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Participatory agroecological diagnosis in small and medium-sized producers in Michoacán and Morelos, Mexico

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ABSTRACT

Objective: To integrate an agroecological diagnosis to small and medium production units by identifying: (i) crop management practices, (ii) types of inputs and technologies used, and (iii) health status of soils and crops.

Design/Methodology/Approach: This implemented research was of the type known as "In-depth case study", where the minimum sample size is 6 to 10 cases. Descriptive, correlational, and explanatory aspects corresponding to the selected production units were considered; based on qualitative and quantitative information.

Results: For indicators of crop management and soil health, the predominant type of agriculture was transition to agroecology. Crop health indicators were the most agroecological.

Study limitations/Implications: The results obtained allowed to establish the current state of the production units; with which further comparisons of the condition of those production units in the future can be made.

Findings/Conclusions: The methodology used allowed to evaluate participatively, from an agroecological approach, the sustainability of soils and crops in production units of the municipalities Ario de Rosales, Michoacán and Tetela del Volcán, Morelos. Within the six productive units studied, it was found a productive unit with the appropriate characteristics to be considered as an "agroecological beacon".

Keywords: sustainability, agroecological management, agroecological beacon.

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INTRODUCCIÓN

In recent decades, the industrial agriculture model has allowed a massive increase in agricultural production through: (i) plants selected according to their high productive potential; (ii) standardization of modes of production; and (iii) the use of synthetic inputs that minimize the effect of production-limiting factors and environmental heterogeneity (Duru *et al.*, 2015). Among them, the loss of biodiversity, including agrobiodiversity, negative impacts on the environment (pollution, climate change, depletion of fossil fuels

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and water resources), and ethical issues related to the lack of consideration of animal welfare in agro-productive units (Clark *et al.*, 2016). All these elements question the relevance of the agro-industrial production model for the future. In this context, a major challenge for farmers is to simultaneously contribute to the food and nutrition security of humanity, on the basis of limited resources, while reducing the negative impacts of agriculture on human health and the environment, maintaining decent living conditions (Biggs *et al.*, 2012). Many researchers believe that agroecology is a promising way to overcome all these challenges (Altieri *et al.*, 2017).

As a scientific discipline, agroecology is defined as "the application of ecological concepts and principles to the design and management of sustainable agroecosystems (Wezel *et al.*, 2009). This definition emphasizes the fact that natural processes, and in particular biodiversity and interactions between biotic and abiotic elements, can support the sustainability of agricultural systems. Thus enabling production at appropriate levels while reducing dependence on agricultural and agrochemical inputs; as well as negative impacts on human health and the environment, even in sub-optimal conditions (Bell & Bellon, 2018). In order to reorient the management and production systems administration towards agroecological practices, it is essential to implement diagnoses that allow evaluating management practices, the types of inputs and the technologies used (Wezel *et al.*, 2020).

Participatory agroecological diagnosis is a methodology that allows identifying and prioritizing the needs and problems of agricultural production units. Therefore, seeking sustainable management alternatives opposed to the agro-industrial production model (Barrios *et al.*, 2020). In addition, participatory methodologies are based on learning close to families in rural communities as key actors, through work dynamics that favor the exchange of ideas, experiences and knowledge oriented to the common good (FAO, 2011).

It is essential that small and medium-sized producers in rural communities recognize which management practices affect the quality and health of their crops and soil (Madsen *et al.*, 2020). Thus, the objective of this research was to implement an agroecological diagnosis to small and medium production units by identifying: (i) management practices for crops, (ii) types of inputs and technologies used, and (iii) health status of soils and crops. This research contributes to the process of observation, registration and decision-making for the agroecological management of small and medium-sized rural producers in Mexico.

MATERIALES Y MÉTODOS

Description of production units

The study was carried out in 6 production units located in Ario de Rosales, Michoacán and Tetela del Volcán, Morelos. The municipality Ario de Rosales is located in the center of the state of Michoacán, within the coordinates 19° 12' N and 101° 40' W, at an altitude of 1910 m. Its area is 696.91 km^2. Climate is defined as temperate with rains in summer and as tropical in some parts. It has an annual rainfall of 761.6 mm and average temperatures of 21 °C (Figure 1).

The municipality Tetela del Volcán is located in the northeast of the state of Morelos, within the coordinates 18° 57' N and 98° 14' W, at an altitude of 2040 m; it has a total area of 98.5 km^2. Climate is wet and cold with dry winters, except in the north, whose climate is

Figure 1. Geographical location of the Municipality Ario de Rosales, Michoacán, Mexico.

typically mountainous. It is frequently cloudy, and characterized by stormy rainfall, usually accompanied by hail. The average annual rainfall is 2341.63 mm and average annual temperature is 23.6 °C (Figure 2).

Research description

Type of research

The research was of the "In-depth case study" type, where the minimum sample size is 6 to 10 cases (Hernández-Sampieri and Torres, 2018). Descriptive, correlational and explanatory aspects corresponding to the selected production units were considered; both qualitative and quantitative information was also used. Farmers were the direct source of information; however, valid documents providing related information were also considered.

Figure 2. Geographical location of the Municipality Tetela del Volcán, Morelos, México.

The methodology of this study was carried out through the following steps:

1. The research topic was defined: “Agroecological management of crops and the health of soils and crops”.
2. Techniques for data collection were established: “Interview. Participatory agroecological survey and participant observation”.
3. Data were collected in the field.
4. The data were organized and statistically analyzed.
5. Data were interpreted.
6. Conclusions and experiences obtained were recorded.

Data collection and analysis

A registration form was used, with which participatively with the farmer in his productive units, the indicators proposed by Padilla and Suchini (2013) were evaluated; grouped into three components, crop management, soil health, and crop health (Rutebuka *et al.*, 2019). All indicators were evaluated on a scale from 1 to 10, where values 1-4 will were assigned to conventional agriculture; 5-7 for agriculture in transition; and 8-10 for agro-ecological farming.

After organizing and generating the database, the statistical analysis was run in STATISTICA® (version 10.0; Statsoft, Tulsa, OK, USA). Measures of central tendency and analysis of absolute and relative frequencies were carried out. For depicting results, radial graphs and a scatter plots were generated to highlight the agro-ecological beacons found (Altieri and Nicholls, 2000).

RESULTADOS Y DISCUSIÓN

Based on the participatory diagnosis of crop management with farmers in their production units, the total relative weight of the characteristics of agriculture was determined based on each of the indicators observed and evaluated during the field trips. The results indicate that the predominant crop management in the production units is a management in agroecological transition. This management represented 49% to 68% of the production units, in 6 of the 10 indicators evaluated.

The second dominant management was agroecological, with a participation of 50% to 83% of the production units, in 4 of the 10 indicators evaluated. Conventional management had the participation of 50% of the farms in 2 out of 10 indicators evaluated, this management was found the least frequent in the production units.

In Figure 3, it is graphically observed that the management in transition of the crops was the one that predominated; the preparation of the land was highlighted, along with the management of insect pests, and the management of wild plants, with a contribution of 67% of the production units. The strength in terms of agroecological management was in the application of fertilization and inputs for the management of wild plants.

This type of graph, also known as a graph of nets or cobweb plot, was used in research as part of a quick and participatory agroecological method, where together with the farmer they were able to estimate the quality of soils and the health of crops in vineyard systems

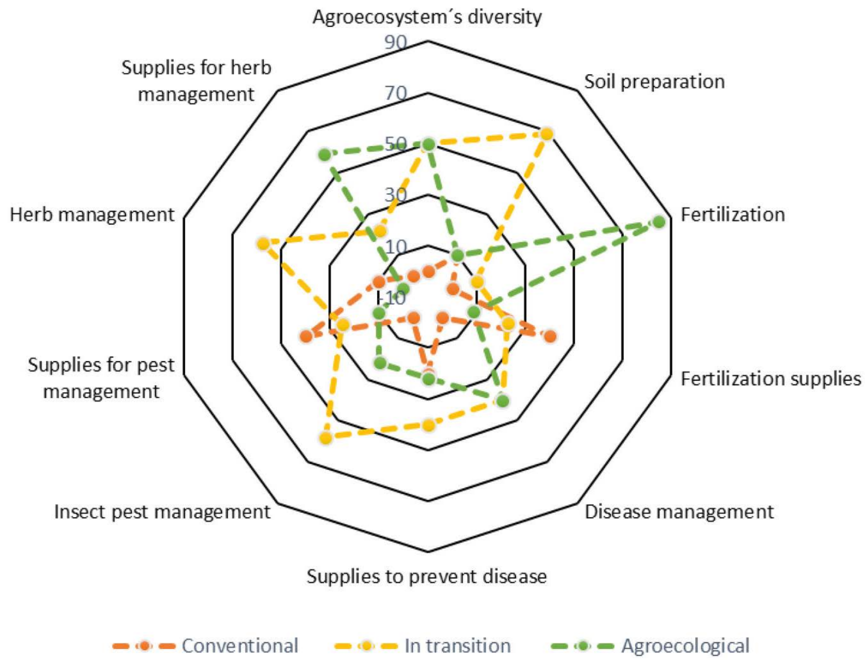

Figure 3. Radial representation of the type of crop management in the production units.

(Nicholls *et al*., 2004). At the same time, it allows to show the areas that require greater attention in the management of crops and soils, to ensure a greater focus on ecological processes.

The weakness of the production units in terms of conventional management was in the use of inputs for fertilization and inputs for pest management. This situation indicates that farmers tend to use more synthetic fertilizers and moderate amounts of organic fertilizers. However, the application of fertilizers occurs under an awareness of agroecological management, where fertilization is applied to nourish the plant, and to replenish nutrients and improve life in the soil.

Conventional management of the use of inputs in pest control implies a strong dependence on commercial insecticides and their doses accustomed by farmers. In a study for the adoption of agroecological pest management (MAP) practices in watermelon cultivation, it was found that, in a sample of 96 farmers, a low level (20%) of adoption of MAP practices predominated (Brzozowski and Mazourek, 2018).

The results of the soil health indicators of the productive units show that the dominant type of agricultural system is that of transition towards agroecology (Figure 4). The indicators of soil depth, soil cover and biological activity were the most agroecological in the production units evaluated. The physical characteristics of the soil such as structure, infiltration and moisture retention, are at a transitional level. Likewise, the characteristics of light brown color without much odor, and with little visible organic matter, represented transitional conditions for the health of the soil.

Crop health indicators revealed that most production units have an agroecological profile based on crop health. However, one of the production units was found in a

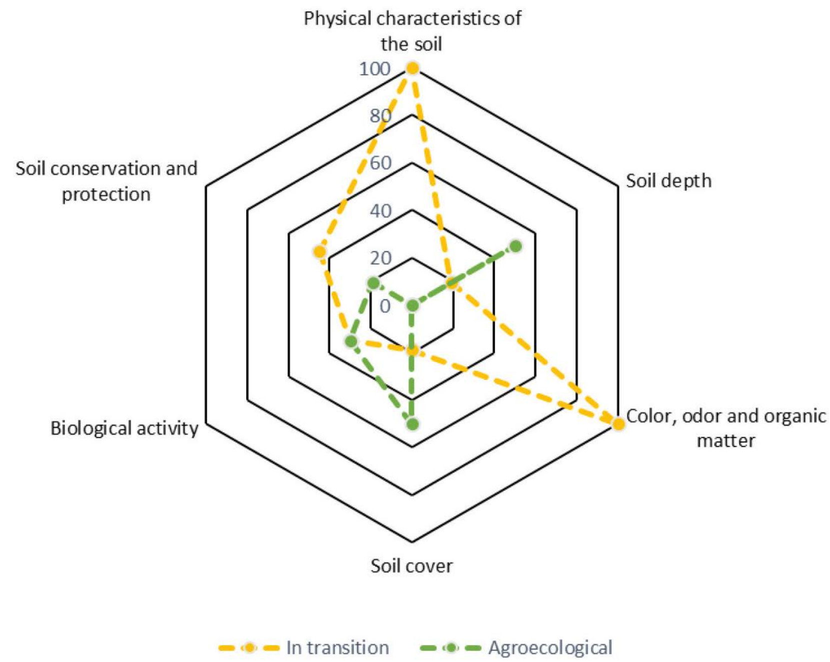

Figure 4. Radial representation of the health condition of the soil in the productive units.

conventional state. Figure 5 depicts that most crop health indicators were classified as agroecological.

The visualization of the average values of the productive units in a dispersion plot, allows to determine the status or condition of the units of production in regard to the threshold value (5) for crop management, soil health and crop health. It also allowed us to identify

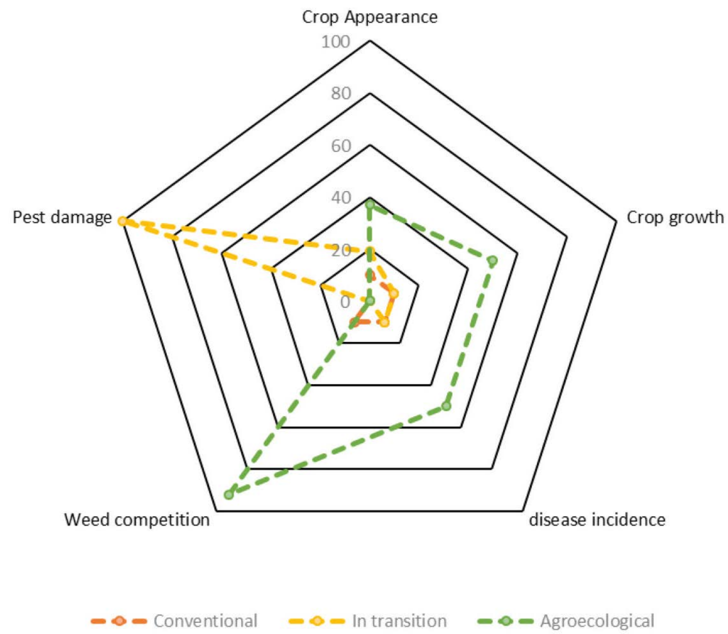

Figure 5. Radial representation of the state of health of the crops in the productive units.

the productive units that presented high averages. According to Altieri and Nicholls (2015), the productive units with higher values are considered as "agroecological beacons", in which ecological interactions and synergisms that explain the proper functioning of the system can be studied.

Ideally, farmers should not copy the techniques used by the farmer from the "agroecological lighthouses", but rather try to reproduce the processes and interactions promoted by the ecological infrastructure of such a production unit, which leads to the success of the system from the point of view of crop management, soil health and crop health. Within this context, efforts should be made to promote that farmers in other productive units tend to use those techniques that are within their reach and that optimize the same processes (Nicholls *et al.*, 2004).

Figure 6 shows that four of the production units are in the status of agroecological threshold in terms of crop management, which is closely linked to the type of agriculture in transition which is dominant in that production units. However, productive units 1 and 4 obtained high average values of 8 for crop management.

The health condition of the crops of the productive unit 4, as indicated by the farmer, was related to significant losses of the harvest due to the attack of pests in the reproductive stage, which was observed during the field tours with the farmer. This situation was further affected by poor management practices for wild plants, which generated greater stress on crops.

The comparison of the different cases allows to identify the healthiest systems. The outstanding systems are demonstrative beacons called "agroecological beacons" that allow generating information on specific agroecological practices that shall optimize the desired processes in the productive units that show values below the threshold (Altieri and Nicholls, 2015).

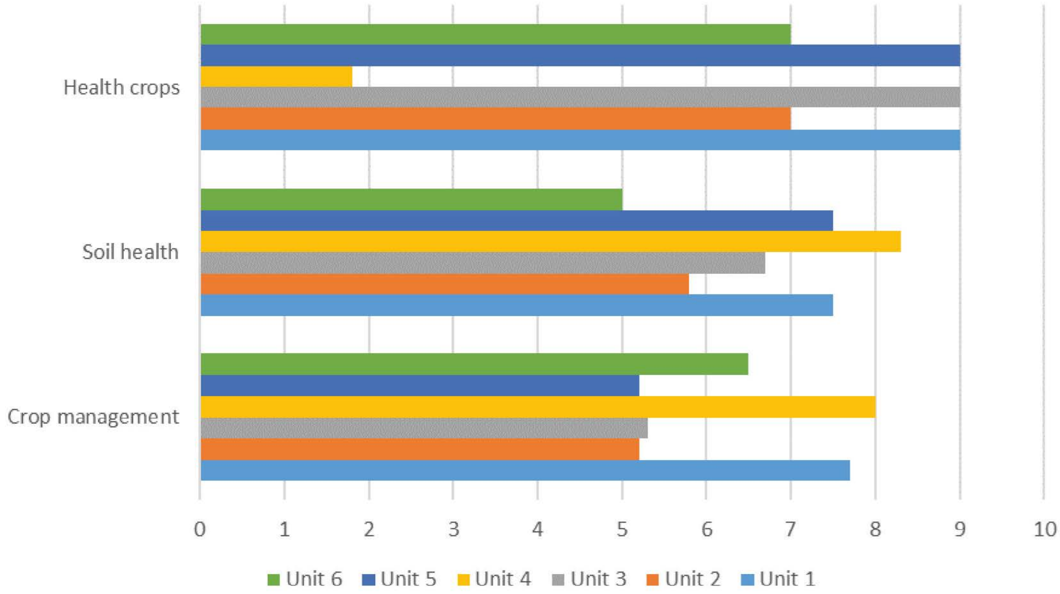

Figure 6. Comparison of the average indicators of crop management, soil health and crop health in the productive units.

Of the six productive units diagnosed in this research, productive unit 1 was the only case with average values of 7.5 to 9 for indicators of crop management, soil health, and crop health. Due to high values in the three components evaluated, this productive unit is considered as a potential "agroecological beacon".

In an agroecological evaluation study of the production units in Centella de Dagua, Colombia (Cerón *et al.*, 2014), those authors mentioned that "agroecological beacons" are examples for the management and conservation of resources; for the planning, the promotion of techniques that contribute to ecological integrity, and the promotion of sustainable human development in the field.

CONCLUSIONS

The methodology used allowed to evaluate participatively, from an agroecological approach, the sustainability of soils and crops in production units of the municipalities Ario de Rosales, Michoacán and Tetela del Volcán, Morelos.

The results obtained allow to establish the current state of the productive units, with which further comparisons can be made of the state of those productive units in the future.

For indicators of crop management and soil health, the predominant type of agriculture was determined as transitional towards agroecology. Crop health indicators were the most agroecological. Of the six productive units studied, it was found a productive unit with characteristics to be considered an "agroecological beacon".

REFERENCES

Altieri, M. A., Nicholls, C. I., Montalba, R., González De Molina, M., & Guzman, G. (2017). Technological Approaches to Sustainable Agriculture at a Crossroads: An Agroecological Perspective. *Sustainability 2017*, Vol. 9, Page 349, 9(3), 349. https://doi.org/10.3390/SU9030349

Altieri, M., & Nicholls, C. (2015). *Un método agroecológico rápido para la evaluación de la sostenibilidad de cafetales*. https://repositorio.catie.ac.cr/handle/11554/6866

Altieri, Miguel, & Nicholls, C. I. (2000). *Agroecología: teoría y práctica para una agricultura sustentable*. http://bibliotecadigital.ciren.cl/bitstream/handle/123456789/18777/00012855.nul?sequence=1

Barba, A., Espinosa, J., Vegetal, M. S.-R. de P., & 2015, U. (2015). Adopción de prácticas para el manejo agroecológico de plagas en la sandía (*Citrullus lanatus* Thunb.) en Azuero, Panamá. *Revista Protección Vegetal, 30*(2), 104–114. http://mail.censa.edu.cu/index.php/RPV/article/view/574

Barrios, E., Gemmill-Herren, B., Bicksler, A., Siliprandi, E., Brathwaite, R., Moller, S., Batello, C., & Tittonell, P. (2020). The 10 Elements of Agroecology: enabling transitions towards sustainable agriculture and food systems through visual narratives. https://doi.org/10.1080/26395916.2020.1808705, 16(1), 230–247.

Bell, M. M., & Bellon, S. (2018). Generalization without universalization: Towards an agroecology theory. Https://Doi.Org/10.1080/21683565.2018.1432003, 42(6), 605–611.

Biggs, R., Schlüter, M., Biggs, D., Bohensky, E. L., Burnsilver, S., Cundill, G., Dakos, V., Daw, T. M., Evans, L. S., Kotschy, K., Leitch, A. M., Meek, C., Quinlan, A., Raudsepp-Hearne, C., Robards, M. D., Schoon, M. L., Schultz, L., & West, P. C. (2012). Toward Principles for Enhancing the Resilience of Ecosystem Services. Http://Dx.Doi.Org/10.1146/Annurev-Environ-051211-123836, 37, 421–448. https://doi.org/10.1146/ANNUREV-ENVIRON-051211-123836

Cerón, W. L., Carvajal Escobar, Y., Javier, Á., & Díaz, Á. (2014). EVALUACIÓN AGROECOLÓGICA DE LOS SISTEMAS PRODUCTIVOS AGRÍCOLAS EN LA MICROCUENCA CENTELLA (DAGUA, COLOMBIA). *Colombia Forestal, 17*(2), 161–179. https://doi.org/10.14483/UDISTRITAL.JOUR.COLOMB.FOR.2014.2.A03

Clark, B., Stewart, G. B., Panzone, L. A., Kyriazakis, I., & Frewer, L. J. (2016). A Systematic Review of Public Attitudes, Perceptions and Behaviours Towards Production Diseases Associated with Farm Animal Welfare. *Journal of Agricultural and Environmental Ethics, 29*(3), 455–478. https://doi.org/10.1007/S10806-016-9615-X/TABLES/1

Duru, M., Therond, O., & Fares, M. (2015). Designing agroecological transitions; A review. *Agronomy for Sustainable Development* 2015 35:4, 35(4), 1237–1257. https://doi.org/10.1007/S13593-015-0318-X

Espinosa, J. A., Barahona, L. A., Solís, O., Morales, T., & González, R. (2016). Diagnóstico agroecológico participativo en fincas satélites de la Granja Escuela Casiciaco Haren Alde de la USMA. *Revistas.Usma. Ac.Pa, 4*(3), 59–73. https://revistas.usma.ac.pa/ojs/index.php/ipc/article/view/101

FAO. (2011). Aprendizajes de las metodologías utilizadas por dos experiencias de atención a comunidades indígenas: FAO - CONADI Programa | MDG Fund. http://www.mdgfund.org/publication/aprendizajes-de-las-metodolog-utilizadas-por-dos-experiencias-de-atenci-n-comunidades-in

Hernández-Sampieri, R., & Torres, C. (2018). Metodología de la investigación. https://dspace.scz.ucb.edu.bo/dspace/bitstream/123456789/21401/1/11699.pdf

Madsen, S., Bezner Kerr, R., Shumba, L., & Dakishoni, L. (2020). Agroecological practices of legume residue management and crop diversification for improved smallholder food security, dietary diversity and sustainable land use in Malawi. 45(2), 197–224. https://doi.org/10.1080/21683565.2020.1811828

Nicholls, C. I., Altieri, M. A., Dezanet, A., Lana, M., Feistauer, D., & Ouriques, M. (2004). A rapid, farmer-friendly agroecological method to estimate soil quality and crop health in vineyard systems. *Biodynamics, Outono*, 33–40.

Padilla, D., & Suchini, J. G. (2013). Guía para el sondeo agroecológico de suelos y cultivos. https://repositorio.catie.ac.cr/bitstream/handle/11554/2265/Guia_para_el_sondeo_agroecologico.pdf?sequence=1

Wezel, A., Bellon, S., Doré, T., Francis, C., Vallod, D., & David, C. (2009). Agroecology as a science, a movement and a practice. A review. *Agronomy for Sustainable Development* 2009 29:4, 29(4), 503–515. https://doi.org/10.1051/AGRO/2009004

Wezel, Alexander, Herren, B. G., Kerr, R. B., Barrios, E., Gonçalves, A. L. R., & Sinclair, F. (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. *Agronomy for Sustainable Development, 40*(6), 1–13. https://doi.org/10.1007/S13593-020-00646-Z/FIGURES/5