

Mechanization of Rice Cultivation in Charapotó Parish, Sucre Canton, Province of Manabí, Ecuador



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Mecanización en cultivo de arroz en la parroquia Charapotó, cantón Sucre, provincia de Manabí, Ecuador

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ABSTRACT: Rice (*Oryza sativa* L.) is one of the most consumed cereals in Ecuador and is considered a fundamental and highly important food for the Ecuadorian population. The objective of this work was to diagnose the state of agricultural mechanization in rice production in Charapotó Parish, Sucre Canton from Manabí Province, Ecuador. The survey technique was used for data collection, applied to 190 rice producers from 13 parish enclosures, as well as an interview carried out to 100% of the owners of the rental machinery. It was identified that 62% of the surveyed producers cultivate rice in 1 ha, 34% in 2-5 ha and 4% in 6-10 ha. For soil preparation, 100% use rental tractors (5 in total) with their respective implements. Another mechanized operation is the harvest, where 100% of the producers also rent the harvesters, for the rest of the work the machinery is not used. In the composition of production costs, machinery rental corresponds to 5-6%, which is the highest input cost of all, representing 48-57% of average direct costs.

Keywords: Agricultural Machinery, Soil Preparation, Harvest.

RESUMEN: El arroz (*Oryza sativa* L.) es uno de los cereales de mayor consumo en el Ecuador y se considera como un alimento fundamental y de gran importancia para la población ecuatoriana. El objetivo de este trabajo fue diagnosticar el estado de la mecanización agrícola en la producción de arroz en la parroquia Charapotó, cantón Sucre, provincia de Manabí, Ecuador. Se utilizó para la recolección de datos la técnica de la encuesta, aplicada a 190 productores de arroz de 13 recintos de la parroquia, y de entrevista realizada a los 100% de los propietarios de la maquinaria de alquiler. Se identificó que el 62% de los productores encuestados cultivan el arroz en 1 ha, el 34% en 2-5 ha y un 4% en 6-10 ha. Para la preparación de suelo el 100% utiliza los tractores (5 en total) de alquiler con respectivos implementos. Otra operación mecanizada es la cosecha, donde también un 100% de productores alquila las cosechadoras, para el resto de labores no se utiliza la maquinaria. En la composición de costos de producción al alquiler de maquinaria corresponde el 5-6%, siendo el costo de insumos más elevado de todos, representando 48-57% de costos directos promedios.

Palabras clave: maquinaria agrícola, preparación de suelo, cosecha.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most consumed cereals in Ecuador and is considered a fundamental food of great importance for the Ecuadorian population. It contains a high nutritional value rich in proteins, vitamins, iron and calcium, and is one of the crops with the largest area planted in the country.

Just two provinces, Guayas and Los Ríos, account for 83% of the area planted with the crop in Ecuador.

Other important provinces in the crop are Manabí with 11%, Esmeraldas, Loja and Bolívar with 1% each; while the remaining 3% is distributed in other provinces. On the other hand, the national average rice yield in the first period 2019 was 4.81 t/ha, Loja Province got the highest yield (9.10 t/ha) and Manabí and Los Ríos had the lowest yields (4.00 t/ha and 3.93 t/ha, respectively) ([MAG-Ecuador, 2020](#)).

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According to producers' perspectives, there are many external factors affecting rice production in Manabí Province, mainly pests and/or diseases. Sixty-four percent of farmers have been harmed by phytosanitary problems while 13% were affected by lack of water, weeds and salinity (MAG-Ecuador, 2020).

Agricultural mechanization is essential to increase production, since it makes it possible to increase the cultivated area, improve cultivation technique, lower the costs and dignify human work (Negrete, 2011). To carry out such mechanization, the small farmer needs economic, practical, easy to maintain and operate sources of energy whose work capacity and costs are appropriate to the size of the farm.

The rural parish of Charapotó is the oldest town in Manabí and one of the most archaic in Ecuador (established by the Spaniard Pedro de Alvarado 488 years ago). It is a town with great economic and commercial activity, mainly, agriculture and fishing in the sea. Rice production is the basis of the economy of 24 villages in Charapotó. This short-cycle product can be developed thanks to the provision of water that is extracted from the Portoviejo riverbed, which in turn, is fed by the Poza Honda dam located in the upper part of Santa Ana Canton, in the center west of the province.

Rice crops are located throughout the lower part of Charapotó Parish, which is traditionally a rice-growing area, where farmers can harvest twice a year due to its geographic location, the presence of irrigation systems and the characteristics of the land (Ponce et al., 2022).

The objective of this work was to diagnose the state of agricultural mechanization in rice production in Charapotó Parish, Sucre Canton from Manabí Province.

MATERIALS AND METHODS

The present research work was carried out in the first quarter of the year 2022, in the rice-growing area of the rural of Charapotó Parish, which is located in the south of Sucre Canton with geographical coordinates: Latitude: -1.26667S, Longitude: -80.4333°; it has an area of 216.42 km², warm humid climate, with 25° C average temperature, 60% average annual relative humidity and average annual rainfall of 500 to 700 mm (GAPC, 2018).

The research work was based on fieldwork, mainly through surveys. To define the size of the sample of rice producers to be surveyed, the population (459 in total) of 13 precincts of Charapotó Parish dedicated to rice cultivation was taken into account, which constituted the universe of the research.

A total of 190 surveys were conducted with a 95% confidence level, which corresponds to the sample size determined by the following equation:

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

Where:

n : Sample size

Z^2 : Confidence level ($Z=1.96$)

N : Population ($N=459$)

p : Negative variable ($p=0.7$)

q : Positive variable ($q=0.3$)

e : error ($e=0.05$)

The stratified sample is presented below, which shows the number of searches to be applied *per stratum*.

The following table shows the results *per stratum* (Table 1).

The survey included questions aimed at obtaining information on the socio-cultural level of the respondents, land tenure, cultivated area, agricultural

Table 1. Stratified sample to the elements under study.

<i>Stratum</i> (precint)	Frequency	Percentage
Charapotó - Head of parish	21	10.89%
Cañitas	26	13.51%
San Bartolo	11	5.88%
El Pueblito	22	11.55%
San Roque	18	9.37%
Drinker	15	8.06%
Passadero	17	8.93%
St. Theresa	13	6.75%
El Blanco	12	6.32%
San Ignacio	7	3.92%
Correagua	6	3.27%
Puerto Salinas	12	6.10%
Puerto Cañita	10	5.45%
Total	190	100%

machinery, production costs, income; the surveyed population was composed of small and medium-scale rice producers.

To find out the brand, year of manufacture, power, traction and technical condition of the tractors, an interview was conducted with the four owners (100%) of the rented agricultural machinery.

A statistical analysis of the information obtained was carried out using the software statistical SPSS Version 25

RESULTS AND DISCUSSION

The analysis of the results showed that 92% of the surveyed farmers belong to the male gender and 8% female. The national composition of agricultural producers, according to 2018 data, evidences that on average approximately 78% are men and 22% women; in Manabí Province, 16.19% are women (MAG, 2020). In other words, in Charopotó the participation of women in rice cultivation is lower than the national and provincial indices.

According to marital status, 41.58% of the surveyed are in free union, 31.58% married and 18.95% single; the rest responded that they are widow or separated (4.21% and 3.68%, respectively). The average age of the surveyed is 48 years old, which indicates that the productive force is not old. The national composition of agricultural producers shows that on average approximately 8.45% correspond to the ages of 15 to 34 years (MAG-Ecuador, 2020).

The level of education by sectors is described as with basic education, 70%. It coincides with that described for agricultural producers (Larqué-Saavedra *et al.*, 2012; Olaoye *et al.*, 2014; Sánchez-Hernández *et al.*, 2014; Li *et al.*, 2019; Loo-Sácido *et al.*, 2019; Aragundi-Demera & Pachecho-Gil, 2022). It also coincides with what was indicated by IICA (2021) on that, in rural areas, the average reaches 6.9 years of study, which limits the possibilities of the population to access higher paying jobs.

In Ecuador, peasant production is characterized by small land ownership; 6 out of 10 private production units have an area of less than 5 ha. On the other hand, half of rural families survive in productive units of two or less hectares (Pastor-Pazmiño, 2019). It is also necessary to highlight what is the predominant type of ownership in rural lands: of the total number of UPAs (Agricultural Production Units) "belonging to the private sector, 577,195 are owned with title, 133,834 have mixed tenure, 56,261 are occupied without title, 42,787 correspond to some other form of tenure, 13,408 are communal or cooperated, 10,135 UPAs are leased and, finally, 9,262 UPAs correspond to sharecropping or splitting" (p.51) (Pastor-Pazmiño, 2019). The distribution of land ownership, according to the responses of the 190 farmers surveyed, is presented in Figure 1, which

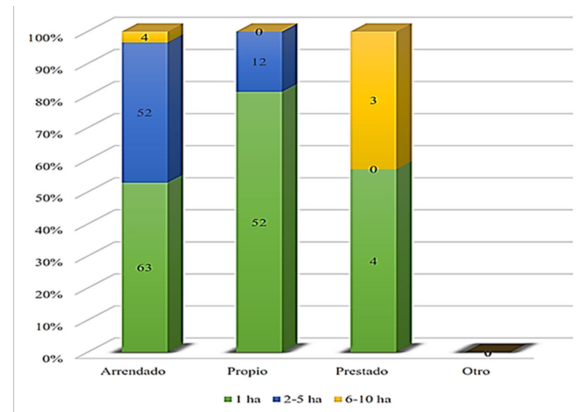


FIGURE 1. Distribution of land by tenure type and extension.

also shows that most of them (119, 63%) have a land extension of 1 ha and lease the land.

The 100% of the surveyed stated that agricultural work, such as soil preparation and harvesting, is carried out using mechanized traction, although in the past they also used animal traction and mixed traction. Sixty-two percent of farmers carry out mechanized work on 1 hectare, 34% on 2 to 5 ha and 4% on 6 to 10 ha. This result is higher than that reported by ESPAC (2022), which refers that 80.02% of the farmers who have transitory crops have carried out at least one activity in which they use agricultural machinery for soil preparation, sowing, development and harvesting of the crop, highlighting that for harvesting activities the use of machinery was equal to 15.6%.

The 100% of the surveyed population, who generate income through the field, do not have machinery for soil preparation due to the minimum amount of rice production, so they indicated that none of them has purchased tractors for such work, because it is more practical to rent tractors with their respective implements to private persons existing in the sector. This is a national trend, according to ESPAC (2017) in 2017, 87.30% of the producer people who used the tractor in soil preparation, rented this equipment, as well as 85.84% of the people rented a fine grain harvester.

In order to know the characteristics of the agricultural machinery rented farmers used in the target study area, an interview was applied to the 100% their owners (4 in total). It was determined that there are five brand tractors, 2 of them are John Deere 5725 brand (81 hp), 1 of Massey Ferguson 5709 brand (93 hp), 1 of Kubota M9540 brand (95 hp) and 1 of Valtra A990 brand (106 hp). The manufacturing years of the tractors are from 2017 to 2022, all are in good working capacity condition. The implements used in the area are a harrow (78% of surveyed) and the disc plow (22% of surveyed), noting that the latter is used for land preparation and to turn

the soil at the end of the harvest, which demonstrated that there are too compacted soils that prevent normal root development of the plant.

According to [Ochoa et al. \(2020\)](#), the use of farm machinery services could alleviate the economic constraints caused by operating at scale, thus facilitating the transfer of land from farmers. In addition, farm machinery services can act as transmitters of agricultural technologies that require specialized farm machinery, such as deep soil plowing, soil measurement, formula fertilization or precision farming.

Regarding combines, their owners (4 in total, two of them are also owners of 2 tractors) during the interview reported that they provide the rental service with combines of the following brands: Kubota DC70G (95 hp, 2 in total), ILGA 4LZ6 (102 hp) and LOVOL AF88 (87 hp, 2 in total). Their manufacturing years are from 2017 to 2020, four of them are in good working capacity condition and one of the Kubota brand is considered to have regular working capacity condition.

Of the total population of 190 people surveyed, 100% indicated that they employed a person to manage agricultural machinery and implements for the area cultivated during the agricultural cycle. This data collected shows that the implements optimize work in agriculture, in addition to saving time and both economic and human resources ([Miranda-Caballero et al., 2019](#)).

While it is true that production costs are directly related to land leasing, they ultimately affect the price of a bag of rice. In Ecuador, the price of a bag of rice is stipulated by the Ministry of Agriculture and Livestock (MAG), by supply and demand and by imports. The price of leasing land varies according to the type of soil, proximity to water, access, etc. In this context, questions were asked in the survey on the subject, seeking to obtain direct data from the sector, in order to know the factors that incur in the costs of the rice production process in the parish.

From the results found in Charapotó Parish, where 63% of the farmers produce rice on one hectare, the average direct costs are USD 1,233.25. These average direct costs represent 47% for labor, 5% for machinery and 48% for inputs. In rice production, in an area of 2-5 ha, the average cost is USD 1,245.40, of which 45% is spent on labor, 6% on machinery rental and 49% on inputs. In rice production, with an area of 6 to 10 hectares, the average direct costs per hectare are USD 1,176.67, of which 38% is for labor, 5% for machinery rental and 57% for inputs.

CONCLUSIONS

The study revealed that in 13 areas of Charapotó Parish, 100% of the cultivated agricultural area is mechanized for soil preparation and harvesting, using

rented tractors and harvesters for this purpose. Sixty-two percent of the surveyed farmers cultivate rice on 1 ha, 34% on 2-5 ha and 4% on 6-10 ha. In the composition of production costs, machinery rental accounts for 5-6%, with the highest input costs of all, representing 48-57% of average direct costs.

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