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Original article

Inconsistency between actors in the maize seed system: a risk for local development

Incongruencia entre actores del sistema de semillas de maíz: un riesgo para el desarrollo local

Incoerência entre os atores do sistema de sementes de milho: um risco para o desenvolvimento local

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ABSTRACT

With the objective of evaluating the existing relationship between actors of the formal seed sector and the peasant cooperative sector to implement development strategies for the cultivation of maize in mountainous areas, in three municipalities in the north of Pinar del Río, individual interviews were conducted with 57 actors (peasants and agricultural technicians), with open and closed questions to collect information on the reasons why they adopt improved and creole seeds of the cereal, as well as relevant information on the varieties they handle. Qualitative and quantitative methods were used for data analysis. The first ones were used to organize the data, such as causal attribution analysis, used to identify and classify categories and dimensions. In the case of quantitative methods, frequency analysis, calculation of averages and percentages were used to characterize the systems studied, and multidimensional scaling analysis was used to determine the relationship between the

actors, based on the categories expressed by them. The results obtained indicate that farmers and seed policy decision-makers have different perceptions regarding the reasons for using creole and improved maize seeds and, above all, have a different vision regarding the value of seed use, which shows the existence of inconsistencies between the two groups of actors.

Keywords: actor analysis; cooperatives; maize; seed system.

RESUMEN

Con el objetivo de evaluar la relación existente entre actores del sector formal de semillas y el sector cooperativo campesino para implementar estrategias de desarrollo para el cultivo del maíz en zonas montañosas, en tres municipios del norte de Pinar del Río, se realizaron entrevistas individuales a 57 actores (campesinos y técnicos de la agricultura), con preguntas abiertas y cerradas para colectar información sobre las causas por las cuales adoptan semillas mejoradas y criollas del cereal, así como información relevante sobre las variedades que manejan. Para el análisis de los datos, se utilizaron métodos cualitativos y cuantitativos. Los primeros se emplearon para el ordenamiento de los datos, como el análisis de atribución causal, empleado para la identificación y clasificación de categorías y dimensiones. En el caso de los cuantitativos, se efectuaron análisis de frecuencias, cálculos de promedios y porcentuales para caracterizar los sistemas estudiados, además, se utilizó el análisis de escalamiento multidimensional para determinar la relación entre los actores, a partir de las categorías manifestadas por ellos. Los resultados obtenidos indican que los agricultores y los técnicos decisores de políticas de semillas tienen percepciones diferentes con respecto a las causas por las cuales se utilizan semillas criollas y mejoradas de maíz y, sobre todo, poseen una visión diferente respecto al valor de uso de las semillas, lo que pone de manifiesto la existencia de incongruencias entre ambos grupos de actores.

Palabras clave: análisis de actores; cooperativas; maíz; sistema de semillas.

RESUMO

A fim de avaliar a relação existente entre os agentes do setor formal de sementes e o setor cooperativo camponês para implementar estratégias de desenvolvimento do cultivo de milho em zonas montanhosas em três municípios no norte de Pinar del Río, foram realizadas entrevistas

individuais com 57 agentes (camponeses e técnicos agrícolas), com perguntas abertas e fechadas para recolher informação sobre as razões pelas quais adotam sementes melhoradas e nativas do cereal, bem como informação relevante sobre as variedades que utilizam. Foram analisados métodos qualitativos e quantitativos, além do mais, foram empregues métodos qualitativos para organizar os dados, tais como a análise da atribuição causal, que foi aplicada para identificar e classificar categorias e dimensões. No caso dos métodos quantitativos, foram usadas análises de frequência, médias e cálculos percentuais para caracterizar os sistemas estudados, e a análise multidimensional de escala foi usada para determinar a relação entre os agentes, com base nas categorias por eles expressas. Os resultados obtidos indicam que os agricultores e os decisores políticos técnicos em matéria de sementes têm percepções diferentes quanto às razões para a utilização de sementes de milho nativas e melhoradas e, sobretudo, têm uma visão diferente quanto ao valor da utilização de sementes, o que evidencia a existência de incoerências entre os dois grupos de intervenientes.

Palavras-chave: análise dos intervenientes; cooperativas; milho; sistema de sementes.

INTRODUCTION

Since the aborigines, maize in Cuba has been a staple food for humans, livestock and poultry (González del Valle, 1941). Throughout history, this crop has made a notable contribution to the subsistence and food security of the inhabitants of the mountainous regions of northern Pinar del Río (Ferro Valdés et al., 2021), and today it continues to be a vital crop in our country, since it is part of the concentrates used in animal production to supply protein to the population, as well as to support the agricultural systems led by the peasants (Ferro Valdés et al., 2019).

The importance of this crop in the national economy is clearly evidenced by annual imports. Currently, the import of this cereal represents twice the national production and in the decade from 2011 to 2021 it constituted about 2 % of total annual imports and approximately about 12 % of all food imports made in this period (Onei, 2021, 2022).

The dependence on maize imports to cover the food needs of the main livestock chains in the country, particularly swine, places it among the strategic crops for the nation. Due to the importance of this cereal, the Economic and Social Policy Guidelines of the Sixth and Seventh Congresses of the Cuban Communist Party (PCC) address the need to ensure compliance with the national program for the

production of maize and other grains to meet priorities such as food security and the gradual substitution of imports. As a result, a national strategy has been taken to the municipalities, as a local policy, to ensure maize production through the Food and Nutritional Security Plan. However, domestic production is still insufficient to meet the needs of our country, so hundreds of thousands of tons continue to be imported annually due to low yields, which have continued to decline in the last 5 years (Onei, 2022).

One of them is that about 85% of national producers responsible for more than 80% of national production since 2000 (Onei, 2022; Ortigoza Guerreño et al., 2019) use traditional or creole varieties and not improved varieties from the formal system (Ortiz et al., 2007). Although creole or traditional varieties have a broad genetic base that gives them adaptability and responsiveness to different productive, environmental and social conditions (Bonicatto et al., 2020), their yields are discrete due, among other things, to the inbreeding generated by cultivating the same populations for several years, which puts at risk, in the long term, the variability of the crop and the stability of the agroecosystems producing the cereal (Keller & Waller, 2002).

To contribute to the transformation of this situation, local programs will be required to favor the development of maize cultivation based on the collaborative actions of all the actors involved in its production, taking into consideration both the technical and the socioeconomic and cultural elements that govern the life of these production systems. In this sense, institutions play a fundamental role in innovation, as well as the actors that make them up (Sánchez Gómez et al., 2021), since they can provide incentives or hinder it (Salmerón Gómez & Gómez Haro, 2012). Therefore, institutional actors in the agricultural sector must consolidate their participation, coordinate actions and manage knowledge that meets the current demands of producers and drives innovation and development of these productive systems (Díaz Espinosa et al., 2019; Gómez Oliver & Tacuba Santos, 2017).

The risk is that any effort to improve cereal production may fail, if it does not take into account the correspondence of interest and perceptions among all the actors involved in the production system. Seeds are an example of divergence of interest between farmers and plant breeders and, as their production is very costly, leaving out producers from the strategies of introduction and dissemination of improved varieties can cause crop improvement plans, based on the introduction of improved materials, to fail with the subsequent effects, such as economic and time losses, which would affect the municipalities in need of this vital commodity that today receive it through the costly import route. The greatest challenge is to achieve a common understanding among the main actors of these

systems (producers and technicians), who are involved in the design of local strategies for seed production and use.

In the case of the maize production systems of the Pinar del Río mountain massif, it is not known if there is a coherent relationship between these actors to be able to carry out actions that help to improve the productive situation of the cereal and, therefore, contribute to local development from the productive improvement of the agrosystems dedicated to maize. For this reason, our objective in this research, based on the analysis of the perceptions of its main actors on the use of maize seeds (improved or creole), is to evaluate the existing relationship between actors of the formal seed sector and the peasant cooperative sector in order to implement coherent strategies between both groups for the development of maize cultivation in three municipalities in the north of Pinar del Río.

MATERIALS AND METHODS

Study region and data collection

The research was carried out in three mountain municipalities of Pinar del Río province, La Palma, Viñales and Minas de Matahambre. In order to obtain information about the maize seed systems in the mountain agrosystems of Pinar del Río, the individual interview was used as a tool, aided by previously designed questionnaires with open and closed questions. Two questionnaires were created to facilitate the collection of information, one for the producers and the other for the technical decision-makers of local policies on seeds, both with the objective of extracting as much information as possible on the reasons why the farmers use creole seed or improved varieties of maize, and other aspects related to the management of their varieties such as: name of the variety, time they have had them and sources of origin of their maize seeds.

The 15 interviews taken with municipal agricultural leaders, seed policy decision-makers, were also carried out with technicians belonging to the municipal agricultural delegation and others linked to the production processes. In the case of the producers, 42 interviews were conducted. The work of collecting information from producers was carried out in 20 agricultural entities, including Credit and Service Cooperatives, Agricultural Production Cooperatives and Grassroots Business Units.

Data analysis

All the information collected in the interviews was entered into spreadsheets, forming data matrices that were organized by municipality, type of actor and type of seed. Using the technique of content analysis and attributional analysis per actor studied, the categories by which they considered that creole or improved seeds were used were determined, and the dimensions to which each of these attributional categories were associated were identified.

The categories expressed by the stakeholdes interviewed were organized and quantified by frequency and then ordered from highest to lowest in order to obtain scales showing the importance of each of these categories, according to the type of actor (producers and technicians), as well as the similarity of their perceptions regarding the use of creole or improved maize seeds.

The statistical analysis was carried out using the multidimensional scaling technique, in order to determine the relationship between the categorical statements made by the social actors in each municipality. This analysis was based on the number of coincidences in the categories proposed by each of them. The information not concerning causes of seed use and their relationship with seed management were analyzed by percentage and average calculation.

RESULTS AND DISCUSSION

The responses analyzed in the interviews made it possible to create Table 1, which shows the eight categories for which the actors interviewed consider that creole seed is used in the mountainous maize production agrosystems of Pinar del Río. Each of the categories was related to a dimension according to the intention and origin of its cause.

Table 1. Definition of the causal categories assigned for the use of creole seed

Categories	Code	Definition	Dimensions
Adaptation to climatic conditions	ACC	This refers to the fact that creole varieties develop adequately in the climatic conditions of the growing region and are therefore productively better.	Technical-economic
Trust and faith	CF	Related to the fact that growers feel more secure with the creole seed.	Cultural-cognitive

Performance	RTO	It includes all the manifestations that refer to yield, such as greater quantity of grains, larger cobs, greater number of rows, etc.	Technical-economic
Economic factor	FE	Referring to the obtaining of criollo seed, which is cheaper to produce than buying improved seed.	Technical-economic
Lack of knowledge	DTO	Indicates the lack of information regarding the existence of new varieties.	Cultural-cognitive
Cultural aspects	AC	Related to the habit or tradition of sowing creole seeds.	Cultural-cognitive
Different uses	DU	Related to the different uses of creole maize by its characteristics.	Cultural-cognitive
Only option	UNI	Relative to the fact that it is the only one they own, and have owned for a long time.	Cultural-cognitive

Two dimensions were defined, the cultural-cognitive and the technical-economic, since the categories mainly relate the use of creole seeds to cultural factors and knowledge about them, and also to factors associated with socioeconomic and agronomic aspects of the cereal.

In the case of creole seed, the actors interviewed considered more cultural-cognitive categories than technical-economic categories, which means the importance of this dimension within the maize seed system, especially if changes are to be produced in it. However, 47.06% of the causes expressed were related to the technical-economic category and the remaining 52.94% to the cultural-cognitive category, which makes clear the importance of both dimensions in the system.

Figure 1 represents the categories ordered from highest to lowest frequency by group of actors, and in it we can see that producers and technicians coincide in seven of the eight categories defined on the causes of the use of creole varieties. Both groups of actors also coincide in considering the yield of creole varieties as the first cause of their use in the system studied. Along with yield, the technicians also state that adaptation to climatic conditions is of primary importance. Both categories, yield and adaptation to climatic conditions, are related to the technical-economic dimension.

However, with the exception of yield as the first causal criterion for the use of creole seed for both groups, the rest of the categories are arranged in different order of frequency between them, showing

that both groups have different perceptions about the phenomenon studied. They did not coincide, also, in other aspects, that the technicians do not consider the use of creole seeds as a unique option and the producers do.

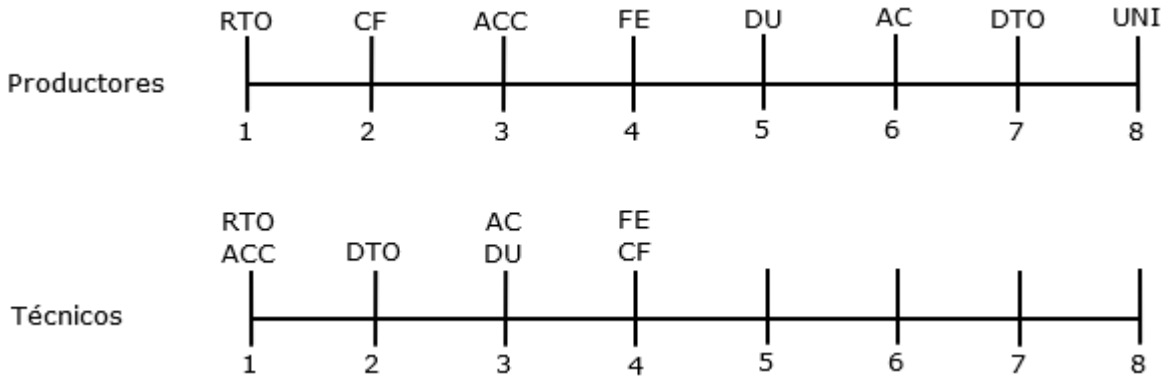

Figure 1. Category scales organized according to the frequencies found in relation to the causes for farmers to use seeds of maize landraces

The first four categories of the scale of priorities assigned to the producers accumulated approximately 70 % of all their considerations on the reason for the use of creole varieties in the system. These four categories as a whole mean, by their given order of priority, that producers consider that criollo varieties are used because they show higher yields due to the fact that they are better adapted to climatic conditions, which gives producers more confidence and, moreover, the seed is easy and very economical to produce.

In the case of the technicians, the first three categories of the scale accumulated about 60% of their considerations, so we can consider that, for them, the producers mainly use creole varieties, because they yield more due to their good adaptation to the climatic conditions and the fact that they are unaware of the existence of other varieties such as improved varieties. The fact that the technicians do not consider criteria such as confidence and economic factor among their first ones, in the scale of categories, shows that there is a more technical vision on their part and that there is not a total understanding of the seed system according to the reason for the use of creole seeds, making clear the incongruence of perceptions among them.

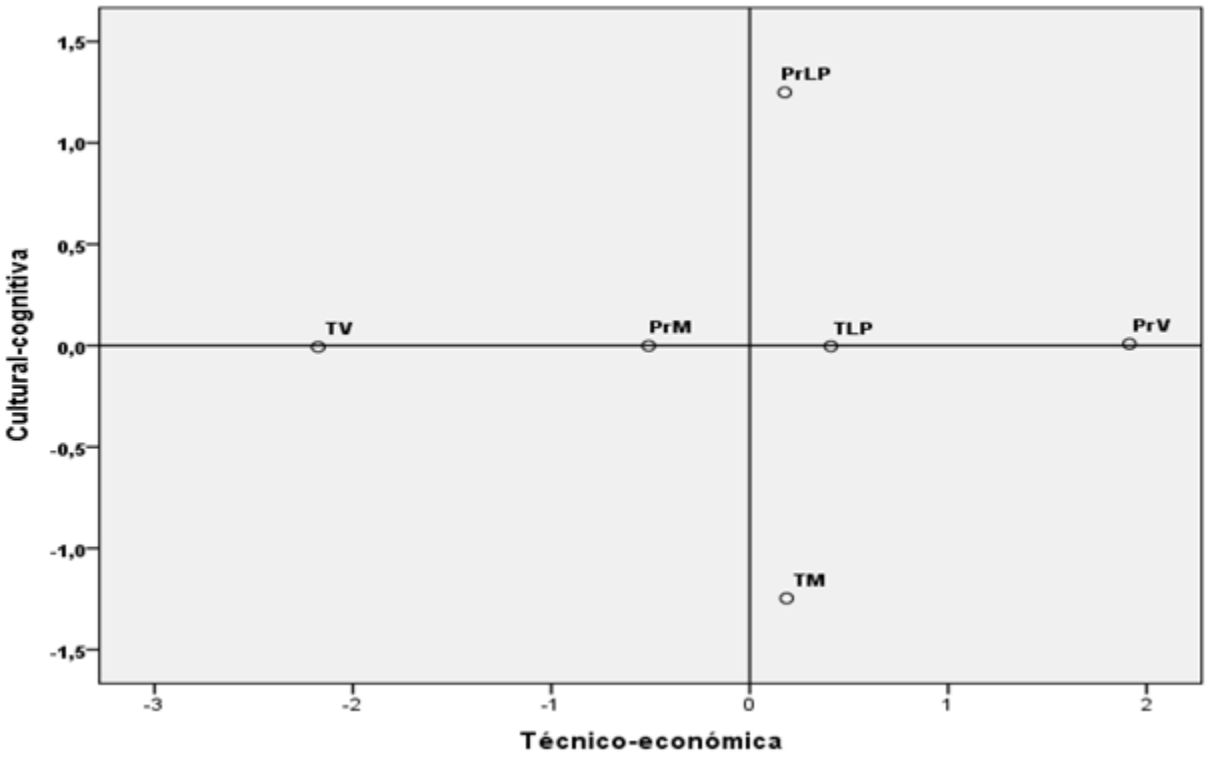

Figure 2. Analysis of similarities based on the categorical coincidences on the use of creole seed, among all the actors interviewed by municipality of origin
PrLP= Producers of the municipality La Palma; TLP= Technicians of the municipality La Palma; PrV= Producers of the municipality Viñales; TV= Technicians of the municipality Viñales; PrM= Producers of the municipality Minas de Matahambre; TM= Technicians of the municipality Minas de Matahambre

Figure 2 confirms the disparity of criteria between producers and technicians and, above all, between those in the same municipality. All the groups of actors interviewed in each municipality show dissimilarity with respect to the criteria for the use of creole maize seeds. With the exception of the technicians in the municipality of La Palma (TLP) and the producers in the municipality of Minas de Matahambre (PrM), who show similarities in terms of the two dimensions of criteria studied. However, the two groups of actors that show the greatest similarities (TLP and PrM) are geographically distant and do not influence each other (Figure 2).

In the case of improved maize varieties, the analysis of the interviews yielded four causal categories, by which technicians and producers consider that these varieties are used in their production

systems. At the same time, the two dimensions shown were related, which coincide with those used for creole varieties (Table 2).

Table 2. Definition of causal categories assigned for use of improved seed

Categories	Codes	Definitions	Dimensions
To try	PP	It deals with planting seed of improved maize varieties to test their performance under your growing conditions.	Cultural-cognitive
Yield	RTO	Related to improved maize seeds showing higher yields than creole.	Technical-economic
Knowledge	CTO	This refers to the knowledge that farmers have about improved varieties, thanks to the dissemination work.	Cultural-cognitive
Economic and commercial value	VEC	It deals with the commercial competitive value of improved varieties, as they are more attractive.	Technical-economic

In the case of improved varieties, the actors interviewed defined more manifestations related to the technical-economic category than to the cultural-cognitive one. Of all the categorical statements, 76.06% corresponded to the technical-economic dimension and only 23.94% were related to the categories associated with the cultural-cognitive dimension. These results show the existence of a more technical than socio-cultural way of thinking about the reasons for using seeds of improved maize varieties.

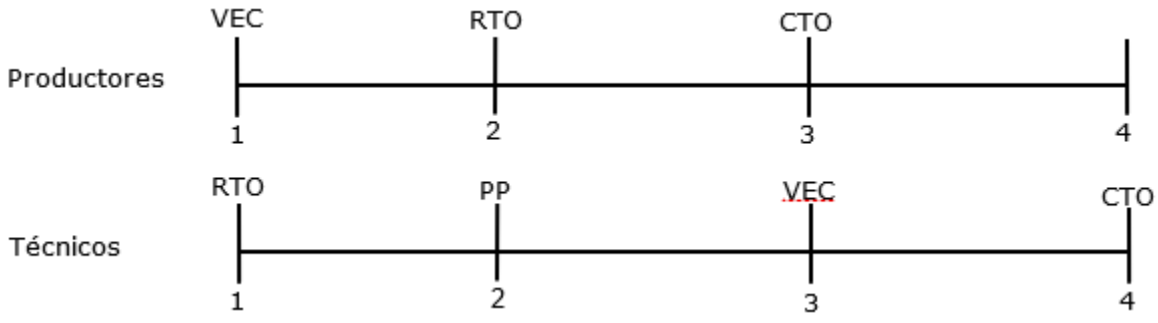

Figure 3. Category scales organized by priorities according to the frequencies found in relation to the causes for farmers to use seeds of improved maize varieties

The scale of categories organized according to their frequencies shows that the producers give less criteria than the technicians regarding the use of improved seeds and, in addition, the order of importance given by the latter with respect to the technicians is different (Figure 3). When analyzing the data, we found that the palm producers did not issue criteria regarding the use of improved varieties in the palm maize production system, since they have not handled improved varieties for a long time; they only use seeds of creole varieties in their production system. Again, analyzing in general the two groups of actors studied, we found inconsistencies between the two groups regarding the reasons for the use of seeds, in this case those referring to seeds of improved varieties.

Figures 4 and 2 show the dissimilarity of criteria among actors in the same municipality, according to their criteria on the use of improved varieties.

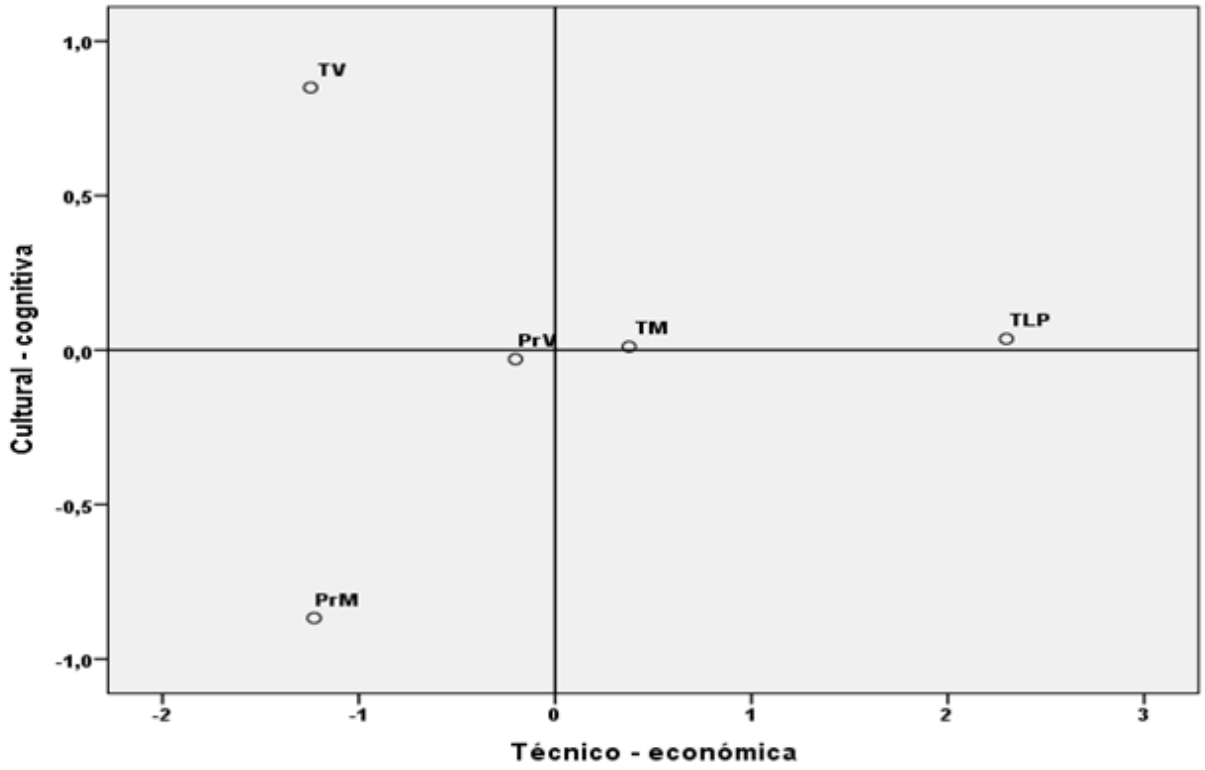

Figure 4. Analysis of similarities based on categorical coincidences on the use of improved seed, among all the actors interviewed by municipality of origin

TLP= Technicians of the municipality La Palma; PrV= Producers of the municipality Viñales; TV= Technicians of the municipality Viñales; PrM= Producers of the municipality Minas de Matahambre; TM= Technicians of the municipality Minas de Matahambre

The technicians of Minas de Matahambre and the producers of Viñales are the ones who show the greatest similarity in their criteria according to the use of seeds of improved varieties, but as in the previous case (Figure 2), they have no influence on each other since they are from different systems. The rest of the actors are dispersed in relation to each other, which shows how different are the perceptions among them. And finally, the point of greatest concern is that palm producers are excluded because they do not provide criteria on the subject.

As elements that characterize these systems, it was determined that 85.71% of the producers interviewed stated that they had never bought maize seeds and only 14.29% of them stated that they had bought maize seeds at some point. At the time of the research, all of them obtained maize seed from their plots, so that its production is linked to the production process of the cereal and does not represent an extra activity. All producers use seeds of the variety known by them as creole, not knowing exactly how long they have it in their possession, since they all claim to have it `'forever or decades''. 78.58% of the producers use only one variety of *Zea mays*, the creole, and 21.42% have used or use more than one, such as those known by them as argentino, jibara and rosita. They recognize that these varieties were introduced into their system, approximately between 8 and 20 years before, but at present they manage them by their own means.

Regarding the use of creole seeds, it is notable that farmers and technicians use a greater number of criteria to justify the use of these varieties than for improved varieties. In addition, the statements on cultural-cognitive categories prevail in their perceptive criteria on creole varieties, which shows the weight of these in plans for the future development of these productive systems. On the other hand, in the case of improved seeds, they mostly use technical-economic criteria.

According to the results, technicians show a more technocratic vision, with a limited approach of seeing seeds as a reservoir of life that gives continuity to their species (Bonicatto et al., 2020) and solves food production, when its concept is much broader, since it relates biological, social, identity, cultural, spiritual and economic aspects (Perelmuter, 2021), which are, as a whole, those who justify the adoption and ensure the existence of seeds in these systems. The producers, for their part, expressed criteria of both dimensions, that is, with a more holistic vision.

The fact that the cultural-cognitive categories have such weight in the systems studied and that a technically focused vision prevails in the local seed policy makers, speaks for itself of the incongruence between both groups of actors. In this situation, each of them makes different decisions

regarding the use and adoption of maize seeds, resulting in the low adoption of improved varieties and a wide use of creole varieties, causing the low yield of the cereal in these agricultural systems to be maintained. The phenomenon of the wide use of creole seeds has also been reported in other crops (Ortiz et al., 2007), and is one of the reasons for the productive stagnation of Cuban agricultural systems.

Finally, in this scenario, it represents a risk to establish development plans with the objective of improving maize production in the mountain agrosystems studied, since it leads to decisions that hinder one of the main ways to improve its production. Taking into consideration that the development of a territory is achieved by the sum of all the local contributions to the economic improvement and welfare of its inhabitants, and that the cultivation of maize, due to its strategic importance, is one of the agricultural variables of weight in the sum of the contributions to the development of these territories, we consider that the incongruence among the actors studied represents a risk for the fulfillment of policies on food security and import reduction and, therefore, for the local development plans of these territories.

There are incongruent perceptions among the fundamental actors of the maize producing agrosystems in the north of Pinar del Río, regarding the reason for the use and adoption of maize seeds. These differences objectively limit the design of strategies dedicated to strengthen the cereal production systems, supported by improved seeds and become a risk for the fulfillment of the local development plans of these regions, due to the strategic importance of the crop.

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Conflict of interest

Authors declare that they have no conflicts of interest.

Authors' contribution

All the authors reviewed the writing of the manuscript and approve the version finally submitted.