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PROSPECTS FOR AGRICULTURAL DEVELOPMENT OF SMALL PRODUCERS IN THE STATE OF GUERRERO, MEXICO, WITHIN THE FRAMEWORK OF THE SOWING LIFE PROGRAM

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Abstract: The diagnosis was carried out in 2022, in the state of Guerrero, Mexico, with the objective of knowing the technology applied by corn producers, and the initial conditions in the application of the Milpa Intercalated with Fruit Trees (MIAF) technology), as well as, propose an intervention scheme to contribute to the achievements of the objectives of the Sembrando Vida program in the state of Guerrero.

The most relevant results refer to the evidence of the majority participation of men in productive activities. Regarding the production conditions, this is carried out on land with high slopes, that is, steep slopes, which makes the use of the Milpa Interspersed with Fruit Trees agricultural system, based on planting the milpa between rows of fruit trees. The use of agricultural machinery is limited to areas of low slope, little use of machinery, and soil tillage is minimal. Weed control is done manually by most producers, although there is use of herbicides and agroecological products among producers. Chemical fertilizers and agroecological products handcrafted by producers are used. Regarding the progress in establishing plots with the MIAF system, 87% of those interviewed stated that they had an average of 1.0 hectares of the system, which were established between the years 2019 to 2022, using the species of lemon, guava, soursop and avocado, mainly. Based on the diagnosis, the technological model to be used was defined, with the areas of opportunities identified in the use of MIAF technology, also in the use of the Field Schools model, for training and technical support.

Keywords: Training, Field schools, Hillsides.

INTRODUCTION

The Sembrando Vida program began in October 2018, as part of the public policies of the Mexican government focused on contributing to the well-being of small producers who are in municipalities with social backwardness, through the production of 2.5 hectares planted with Agroforestry Systems and/or Milpa Interspersed between Fruit Trees (MIAF), in order to cover their basic nutritional needs (Official Gazette of the Federation, 2019).

The operation of the Sembrando Vida Program coincides when the effects of climate change are evident, reflected in the deterioration of natural resources; degraded soils, water scarcity, deforestation and loss of biodiversity.

In the specific case of soil, a study carried out by the Ministry of the Environment and Natural Resources and the College of Postgraduates (2003) indicates that the country has soils degraded by human action in 45% of its territory. The main process is chemical (18%), followed by water erosion (11%) and wind erosion (9%), and the smallest proportion corresponds to physical degradation (7%), with agricultural activities and overgrazing being the main causes.

To reduce the risks of erosion, it is desirable to protect soils through vegetation cover, and reduce the slope, through banks and ditches, as pointed out by Canqui and Lal (2001). Part of this strategy has been implemented in Mexico, under a basic crop system scheme intercropped with a vegetal barrier, in this case, it was with Gliricidia sepium, a legume with the capacity to fix nitrogen, for forage use (Cuervo et al., 2013) and with the capacity to resprout, in such a way that it can be used as firewood, despite its efficiency in reducing erosion, up to 98%, compared to the control treatment, it was not adopted by the producers, since it did not generates economic income in the short term (López et al., 2000).

With the premise that economic and environmental benefits must go hand in hand in soil restoration programs, the Milpa Intercropped with Fruit Trees (MIAF) system was integrated in Mexico, where the milpa is intercropped with fruit trees, in a design tested with indigenous producers from Oaxaca. This is a strategy aimed at hillside plots in order to obtain environmental benefits by controlling erosion; nutritional benefits through the production of basic grains, such as corn, beans and pumpkin, among others, as well as economic benefits through the production and marketing of fruit trees. (Cortés et al., 2005, Francisco et al., 2010; Cortés et al., 2012 and Cadena et al., 2018).

With this information, and with the support of the National Council of Humanities, Sciences and Technologies (CONAHCYT), INIFAP participates in the Sowing Life program, to contribute to strengthening the capabilities of the technical team through training in different areas, such as application of MIAF technology, as well as aspects of agroecology, pest and disease control, community diagnostics and market strategies, to contribute to strengthening the agri-food autonomy of the Mexican rural sector. For the specific case of this article, the results of a diagnosis carried out with the producers participating in the Sembrando Vida program in the state of Guerrero are described, which allowed us to know their production processes, from the conditions of the production units; how they cultivate the cornfield, its management, marketing, infrastructure, problems and training needs, based on which, a proposal for training and technical support is presented, based on the concept of learning by doing in the Peasant Learning Centers (CAC).), transformed into meeting and practice centers for relevant production technologies in terms of the identified needs, these actions are strengthened with other actions such as experience exchange tours between the different CACs.

MATERIALS AND METHODS

Given that in the state of Guerrero the Sembrando en Vida program was developed in 2023 with the participation of 29,922 producers and 1,197 CAC'S, the diagnosis was carried out in 28 municipalities of said state, this represents 33% of the state's total. The sample size was 400 personalized interviews with producers, which was determined with the formula proposed by Rendón and González (1989), for multiple-purpose studies, useful in diagnostic studies that use the sample survey method.

$$n = \frac{N\,K^2}{(N-19\,)\delta^2 + K^2}$$

Where;

n = Sample size for multiple purposes.

N = Population size.

δ = Relative precision with respect to the population standard deviation (σ), is a value between 0 and 1.

K = Value from the Z or t tables, when the distribution of the estimator is normal or approximately normal

The information was obtained through the application of a questionnaire, made up mostly of questions with pre-coded answers, and a minimum of questions with open answers, which were categorized to facilitate the analysis. The sections that made up the questionnaire were: a) Identification of the producer, b) Characterization of the MIAF system, c) Technical-productive characterization of the MIAF system, d) Marketing of annual products, e) Marketing of perennial products, f) Infrastructure within its MIAF system and g) Appreciations of the producer and training needs in the MIAF system.

Field tours and interviews with key actors were also carried out. The information from the questionnaires was captured in the Excel© database, and was analyzed based on the SPSS introductory manual. Statistics Standard Edition 22 (Méndez y Cuevas, s/f) from which the results were obtained, which are described later.

RESULTS AND DISCUSSION

SOCIOECONOMIC ASPECTS

Regarding gender, 72% of the participants are men and 28% women, which shows that this activity is dominated by men. Even so, participation in this program is higher than what was reported in the 2022 Agricultural Census, where it is reported that participation is 16% (INEGI, 2022). This situation occurs largely due to the absence of the husband or partner, to attend to other productive activities or due to emigration (León et al., 2002).

The average age of participating producers is 46 years; that is, a productive age, with the presence of young people, which is attributed to the economic orientation of the activity (Chávez et al., 2019), which is provided by the commercial nature of the fruit trees that are included in MIAF technology.

Regarding schooling, 50% of those interviewed have education up to the primary level, 25% the secondary level and 12% the high school level. The proportion of people without education of 12%, similar to the state average which is 12.5% and higher than the national average of 4.7% (INEGI, 2020)

Regarding the size of the families, 56% are made up of 3 to 5 members; while 24% have 6 to 7 members. In marital status, families that are married predominate (73%), while 12% are in a free union. Regarding family participation in productive activities, on average two family members participate, although they do not receive any remuneration.

Another relevant aspect refers to the knowledge of the distance from the house to the plot; The majority (70%) have their plots more than 10 km from their homes, which limits the transfer of inputs and crops to the plots and houses, respectively.

In general, the context is an agriculture that is oriented towards self-consumption, with limiting aspects such as low schooling, the effects of male migration, the advanced age of producers and family work (Becerra, 2021., Ramírez, 2022., Cid et al., 2022., and Cabrera et al., 2022).

PRODUCTION CAPABILITIES

51% of those interviewed indicated that their land ownership is ejidal, 34% is communal and 11% is small property; in legal terms, the usufruct of community ownership predominates.

The producers interviewed carry out their activities on two to three hectares on average, this value in the state is 6 hectares (INEGI, 2022), with this surface and given that the production is seasonal, the prospects of obtaining sufficient income for the well-being of families are complicated.

Regarding the land for production, only 18% of the land is flat, the rest are hillside land with different degrees of slope. This creates difficulties for mechanization, making it more feasible to perform different tasks manually.

The soils, for their part, are mostly black earth (41%), clay 27%, sandy 16% and stony 16%. In cultivated soils, color is an important property, since it is a differential method of soil fertility, specifically in the content of organic matter. Dark soils have more organic matter, an important factor for crop nutrition (Cloy and Shephered, 2015).

Regarding the resources to finance productive activities, 73% use their own resources, 11% use loans, 7% use resources from family members, 6% from government programs and 3% from remittances received from family members from the States. United of America. As can be seen, most of the resources for production (91%) correspond to the availability of families, including personal loans.

MANAGEMENT OF THE CORNFIELD

For the development of field activities, the use of agricultural machinery only occurs in 15% of producers, while 85% do not use machinery. The above is directly related to the physiography of the land, which limits mechanization in the productive part, coupled with its shortages (51%) and the high costs of the maquila service (20%).

Regarding the tillage system used in the production units, 34% of those interviewed apply the conventional system that includes fallow, tracking, furrowing and the necessary cultivation work. It is important to note that there are other modalities of tillage, such as minimum tillage with 46%, and the absence of soil tillage with 20%, mainly on hillside lands. These three methods of preparing the seed bed are associated with the physiography of the crop land, and both minimum tillage and zero tillage are classified as direct sowing, according to the Conservation Technology Information Center (2002).) and its importance lies in a lower emission of greenhouse gases due to lower consumption of fossil fuels, and lower oxidation of soil organic matter due to tillage (Lal, 2004).

To control weeds, the most common way is manual control in 34% of production units, given that in many cases it is provided for feeding work animals, and in other cases, as food for humans. In this sense, 6% of production units apply chemical products to control weeds, while a similar percentage (6%) uses agroecological products for control, and only 2% uses machinery to control weeds.

74% of the producers mentioned that they are affected by the presence of pests in the cornfield crop, with the cutters (56%) being the most affected, other pests are the defoliators (16%), suckers (13%) and scrapers (3%). To control pests, 54% use manual methods with the use of agroecological products, while 22% apply commercial chemical products for control. The above shows minor damage to the environment, although the use of chemical products still persists.

Regarding the presence of diseases, 61% indicated that the plants get sick, without specifying the symptoms. In general, disease damage in corn has been minimal, and there is no knowledge of more aggressive diseases, such as asphalt spot.

For the nutrition of the cornfield, 65% of those interviewed indicated that they do apply fertilizers, for the most part, they are applications of solid products to the soil, although they also make foliar and liquid applications to "drench", to a lesser extent. The above implies that producers, through the use of inorganic and organic products, complement the methods of providing nutrients for plants, those of higher concentration and inorganic to the soil and organic products, derived from leachates, are used to correct nutritional deficiencies, both in foliar form, as well as applications at the base of the plants.

Regarding the fruit trees that families have on their land or in their backyards, 67% indicated that they are affected by the presence of pests, mainly by cutters, defoliators and suckers. For its control, they preferably use agroecological methods (44%), and 25% apply chemical products.

COMPONENTS RELATED TO THE MIAF

When the diagnosis was carried out, 84% of the producers participating in the Sembrando Vida Program had already established their plots with MIAF technology, on an average surface area of one hectare per producer, which was established between the years 2019 to 2022, starting with 9% in the first year, with a growth of 34% by 2020, and 32% by 2021, and the last plots were established in 2022.

Among the fruit trees that have been established to form the association with the cornfield, the lemon (Citrus limon) stands out (15%), the guava (Psidium guajava) (13%); with 12% the species of soursop (Annona muricata) and avocado (Persea Americana), and to a lesser extent, the mango (Mangifera indica) (9%) and 5% with peaches (Prunus persica), nanche (Byrsonima crassifolia) and tamarind (Tamarindus indica).

The species were defined by the producers and the technical team of the Sembrando Vida Program, based on the agroecological conditions of the communities, with the principle that the MIAF seeks to make three contributions to families and the environment; with the milpa contribute to the food self-sufficiency of the families through improvements in the production of corn, beans, broad beans, peas and other species that the families grow in the milpa, while the structure of the MIAF, with the rows of fruit trees and the living barriers where the fruit trees are established, allow reducing the speed of surface runoff, promoting greater infiltration of water to the lower layers of the soil; Furthermore, by placing the stubble on the trunk of the fruit trees, the formation of a border is promoted, which when decomposed becomes a long compost heap and a good space for the radical development of the fruit trees, and fruit production represents the driving force. economic of the MIAF system (Cortés, et al., 2012).

The design for the establishment of the MIAF begins with the drawing of the contour curves, mainly for the location of the rows of the fruit trees, and later, the furrows for the production of the cornfield, following the drawn curves. 72% of those interviewed indicated that they had established the MIAF with the drawing of contour curves, while 28% did not do it this way, this is mainly due to the fact that their plots are located in flat areas without slopes, only The established measures were respected.

The runoff filter refers to the placement of the remains of corn stubble or some other annual crop that they plant on their terraces, along the row of fruit trees, stopping at their trunks, intertwined for greater mooring The material initially contributes to stopping the sediments mobilized by rain, both soil and water, and over time it decomposes to contribute to the fertility of the soil. Regarding this practice, 41% of those interviewed indicated placing corn stubble at the base of the fruit trees, and 59% do not do so. It is important to note that, in the context of seasonal and subsistence agriculture, stubble serves mainly to feed the family's working livestock; team, donkeys and horses, so the decision to occupy the stubble to meet the requirements of MIAF technology becomes difficult.

In the design of the MIAF technology, the distances between the rows of fruit trees and the space designated for the cornfield are established. If the slope of the land is less than 20%, a distance of 14.4 meters between the rows is recommended. In cases where the slope exceeds 20%, it is suggested to reduce the distance between rows to 10.6 meters. According to the results of our survey, 43% of those interviewed use the recommended distance of 10.6 meters between rows of fruit trees. However, 35% of producers opt for a non-recommended distance of 7.4 meters. Furthermore, regarding corn cultivation, the distance between rows is in the range of 70 to 80 cm in 68% of the cases, and the average distance between the bushes is 50 cm. With these measures, a population density of 50,000 to 57,000 plants per hectare is achieved.

During the time of participation in the Sembrando Vida program, producers have participated in different training events, mainly in the preparation of different agroecological fertilizers that contribute to plant nutrition; 29% indicated that they have learned to prepare bocashi, 10% composts of different types; 5% vermicompost and 5% leachate preparation.

In the case of the fruit trees established in the MIAF system, a central element for the survival of the plants is water, 59% of the producers provide relief irrigation to the fruit trees, which has made it possible to ensure the development of the plants. while 41% have no possibility of providing relief irrigation to the fruit trees.

In tree management, producers do not carry out any type of pruning on their fruit trees, so the growth and development of the trees is not directed (61%), 37% indicated that they do pruning fruit trees. In field observations, it was observed that the pruning carried out is deficient, and that it requires greater technical attention. To the question about whether they know the pruning system called Modified Tatura, the majority responded that they do not know it (66%), and 39% that they do know it, although they indicated that they require more information about it.

Regarding the usefulness of stubble (harvest residue from annual crops) in cornfield production, the majority (97%) indicated that, if they know of its usefulness, they leave it on the trunk of the fruit trees (78%).

Another necessary practice in the MIAF is thinning, when there is an excessive number of small fruits, it is suggested to eliminate a part so that those that remain reach a larger size, and, therefore, a better price. The result obtained indicates that 52% of those interviewed do not practice it.

PROPOSED TECHNOLOGICAL MODEL

Due to the physiographic conditions, characterized by high slopes, as well as the information obtained in the diagnosis, in which areas of opportunity for improvement in the application of MIAF technology were identified, the proposed technological model is described below.

The MIAF agricultural system is a compound crop that includes corn, one or two edible legumes, or another low-growing annual commercial species and fruit trees, established in intercropped rows and rows, designed as a Milpa Intercropped with Fruit Trees (MIAF) system. for hillside agriculture. The MIAF system takes advantage of the complementary relationships between annual species such as corn and beans, and fruit trees in terms of the comprehensive use of soil, water, light, family labor and carbon capture (Ordoñez-Ovalle et al., 2022).

It is suggested that MIAF be planted on land with steep slopes, with slopes of 20 to 40%, spaced 14.4 m apart, with fruit trees planted 1.0 m apart, with a space or strip for planting 4 rows of corn. and beans with a distance of 0.80 m between furrows parallel to the row of fruit trees. The first row of corn and/or beans is at a distance of 2.4 m from the trunk of the fruit tree on both sides of the row. Along the row of the fruit tree on the upper side, there is the runoff filter based on corn stover supported by the trunks of the trees, to control soil water erosion. This filter is formed each year by placing corn stubble horizontally intertwined. This distribution allows the design of eight rows of corn and/or beans, interspersed in rows of fruit trees spaced 14.4 m apart. Then corn and beans occupy 58% of the land and fruit trees the remaining 42%, with a planting density of 909 trees per hectare.

For the establishment of the MIAF system, it is recommended that the species be according to the climate of each region, that they respond to modified Tatura type management and pruning, and with quality fruit for fresh consumption, harvested in the season of lowest supply. in the market. In temperate climates, deciduous fruit trees are recommended, while in subtropical and tropical climates, evergreen fruit trees. As indicated, recommendations have been defined for the formation and pruning of trees, both in summer and winter, nutrition and fruit thinning.

Regarding the production of corn and beans, at the beginning of the MIAF, the soil is broken to favor the formation of terraces, and this will be maintained until the slope of the strips between the rows of fruit trees decreases by around 15%., later it will be managed with conservation tillage.

The nutrition of the plants will depend on the fertility conditions of the soils, and the requirements of the varieties to be used. The sources to be used are suggested to be agroecological products.

Regarding weed control, during the first stages of growth of corn and beans, weeds compete strongly for water, nutrients and light, it is recommended that it be done manually with a shovel, hoe or machete, and it must be carried out in the first five weeks. after germination.

Hilling is suggested, which is the operation that consists of gathering, forming and piling a certain amount of soil at the foot of the plants, which helps the aerial roots to fix or anchor themselves in the soil, thus reducing the problem of lodging for tall plants, which is a characteristic of native corn. Hilling coincides with weed control and can be done with a shovel or hoe.

Likewise, detasseling is suggested in corn, once pollination has been carried out and thus reduce water consumption, be able to use that forage to feed livestock and promote the products derived from photosynthesis to be distributed to the rest of the plant. It is good to remove the stem without damaging the leaves, especially when there are high population densities, lack of humidity and nutrients (Sangof and Salvador, 1998).

Regarding the control of pests and diseases, they will be controlled when damage is observed, for which the use of agroecological products is suggested, for which they must consult with the corresponding technician.

TRAINING AND TECHNICAL SUPPORT PROPOSAL

Due to the conditions of the context of the Sembrando Vida program in the state of Guerrero, characterized by the presence of elderly producers, illiteracy and indigenous groups, it has been considered that the training and technical support model is that of Field Schools.

The Field School is conceived as a space where a group of producers and technical teams meet to analyze, share and exchange knowledge and experiences of their productive life, to seek and apply solutions in order to achieve change in their production system and improve the well-being of their family (Morales et al., 2015). Field Schools have also been known as "Schools without walls", where producers learn through observation and experimentation in their own fields. This allows them to improve their management skills and become knowledgeable experts in their own fields (Ardon, 2003).

Typically, a Field School is made up of a group of 20 to 30 farmers who meet regularly for a defined period of time; for example, during a crop production cycle, to test or validate new production options with the help of a facilitator (Morales, 2007).

The main characteristic of Field Schools, refers to their approach to learning - by doing, is their practical nature, that is, it is assumed that the learning and mastery of various techniques will be achieved through the exercise of the same, so In the training courses, all attendees will be encouraged to carry out the practices.

The plot is the place of learning: Field Schools are developed in the communities where farmers live. This way, they can easily attend the sessions and continuously monitor the learning activities. The facilitators travel to the site on the day chosen for the meeting. The school has a plot that serves as a learning classroom. It is not a demonstration plot, but a live laboratory that gives farmers the opportunity to test new methods for themselves before applying them to their own crops. It is important to remember that the plot must be managed by the group of participants themselves. The plot is the main learning tool. All activities are organized in and around it.

TRAINING STRATEGY AND TECHNICAL SUPPORT

The evolution of the training model towards a training and support strategy, that is, a form of rural extensionism based on Field Schools, is based on the capabilities that are generated with training in field school sessions, training of promoter producers and visits to the producers' plots.

The training and technical support strategy has been structured into three levels of action; training with the Field School method in headquarters sites, later the replication of the training in neighboring sites and finally, technical support to producers in their plots.

Training at the headquarters site must preferably be given by a specialist in the programmed topic, which may be a researcher, a technician with mastery of the topic, or an experienced producer. This training is mainly attended by producers who perform the function of promoters, as well as the technical team.

Once the training has been completed at the headquarters site, the technicians and the promoting producers share what they have learned with other members of producer groups from neighboring communities. This is the replication of what was learned in the headquarters training. Greater participation by the promoter in the phase of sharing his knowledge is suggested. His participation in cases of illiterate producers is very important.

The next phase is technical support for producers. For this phase, it is suggested that, at the end of the replications, the team proposes to the producers to visit them in their plots, this part provides strength to the way of working, since the producers greatly appreciate that the field technician visits them in their plots. During these visits, the technician will find out if the producers are applying the technological components that have been promoted in the training program. In cases where the technological components are not being used, he may investigate the reasons that limit the use of the components, and may also support producers on other topics not included in the training.

CONCLUSIONS

With the information obtained in the diagnosis carried out, various areas of opportunity were identified for improvement in the application of the Milpa Intercalated with Fruit Trees agricultural system, these technological components were incorporated into the described technological model, also due to the context and characteristics of the producers. participants, it has been considered that the Field Schools training and technical support model is appropriate to improve the capacities of producers, given that it is based on the process of learning by doing.

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