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Social, technological and productive situation of the coconut palm cultivation in Baracoa, Cuba

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ABSTRACT

The Baracoa municipality, Cuba, treasures the highest volume of the national coconut production, which is mainly destined to the elaboration of the oil used by the Suchel firm in the soap and perfume industry. In recent years a drastic decrease of the dry coconut production has occurred: from 21 298 t in the eighties to 7 499,9 t in 2011. In order to learn the current status of the social, technological and productive dimensions of the coconut agroecosystems in this municipality, an exploratory, descriptive and non-experimental research was conducted, with a cross-sectional descriptive and group evolution longitudinal design. The techniques used were: questionnaire, content analysis and observation. The sample was constituted by 46,3 % of the production forms dedicated to the coconut palm cultivation and 96,2 % of the managers. It is concluded that cooperativism is the fundamental basis on which the coconut production system is supported, whose productive process is affected by the increasing lack of labor –due to the ageing of the active labor force and the migration of young people–, the application of a very low-input traditional technology, as well as the lack of sensitization of producers for the access to scientific-technical services. To design development strategies of coconut palm is recommended, including the crop association and farmer practices based on local knowledge, which contribute to the increase of yields and the families' quality of life.

Key words: coconut palm cultivation, participatory rural diagnosis

INTRODUCTION

Coconut palm (*Cocos nucifera* L.) is the most widely extended tree crop throughout the world and has been linked to the development of several cultures. It is used as a source of food, beverage, fiber, fuel, timber and other products. Asia is the region with the highest coconut production, with little more than 90 % of the world production, in which such countries as Indonesia, the Philippines and India stand out. The second large producer is Central and South America, with a participation of 6,6 % where Mexico and Brazil are the ones with higher contribution. It is currently acknowledged as one of the most profitable perennial crops worldwide, due to its integral utilization and the huge demand of its products (Nogueira, 2000).

C. nucifera L. is a tradition and has great importance for the Baracoa municipality –located at the easternmost extreme of Cuba–, where the highest volume of the national coconut production is treasured, because 25,10 % (9 427,5 ha) of the total arable land is dedicated to it (Alvarado *et al*., 2002). It is mainly found as monocrop, with little intercropping and integrated with livestock production in some plantations (Tillekeratne *et al*., 2010). Of the areas, 80,5 % is located in the cooperative sector and only 19,5 % is found in enterprise areas (Empresa Coco Baracoa, 2008). The producers are organized in enhanced cooperatives of credits and services (CCSF), basic units of cooperative production (UBPC) and agricultural production cooperatives (CPA). The State supports and supervises the production, commercialization and financing activities, and directs exportation through the Baracoa Agricultural and Coconut Enterprise (ENPA, 2012).

In recent years the dry coconut productions have decreased: from 21 298 t in the eighties to

7 499,9 in 2011 (MINAG, 2011). For such reason, it is necessary to implement a crop development strategy, contributing to increase yields and the producer families' quality of life, for which it is essential to know the current status of the social, technological and productive dimensions of coconut palm agroecosystems in the Baracoa municipality; this constituted the objective of this work, from the above-mentioned premises.

MATERIALS AND METHODS

The study was conducted in the Baracoa municipality, in the period between January and December, 2011. The research was exploratory, descriptive and non-experimental. The cross-sectional descriptive and group evolution longitudinal designs were used (Hernández *et al*., 2003). The studied variables were:

Social dimension: number of producers linked to coconut production, farmers' age and motivation towards work (given by the salary).

Technological dimension: activities conducted per area in nursery and plantation; degree of application of biopreparations, biofertilizers and organic matter; and access to scientific-technical services.

Productive dimension: performance of the historical yields of coconut crop in the municipality, in the state and private sectors.

The following techniques were used:

- Questionnaire with open and closed questions, to determine the indicators (see annex I): farmers' age; motivation towards work (given by salary); activities performed per area in nursery and plantation; degree of utilization of biopreparations, biofertilizers and organic matter. For their application the participatory method was implemented, from group dynamics techniques (Geilfus, 2005).
- Content analysis, to determine: the number of producers linked to the coconut production, for which work was done with the official model of the production forms; the performance of the historical yields of coconut crop in the municipality, in the state and private sector, from the review of the statistical yearbook of coconut production of the Ministry of Agriculture (MINAG) (1976-2011) and the agroproductivity map of the cultivated soils with coconut palm in the Baracoa municipality.

In all the cases filed documents were consulted: the development programs of the Agricultural and the Coco Baracoa Enterprises; the project reports, in the Mountain Development Center; those referred to plant health, in the Provincial Direction of Plant Health; as well as those of service request, in the productive units. In addition, observation was used to detect in the field the performance –or not– of the activities.

The sample was constituted by 96,2 % of the workers of the Agricultural and Coco Enterprise, 54 % from the UBPCs, 60 % from the CPAs (only the presidents, taking into consideration the knowledge they have of their areas), and 25 % from the CCSFs (250 workers belonging to 17 CCSFs).

In addition, the payment and stimulation systems used were considered:

Invoice payment: the farmer receives an invoice for the total amount of money to be paid according to the quantity of dry coconut sold to the enterprise, which is multiplied by the price of the quintal (qq; one hundred pounds) of coconut, and this invoice should be cashed in the bank.

Purchase capacity to buy from the stimulation store: 85 % of the production sold by the farmer to the enterprise is returned to him/her in points equivalent to 1,05 CUC/qq of dry coconut, which is multiplied by ten to be turned into points, whose total is the purchase capacity.

RESULTS AND DISCUSSION

In the Baracoa municipality 1 460 producers are directly linked to coconut production, grouped in 17 CCSFs, 11 UBPCs and 10 CPAs (fig. 1). According to Freyre (2000), due to the crisis of the 90's socioeconomic transformations occurred in agriculture, which allowed to reform the land tenancy regime in favor of leasing cooperative property for indefinite time (UBPC), which favored that at present there is a strong "non state" sector, which prevails in participation, structure of the cultivated area and average structure of the agricultural production. In the case of coconut production in Baracoa, the highest number of producers is linked to CCSFs, followed by UBPCs and CPAs. In this sense, Altieri (2009) stated that no less than 60 % of the arable land in Cuba is in the hands of private or cooperative farmers.

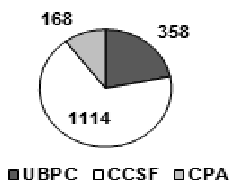


Fig. 1. Producers linked to coconut production, according to land tenancy.

According to the age of the people directly dedicated to coconut production, 3,47 % was observed to be between 46 and 54 years old and only 1,34 % is between 17 and 30 years old; nevertheless, 92,5 % is 55 years old or older, which represents the actors with the highest influence on the productive process (fig. 2).

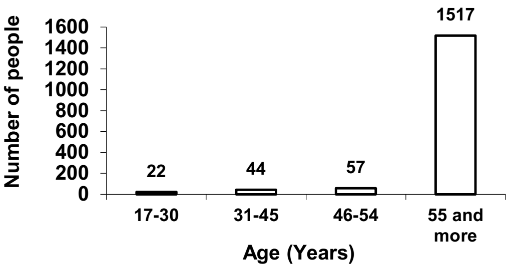


Figure 2. Age characteristics of the people directly linked to coconut production.

This difference shows the progressive ageing of the productive force and could be due to the creation of new jobs alternative to agriculture, as well as to the possibilities of young people to study in the cities, which facilitates their emigration towards those places. The above- expressed explanation endangers the coconut culture of the region, which is the added value in these agroecosystems. Frómeta (1999) refers that the generation of many job positions alternative to agricultural work, as well as the concentration of other service entities in relatively small perimeters, are the causes of the labor force deficit and the labor fluctuation; the last two ones are acknowledged as two of the main factors which affect production in Cuban mountains. In addition, the inclination of highlanders towards non agricultural jobs is shown.

On the other hand, Nova (2009) states that "depeasantization" and the high degree of centralization, with subsequent separation of the farmer from the land and its results, are some of the problems Cuban agriculture has gone through in the last fifty years. According to Carballosa (2012), "depeasantization" deteriorates the sustainable management trend, because the medium- and long-term active labor force is not guaranteed. González (2005) explained that among the social problems which are affecting the coconut production in Mexico are ageing of farmers (plot owners), migration of young people and increasing lack of labor, which coincides with the findings in this study.

Concerning the role played by the payment and salary stimulation system in the motivation of producers for work, 66 % of the surveyed people (335) considered that such system did not motivate them, 16 % (81) said it did, while 18 % (91) referred that it not always encouraged them. These results are related to the price of coconut, which is low (25,00 pesos/qq in 2011), for which personal incomes are insufficient to cover their expenses, mainly those related to the family's feeding, clothing and footwear. This causes a part of their production to be used in another kind of activity which provides them with additional incomes (feeding of farm animals, mainly pigs). On the other hand, the supply of the stimulation store is not continuous, which upsets the producers as they do not see their demands satisfied when necessary, especially the inputs required for attending the plantations.

The results of this work coincide with those reported by Pérez *et al*. (2009), who stated that in Cuba personal incomes are insufficient to cover the necessary expenses of a family. They also express that the incentives to the worker is an objective which should be given top priority by the State in order to increase national productions, which will favor the decrease of the commercial deficit of goods that prevails in Cuban economy. According to Sarmentero and Perera (2008), the payment according to the work, per quantity and quality, is the main element of material stimulation.

During the diagnosis of technology regarding the technical instructions for the production of coconut palm seedlings in nursery it was found that most of the cultural activities (management of seed masses, preparation of substrata, seed selection, mineral fertilization and transplant to nursery) are not performed, while irrigation, pest and disease control and seedling selection are carried out in 50,0; 46,7 and 38,0 %, respectively (fig. 3). In the case of the germinator, it is done in 100 % of the nurseries. It was identified that in seedling production the germinator method is used –reported by Lizano (2005) and Alfonso and Ramírez (2008)– with the application of a traditional very low-input technology, more adapted to their conditions, but without utilizing local resources. In addition, such problems as: non-certified seed mass and germinators, seeds which do not have the required quality, low seed germination rates and high mortality of the seedlings when transplanted to the field, were reported; this coincides with the report by Blanco (2007), who made reference to the low germination rates (40 %) obtained in the main nurseries, as well as to the little vigor of the seedlings when transferred to the field, which has incidence on the high mortality during the first months of establishment of the plantations (52,8 %) and defines their low quality. According to Doria (2010), obtaining high-quality seeds plays a determining role in the final yield of the crop.

Regarding the established plantations (fig. 4), in none of the areas irrigation is used. Re-planting is done only in 11,5 % of the producing areas, followed by mulching (22,0 %), rehabilitation (25,0 %), mineral fertilization (25,1 %) and weed control (30,0 %). Similar results were reported in the Valdez municipality, Sucre State –in Venezuela– by Gutiérrez *et al*. (2007), who declared that very little technology is used in this crop from the agronomic point of view. No fertilization is applied, no drainage practices are done and no pest insect and disease management is made. Weed control is performed twice a year, generally to facilitate harvest, and replanting is very scarce.

In the association of coconut with other crops no policy to increase its yields is followed, because intercropping is used in 4,5 % of the areas. The trend is to eliminate crop areas to have other plantations; in the few areas where intercropping is used with the coconut palm the vital space of each crop is not taken into consideration and, thus, this technique becomes a problem. Similar results were reported by Espinosa et al. (2011) in Medellin, when referring that the cacao-coconut palm systems have "spontaneous" arrangements, that is, they do not correspond to structured designs. However, Domínguez *et al*. (2003) reported that throughout the world one of the most applied practices among coconut producers is associated cropping.

The above-stated elements have a direct relation to the fact that 100 % of the interviewed people manifested that they do not have the most important inputs guaranteed to attend to the crop. Regarding the access to services, although the province has research centers and laboratories with equipment and qualified personnel, a lack of sensibility was observed towards the request of this type of services, because very few areas (12,4 %) have documents to support their certification (plant health, soil) and the highest percentage of interviewees (74 %) do not acknowledge their need. This allows to define that a traditional technology of very low economic resources is used, with monocrop system and very little intercropping and/or silvopastoral systems.

The current management of the plantations seems to be the cause that 55,00 % of the area under production is reported as unproductive; from it, 44,96 % due to ageing and 81,89 % because of low fertility. On the other hand, 70 % of the total is completely or moderately covered by weeds (Empresa Coco Baracoa, 2008). Regarding pests, 52,87 % of the total area is affected by *Aceria guerreronis* Keifer and 15,98 % by the insect *Oryctes rhinoceros* L., as the most important ones (Sanidad Vegetal Provincial, 2011). All this influences the achievement of lower quality fruits (size reduction) and, thus, yield decrease. In this sense, Damián *et al*. (2005) stated that two equally important elements influence the increase of the unitary yields of the crops: the modifiable factors, related to the plant and its management by men, which interact with factors that cannot be modified, such as climate and soil.

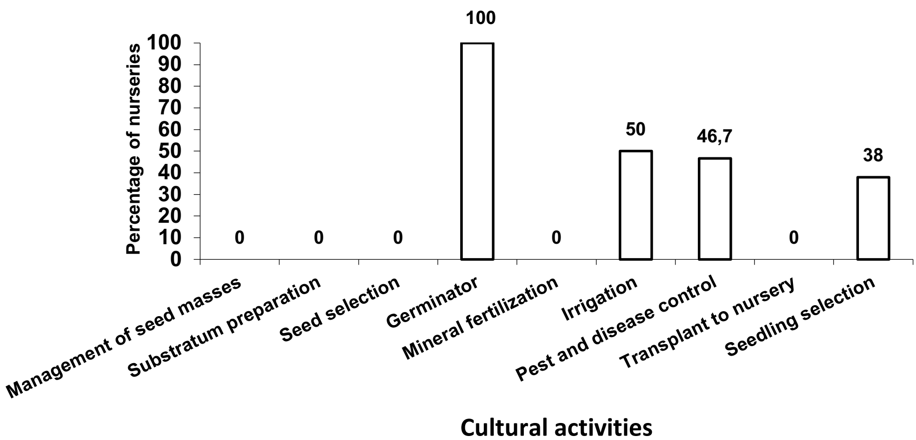


Fig. 3. Percentage of nurseries where the activities and procedures established by the MINAG (1990) are fulfilled.

On the other hand, there are difficulties to make harvest estimation; the number of plants per hectare is completely unknown, which has had incidence on the fact that the real yields of the crop cannot be determined, taking into consideration that an important part of the production is used for animal consumption and is not counted. Another important aspect is that the varietal policy is not properly considered within the productive process, because a strategy has not been defined for this indicator, as it does not appear in the current development program of the crop. Soto *et al*. (2003) referred that in Venezuela one of the causes of low yields obeys the lack of availability of superior genetic cultivars.

Table 1 shows the knowledge degree of the interviewees about how the agroecological techniques are applied in coconut cultivation. More than 70 % state that crop protection is not guaranteed with biological controls or biopreparations, and more than 80 % say that neither biofertilizers nor organic manures are used.

In this sense, the actors were verified to know the existence of those techniques, such as the use of green manures, vermiculture, compost, biofertilizers, biopesticides, minimum tillage, among others; but they do not apply them as they do not know all their benefits and due to the lack of orientation about their attainment, elaboration and application, and they also have the paradigm that the techniques and inputs associated to the Green Revolution are the ones which allow to obtain high production levels.

In this sense, Leyva (2005) and Funes (2007) reported that in Cuba traditionally the direct actors applied agroecological techniques, but the boom of modern or high-input agriculture –during the seventies to the eighties– favored a national movement of changes towards scientific advances, in correspondence with the international agrarian policy; which still prevails in the minds of many producers and decision-makers, although this agriculture has been very questioned due to the ecological unbalances it has caused, especially in monocrop plantations (Altieri, 2009).

In Venezuela, Soto (2003) referred that small farmers –who have less than 10 ha– are reluctant to introduce agroecological practices which decrease costs; and that with the performance of basic practices higher yields than 1 t ha-1 of copra/year have been obtained.

The historical analysis of the coconut yields (t/ha) in the state and private sectors (period from 1976 to 2011) reflected a very similar performance until the end of the 20th century (fig. 5), with stable productions over 1,50 t/ha. In this stage a drastic decrease occurred since the beginning of the austerity period (1991), related to the fall of the socialist block and the economic crisis of the country; however, in 1997 there was a slight increase. At the beginning of the 21st century the state sector showed the highest growth in this indicator, but since 2004 –and until the present– the contrary occurred: the private sector grew and it was maintained over the state, which is ascribed to the many functioning difficulties and the low productivity of the UBPCs, together with the low salaries and the lack of stimulation to cooperative members. This has led to the dissolution of some cooperatives and the land was granted to representatives of the private sector, through the Executive Order 259, which authorizes the leasing of unused state lands to natural persons or legal entities, to be rationally and sustainably used according to the aptitude of soil use for agricultural production.

In spite of the above-explained factors, we can state that UBPCs as well as private entities maintain very poor yields. In this sense, Levin (2003) said that a dry coconut yield from 4 to 8 t ha^{-1} is considered acceptable on soils described as adequate for this crop, and that the production

Table 1. Application of agroecological techniques for plant health protection and nutrition of the coconut crop, according to the interviewees' criterion.

Question / Answer	Is crop protection guaranteed with biopreparations?	Are biofertilizers and organic fertilization used?
Yes	27,2 %	19,0%
No	53,7 %	50,6 %
Not always	19,1 %	30,4 %

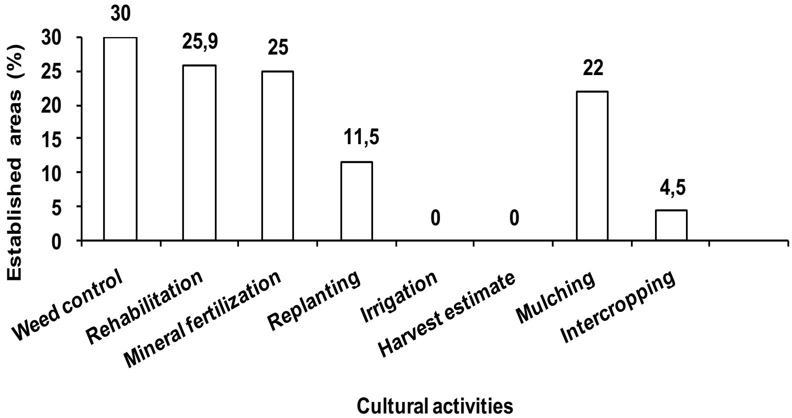
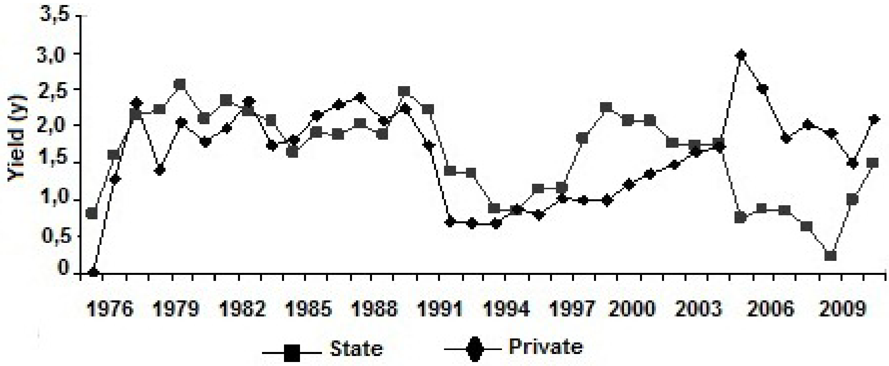


Fig.. 4. Percentage of established areas where the activities and procedures for the coconut plantations are fulfilled.



Source: Anuario Estadístico del MINAG provincial, 1976-2009.

Fig. 5. Performance of the historical yields of the coconut crop in the Baracoa municipality, in the state and private sectors.

mean of the private sector did not exceed 2 t ha^{-1} in the last eight years; while the state sector, in spite of having the highest quantity of soils classified as good and regular, has always been below 1,5 t, which shows the unutilized potential until now and corroborates that the management adopted by producers is not productively acceptable. According to Soto *et al*. (2003), coconut involves more than 4 000 agricultural producers in Venezuela, with yields of 1 t ha^{-1}, which are considered relatively low.

CONCLUSIONS

Cooperativism constitutes the fundamental basis on which the coconut production system is established in the Baracoa municipality. The results obtained in this work allow to verify the ageing of the active labor force, which conditions the increasing lack of labor.

The application of a traditional technology without integrality in the utilization of local resources, conditioned by the lack of inputs and the little sensibilization towards scientific-technical services, has favored the ageing of plantations and the reduction of fruit yield and quality. This, along with the low price of the product, causes the low incomes of producers.

The non correspondence between the agroproductive category of soils and yields is a measure of the unutilized potential of coconut cultivation, for which it is necessary to use farmer practices based on local knowledge systems and ecological rationality, and adjust them to the potentials and limitations of the environment with the aid of scientifid-technical services.

Training –with emphasis on the producers' children and on the schools of the municipality– should also be oriented towards the economic, technical, social and environmental aspects of coconut cultivation, as well as towards teaching its cultural and traditional importance for the municipality.

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Annex 1. Questionnaire

The Mountain Development Center is conducting a work in order to learn how certain aspects are influencing coconut production, for which we need your collaboration in answering some questions below. The information you provide will be absolutely confidential; although, of course, there are no delicate questions.

This will only take fifteen minutes. Thank you very much beforehand for your collaboration.

a) Work area: 1) CCSF _____ 2) CPA ____ 3) UBPC ______ 4) Enterprise __________
b) Work qualifier: 1) Producer _________ 2) Manager _____________

Social dimension

c) Age: ________

Only for producers

d) How many people work in your farm with you?

1) Nobody ____ 2) 1 _____ 3) 2-3 _____ 4) 4 or more ________

e) Average age of the people who work with you.

1) 17-30 ______ 2) 31-45 _____ 3) 46-54 ____ 4) 55 or more _____

For producers and entrepreneurs

f) What do your children do? 1) Study _______ 2) Work _______

g) Where? 1) City ____ 2) Countryside ____

h) In what sector?

1) Agricultural ___ 2) Commerce ___ 3) Education ___ 4) Computers and Communications ___ 5) Others ___

i) Do you consider that the salary you receive encourages you to work? 1) Yes ___ 2) No ___ 3) Not always ____

j) Do you think the salary (income) is in correspondence with the final results you obtain (production of dry coconut, oil, seedlings and others) at work? 1) Yes __ 2) No ___ 3) Not always __

k) Have payment and stimulation systems propitiated encouragement for work?

1) Yes ___ 2) No ___ 3) Not always _____

l.1) Why?

Technological dimension (mark with an x)

m) Considering your knowledge about the areas, is an adequate management (according to the technology) of the seed masses performed? 1) Yes ___ 2) No ___

n) Are the seed masses certified? 1) Yes ___ 2) No ___

ñ) Only for nursery-responsible producers

Which of the following activities are performed in your nursery?

1) Substratum preparation Yes ___ No ___

2) Seed selection Yes ___ No ___

3) Germinator Yes ___ No ___

4) Mineral or organic fertilization Yes ___ No ___

5) Irrigation Yes ___ No___

6) Pest and disease control Yes ___ No ___

7) Transplant to nursery Yes ___ No ___

8) Seedling selection Yes ___ No ___

9) Is your nursery certified? Yes ___ No ___

10) Do you perform management according to genotype? Yes ___ No___

o) Only for producers who work directly in the coconut plantations

Which of the following activities are performed in your area?

1) Weed control Yes ___ No ___

2) Plant rehabilitation Yes ___ No ___

3) Mineral or organic fertilization Yes ___ No ___

4) Replanting Yes ___ No ___

5) Irrigation Yes ___ No ___

6) Mulching Yes ___ No __

7) Intercropping Yes ___ No ___

p) Explain how harvest estimate is made _______________________________________

q) Do you take into consideration genotype management? 1) Yes ____ 2) No _____

r) For all producers

Do you have the necessary resources and inputs for attending your nursery and/or plantation?

1) Yes ____ 2) No _____ 3) Not always ______

s) Is plant protection guaranteed with biopreparations? 1) Yes ___ 2) No ___ 3) Not always _____

t) Are biofertilization and organic fertilization used? 1) Yes ___ 2) No ___ 3) Not always _____

u) Do you know any agroecological techniques? 1) Yes ___ (continue) 2) No ___ (go to x)

v) Which ones? ____

w) Do you apply them? 1) Yes ___ 2) No ___

x) Why? ____

y) Do you request specialized scientific-technical services (soil analysis, plant health diagnoses, soil agroproductivity, seed certification, etc.)?1) Yes ___ 2) No ___

z) Why? ____

Productive dimension

aa) For nursery producers

From the seed quantity you plant in the nursery, what percentage become seedlings ready to be taken to the field? ___________

bb) Of the seedlings from the nurseries of the enterprise, which you plant, what percentage survives? _________________

cc) What is the average annual yield of your area? ____