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Food Safety Management Capability in Corn and Temporary Agriculture in Mexico

[1]Miguel Ángel Damián Huato, [1]Omar Romero-Arenas,
[2]Alfredo Simón Báes, [3]Dora María de Jesús San Germán-Jarquin,
[4]Anel de la Vega Mena and [5]Conrado Márquez Rosano

[1]Centro de Agroecología y Ambiente, Instituto de Ciencias de la Benemérita Universidad Autónoma de Puebla (BUAP). Avenida 14 Sur 6301, Ciudad Universitaria, CP 72570, Puebla, Puebla México
[2]Facultad de Ingeniería Agrohidraulica, adscrito al programa de Ingeniería Agrogorestal *Campus* Tetela-BUAP.
[3]Campo Experimental Valle de México, INIFAP. Carretera los Reyes-Texcoco, km. 13.5. Coatlinchán, Texcoco, estado de México. C. P. 56250
[4]Estudiante de Doctorado Colegio de Postgraduados- Montecillo Programa de Economía
[5]Maestría en Ciencias en Desarrollo Rural Regional, Universidad Autónoma Chapingo, Km 38.5 Carretera México-Texcoco

Abstract: Grower-Innovator (MP-I) method is disclosed for improving the productive potential of rainfed maize. This investigation interviewed producers Cohetzala and San Nicolas de los Ranchos (SNR) Puebla, Mexico to calculate household food security, the rate of radical appropriation of technology, the degree of use of progressive technologies and to design the MP-I. The 82 and 40% of producers and SNR Cohetzala not have SAF, all apply radical and progressive innovations to handle corn, no relationship between the use of radical innovations and returns, but with progressive; 29% of producers are successful in Cohetzala and 30% in SNR. If transferring technological standard for producers of low and average 91-24% performance increase and these 157-38% for Cohetzala and SNR, respectively.

Key words: Household Food Security · Management of Corn · Innovative Producer And Agro-Beam Method

INTRODUCTION

Food is the most elementary human right registered in the Universal Declaration of Human Rights of the United Nations [1]. A concept suitable for assessing access to this right is to household food security (SAF), that is achieved when all people at all times have the physical, social and economic access to sufficient, safe and nutritious food to meet your needs and food preferences for an active, healthy life [2, 3]. Agriculture refers to the processes involved in the controlled production of plant and animal materials which are used by man. From the definition above, we may assume that production of food is solely for man's survival. Agriculture need to be man transformed, not only for man's survival, but also, for the improvement of the farming system in order to produce sufficient high commodities for export that will help in increase of the socioeconomic condition of the rural people and pulling them out of the vicious cycle of poverty [4]. Maize, being the highest yielding cereal crop in the world, Its uses are not only restricted as food and feed for livestock and poultry, maize grains are also utilized in many other industrial and commercial products [5]. It is the most important cereal crop in the world after rice and wheat. As regard cultivated area, it ranks third position after wheat and rice in world statistics. It is also year-round crop for its wider range of climatic adaptability [6]. Corn is a good

Corresponding Author: Omar Romero Arenas, Centro de Agroecología y Ambiente, Instituto de Ciencias de la Benemérita Universidad Autónoma de Puebla (BUAP). Avenida 14 Sur 6301, Ciudad Universitaria. CP 72570. Puebla, Puebla México.

base for Mexicans with an average daily consumption per capita of 343 grams, 72% of the total cereals consumed [7]. For peasants, is the foundation of your diet; in addition, the sale of surplus maize is an economic link that families get other resources, in part, to purchase other food to complement your SAF. For this reason, it is assumed that the corn can be the basis of the SAF, especially when planting in temporary where has been associated with beans, pumpkin, chili pepper and weeds, agricultural system known as Milpa.

An essential factor for achieving the SAF is the productive potential, studied by the National Institute of Forestry Research, Agricultural and Cattle (INIFAP) since 1963. Actually the INIFAP considers to the land of work from eight states of the south-southeast feasible to be irrigated and posted a portion of the land with agricultural vocation that is handled under the system of extensive livestock [8]. The Modernization Program of the Sustainable Agriculture Traditional (Mas-Agro) Responsible for promoting the productive potential of the traditional management of corn promotes the use of cutting edge technologies that are capable of revealing the productive potential of the genetic materials [9]. The Project Phasing of Agro ecological Successful Experiences in Latin America, have recognized that it is in the "how to do it", where lie the success of the proposals for phasing [10]. That is to say, in the management of crops lies the possibility or not, to improve the productive potential, understood as the performance difference between actual production levels and the potential to achieve to improve the management of the maize [8].

In this management interact with two conditions: a) general endogenous (climate, plants, soil, etc.) and exogenous (programs in agricultural development, family income, etc.) immutable in the medium term. The climate is an important factor of agricultural productivity. The fundamental role of agriculture in human welfare, concern has been expressed by many organizations and others regarding the potential effects of climate change on agricultural productivity [11] and b) specific, referring to the factors that directly involved in the production. In terms of how the producer combines these resources explains the particular form of as it handles the corn, speaking in the execution of multiple tasks (planting, tillage, etc.) made successively, applying technologies and conventional inputs (hybrids, agrochemicals, etc.) or traditional (native seeds, crops, etc.) or a syncretism when used again and innovation, interchangeably.

Of the factors involved in the management of maize emphasizes technology. It is a product of the interaction of science, technology and culture. Represents the scientific knowledge applied to the production that is embodied in objects (machines and artifacts) or in systems of management and organization of economic activity [12]. The innovation is to incorporate new technological elements, products or services (radical) or enhanced (progressive), or in the adaptation of new production methods or improved [13], which are suitable to the productive processes. It exposes the MP-I, validated with corn growers from temporal Cohetzala and San Nicolas de los Ranchos, Puebla-Mexico, which assumes that the management of maize is carried out under general conditions and specific differentiated, speaking in the coexistence of different producers, highlighting the successful technological whose pattern is easy to be transferred to other corn growers.

MATERIALS AND METHODS

Areas of Studies: Cohetzala has a semi-dry climate, too warm with very summer rains and regosols degraded. SNR predominates in a cold climate with summer rains and regosols deeper than in Cohetzala. In Cohetzala were cultivated 963 hectares in total, 80% of whom were planted with corn in temporary. These cipher for SNR were 2.203 and 61% [14].

Survey. A questionnaire was applied to a sample of producers who were members of the Direct Program Support to the Field (PROCAMPO) that included questions relating to the conditions that influence the management of the corn. We calculated the size of the sample [15] and was estimated at n = 60 and n = 77 for Cohetzala corn producers and SNR.

The systematization and analysis of data collected with the survey allowed us to estimate:

- The Index of Food Security (ISA), apply the following mathematical expression:

$$ISA = \frac{(R)\ (SS)/NMF}{500^{*}}$$

Where:

R = Production in kg/ha.
SS = Planting Area (ha).
NMF = Number of members in the family of the producer.

Factor that considers that the SAF will be achieved when every member consume 500 kg of maize/year.

- The Index for the Appropriation of Radical Technologies (IATR) and the Degree of use of Progressive Technologies (GETP). With this goal was applied the equation made by [16].
- It was built the typology of producers according to the value of the IATR and GETP: a) low (0 -33.33), b) average (33.34 -66.66) and c) high technology appropriation (> to 66.66).
- MP-I was designed. The corn growers was selected from high to low production, the difference was valued, It is divided between 3 and the quotient joined the lower production to create 3 ranges corresponding to types of producers: low, medium and high production or successful.

It characterized the pattern of the technological successful corn producers and the types of producers.

And is proposed to transfer the pattern of the technological successful producers, through the establishment of agroecological headlights.

RESULTS AND DISCUSSION

Household Food Security: It was found that each family member of Cohetzala (401) have, on average, 317 kg/year of corn and the SNR (328) 785; 15% of households in Cohetzala and 58% of SNR possess SAF and the value of the ISA was 1.72 and 1.79 for Cohetzala and SNR, respectively.

Radical Innovations and Productive Potential: Innovations by the INIFAP recommended for the management of corn from the municipalities surveyed are shown in Table 1, while the heterogeneity of producers is a trait that the Law of Sustainable Rural Development [17] suggested that consideration be given to design-execute public policies, INIFAP proposes a technological package homogeneous.

When calculating the IATR it was found that: the use of radical innovations is low and differentiated, especially in Cohetzala where was applied a fourth part of the innovations recommended by the INIFAP; there is no significant relationship between the use of these technologies and production (n=144, r = 0.0155, p=0.8789) and there is no statistically significant difference between the mean yield of the corn growers of low and medium appropriation (t= -0.6930, p=0.4900), even when on average in the two municipalities, the seconds used 18.6 units more than modern innovations.

The low employment of these innovations is that they are not proportionate to the general and specific conditions in which producers of temporary handle the corn. With regard to the early conditions [18], posits that in Mexico have subsisted 12 elements of conflict rooted in the agrarian history, evidenced in the management of the public purse used to promote to the agriculture business and against the farmers. In regard to the specific conditions, data of the Census of Agriculture and Forestry 2007 [19], emphasize that the access to land, machinery and agricultural inputs is less in those entities with lower SAF, where prevails rainfed agriculture.

Progressive Innovations and Productive Potential: The findings indicate that in the management of maize predominates the employment of progressive technologies, especially in Cohetzala where the GETP on average is 41.6 units higher than the IATR. Statistically significant differences were found between the averages of the production of the producers of medium and high GETP (t=2.8103, p=0.0064) of Cohetzala and between the high and medium GETP (t=2.0350, p=0.0155) of SNR.

Model Design Producer-innovator

Identification of the Corn Growers Successful: It was found that in Cohetzala yields greater and lesser were 400 and 1000 kg per hectare; the difference was 600; the value of the quotient was 200 and the ranges for corn growers from low, medium and high productivity or successful they were, respectively, 400-600, 601-800 and > 800 kg per hectare. These ciphers for SNR were 500 and 2.200; 1.700, 567, 500-1.067 and 1.068 -1,635 > to 1.635, respectively. Applied Innovations by these producers types and yields (Table 2) show that almost one third of producers in the two municipalities are of high productive potential; the significant difference between corn yields of producers was greater among the medium and low, that between the high productive potential, compared to those of medium (Tukey; $p<0.05$), in the municipalities studied and the increase of the IATR is not reflected in a consistent way in a significant increase in the productive potential (n=144, r = 0.0908, p=0.4324), but on a larger GETP, the productive potential was significantly higher (n=144, r = 0.4621, $p<0.0001$).

Table 1: Technological package recommended by the INIFAP for handling corn in Cohetzala and San Nicolas de los Ranchos, Puebla-Mexico.

Cohetzala	Practice/Innovation	Recommendation
	Planting date	Between March-May
	Kind of seed	H-137, H-139, H-34, H-30, H-33, H-40, H-48, H-50, H-311, H-516, H-515, VS-536, H-507, H-509, V-524, VS-529 y VS-22
	Plants density/ha	50-60 thousand plants
	Fertilization formula	120-60-00; 100-50-00; 180-80-60
	Date of fertilization	Applies in the planting and second work
	Name and dose of herbicide/ha	Gesaprím 50 (1Kg); 500 FW (1.5 Lt); Gesaprím 50 (1Kg) y Hierbamina (1Lt); (1Kg); Basagrán 480 (0.5 Lt); Marvel (1Lt); Fitoamina 2.4 D (1Lt), Hierbamina 2.4 D (1Lt); Esterón 2.4 D (1Lt).
	Name and dose of insecticide/ha	Volatón al 2.5% (25Kg); Volatón 5% (12Kg); Furadán 5% (12Kg); Folimat 1000 (0.5Lt); Parathión metílico 50% (1Lt); Malathión (1Lt); Sevín 80 (1Kg); Sevín 80% P H (1Kg); Malathión 1000 E (1Lt); Diazinón 25% (1Lt).
SNR	Date of planting	Between March-May
	Kind of seed	H-30, H-33, H-34, H-40, H-48, H-50 H-137, H-139, VS-22
	Plants density (ha)	50 thousand plants
	Fertilization formula	140-60-00 and 110-50-00
	Fertilization date	Applies in the planting and second work
	Kind of herbicide and dose (ha)	Gesaprim 50 (1 kg), 500 FW (1.5 L); Gesaprim 50 (1 kg) más Hierbamina (1L).
	Kind of insecticide and dose (ha)	Volaton 2.5%, Furadan 5% ó Volaton 5% (12-25 Kg); Folimat 1000 (0.5 L); Parathión (1 L) metílico 50% o Malathion (1 L) disuelto en 200 L de agua por hectárea.

Source: [20].

Table 2: Number of producers, IATR, GETP and productivity (kg ha-1), according to their productive potential of the corn growers from Cohetzala and San Nicolas de los Ranchos, Puebla-Mexico.

		Low		Medium		High		Municipal average	
Towns/Indicator		Number	%	Number	%	Number	%	Number	%
C	Producers	14	23	27	45	19	32	60	100
	IATM	23.4 a		27.3 a		28.3 a		26.7	
	GETC	58.6 a		73.3 b		71.6 b		69.3	
	Productivity	486 a		751 b		930 c		746	
SNR	Producers	27	35	28	36	22	29	77	100
	IATM	44.1b		35.8 a		42.5 b		40.6	
	GETC	48.1a		64.3 b		73.6 b		61.3	
	Productivity	763a		1425 b		1964c		1347	

Source: Developing own with data obtained from the survey, 2009.

* Within each row (performance, IATM and GETC), different letters in the average indicates that there is significant statistical difference between them (Tukey test, $p<0.05$).

Pattern of the Technological Successful Producers and Agroecology: In this pattern have been implemented more progressive that radical innovations in the management of corn, by what is closest to the agro ecological paradigm that the productivity. The first is based on the agro ecology, which has as a basic unit of study the agro ecosystem. As a science, the agro ecology provides the basic ecological principles to study, design and manage agro ecosystems that are productive, sustainable culturally sensitive, socially just and economically viable [21]. As agricultural practices, seeks to improve agricultural systems, imitating the natural processes, creating biological interactions beneficial and synergies among the components of the agro ecosystem [22].

In this management coexist heterogeneous elements that interact with each other, to create new structures and functions in the agro ecosystems that separately would´t origin any element. These unities of the diverse are personified in the biodiversity of plants and wildlife that exists above-below ground and inside-around of the agro ecosystem.

This biodiversity includes plants C4 and C3 with various needs of radiant energy to transform inorganic compounds in organic. The associated plants have root systems of various sizes and the presence of legumes in the association increases the use of nitrogen, a macro-nutrient essential for plant growth. Greater biodiversity of plants and wildlife up-around the soil favors the creation

Table 3: Innovations used in the management of corn by the producers of successful high productivity Cohetzala and San Nicolas de los Ranchos, Puebla-Mexico.

Municipality/activities		Practices/ technologies
Cohetzala	Soil Conservation (%)	Boards (21). Not implemented techniques for the conservation of soils (79)
	Date of planting (%)	June (74); july (26)
	Seed variety (%)	Creole (100)
	Plants density (ha)	50,781
	Association of crops (%)	Maize associated with: bean-pumpkin (74), beans and Jamaica (5), Jamaica (21)
	Crop rotation (%)	Alternated with: sesame-Jamaica (11); Jamaica (26) and sorghum (5). Not alternated crops (58)
	Manure application (Kg/ha)	1.754 Applied prior to planting
	Fertilization formula (%)	Applied 8 formula predominate: 92-00-00 (26); 115-00-00 (21); others formula (53)
	Name and dose of herbicide/ha (%)	Esterón 1lt/ha (5); Gesaprím 1kg/ha (5), No sabe (6); Tordón 2 lt/ha (5); no applied (79)
	Name and dose of insecticide/ha (%)	Folidol 1 lt/ha (11), gallito 1 lt//ha (5); no aplicaron (84).
San Nicolás de los Ranchos	Soil conservation (%)	Boards (18), terraces alive (23) and ditches (9). Not applied techniques of soil conservation (50)
	Date of planting (%)	March (77) and april (23)
	Seed variety (%)	Creoles
	Plants density (ha)	67,900
	Association of crops (%)	Maize associated with: fruit and beans (32), fruit-pumpkin (4) and beans (14). Not associated with crops (50)
	Crop rotation (%)	Alternating with: barley (23), beans (27), bean (14) and wheat (4). Not alternated crops 32
	Manure application (Kg/ha)	1.383 Applied prior to planting
	Fertilization formula (%)	Applied 7 formulas prevail: 69-00-00 (36), 92-00-00 (18), 46-00-00 (14) and other formulas (28). No fertilizers were applied (4)
	Name and dose of herbicide/ha (%)	First work (41), second work (37) and third work (18).
	Name and dose of insecticide/ha (%)	Applied 5 types of herbicides predominate: Esteron1lt/ha (14), Gesaprim1kg/ha (23), Hierbamina (9) and other types (9). Not applied herbicides (45)

Source: own preparation with data obtained from the survey, 2009.

of food webs that inhibit the harm they do organisms at the agro ecosystem. A greater biodiversity generates more biomass below ground that translates into a greater abundance and wealth of micro-organisms responsible for breaking down the organic material and recycle nutrients and energy. The complementarities, interactions and synergies arising from biodiversity are expressed in higher yields.

If in this biodiversity there is redundancy of species by the role they play in the agro ecosystem, explains the origin of the stability, resilience and sustainability of the agro ecosystem. In the event of an environmental change end these redundant species have greater capacity to absorb these shocks (stability) and to recover soon the functionality of the agro ecosystem (resilience); a resilient system is more sustainable. This technological pattern is available between the corn producers in any area of space. Simply identify it and transfer it to the corn growers with less productive potential to strengthen the national production and supply of corn. It is easy transfer it, because the majority of the producers have implemented, since it fits to the general and specific conditions involved in the management of maize.

Characteristics of the Types of Producers for Their Yield: The data in Table 3 indicate that: the types of producers live under similar conditions. Smallholders are in extreme, have low availability to the means of production; the production is intended for local consumption and perform multiple survival strategies prevail the sale of labor force, the handling of backyard and the collection of natural goods; all the poor food producers are already that its per capita income monthly average is less than 707 Mexican pesos. Any income of less than this amount is insufficient to purchase the food basket [23] and the corn growers successful have diversified their tasks in the primary sector and the other in secondary and tertiary tasks, causing an increase in their income [24] and a reduction in its agricultural income [25]. Pluriactivity inhibits the productive potential. To reduce the low yields of producers not successful, there is technological transfer the pattern of the successful, through the establishment of agro ecological headlights.

The agro ecological headlights and productive potential. They were induced by the Cuban Association of Agricultural and Forestry Technicians of Cuba, to disseminate agro ecological practices successful in Latin

America. They are designed as a culture of institutional articulation to bring professionals and farmers, to raise a new agrarian culture, recognize and revalue the peasant culture and pass by the peasant agriculture to an agro ecological proposal. For the MP-I, the headlights agro ecological have two purposes: to transfer the pattern of the technological successful producers and improve, through experimentation, the productive potential of the maize growers. If you transfer the pattern of the technological successful Cohetzala corn to the low and medium, yields would grow, on average, in 91 and 24 %, respectively. These ciphers for SNR would be 157 and 38 %, respectively. The volume of production would increase, 26% in Cohetzala and 36% in SNR. Expressed in per capita terms, this would mean an increase of 81 kg of maize to Cohetzala and 287 kg for SNR.

CONCLUSIONS

In the last six decades the Mexican State has sought to modernize agriculture, through the generation and transfer of a technological package homogeneous and radical to improve the handling of the maize that has been suitable for irrigated agriculture, but not for the producers of temporary because it has ignored the conditions under which produce and live these producers. The way in which the producers have managed the maize is expressed in obtaining yields differentiated unit and in the co-existence of various types of producers, highlighting the successful that were characterized because applied agricultural practices re-created in a gradual manner, which are embedded in the agro ecological paradigm.

Promote the productive potential, requires reevaluating the technological pattern that apply successful producers to improve the management of maize, the unit yields and food security of the least efficient producers.

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