Essay

Use of the land and the elements of agricultural technology for maize in the Morelia-Queréndaro Valley

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Abstract

The objective of this work is to know the use of land and the elements of agricultural technology (ETA) that is used in the cultivation of corn at the community level and the participation of public and private institutions in the promotion and employment of the ETA in the cultivation of corn, in the communities of The Troje (Álvaro Obregón) and Cañada of the Sauces (Tarímbaro), Michoacán, Mexico. A Random Stratified Sampling with 57 interviews with corn producers was used. It was found in the communities can be used five elements of agricultural technology: biological, chemical, mechanical-computer, agronomic and water in a differentiated way; whose use is subject to the topographic conditions of the cultivation terrain, availability of economic resources, diffusion, quality, presence at the community and cultural level and for the promotion made by public and private institutions, based on the type of agriculture that is practice in the community: traditional or modern.

Keywords: agricultural paradigm, peasant, traditional and modern agriculture.

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Introduction

It is considered that in Mexico there are two types of agriculture: the traditional, -used for self-sufficiency and the technology, conventional or modern, to supply the market and reinvest the surplus-. Among them there is a close relationship with the technological needs of reciprocal supports, since without the biotechnological elements extracted from the tradition: selected seeds, calendars, soil and water conservation practices, and increased fertilization; there would be no modern one. In addition, certain ways of doing agriculture have both technological overlap, i. e. they have, to some degree, traditional and modern technological elements mixed.

In the production of food and fodder, different components of agricultural technology are used according to the conditions of the land, climate, slope, space and type of crop; which are complemented with the knowledge, in time and form, of the realization of agricultural practices, strength and type of energy. They use, seed varieties and way to water and drain the land farmers (Márquez, 2008), through millenary practices and selection, which, in the last three centuries, fertilization, fertilizers, hormones, insecticides, herbicides and other biocides, as well as the increase of the use of mechanical energy through of agricultural machinery.

In general, the cultivation of corn is characterized by showing a great variability in production per hectare. The causes are multifactorial, highlighting the adverse factors, edaphic and technological related to the variety used, form and control of production, harvest, post-harvest management and in the organization, marketing and inconsistencies in the transformation of the product in the production chain. Data from the International Cereal Council (2018) show that in the period 2015-2016, there was a world production of corn of 983 000 000 t and an increase in the period 2016-2017 and 2017-2017 to 1 087 000 000 and 1 044 000 000 t, respectively, decreasing in the following period to 1 054 000 000 t.

In the case of Mexico, the cradle of corn and possessor of 59 creole maize races (Sánchez *et al*., 2000), its cultivation is of great economic, nutritional, biological, cultural and technological importance. From this grain the industry extracts: oil, flour, fructose, starch, fuel for automotive vehicles and producers: tortillas, tamales, snacks, cereals, animal feed and other products. Data from the Agrifood and Fisheries Information Service (SIAP, 2018) show that in the autumn-winter 2017-2018 cycle, maize production is 629 000 t, extracted from 1 173 000 ha. Despite the amount obtained, food self-sufficiency has not been achieved, a problem that is solved by the importation of grains.

Since its domestication, 8 000 years ago, the corn plant has undergone modifications, especially at the genetic level, with the interest of making it more productive and resistant to the attack of pests and diseases, and environmental problems. Some variations have occurred naturally in response to environmental conditions (climate, geographic and biological isolation) and others have been induced by humans in their selection processes, carried out in the field for centuries by corn producers and in the last few years by agricultural researchers. Modifications that increase in the transgenic corn, promoted by the main biotechnological corporations of the planet, who have achieved that researchers, institutions, government offices, members of the congress and mass media claudicate before their economic power, without caring about the global ecological imbalance that the planet is having and the indigenous and mestizo peasants.

However, in spite of the fact that there is a large accumulation of agrobiotechnological knowledge around the world regarding the cultivation of corn, breeds, varieties, commercialization, distribution, etc.; in underdeveloped or emerging countries, small community spaces persist where these innovative technologies have not arrived or have been adopted incipiently, either because the physical-biotic conditions prevailing in their lands are not appropriate or because the forms of dissemination, transfer and appropriation have not been adequate; so when they are used, they have had to do it according to their understanding, possibilities and access to them.

The objectives of the research consist of knowing the use of the land and the elements of agricultural technology (ETA) that are used in the cultivation of corn at the community level; as well as the participation of public and private institutions in the promotion and employment of ETAs in the cultivation of maize in the communities of The Troje (Alvaro Obregon) and Cañada of the Sauces (Tarimbaro), Michoacan, Mexico.

Technological of agriculture and corn

Mexico has a rich agricultural history that spans thousands of years. In the corn, there are several farming systems: in monoculture or polyculture, such as the milpa, which is practiced throughout the country. Some such as the "huamil" is carried out in the Bajío (Palerm, 1997). The "slash, burn and burn" in southern Mexico. The system of "year and time", a European system characteristic of the Mexican treasury, where cattle are mixed timelessly with the cultivation of corn; the 'mawechi' of the Raramuris, polyculture that integrates corn, beans and potatoes (Rubio and Rodríguez, 2014). National agriculture is so diverse that we find it occurring in wetlands, terraces, calmiles, chinampas, terraces, 'Ekuaros or ecuaros' and other characteristic systems of the Central Mexican High Plateau (Whitmore, 2003; Pérez-Sánchez and Juan-Pérez, 2013).

Several factors that characterize traditional and modern agriculture are related to the operationalization, management and dependence of human, animal and mechanical energy and inputs used; with the transfer of information, use of tools and techniques appropriate to the forms of work, intensity of land use, slope, water, climate and space available for production (Wilken, 1990, Cruz *et al*., 2004). These factors foster agricultural heterogeneity and technological particularity.

In the last sixty years, the traditional agricultural sector has had a process of "permanent modernization" due to the "supposed" incorporation of technological innovations that alter, to a certain extent, the levels of productivity of the land. On the other hand, modern agriculture has reaffirmed the capitalist character of the economic system, in which context the State has promoted multiple policies to guarantee sectoral technological adoption and adaptation in order to achieve efficiency and productive competitiveness (Jimenez, 1993), inducing technological changes that do not always favor the entire agricultural sector.

The pinnacle of modern agriculture was the Green Revolution, an agricultural program generated in Mexico in the 1960s; in whose development, great flat surfaces were privileged, with good soil, irrigation or good weather and it was aimed at farmers with the capacity to adopt the improved material, agrochemicals and machinery that the expanding US industry was marketing as a

"technological package" (Jiménez, 1993; Mariaca, 2001). This innovative process of agriculture favored the large producers and only partially permeated the peasant smallholders, owners of rainfed lands, with some inputs.

The success achieved by the Green Revolution partially mitigated the hunger in the world and encouraged the exorbitant increase in grain exports. However, its ideologists never foreseen the collateral impacts of environmental and social order that would cause the overexploitation of the land and the excessive use of fertilizers and chemical products that it was proposed to use in package to the rural producers (Tapia, 2013). This caused an environmental imbalance that now seeks to reverse; because it was assumed that there would always be abundant water, cheap energy and that the climate would not change (Altieri and Nicholls, 2012).

The elements of agricultural technology

A factor that has made life easier for human beings and produced differentiated resources has been technology, which, similarly to science, is also divided and subdivided into large areas of knowledge. Among them is agricultural technology, which has been part of humanity since the beginning of agriculture and its development has advanced through the creation of innovations that facilitate work and achieve higher yields. According to Arellano (1991, 1999); Regidor (1987), innovations in agriculture can be of the following types: mechanical (agricultural mechanization), biological (new varieties of high-yielding plants) and chemical (fertilizers, herbicides, pesticides, etc.). On the other hand, Tapia (2006) considers the same innovations as components of the technology and classifies them into: a) machines and techniques; b) organization; c) knowledge; d) products and services; and e) access to information.

Such classifications only consider some technological components that are used in agriculture; However, comparing them we can see that they are incomplete and some factors are out of classification or forming another taxonomic space. Given this, in this case we propose another way to classify innovations and components of agricultural technology, according to their frequency of use. We consider these components as "elements" and we define them as: a set of categories, divisions, levels and components of use, of a biological, hydric, mechanical and computer nature, agronomic and chemical and magic-religious knowledge, which are present, in different proportions of use, alone or mixed, in any crop; which when acting in a systemic way, allow the potential of the crop to be expressed under different environmental and cultural conditions.

Because of their origin, the elements of agricultural technology (ETA) are not used or applied independently, nor move by themselves, for this it is necessary a whole process of dissemination and knowledge of their use, either directly or from one person to another, via extension, transfer, direct observation in the field, in an institutional way (public or private) or another way; as manifested in the "theory of induced diffusion" proposed by Hayami and Ruttan (1971), which considers the existence of an efficient system of information exchange between producers, research institutions, agricultural input producing companies, and markets for factors and products (López et al., 1996); which can be disseminated, transferred or appropriated in the form of biological, chemical, mechanical, agronomic and irrigation technology, in different tangible and intangible presentations, such as dissemination documents, whose ease of approach and low cost promote the adoption of technology (Regidor, 1987).

Corn as a technical object of study

The maize plant (*Zea mays* ssp.) is a tropical plant of Mexican origin and that before the conquest its biogeographical distribution was confined to Mesoamerica. At the moment, it is dispersed in the greater part world, to the being the third cultivation more sown, after the wheat and rice. Its cultivation is articulated in a diverse, holistic and sustainable agricultural set, adapted to the dominant agro-ecological conditions, and always responding to social needs (Bartra, 2010).

It is important to note that since the human domesticity, has continued its effort to modify it to meet their dietary needs and their animals. In this has used various breeding techniques, traditional and scientific, always seeking to obtain the best plant, the most productive, the largest ears and the most nutritious grains that offer greater resistance to adverse environmental conditions and the attack of pests and diseases.

However, in the last century the process of traditional selection of corn and use, which takes several thousand years, has been violated, as a result of the intervention of different governmental and private actors that seek to maintain control over the production of the same biological and productive level, through the promotion of the improved product; offering it; through, a credit or reducing prices. Situation that has caused a loss of germplasm and eroded the practice of selection, which the peasants made in their cultivation lands and generated a dependence on the acquisition of the seed, by preventing the reproduction and sowing of the seed of the previous harvest for the next growing period. This implies that a serious danger hangs over the production unit of the peasants, highlighting the total loss of control of their crops, due to the interest of large transnational corporations to take over the germplasm of corn and become absolute owners of the crop on a world scale, through the creation of patents on improved seeds, transgenic and specific cultural practices (Toledo, 2013).

At a historical level, it is feasible to consider that the corn plant has undergone at least three important technological transformations, which are manifested in the production of creole, hybrid and improved seeds, and now in transgenic ones, whose introduction and use have displaced the old cultivation practices and techniques, adopting new ones, as shown in Table 1.

The study communities are located in the north-central part of the state of Michoacan, in the Morelia-Queréndaro valley, in the municipalities of Álvaro Obregón (The Trojes, Lat. 19° 53’ 01”, longitude 101° 03’ 24”, altitude 1860 m) and Tarimbaro (Cañada of the Sauces, latitude 19° 49’ 55”, longitude 101° 12’ 57”, altitude 2 020 m). Municipalities, which together with Morelia and Charo, are part of the Morelia metropolitan area (SEDESOL-CONAPO-INEGI, 2004). In them the ejidal surface predominates, followed by the small property. According to the 2010 of INEGI census, the first community has a population of 650 people and the second of 813, both are characterized by preserving their rural condition. They belong to the Irrigation District number 20 (DR-20), whose main water supply is from the Cointzio dam and deep wells. The slope of The Trojes farmland is less than 3% and the Cañada of the Sauces is more rugged, as it usually reaches up to 12%.

Table 1. Presence of technological paradigms in the corn plant.

Characteristics	Creole corn before 1931	Hybrid corn from 1940	Transgenic corn end of the 80's
Fundamental characteristic	The genetic exchange was produced by crossing races and varieties in a natural way, with full reproductive capacity.	Genetic exchange is produced between races and varieties artificially selected. Restriction of reproductive capacity.	Incorporation of genes in their chromosomes with specialized techniques of genetic engineering. The reproductive capacity is restricted.
Technological elements	Selection of relevant qualities by the farmer. Traditional agricultural practices, use of human and animal energy, and minimum use of inputs.	Selection by double cross to produce commercial seeds. Technified agricultural practices and extensive use of "technological packages" type Green Revolution.	Incorporation of intra and interspecific genes. Excessive use of the elements of agricultural technology (ETA): biological, chemical, agronomic, hydric and mechanical.
Example of use	Milpa, composed of polycultures.	Varieties of commercial hybrid corn in monoculture.	BT corn inoculated with *Bacillus thuringiensis* genes.
Problematic	Long period of adaptation. Little performance High labor investment. Difficulty to cover the nutritional and economic needs of the population increase.	Abundant use of ETA, which has an impact on higher spending. Loss of germplasm, biodiversity and agro-cultural knowledge. Pollution by agrochemical products.	Ignorance about the consequences that the incorporation of genes other than maize, native species and humans will entail. Little genetic diversity Monopolized commercial control. Agro-cultural polarization.
Benefits	Productivity and conservation of germplasm.	Productive when using the technological package properly.	Resistant to the attack of some larvae of lepidoptera and herbicides.
Knowledge	Transition of traditional knowledge to the scientist		Scientific knowledge

Elaboration with data taken from Escobar (2003).

In the research, the structured questionnaire technique was used, where social, economic and technological variables of the cultivation of corn and cattle were considered. The information was supplemented by semi-structured interviews with government officials and heads of livestock

associations in each municipality. Field work was carried out from February to May 2014. To determine the size of the sample, the list of beneficiaries of the Direct Field Support Program (PROCAMPO), now PROAGRO Productivo, of 2013, was used as a sampling frame, that cultivated corn, both in irrigation and temporary.

To determine the population sample, we applied a stratified random sampling with Neyman distribution for two strata (communities). The size of the population of corn producers was N= 170. In a communal way: 108 for The Trojes (s^2= 5.7809), who sow in irrigation, temporary or both and of 62 for Cañada of the Sauces (s^2= 5.0332) who do it in temporary. The precision was d= 0.42 and reliability of 90%. Obtaining a sample size of n_1= 36.86 for The Trojes and n_2= 19.74 for Cañada of the Sauces. In total 57 interviews were conducted, 36 in The Trojes and 21 in Cañada of the Sauces, 55 men and two women.

To consider the use of the land and homogenize the information obtained in both communities, the classification of Boserup (1967) was used, which is based on soil limitations and demographic pressure, for which it considers five systems: slash-and-burn cultivation. high forest, slash-and-burn cultivation, short-fallow cultivation, annual cultivation and multiple cultivation.

The communities were selected because there is previous experience of five years of study in the agricultural sector of the region and the presence of different types of traditional and modern agriculture that they present; this condition allows us to identify and contrast the diversity of elements of agricultural technology used in the cultivation of corn and the participation of the institutions that promote its use.

Because the topographic conditions of Mexico are very abrupt, it is practically impossible for there to be a homogenous regional agricultural production system. This has led to the development of a highly heterogeneous agriculture, as appreciated in the study communities, which despite being relatively close, present differences in their agricultural and agrarian history: because while the community of the Cañada of the Sauces received the first ejidal endowment in 1936, in The Trojes began the small proprietors, result of the dismemberment of the economy economic system. Later they differentiated, since while in the first community a second and third common extension was given, in The Trojes one was made, whose definitive assignment continues in community litigation, given that it was assigned to another neighboring community.

The total land granted to Cañada of the Sauces was in a rough area, with slopes close to 12%, due to which they created technological strategies to avoid loss of soil and crop due to water erosion, which consist in leveling the furrows of way contrary to the slope and build stone cords in places with higher slope to retain the soil. In the case of The Trojes, flat lands were granted inside the ex-glass of Lake Cuitzeo, these are worked with modern machinery, and present risks of flooding when the lake overflows, due to heavy rains. These topographic conditions caused each community to develop particular farming systems.

Land use and characteristics of corn producers

Considering the classification on soil exploitation systems with respect to the degree of intensity of the Boserup crop (1967), in Cañada of the Sauces there was dominance of short fallow crops, exploited in the form of “year and time”; that is to say: the fallow is annual and biennial, which

implies that they carry out the rotation in the land they own, one year they cultivate a fraction and the next year they let it rest, in that time the cattle is introduced so that they can fertilize it with their feces.

In The Trojes an evolutionary process has been followed in the use of the land and the degree of intensity of the crops. In its tax stage, worked in "year and time" and milpa, method that was abandoned, when the federal government applied the program of control against foot-and-mouth disease in 1946, where the method of "sanitary rifle" was applied, which forced to get rid of cattle (Franco, *et al*., 2012). This involved the loss of the team, the entrance of the tractor and changes in the production process of the crops. Of the short fallow, it happened to the annual and multiple crop in temporary and irrigation, when obtaining two sowings to the year, maize-chickpea and corn-oats or another fodder.

The interviewees of both communities considered that the quality of the land they cultivate is good (72.9%) and that in order to produce more, it is only necessary to devote more work to cultural practices. The 4.2% said that it is very good, 18.8% that is fair and 2.1% that is bad. In this case, they referred to the lands located in the ex-vat of Cuitzeo Lake that are salty or that are flooded. The sale of land in the communities is minimal, at least that's what 95.6% of the respondents said, and in the event, that they come to market their land, this will be due to a need, such as paying a debt incurred, not to be able to work the land because of advanced age, urgency related to some disease or because they emigrated. They said that whoever comes to buy it is a private individual. From there, it was found that 51.7% work their land, 10.3% do it to the third (two parts for the sowing, and one for the owner), 5.2% do it half (half of expenses, half of production), 8.6% rent for a while and 6.9% lends it so that it is not abandoned. The use of the land can be for cultivation or to introduce cattle.

A common characteristic of corn producers in the study communities is the amount of land they sow, from one to five, with measures ranging from 0.5 ha to five hectares. This division is explained by the way in which the land was distributed, since it was sought to always touch all lands under equal conditions. The area sown with maize in 2013 per community is shown in Table 2.

Table 2. Area of corn cultivated in 2013 by community.

Community/ Variables	Cañada of the Sauces					The Trojes				
	Total	Media	Max	Min	SD	Total	Media	Max	Min	SD
Producers	67					127				
Ha cultivated	384.2	5.73	14.43	1	2.48	328.3	2.58	20.63	0.50	2.83
Irrigation prod.	0					84				
Ha of irrigation	0					135.72	1.616	5.46	0.7	0.82
Temporary prod.	67					43				
Ha of temporary	384.2	5.73	14.43	1	2.48	192.58	4.479	5.46	1.39	4.14

Elaboration with data and PROCAMPO (2013).

Sangerman-Jarquín *et al*. (2009) mention that the age and schooling of the producers, explains the technology used in corn production at the community level and that must be taken into account to promote processes of technological changes and introduce new productive activities. The average

age of the ejidatarios in The Trojes was 65.9 years and in the Cañada of the Sauces, 53.1 years; it means that currently agricultural land is in the possession of older people, and is considered to be related to the intensity and frequency of the use of ETA in the cultivation of corn, which in turn are closely related to the topography of the land, the possibility or not of using modern implements, such as the tractor and its equipment, as well as the economic availability of the production unit. This implies that the use of ETAs is done in a fractional and incipient manner.

Cultivation of corn and elements of agricultural technology

It was found that due to the abruptness of the agricultural lands of the Cañada of the Sauces -increased between 5% and 12%-, and the lack of water for irrigation, a rainfed agriculture was developed, propelled by the yunta and the trunk of horses or mules and 100% sows corn. In The Trojes, whose slope of the land is less than 3%, irrigated and temporary agriculture is practiced, using modern technology, such as the tractor and improved seeds and in some cases using mixed-force technologies. Regarding the cultivation of corn, 47.2% sowed it in monoculture and 41.4% in milpa (maize associated with beans and squash). The remaining percentage sow's alfalfa. The monocultures are in the flat area and irrigation of the lake and the milpas on the slopes.

The ETA that they used most frequently in their culture, at the community level, were the biological ones, the chemists and the computer mechanics, the agronomic ones, they are implicit in each cultivation system and the hydric ones, with the presence of rainwater, river or well. The magic-religious, related to rites and ceremonies, were not investigated.

The biological ones have to do with the species and varieties of seeds -creoles or improved - that they use in the sowing. In the Cañada of the Sauces they sow creole corn, which they call "humado", "ancho" and "arroz". The first two varieties sow it throughout the community, because they produce good stubble and seed. In the case of improved seed, only use the variety "Milpal H-318" for temporary. In The Trojes they use creole and improved varieties for irrigation and temporary. Its use depends on the capital that is available for its acquisition; however, there is a preference for improved seed (92.30% sowing). It is possible to find "grazed" seeds in irrigation, which they call "charqueño", possibly a derivation of the Chalqueño corn introduced in the Guanajuato basin in the 1960's.

Of the improved varieties of maize, white and yellow used, some are produced in the region such as Milpal H 318 for seasonal and Milpal H-377 and 382 A, which are varieties of intermediate-late white maize for irrigation, whose price was $450.00 the bulk of 20 kg. They also used the varieties of improved corn "Bida Sem 57", a cuatero white corn, intermediate at a cost of $850.00 and Novasem, triple-cross corn, whose cost was $1 310.00. These varieties were marketed by the municipal Agricultural Development Office and seed vending stores, with great variation in price. However, apparently there is no criterion of improved seed to plant, possibly the most important to consider is the economic availability and that the seed will not be rejected or receive a price penalty from the winery to which they sell.

The price of the seed plays an important role, since according to those in charge of the Municipal Development Office, the cheap maizes "do not trust you, because of the price, so they decide to buy expensive ones". Some producers with greater economic capacity, confirm the previous comment "I am sure, that's why I buy the most expensive corn, because the other one later does

not work for me". Other responses were "the creole seed does not yield the same as the improved one", "the corn does not resist the strong winds, because it is very high", "the creole seed has already been lost" or "they do not want to buy the native corn in the winery and if they buy it, they pay it very cheaply". In the commercial stores and seed distributors of the municipality it was possible to find varieties of improved corn seeds from the companies Aspros, Asgrow, Avante, Novasem, Dekalb and Forza, with prices from $1 690.00 (Var.: AS-900 of Aspros), up to $33 800.00 as the Cimarron with Poncho (treatment against pests) of Asgrow. The municipality expends improved seeds at half price, but only sells up to five packages of 60 000 seeds or 20 kilograms per producer.

Likewise, it was found that the interviewees are ignorant about the biological control of pests, the use of trap crops, of parasitoids or other types of less aggressive population controls of plants and animals that attack the corn crop. It is considered that it is due to the educational level, age and the lack of information granted by the different institutional actors, who are basically focused on the distribution and sale of commercial products. However, the presence of biofertilizers was observed, such as mycorrhizae and ecoguano, promoted by the municipal presidency.

With regard to the use of chemical elements, it was found that factors such as the availability of water and the instrument of application, in the case of the pump, manual or tractor, will influence its application; and that its use is very uneven. The most common chemicals they use are insecticides, such as Lorsvan, Malathion, Foley (36%), Furadan, Bayer, Dragon (20%), Cypermethrin (16%), Murcielago, Sanson and others whose names they did not remember. They use them to control the intense attack of insects like the "trips" in The Trojes and grasshoppers in Cañada of the Sauces. The herbicides were used by 78.6% of the interviewees and the most common were Gramocin (20%), Marvel (25%), Hierbamina (15%), Tordon (10%), Banvel, Foliar, Arrasador, Pardy, Machetazo and others in smaller proportion. Its price is usually varied, since it depends on the brand and the presentation of the product.

The use of fertilizers was particular, because the doses they handle and the way they were applied varied widely, since they were conditioned by economic availability; after the purchase of the improved seeds, it is the most expensive product and in a certain way, the producers consider that it is the factor that determines the level of production. It was applied alone or in mixtures and at different times of the plant's phenology. The most used product was ammonium sulfate ($(NH_4)_2SO_4$), they applied it in the first weed (81.3%) or at the time of sowing, in doses ranging from 150 kg ha^{-1}, to 300 kg ha^{-1}, whose cost ranged from $3 200.00 to $3 500.00 due to transportation payment.

The use of fertilizer mixtures is common in the cultivation of irrigated maize, usually applied during the formation of the jilote. These may consist of two or three components, these being: a) Ammonium sulphate plus DAP (diammonium phosphate) (ratio = 100 kg ha^{-1} + 50 kg ha^{-1}); b) ammonium sulfate plus DAP plus potassium chloride (ratio = 250 kg ha^{-1} + 100 kg ha^{-1} + 100 kg ha^{-1}); c) more foliar urea of Bayer 20/30 (vitamins, phytohormones and microelements) in proportion of: 280 kg ha^{-1} plus 3 kg ha^{-1} and 400 kg ha^{-1} + 2 kg ha^{-1}, respectively; d) ammonium sulphate with urea (200 kg ha^{-1} + 200 kg ha^{-1}; and e) ammonium sulfate plus simple superphosphate ($Ca(H_2PO_4)_2$), (222 kg ha^{-1} + 111 kg ha^{-1}). Urea is the only fertilizer applied only for the second time in doses of 200 kg ha^{-1}, whose cost was $6 600.00 ton and the DAP of $7 000.00. The application of mixed fertilizer involves very high costs in the production of corn.

Products such as fungicides for vegetables and hormones for animal fattening, such as Clenbuterol, are mentioned that are not used. It is important to consider that the lack of technical assistance in carrying out chemical analysis of the soil to determine nutritional needs, coupled with the lack of resources and the tendency to apply what your neighbor or friend does, can result in excessive spending by the ignorance of the adequate dose, since the yield will not increase beyond the recommended dose.

The mechanical-computer elements are the sources of force, instruments, devices, machines and modern computer systems used in the productive activity under different conditions, from the preparation of the land or in planting, fertilization, harvesting and storage; until the monitoring of the conditions of the crop of automated way, as it happens in the greenhouses constructed with high technology. The use of this element is related to the topography of the land, in such a way that in the flat areas or with minimum slope the space exists an evolution whose final result is the total appropriation of the modern technology.

In The Trojes there are temporary and irrigated lands with slopes of less than 3%, the human and animal strength used to cultivate corn has practically disappeared, and the tractor, owned by private individuals, of the The Trojes farmers' union or the rural development module; its collection is lower than those that the maquiladoras rent. There are different brands of tractors such as CASE IH, New Holland, John Deere, Ford, some of them are very old and varied power take off, ranging from 33 Hp to 155 Hp, the latter being one of the most modern, property of the rural development module of SAGARPA. Others are 54 Hp, 64 Hp, 80 Hp, 90 Hp, whose importance is manifested by the presence of several tractors marketing agencies.

With the tractors level the land, track, cross, barbechan, furrow, sow, apply insecticides, fertilize, apply herbicides and grind the stubble. Its use will depend on the size of the property and needs for use. To save money on the rent of the tractor, mixed work is usually done, that is: the heavier work such as leveling, fallowing and sowing do with the tractor, and the rest of the practices use the trunk of mules. In contrast, in the Cañada of the Sauces the work of growing corn is done with work animals and manual, only the milling of corn they do with a tractor. Given this, it was found that 81% of the interviewees have an egyptian plow, 43% a team of oxen, and 38% a mule trunk. The informants stated that the use of a team of oxen high ($30 000.00), in addition to the frequent theft of working animals. This problem has not been solved due to the lack of attention of the authorities. Other tools that are used in the realization of activities in the field are: machetes, wheelbarrows, curved and flattened shanks or jaws, shovels, hoes, etc.

The agronomic element has to do with the calendars and agricultural practices (traditional, modern, technified, conservation, etc.) and with the formation of committees, boards, councils and other forms of organization, who are constituted to achieve a common goal, meet pre-established goals and objectives through collective effort. Thus, in The Trojes there is the organization Agricultural Producers from The Trojes, SPR of RL, which carries out activities around the raising of cattle for meat, and has developed a production chain, which includes the care, management and maintenance of agricultural machinery, well water control, livestock management and care; as well as small productive projects that are in the process of consolidation. It is important to highlight the importance of the organizational process, given that with two tractors and their implements work about 350 hectares, cultivated with corn, harvested and improved, alfalfa and sorghum. This allows freedom and economic resources to the 92 members.

However, there is a generational situation that to a certain extent marginalizes the development of the organization. This implies the need to initiate, in some way, the generational change, which in doing so would provide work for young people, many of them with a profession and adequate management, technological and administrative. In the communities, there are young and well-prepared people, who, apart from ensuring a quality of life for the elderly ejidatarios, would contribute to reduce migration through the increase of work activity. For strengthening and increasing the productive chain of the cultivation of corn and other fodder, and join them to the exploitation of fattening cattle, internally it would allow to diversify human resources.

In the case of the Cañada of the Sauces, most of the work is family, where the productive chain in the production of corn, dairy cattle, milking, cheese production and direct marketing to consumers in the squares close to the community stands out. However, they lack organization possibly due to lack of confidence or lack of experience. The organization would bring greater technological and economic support that would allow them to diversify the chain.

It is important to mention that the production of vermicomposts and compost in the communities is not worked, despite being commercialized in the region, nor was information on elaboration and knowledge on the part of the ejidatarios found. It is considered that due to the age of the informants of both communities and the educational level, Internet management is practically unknown to all of them and they have only had contact with it in the government offices, which identify its use due to the presence of the computer and the search that they make of them when they are going to carry out some management before the government entities.

The water element is formed by irrigation and drainage, with two levels that depend on the origin of the water: a) natural, characterized by rainwater; and b) artificial, from wells, rivers and their tributaries. Therefore, in its correction a series of construction works must be carried out, such as embankments, dams, drainage channels, leveling of the land or of the furrows and others. The community of Las Trojes has irrigated land, which is located in the former vase of Lake Cuitzeo and on the banks of the Río Grande. In the case of the lake area, the water is extracted from a deep well via a submersible pump, in the river it is made with a stationary pump or "charquera". In both cases the water is piped, driven by an electric pump and then rolled in the ground. Its management and control is done by a person responsible for irrigation, both the well and the river, who is responsible for distributing the water and collecting the money to pay for the electric power that the pump spends. In the case of river water, user fees are paid to the water module of the Water Commission of the Irrigation District.

About the drainage, it can be said that its management is discretional and personal, due to the topographic condition of the land. So, we find that in flat area level the ground using the tractor, guided by laser beam. In the land, they tend to form water harvest ditches, whose function, in the lake, is to wash the land and avoid flooding in the crops. In the case of The Cañada of the Sauces, due to the slopes of its land, there are no flood problems. The biggest problem is the landslide, so they have to make level grooves and place drains with stones. When it gets to sink, they simply release the water, with small drains and do not perform cultural practices that cause loss of land, as it crosses it.

Regarding the participation of public and private institutions in the use of ETA at the community level, it was found that in the case of the government, it promotes them by offering the products at lower prices. For example, in the case of improved seeds, they sell them at 50%, with the disadvantage that they only sell up to five packages per producer. In the case of other products, such as veterinary medicines, fertilizers and agrochemicals are provided at the factory price. This is coupled with another type of support that is PROCAMPO, whose resource has several uses, the most frequent being the purchase of agrochemicals. When it does not reach products in the government or is not satisfied with the quality of the product marketed by the municipality, they turn to the agrochemical stores, with which there is close contact because they usually grant them credit and provide them with technical advice to solve their production problems.

Conclusions

The use of land and the elements of agricultural technology in the production of maize, at the community level, is related to the conditions of the cultivation lands, mainly with the slope, size, presence of water and soil quality of cultivation and use of the elements depends on the availability of economic resources, dissemination, quality, presence at the community and cultural levels; as well as for the promotion that government institutions make of them, by offering them at lower prices; in contrast to what private institutions do, who to promote a certain element include it within a package, which is promoted through a credit and purchase of the harvest.

In Cañada of the Sauces, where the topography of the agricultural space is abrupt and there is a lack of water, a traditional production system of "year and time" is preserved, dominated by the presence of creole seeds, use of the yoke of oxen and the shooting of horses as a source of strength and family work; and in the production of corn they use less quantity of agrochemicals such as: insecticide, herbicides and fertilizers. Until now, there is a difficulty in the use of the tractor, as a mechanical element in the work of the field.

In The Trojes, where the topography is flat, the use of technology is more technical, since there is a greater use of improved seeds, insecticides, herbicides, fertilizers and machinery. With the tractor, they carry out the greatest amount of agricultural activities, such as: furrowing, sowing, applying chemical products, fertilizers, harvesting, grinding and transportation. Work in the community is done in an organized manner, a condition that gives it an advantage over the other communities. The machinery, water management and livestock is controlled by committees. Which implies that working with two tractors cover 350 ha that they grow with corn for the most part and alfalfa. The organizational process has allowed the construction of a productive chain from a corn derivative, the stubble, with which a cattle herd is fed close to 500 cattle for meat production.

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