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Agroecological production experiences in four agricultural regions of Mexico

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ABSTRACT

Objective: To analyze experiences with various activities and practices carried out in different agroecological regions of Mexico, involving diverse crops, but excluding the use of chemicals.

Design/Methodology/Approach: Surveys were conducted in four agricultural regions of Mexico (Texcoco, Estado de México; Vicente Guerrero, Tlaxcala; Michoacan; and Tetela del Volcán, Morelos); they tackled a broad description, background, inputs, and agroecological practices, in order to enable a descriptive analysis.

Results: Out of all the agroecological units, 60% are ejidos and 40% are small private properties. Producers are between 25 and 68 years old. Plots range from 0.50 to 20 ha. The main crops are corn (*Zea mays* ssp. *mays*) and avocado (*Persea americana* Mill.). Forty-five percent of the crops are rainfed and 36% are irrigated/rainfed. Half of the producers perform crop rotation, while 40% prefers crop association. After 15 years of experience, the number of producers who did not use chemical herbicides increased from 59% to 95%. Crop nutrition is based on such elements as compost (27%) and manure (23%). Fifty percent of the producers manage pests and diseases through agroecological practices. Sixty-eight-point-two percent receive technical advice, while 77.3% are familiar with the decree to phase out the use of glyphosate.

Study Limitations/Implications: Currently, 13.6% of producers are still transitioning and continue to perform chemical control of pests and diseases, as well as chemical fertilization.

Findings/Conclusions: It is indeed possible to produce crops and obtain healthy food while caring for biodiversity, making use of environmental-friendly local resources, and achieving soil conservation.

Keywords: Agroecological, Chemical-free, *Zea mays*, *Persea americana*, Healthy crops.

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INTRODUCTION

Food security means that all people should have access to safe and nutritious food, which in turn will allow them to lead a healthy life (FAO, 2009). Meeting these food needs calls for sufficient production, in terms of availability and access for the population. However, agricultural environments are increasingly limited, mainly as a result of demographic changes (structure, distribution, and concentration), as well as of the effects of climate change (OMS-FAO, 2018) that directly affect production systems and crops.

Moreover, these changes also affect farmlands. This is relevant because, in order to guarantee food security, agricultural production must be carried out in healthy substrates,

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with no physical, chemical or biological limitations, with sustainable productivity, and with minimal environmental degradation (FAO, 2015; Montanarella *et al.*, 2015; IICA, 2021).

The increase of food production can be achieved by either the enhancement of crop capacity in existing agricultural land or the expansion of the area of crop production, or both (Van Wart *et al.*, 2013). In Mexico, 18 million hectares are allocated to agricultural production (SIAP, 2020); however, some authors argue that the agricultural frontier amounts to 31 million hectares (Turrent *et al.*, 2012). Nonetheless, increasing productivity could reduce this agricultural frontier. Therefore, production systems must become more efficient, in order to meet the food demand of a population that is estimated to surpass 138 million by 2030 (Torres-Torres y Rojas-Martínez, 2018). This food demand must be met in volume and quality, avoiding soil degradation and preserving biodiversity. Production systems must focus on the search and implementation of productive practices and technologies; they must also promote healthy products, appreciate cultural settings, preserve resources, and be economically viable for producers and consumers.

The experiences accumulated by generations of producers, along with new technologies and technical monitoring, will have a major impact in the search for food security. Many practices carried out by producers are part of traditional agriculture, a lore transmitted through experience from one generation to the next one. Consequently, much of this information and lore could be lost. Therefore, lines of research that enable an optimal development and expansion of such knowledge should be designed.

In accordance with social movements and government initiatives that seek to phase out the use of glyphosate, transition and conversion processes from conventional agricultural production systems (monocropping, use of agrochemicals, etc.) to agroecological production systems (agrobiodiversity, nutrient recycling, etc.) have been promoted in recent decades. Their aim is to further food security and sovereignty (Cevallos *et al.*, 2019) and to move towards healthy agrifood models that are ecologically responsible, economically viable, socially just, culturally relevant, and environmentally friendly.

Hence, the objective of this work was to analyze experiences with various activities and practices carried out in different agroecological regions of Mexico, involving diverse crops and excluding the use of chemicals. The aim was to document, assess, and potentiate their replication and expansion, consequently contributing to the development of tools that enable the production of healthier and better food.

MATERIALS AND METHODS

This work relied on field visits and surveys conducted in four agricultural regions of Mexico, known as agroecological centers, which were chosen because they have produced crops without the use of agrochemicals. The goal was to gather the experiences related to these production systems and to determine how they can be replicated and expanded to other agricultural zones. The agroecological centers were: 1) Texcoco, Estado de México, Mexico, particularly the producers who take part in the Tianguis Orgánico Chapingo (TOCH); 2) Grupo Vicente Guerrero, Tlaxcala, Mexico (Tlaxcala); 3) Ario de Rosales and Uruapan, Michoacan, Mexico (Michoacán), which have considerable experience in organic avocado production; and 4) Tetela del Volcán, Morelos, Mexico (Tetela), an agroecological center currently transitioning towards chemical-free production.

The visits took place from March to August 2021. Field observations were made of the prevailing conditions in the crop plots, the activities performed, and the tools and inputs used. Depending on the phenological state of the crops, the quality of the harvested products was analyzed. Meanwhile, surveys were conducted with the managers and owners of the production units. These included open and closed questions distributed in four sections concerning an overall description, background, inputs, and management practices within the production units. A database was created with the gathered data; a descriptive analysis of the production units and the agroecological farming systems practiced in the various centers under study was developed from the said database.

RESULTS AND DISCUSSION

A total of 22 production units were visited: 45.5% belong to the agroecological center of the Tianguis Orgánico Chapingo; 22.7%, to Michoacan; 18.2%, to Vicente Guerrero, Tlaxcala; and 13.6%, to Tetela del Volcán, Morelos. Sixty-percent of all agroecological centers are ejidos and 40% belong to small owners.

Out of all producers, 73% are men and 27% are women. Their ages range from 25 to 68 years old; most of them (45%) were 50 to 70 years old and 14% belong to the 40-50 years old range. Regarding the size and distribution of production units, we found diversity within and between agricultural centers, as well as among producers. Some centers feature very large plots (such as avocado orchards), while others have small plots distributed in different lots (for example, the Texcoco and Tlaxcala centers). The two largest plots (20 ha) were used for the production of fruit crops. Others plots have 14, 8, 7, and 4 ha. However, the largest number of plots ranged from 0.5 to 4 ha.

Corn (*Zea mays* ssp. *mays*) and avocado (*Persea americana* Mill.) were the main crop species; they accounted for 32% and 36% of all the crops, respectively. Nevertheless, vegetable crops, maguey (*Agave salmiana*), coffee (*Coffea* sp.), and even forage grasses were also found (Figure 1). The diversity of crops in these places proves that healthy food can be produced using agroecological practices that do not involve chemicals. Moreover, these practices contribute to one of the principles of agroecology: exploring agrodiversity as an instrument for a healthy, diverse, and abundant production of food, while preserving the common goods (Sarandón, 2020).

In the agroecological centers, producers practiced rainfed agriculture (45%), agriculture with irrigation (8%), and a combination of both production systems (36%). Units with access to irrigation are mainly focused in the production of vegetables, while rainfed production is practiced with annual crops, mainly corn and beans (*Phaseolus vulgaris* L.), as well as other cereals and legumes. In the case of avocado production, there are differences between centers: rainfed agriculture is practiced in the Michoacán center, while in Tetela —in addition to rainfed production— a fertigation system is used for the nutrition of orchards. The main sources of water for irrigation are wells and springs.

Crop rotation is practiced in half the units under study. This agroecological practice depends on the crop species, since annual or short cycle crops —as well as the different

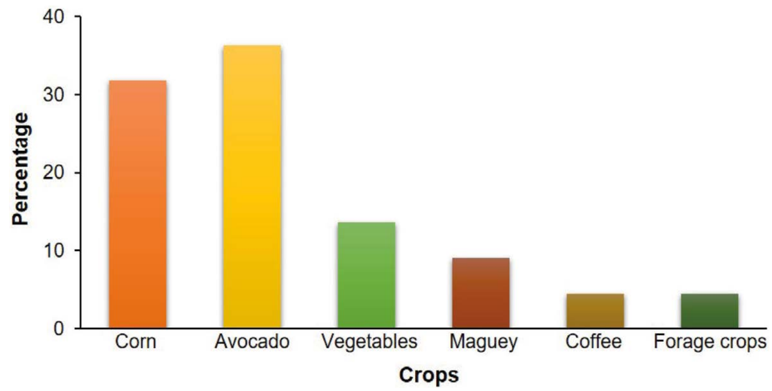

Figure 1. Main species cultivated in the production units of the agroecological centers in four regions of Mexico.

seasons in which those crops are established— enable rotation. In contrast, perennial crops such as avocado, coffee or forage grasses limit this practice. Another activity (associated crops) is carried out in less than 40% of the units considered in this work. Cereals can be associated with legumes and, in some cases, with other species. Corn, wheat (*Trititicum aestivum* L.), beans, broad beans (*Vicia faba* L.), and zucchini (*Cucurbita* spp.) stand out among these crop species. This practice is mainly carried out in the Texcoco and Tlaxcala centers, which are focused on the production of annual crops. Texcoco is an outstanding case, since vegetable producers practice crop association and rotation, mainly with short-cycle vegetables that allow them to grow several crops on small surfaces and in short periods. Additionally, these practices maintain a constant production and contribute to the enrichment of soil fauna diversity (Rodrigues *et al.*, 2016).

Regarding the last time they used chemicals, more than 50% of interviewees did not specify a date or have not kept an exact record. However, some have gone chemical-free for a year, while others have spent 18 years without using chemicals in the production of their crops. This reveals that transitioning towards a chemical-free agriculture entails a transformation process in which various actions must be implemented in order to achieve the agroecological production goals. In the particular case of glyphosate, 59% of producers used this product when applying chemicals. As a result of the transition towards agroecological crops, currently 95% of units use neither glyphosate, nor other chemically synthesized herbicides.

Consequently, the management of weeds is now carried out using two methods: manual (22.73%) and mechanical (31.83%) (Figure 2). The agricultural system, the crops, the phenological state, and the area, as well as the producer's ability to acquire tools and equipment, all contribute to determine the method and the moment when weed control will be carried out. In areas larger than 1 ha, mechanical control prevails. In addition, 30% of producers combine manual and mechanical methods.

In avocado production centers and in places where perennial crops are present, weed management may vary. In Michoacan, for instance, weeds are allowed to grow until they complete their biological cycle, before they are cut out. In Tetela, weeds are cut in their early stages using manual weeding machines. In both centers, the remains are

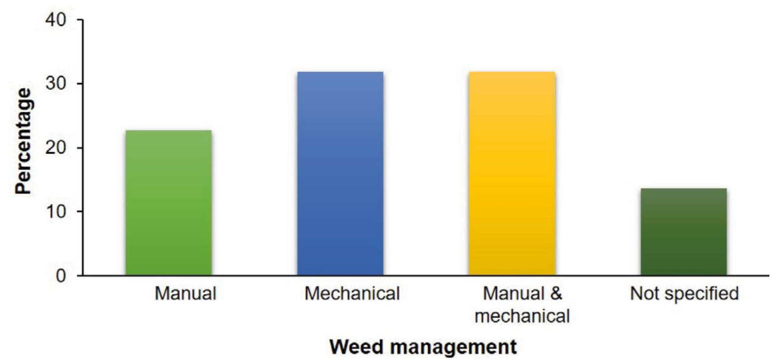

Figure 2. Weed management practices in agricultural production centers in four regions of Mexico. Source: field work, 2021.

incorporated into the soil, in order to allow the agroecological system to make the most of them.

Crop nutrition is one of the activities that most impacts agricultural production (Alcántar and Trejo-Téllez, 2009). Different nutrition-focused practices and inputs were registered, mainly based on local elements (direct or processed): for example, the use of compost (27% of the units) and (fresh or dry) manure (23%). Moreover, 18% of units use elements that can make up an agroecological fertilization program (minerals, rocks, green manures, leachates, etc.). When fertigation is applied (13%), chemical fertilizers are the main source of nutrients for crops (Figure 3). An example of this situation occurs in avocado plots that are transitioning towards agroecological production.

Regarding pest and disease control, 50% of units carry out various agroecological practices; 9.09% combines trapping and manual management when the characteristics of the agent that causes an affectation allow it. No control is carried out in 27.27% of production units. Producers consider that organisms are part of the agrosystem and, along with weed management, do not affect the crops. Therefore, their presence within the system promotes the proliferation of beneficial organisms that enrich the biodiversity of the agricultural system. On the same subject, Redin *et al.* (2021) mention that the quantity and quality of plant materials deposited in the soil influence the edaphic fauna. A small

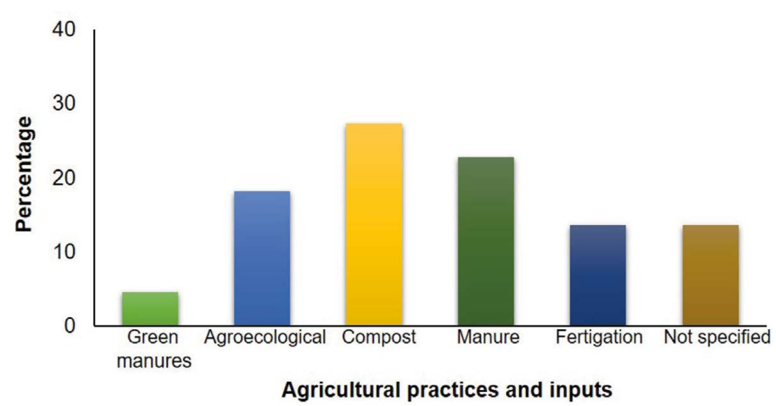

Figure 3. Practices and inputs used as fertilizing sources in agroecological production in four regions of Mexico.

percentage of units (13.6%) still carry out chemical control, especially when combating fruit crop diseases (Tetela). However, they are transitioning and they hope that, in the short term, this practice will go hand in hand with chemical-free weed management (Figure 4).

Figure 5 shows that nearly three quarters of producers receive technical advice (68.18%). This is an important finding, because when producers were questioned about their knowledge about alternatives to the use of glyphosate, the same percentage (68.18%) responded they were not aware of any alternatives. In personal communication, they mentioned that they associate an alternative to the use of a similar product or a product that fulfills the functions of glyphosate. Nonetheless, 77.27% of interviewees are aware of the decree that establishes actions for the phasing out of products that contain glyphosate as an active ingredient (DOF, 2020).

The various agroecological practices registered in this study not only maintain a healthy production, but they also contribute to a reduction in the use of chemicals. Employing traditional lore, together with technical support, makes it possible to move from conventional, agrochemical-dependent agriculture to a kind of agriculture that has understood that the main alternatives to reduce the use of chemicals lie in cultural and biological management methods (Shimada *et al.*, 2021).

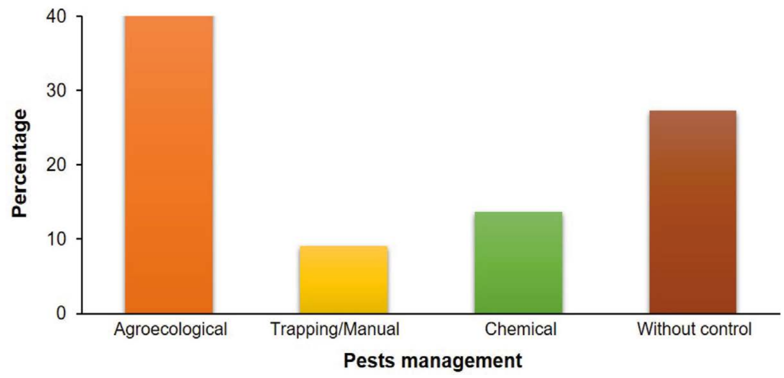

Figure 4. Main practices and input used for pest and disease control in agroecological production in four regions of Mexico.

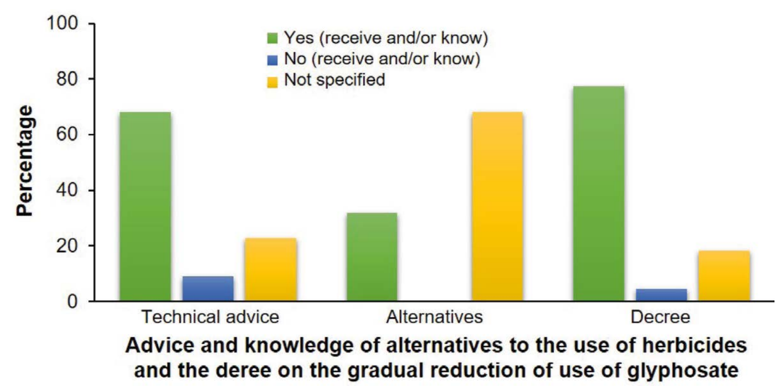

Figure 5. Consultancy and awareness about alternatives to the use of herbicides and of the decree for the gradual reduction of the use of glyphosate in agroecological centers in four regions of Mexico.

The results of this work show the experiences of the producers themselves in agroecological systems. This will enable further exploration, particularly in each one of the different study areas (nutrition, weed management, pests and diseases, among others).

CONCLUSIONS

Producers from the agroecological centers in Texcoco, Tlaxcala, Michoacan, and Tetela perceive that agroecological production is viable, friendly to their environmental and cultural surroundings, and it also allows them to obtain healthy food.

The experiences of the agroecological centers result in a successful production of crops without using synthetic products. They may be replicated in other production units adjacent to the centers themselves and even in other agricultural regions throughout the country, once they have been adapted to their particular characteristics.

Agroecological production systems reveal that producing crops and obtaining healthy food products, free of toxic agents for consumers, is indeed possible while still respecting biodiversity, using environmental-friendly local resources, and achieving soil conservation.

REFERENCIAS

Alcántar-González, G., & Trejo-Téllez, L. I. (2009). *Nutrición de cultivos*, Mundi Prensa: Texcoco, Estado de México, México. 454 p.

Cevallos, S. M., Urdaneta, O. F., & Jaimes, E. (2019). Desarrollo de sistemas de producción agroecológica: Dimensiones e indicadores para su estudio. *Revista de Ciencias Sociales, 25*(3), 172-185. https://doi.org/10.31876/rcs.v25i3.27365

DOF. (2020). Decreto por el que se establecen las acciones que deberán realizar las dependencias y entidades que integran la Administración Pública Federal, en el ámbito de sus competencias, para sustituir gradualmente el uso, adquisición, distribución, promoción e importación de la sustancia química denominada glifosato y de los agroquímicos utilizados en nuestro país que lo contienen como ingrediente activo, por alternativas sostenibles y culturalmente adecuadas, que permitan mantener la producción y resulten seguras para la salud humana, la diversidad biocultural del país y el ambiente. Recuperado el 1 de abril de 2022, de DOF: https://www.dof.gob.mx/nota_detalle.php?codigo=5609365&fecha=31/12/2020

FAO. (2009). *Declaración de la Cumbre Mundial sobre la Seguridad Alimentaria*. Organización de las Naciones Unidas para la Alimentación y la Agricultura. Recuperado el 10 de octubre de 2020, de FAO: http://www.fao.org/tempref/docrep/fao/Meehttp://www.fao.org/fileadmin/templates/wsfs/Summit/Docs/Final_Declaration/K6050S_WSFS_OEWG_06.pdfting/018/k6050s.pdf

FAO. (2015). *Los suelos sanos son la base para la producción de alimentos saludables*. Organización de las Naciones Unidas para la Alimentación y la Agricultura. Recuperado el 10 de octubre de 2020, de FAO: http://www.fao.org/3/a-i4405s.pdf

IICA. (2021). Healthy Soils: the bedrock of sustainable food systems in Latin America and the Caribbean. Inter-American Institute for Cooperation on Agriculture. Retrieved on October 10, 2020, from IICA: https://repositorio.iica.int/bitstream/handle/11324/18585/BVE21088330i.pdf?sequence=10&isAllowed=y

Montanarella, L., Badraoui, M., Chude, V., Costa, D. S. B. I., Mamo, T., Yemefack, M., Aulang, M. S., Yagi, K., Hong, S. Y., Vijarnsorn, P., Zhang, G. L., Arrouays, D., Black, H., Krasilnikov, P., Sobocá, J., Alegre, J., Henriquez, C. R., Mendonça-Santos, M. L., Taboada, M., Espinosa-Victoria, D., Alshankiti, A., Panah, S. K. A., Sheikh, E. A. E. M. E., Hempel, J., Pennock, D., Arbenstain M. C., & McKenzie, N. (2015). *Status of the World's Soil Resources*. Retrieved on October 10, 2020, of FAO: https://www.fao.org/3/i5199e/I5199E.pdf

OMS-FAO. (2018). Sistemas alimentarios seguros y sostenibles en una era de cambio climático acelarado. Organización de las Naciones Unidas para la Alimentación y la Agricultura. Recuperado el 21 de septiembre de 2020, de FAO: https://www.who.int/es/news-room/events/international-food-safety-conference/background-documents

Redin, M., Canepelle, E., Carlson, W. T., Maisa-da Silva, D., Guerra, D., & Drescher, M. S. (2021). Single cultivation versus sweet potato and popcorn intercropping : benefits over edaphic fauna in ecological-based system. *Soil and Plant Nutrition, 68*(5), 484–490. https://doi.org/10.1590/0034-737X202168050013

Rodrigues, D. M., Ferreira, L. O., Silva, N. R. da, Guimarães, E. dos S., Martins, I. C. F., & Oliveira, F. de A. (2016). Diversidade de artrópodes da fauna edáfica em agroecossistemas de estabelecimento agrícola familiar na Amazônia Oriental. *Revista de Ciências Agrárias, 59*(1), 32–38. https://doi.org/10.4322/rca.2097

Sarandón, S. J. (2020). *Biodiversidad, agroecología y agricultura sustentable*. EDULP: La Plata, Buenos Aires, Argentina. 429 p. https://doi.org/10.35537/10915/109141

Shimada, B. S., Simon, M. V., & Cunha, L. S. (2021). Cultural control: A sustainable method of pest and disease control. *Journal of Experimental Agriculture International, 43*(6), 19-26. https://doi.org/10.9734/jeai/2021/v43i630698

SIAP. (2020). Estadística de Producción Agrícola. Servicio de Información Agroalimentaria y Pesquera. Recuperado el 12 de noviembre de 2020, de SIAP: http://infosiap.siap.gob.mx/gobmx/datosAbiertos.php

Torres-Torres, F., & Rojas-Martínez, A. (2018). Suelo agrícola en México: Retrospección y prospectiva para la seguridad alimentaria. *Realidad, Datos y Espacio Revista Internacional de Estadística y Geografía, 9*(3), 137-155.

Turrent, F. A., Wise, T. A., & Garvey, E. (2012). *Achieving Mexico's Maize Potential*, GDEI/Tufts University: Medford, MA., USA. 40 p.

van Wart, J., Kersebaum, K. C., Peng, S., Milner, M., & Cassman, K. G. (2013). Estimating crop yield potential at regional to national scales. *Field Crops Research, 143*(1), 34-43. https://doi.org/10.1016/j.fcr.2012.11.018

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