope as it is seen in Figure 1. (SNI, 2012b).

In Portoviejo Canton, where Mapasingue and Santa Martha Communities are located, soils occupied for agricultural activities are mostly deep, moderately deep to superficial, with clay loam, clay, silty loam and sandy clay loam textures, located in reliefs of gentle slopes, medium to strong, strong, medium and soft. Among the main crops are corn, cacao, coffee, bananas and rice. Corn present in areas with irrigation grows over one cycle. The areas dedicated to corn, rice and pearl onions for its management and land availability are considered as small plots (SNI, 2012a).

To carry out the investigation, 100% of houses in communities study objects were visited during May-July period of 2018, in order to interview at least one person related to agricultural production. Table 1 shows the information on the population in each community and the number of people interviewed.



Source: CLIRSEN, 2012, quoted by (SNI, 2012b).

FIGURE 1. Corn crops in favor of the slope in Santa Ana Canton.

TABLE 1. Number of adults in communities and the number of people interviewed

Community	Population	Amount of people			
		Interviewed	Percent	Men, %	Women, %
Bonce	325	83	25.5	79.5	20.5
The Beldaco	160	47	29.4	72.3	27.7
Mapasingue	300	78	26.0	87.2	12.8
Santa Martha	101	31	30.7	87.1	12.9
Total	886	239	27,0	81.5	18.5

Source: prepared based on the information obtained during interviews.

In the four communities, 239 direct interviews were conducted, by applying 24 quantitative and qualitative questions to people involved in agricultural production, particularly, users of agricultural machinery. The questions were structured in identifying personal data producer, characteristics of the production system used, and machining resources used in production (Olaoye y Rotimi, 2010; da Silva et al., 2018). A statistical analysis of the information collected in each community with the use of SPSS System and then, using Excel Program, tabulating of the comparative results of four communities studied was carried out and the average values were determined.

Mechanization index was obtained by dividing the available power (hp) by the number of working hectares in four communities. The available power is obtained by adding the contribution of each tractor used in agricultural activity. The number of hectares divided by the tractor power (ha / hp) was also determined (Larqué et al., 2012; Sánchez-Hernández et al., 2014).

## RESULTS AND DISCUSSION

The analysis of the results showed that, on average, 51% of respondents were older than 50 years and only 3.8% were under 20 years, noting that in the community El Beldaco, 66% of farmers are over 50 years and no younger than 20 years were recorded. These data indicate that the population engaged in agricultural production is tending to age and there is very little generational change, trend observed at the national level in Latin America and the Caribbean (FAO, 2014).

The factor of schooling of farmers is of great importance today as it opens the possibilities to compete successfully in an increasingly

demanding market and influences the introduction of new technologies and innovations that allow them to have a more proactive role in rural areas. According to interviews, the educational level is focused on the completion of primary school (41.7%), noting that in the community of Mapasingue prevails incomplete primary level (50%). In addition, as it can be seen in Table 2, it is emphasized that there are very few professionals with the highest level (2.5%) and 3.3% have no schooling level. That may hinder access to scientific knowledge and technology for the benefit of field crop management (Olaoye y Rotimi, 2010; Larqué et al., 2012; Chisango y Dzama, 2013; Sánchez-Hernández et al., 2014).

Regarding to incomes of farmers, nearly 99% of respondents stated that their main income comes from selling agricultural products and earn less than USD 500 per month, which is considered a low value, considering that 45.6% of families have three to six people and 50.4% have one to three people. At the same time, they work on their own farms, 79.1% carry out complementary activity as day laborers.

The dimensions of the surface areas used for agricultural crops, together with the low incomes, are considered limiting factors in the purchase of tractors, farm implements and other equipment (da Silva et al., 2018). Over 62% of respondents said their areas of agricultural land do not exceed six hectares. The lowest value was in Santa Martha Community (35.5%), where 45.2% of respondents reported owning the agricultural areas up to 14 ha. It is noticed that 55.4% of the agricultural land is leased and the rest is of their own.

**TABLE 2.** Maximum level of education of those interviewed in four communities

Highest Level of Schooling	The Beldaco		Bonce		Mapasingue		Santa Marta		Average
	Value	%	Value	%	Value	%	Value	%	%
Incomplete Primary	18.0	38.3	22.0	26.5	36.0	50.0	10.0	32.2	36.7
Full Primary	21.0	44.7	44.0	53.0	15.0	20.8	15.0	48.4	41.7
High School	5.0	10.6	11.0	13.3	16.0	22.2	6.0	19.4	15.8
Professional	2.0	4.3	1.0	1.2	3.0	4.2	0.0	0.0	2.5
None	1.0	2.1	5.0	6.0	2.0	2.8	0.0	0.0	3.3
Total	47.0	100	83.0	100	72.0	100	31.0	100	100

Source: prepared based on the information obtained during interviews.



In four communities, corn (72.8%), followed by peanuts, vegetables and fruit are the most cultivated. It is observed the prevalence of this culture in Mapasingue (92.9%). Corn provides security for small and medium farmers, since being a culture of short cycle allows them to generate profits to four months and ensure raw material for the elaboration of balanced food, contributing to food security of communities (INIAF, 2015).

The predominant planting season is winter (90.4%) which is directly related to the irrigation factor. About that, 91.2% of respondents said they do not water. This value reaches 100% in Mapasingue and Santa Martha, much higher than 78.6% of the national level values (ESPAC, 2017).

Much labor is represented by family members (48.2%) and 34.8% combine family labor with hired. These values confirm the statement by Silva (2015) cited by da Silva et al. (2018), that family farming is characterized precisely by the involvement of the family in agriculture and should be understood from studies and research that it is focused on their socioeconomic specificities.

Availability of tractors, implements and other agricultural machinery in the investigated communities is very limited. Of the 239 interviewed, only 14 people know how to drive the tractor and only two in the communities of Santa Martha and Mapasingue, and identified respectively, they declared owning a tractor. For this reason producers are turning to hire tractors with their respective implements to private companies (over 60%), and very few to community associations (2%) and only for the preparation of soils where topography permits it. None of the respondents used a tractor for sowing, spraying, harvest or transport.

More often tractors of the following brands and powers are rented: John Deere 120 hp and 110 hp; Case 90 hp and 70 hp YTO. Respondents did not specify models of tractors. Community associations from El Beldaco, Bonce and Mapasingue were benefited in 2014 by the "Agricultural Mechanization Community" Program and each of them received a YTO- 704 tractor with a disc harrow. However, not having the plow and not being able to buy it for lack of financial resources these tractors are rarely used. Another cause of inefficient use of these tractors is the lack of knowledge of the community members about other activities in which that machinery can be used in addition to soil preparation.

Tractor hire values vary with the purpose and number of hours to be used. Respondents were very reserved in this regard and expressed their opinion only qualitatively. Some of them (26%) said that the cost of the rent is high, while more than 32% considered it low.

From the interview with agricultural producers and managers of community associations, it was possible to quantify the mechanized and non-mechanized land surface in each community (Table 3). Besides, it was determined that in soil preparation the following tractors were used: five tractors John Deere 120 hp and one 110 hp, and three tractors Case 90 hp. The total available power was 980 hp and 108.9 hp as average.

By dividing the total available power (980 hp) by the number of working hectares (429 ha) in four communities, it was found that the rate of mechanization is equal to 2.28 hp / ha, which is high, according to Gaytán (2007) cited by Sánchez-Hernández et al. (2014). They recommended that it should be 1 hp / ha. High level of mechanization rate is due to the use of tractors with higher power than necessary, according to the worked surface. Average surface

**TABLE 3.** Mechanized and non-mechanized surfaces

Community	Mechanized surface, ha	Non-mechanized surface, ha	Total surface cultivated, ha
Bonce	123	190	313
The Beldaco	70	105	175
Mapasingue	156	246	402
Santa Martha	80	114	194
Total	429	455	1084

Source: prepared based on the information obtained during interviews.

used by a tractor is 48.8 ha/ tractor, which is close to the recommended value of 50 ha / tractor by [FAO-FAOSTAT \(2011\)](#).

## CONCLUSIONS

The study revealed that in four of the communities investigated, only the operation of soil preparation on average 39.8% of agricultural surface is mechanized, using for this purpose tractors mainly leased to private companies (over 60%) and very few to community associations (2%). The indicator of the average surface used by a tractor is 48.8 ha/ tractor, mechanization index is as average of 2.28 hp / ha, which is high compared to recommended 1 hp / ha.

Socioeconomic factors, such as age of farmers, their educational level, household incomes and dimensions of the surface areas used for agricultural crops must be taken into account in the strategy of agricultural mechanization, since they can be limiting for their development.

In the present, mechanization has a prominent role in the increasing of agricultural production and the modernization of agricultural production units, requiring an understanding of the reality of farmers and their motivation in the use of agricultural machinery.

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