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METHODOLOGICAL PROPOSAL FOR THE STUDY OF ACTORS AND TECHNOLOGICAL INTERVENTION STRATEGIES IN CHIAPAS, MEXICO

Propuesta metodológica para el estudio de actores y estrategias de intervención tecnológica en Chiapas, México

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ABSTRACT. Since the 1960s, the Mexican government has implemented different models and intervention strategies in the agricultural sector. However, the results and impacts are still far from the global and regional goals for this sector. In this context, the Sustainable Modernization of Traditional Agriculture Program (MasAgro) emerged with the objective of strengthening farmers' work with a closed support of local actors. This article presents a conceptual and operational theoretical framework proposal (MaTCo) to document the experiences of these actors and the technological innovation strategies implemented within the Hub Chiapas of MasAgro's. The framework integrates several indicators to know principles, methodologies and tools used by each actor. It was necessary to build and implement the framework from a holistic socio-agronomic perspective and apply it to four case study of actor that collaborate with the program. The results display that MasAgro's current attention to maize production is based on a series of actors from both the public and private sectors, who use intervention and technological innovation approaches according to three factors: a) the socio-environmental and productive context; b) the type of farmer and its farming systems and c) the type of actor and its origin. The study of technological innovations and the implemented interventions demanded a systemic approach to precisely understand the processes of local innovation in the maize farming system in Chiapas.

Key words: farmers, conservation, indicators, innovation, maize

RESUMEN. Desde la década de 1960 el gobierno mexicano ha implementado diferentes modelos y estrategias de intervención en el sector agrícola. Sin embargo, los resultados e impactos están aún muy alejados de las metas globales y regionales para este sector. Bajo este contexto surgió el programa Modernización Sustentable de la Agricultura Tradicional (MasAgro), con el objetivo de fortalecer el trabajo de los agricultores en torno a la innovación con el apoyo de actores locales. Este artículo presenta una propuesta de marco teórico, conceptual y operativo (MaTCo) diseñado para documentar las experiencias de dichos actores y las estrategias de innovación tecnológica implementadas en el Nodo de Innovación (HUB) Trópico Bajo de Chiapas. Dicho marco incluye indicadores para conocer los principios, metodologías y herramientas utilizadas por cada actor estudiado. Para ello fue necesario construir e implementar el MaTCo, desde una perspectiva socio-agronómica holística y aplicarlo a cuatro estudios de caso de actores que colaboran con el programa. Los resultados indican que la atención actual a la producción de maíz, por parte de MasAgro, se sustenta en una serie de actores tanto del sector público como privado, quienes utilizan enfoques de intervención e innovación tecnológica acorde a tres factores: a) el contexto socio-ambiental y productivo; b) el tipo de productor que atienen y su sistema de producción y c) el tipo de actor y su origen. El estudio de la innovación tecnológica y las intervenciones implementadas demandan enfoques sistémicos para entender de una manera precisa los procesos actuales de innovación local en el sistema de producción de maíz en Chiapas.

Palabras clave: agricultores, conservación, indicadores, innovación, maíz

INTRODUCTION

Agricultural extension programs or interventions for agricultural technological development have often failed to deliver the expected results, especially in developing countries. This fact has led to several transformations in these programs during the last decades (1-3).

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The change from the top-down approach of technology transfer to the training and visiting system was one of the main transformations. The new conception is focused on the interaction between agents of extension and groups of producers, who disseminate in their contexts the new ways of doing, and at the same time, strengthen the feedback processes of extension agents, very weak or absent in the conventional system (4-6).

The linear transfer model is simpler to implement and monitor. For this reason, institutions, such as the World Bank, promoted it for almost three decades. However, it ended up receiving a number of criticisms of insufficient capacity to increase its coverage and extend significantly in smallholder settings; as well as to respond to the diversity of the needs and problems of these, with proposals of unique and inflexible packages (7-9).

In Mexico, from 1960 to 1990, the government developed its agricultural extension and transfer system, implemented through the Secretariat of Agriculture and Hydraulic Resources (SARH, now SAGARPA) and with the support of INIA research (now INIFAP) (4, 10). After a relapse, in the mid-1990s, extensionism resurfaced with a strong component of Professional Services Providers (PSP). These actors, although operating under a scheme of private services with public funds, are disconnected from institutions of higher education (11, 12). Therefore, the current system of technical assistance is fragmented and disjointed from the productive processes of the sector (13).

Based on this background and with the aim of strengthening the mechanisms for integrating scientific and traditional knowledge, the Sustainable Modernization of Traditional Agriculture (MasAgro) program emerged in 2010; which promotes joint work between farmers and local organizations to achieve productive improvements and the reduction of effects on climate change. This initiative is aimed at small producers with limited access to technology and information on production processes and their markets (10, 14).

Under the scheme of MasAgro in Chiapas, different organizations develop experiences with different intervention strategies, according to the needs of the sector they serve. The Chiapas Low Tropic Hub (Node) promotes interactions among different actors in the production chain, through strategic links between the public and private sectors. In its action, various intervention strategies are used based on certified technical services, clubs, technology platforms and projects associated with institutions and organizations in the state's agricultural sector (10).

Within this wealth of actors with their own strategies, the need for a theoretical, conceptual and methodological framework to document, reflect and understand the performance, dynamics and limitations of these organizations, and the processes they promote, with the intention of feedback the same. In this paper, a proposal is made, from the integration of the implicit precepts into the diversity of the operational actors integrated into the Hub and its intervention strategies. Also, the contextualized instruments for the collection of field information are presented.

MATERIALS AND METHODS

The research was developed in the period from 2013 to 2015 in the following geographical scenarios of the Chiapas state: Villa Corzo, Villaflores, Ocozocoautla de Espinosa and Rayón. These scenarios identified social, public or private organizations that collaborate as the Hub and that promote the implementation of technological innovation strategies for maize cultivation under the MasAgro approach and which were considered as case studies (Figure 1).

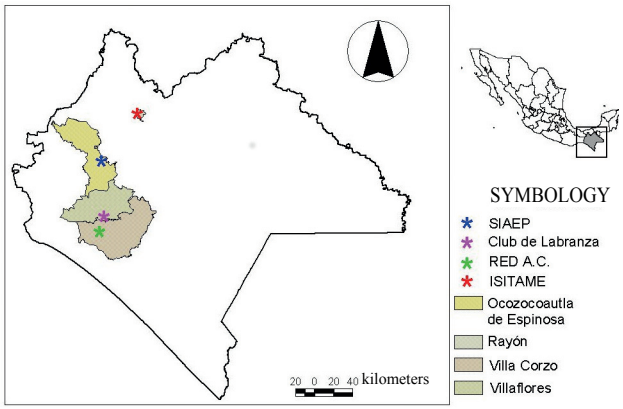

Figure 1. Location of the cases studied

The Conceptual and Operational Theoretical Framework (MaTCo), was constructed from the perspective of multiple institutional and organizational actors participating (11) in the rural agricultural development experiences in the state (15). In that sense, in all the selected cases, the historical analysis of each of them was facilitated based on the approaches of technological intervention that they have used.

To this end, methods of socio-anthropology, socio-agronomy and in-science (16-18) were integrated, which base their studies on descriptive and analytical ethnography based on the formation of focus groups and identification of key informants.

For the collection of information, quantitative and qualitative methods were used (19), such as the structured interview and the implementation of participatory workshops. In addition, the approach was based on Action-Research form as a way of self-reflective search of social situations and analyzes the reality under study (17, 20). In order to carry out the research, a work team composed of five people with professional profiles related to rural development was formed, who developed the documentary and field research that is described below.

The methodological steps of the research process were:

- Elaboration of a conceptual note based on historical information related to the dynamics of the approaches and models of technological intervention and extensionism used in agricultural and technological development in the international area, including Mexico. The concept note was developed during the year 2013.
- Identification of criteria and construction of indicators for the integration of (MaTCo), focused on the documentation of technological intervention strategies. This step was implemented during the year 2013.
- Validation of the MaTCo through its application to four case studies selected on the basis of their participation in the MasAgro program (Figure 1) and of which the information is focused in the results section. This step was developed during the years 2014 and 2015.

RESULTS

The historical analysis of the approaches and models of intervention for development allowed identifying the existence of different stages both in ways of implementing intervention strategies and extension of technological development in agriculture. However, a turning point was evident from the 1990s onwards in which the conventional or linear model was criticized (Figure 2). In that period the ideological conditions were incubated for a paradigm change[A] (11). In response to this turning point in the conception of development came the MasAgro program.

The actors involved in this analysis process identified that the launch of the MasAgro program was a milestone to temporarily contextualize a Conceptual and Operational Theoretical Framework (MaTCo) in this respect and that had not initially been considered as part of the methodological tools to accompany the program. This means that the launch of MasAgro proved to be a benchmark for defining criteria and indicators that would allow MaTCo to be formed with just relevance to the innovation process and thus facilitate the analysis of the cases that were subsequently selected and studied (Figure 2).

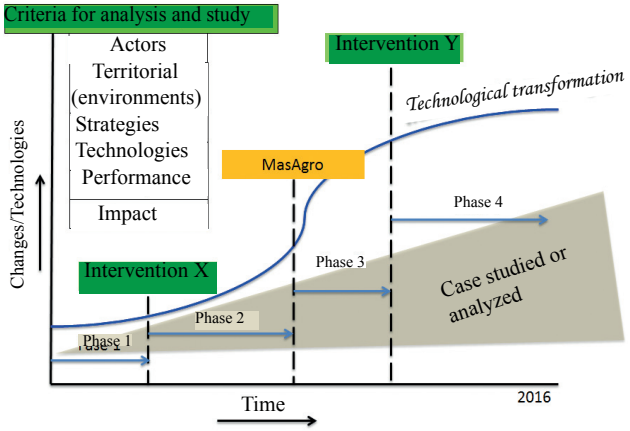

Figure 2. Schematic representation of the MaTCo

From the review of the strategies of technological intervention and the historical foundations, six criteria were defined to document and analyze the case studies, which were: 1) actors involved, 2) environment addressed, 3) strategy used, 4) Technology diffused, 5) performance of the intervention and 6) impact achieved. On the other hand, temporary and spatial indicators were identified that allow them to be operated (Table I) (15).

From the experiences of the NGOs, stages were proposed for the documentation process in the field (Figure 3) and operational specificities were identified for them (Table II). In this way it is demonstrated that for this methodological proposal, the stages must be interactive and not strictly linear. This means that all information raised in a stage can and should be validated through triangulation and feedback processes in higher stages (15).

In summary, the (MaTCo) proposed for the analysis of actors and intervention strategies for technological innovation, considers the recent context of development in which the criteria to identify and typify the profiles of the change actors are important, as well as their rationalities and forms of action. For this, work stages are required that facilitate the identification of these actors and the gradual characterization of them.

[A] La O, M. Estudio de conservación de la cabra criolla cubana en la subcuenca cautillo del valle del cauto. Ph.D. Thesis, Instituto de Ciencia Animal, 2013, Mayabeque, Cuba.

Table I. Integrated criteria and indicators in the MaTCo for the study of agricultural intervention strategies and technological innovation

Criterion	Indicators	
Participating actors	Number of actors Types of actors and roles Origin of the actors Links of the actors with the producers Organization among the different actors Types of actor organization	Type of producer organization Map of actors The role of indigenous / local science and knowledge among actors Frequency of action of the actors: who visits the field, why and when (frequency)
Environment / Territory	Topography and geography Agroecological environments The purpose of production	The level of technification (areas of self-consumption, moderately technical and technified) Geographic coverage
Strategy used	Metodología, método o enfoque de intervención Fuentes de financiamiento Costos de la estrategia (eficacia; gastos hecho/ presupuesto)	Level and type of stakeholder participation in the strategy Functionality of scientific knowledge and indigenous / local knowledge The gender role
Broadcast technology	Type of production system Innovation approach Generation of innovations Type of technology	Origin of technology Success of technology and at what level Scaling level Dependence of external inputs
Performance of the *Economic* intervention	Market access Access to inputs Financial access (loan, security) Food safety Integration of the value chain	Access to agricultural services Production cost Energy efficiency Production revenue Distribution of risks Self-sufficiency
Cultural	Adapting the intervention to the characteristics of the locality The organization for learning	Types of producers Gender focus in the intervention
Environmental	Soil management Water use and management Fire prevention and management Influenced forest mass Effects of climate change	Wildlife Impairment Use of chemicals Management of agro-diversity (management of native varieties, number of crops, rotation)
Impact	Direct and indirect effects Level of participation in the project The gender role Level of cooperativism of producers Organization for the learning process Empowerment (individual, social, political)	Food safety Diversity of technical options Quality of life (participation in networks with other peasants and actors) Equity; distribution of costs and benefits (ethnicity, gender, social group

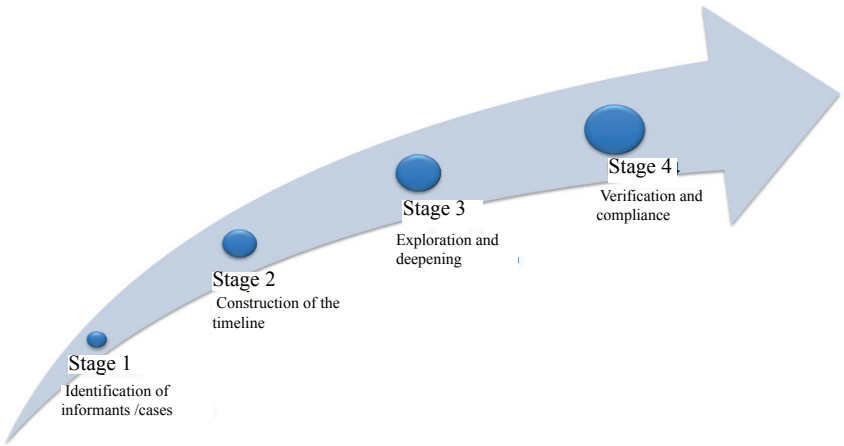

Figure 3. Stages for the documentation of case studies from the MaTCo

Table II. Integration of methodological stages and tools for the application of the MaTCo

Stage / methodological step	Objective	Instrumentos metodológicos
Identification of actors	Identify people with important information to build the history of the different processes	The identification of the actors is generally an interactive process. The gathering of information is done with experts, focus groups, semi-structured interviews, "Snowball" sampling, or a combination of these methods. Among other things, it is done: Analysis of NGOs Workshops with groups or civil organizations (groups of peasants or rural women) Visit to Communities / ejidos Interviews for companies and private organizations Diagnosis of research organizations (private and governmental) Diagnosis of Government Organizations and Institutions Analysis of the presence or incidence of political parties Key individuals; peasants, experts, etc.
Construction of the timeline	Identify critical events and significant processes	The timeline is based on the systematic recall of events or significant changes that have taken place in the life of the organization, the community or the individual and that are listed in chronological order while the key informants state them. Through this analysis, changes and trends can be identified over time, for example, land use, harvest patterns, etc. In the case of a community's timeline, people can mention events as far away as possible in the past (17)
Exploration and deepening of intervention processes	Describing and analyzing the most important elements of each actor and their interventions (principles, methodologies, etc.)	Dialogue with focus groups Participant observation Organizational / institutional analysis; Venn Diagram Historical graph of the production system Document Review Informal interview
Verification of information collected	Comparing the results with other sources of information, beyond those initially considered	To this end, a structured interview was designed, which was applied to the selected cases. In addition, informal interviews, field visits, and focus group analysis were conducted to collect as much information as possible (21) The analysis of the results consisted in the integration and analysis of each documented case, considering the variability of production processes and the ability to apply the principles of conservation agriculture, especially in hillside areas. It also suggested the study in changing the organizational structure of government programs, to provide the producer with efficient technical advice (22)

Actors and intervention strategies: case study Hub (node) down tropic of Chiapas

The application of this theoretical framework for the collection of information in the environment of the Trópico Bajo of Chiapas allowed the analysis of four relevant and representative organizations of the extension activity for agricultural innovation.

Office of Integral Services of Professional Advice, (SIAEP, according its acronyms Spanish). Group of agronomists associated with an office for sale are professional services. They operate in the Central Valleys of Chiapas and work with 40 cooperating producers.

Conservation Tillage Club. It is a group of producers accompanied by an agronomist and an investigator. It operates in the inter-montane valleys of La Frailesca and operates with 16 cooperating producers.

Network of Studies for Rural Development (RED A.C.). NGO integrated by agronomists and agro-ecologists, it is oriented to projects of sustainable management of natural resources. It acts in the foothills of the Sierra Madre de Chiapas and low slopes in the Zoque jungle. It has coverage in 15 communities and 1,000 producers.

Collective ISITAME A. C., Agency for Regional Development. NGO composed of agronomists and professionals from other disciplines for managing and implementing community development projects. They work in 30 communities and 1,700 producers.

The RED and ISITAME actors are civil society organizations (NGOs) with a comprehensive vision of development, broad coverage of communities and producers in areas of low and moderate productive potential. These are their common features. They differ from one another by the intervention strategies with which they interact with communities and producers. These organizations have a strategy based on participatory and intersubjective methods for capacity building and the design of local development with reduced use of external inputs for production and guide innovation processes with low-income producers who also practice subsistence farming.

The ISITAME work model promotes the lesser use of external inputs and a strong interaction among those involved. Under this model, it assumes the moderation of the technological innovation process, in which the innovation intermediary plays the role of facilitator and moderator between the producer, the science and the decision makers. It focuses on strengthening the interaction between producers themselves in order to enhance local knowledge and empowerment.

RED, is an organization focused on the local production system based on the individual for the field work. It is composed of researchers who facilitate technological innovation activities and participate in various government programs and institutions. In the context of study, it can be said that it assumes the mediation model of the process of technological innovation between science and decision makers to promote participatory technological development.

The cases of SIAEP and Tillage Club are located geographically in an area of high maize productive potential, where the use of external inputs is high. However, SIAEP is a team of agronomists who commercialize advisory and consulting services aimed at improving yields through conventional methods of technology diffusion, training and visit. This group of extensionists is coordinated by a professional with experience in the production of maize and in the management and operation of government programs. They have high interaction capacity with different actors (producers, researchers, officials, technicians) and base their work on the design of a joint program of activities between the extensionist and the producer. SIAEP can be defined as a strategy for implementing the technological innovation process, with a productive orientation towards increasing yields, which is enriched by the extensionist's linkages in its extensionist-producer relationship.

These profiles allow identifying three relevant vectors or trends through which all the criteria and indicators predefined in the conceptual framework can be analyzed. These are the economic-productive, environmental and socio-economic vectors (Figure 4). This three-dimensional framework, based on systemic perceptions of analysis, allows locating and even grouping actors in types of actors.

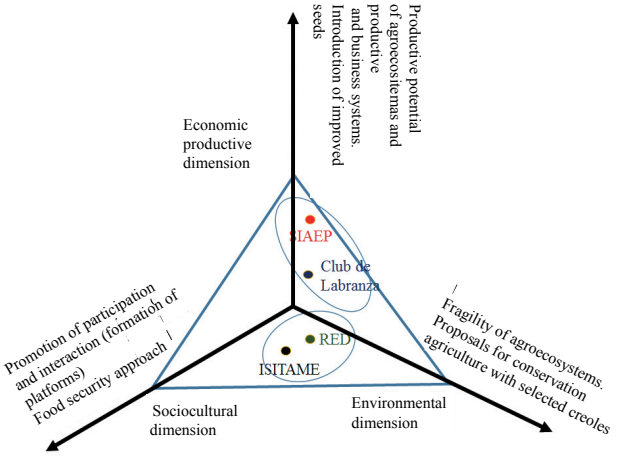

Figure 4. Vectors to establish domains of analysis related to the actors and their profiles

In this case, SIAEP and Club of Tillage are considered very close to the economic-productive and environmental dimensions, which produces a certain similarity between them, allowing them to be assigned common points and considered as a single domain of analysis; although, their particularities should not be ignored. The case of SIAEP is very focused on the economic-productive, while Club of agriculture maintains environmental considerations and has group identity; which gives it a certain attraction for the social vector, considered from the participation point of view that is not inclusive but selective (5, 23, 24).

For the ISITAME and RED cases, a shared analysis domain can also be established, since both organizations are inclined to the sociocultural and environmental vectors. However, ISITAME is more attracted by the sociocultural and RED by environmental (Figure 4).

These group and dimensions have logical foundations as to the criteria and indicators that were previously defined in the MaTCo, which undoubtedly confirms their relevance for this type of studies. For example, the inclination towards the economic-productive dimension brings the actors involved in SIAEP and the club of tillage to a business rationality, in which the utilities have an important weight. In addition, it is consistent with the environment-territory criterion,

since they are located in areas with greater productive potential. For its part, the environmental problem, caused by its own practices, is projected in its management. In this way, the intervention strategy employed and the productive performance are also consistent in this domain of analysis because the transfer processes predominate to maximize the production with high inputs.

For their part, RED and ISITAME, are congruent with the fragile environments with little productive potential in which they operate and in which there are self-subsistence food systems. Therefore, their methods aim at participation, to generate solutions focused on the conservation of the agroecosystem and the promotion of production in conditions of low energy inputs that contribute to food security.

Proposals for technological innovation since the MaTCo

The proposal of the studied actors has two aspects: facilitated from MasAgro and the own of each actor. The proposal from MasAgro considers three basic principles: zero tillage, management of crop residue on the land and non-removal of soil. All of this also leads to the application of other technologies that contribute to the sustainability of the systems involved, such as the use of green manures and permanent beds, management of post-harvest grains, promotion of the selection of native maize and sowing to double row, which facilitates the possibility of intercalating crops and making an intensive and sustainable use of the land. For the case of each actor's own offer, it is the result of a diagnostic work and includes outstanding proposals such as: plant nutrition and delivery of maize seeds for testing in all cases studied.

ISITAME and Club of tillage direct their efforts towards productive diversification at the production unit level, through the intensive use of land. ISITAME is promoting Fruit Intermixed Maize (MIAF, according its acronyms in Spanish) to reduce fires and generate diversified production that meets the food needs of families. Club of tillage, on the other hand, adds soil improvement (fertilization, liming and organic waste) and the use of hybrid seeds for the production of high potential maize. The trial of double-row maize sowing is to make better use of space, including crops such as beans and forage production for livestock rearing. In this sense, an interaction between the production of maize and cattle in the intervention areas is perceived.

For its part, SIAEP has a proposal based on the high production of grains, so it focuses on the use of agrochemicals and hybrid maize for the efficient use of alluvial lands and irrigation.

Organizations located in the low or moderate potential environment, such as RED and ISITAME, focus their efforts on strengthening the technical and organizational capacities of producers for a more efficient management of the maize production system, under a systemic and agroecological approach. For RED, the starting point is the improvement of the Creole maize, adapted to the risky environment and the substitution of the hybrids, to reduce the production costs.

From these cases, a proposal of intensive production (IP) for the technological innovation of the maize production system is identified as common and outstanding.

- Improving soil fertility and crop nutrition focusing on external inputs and others on their reduction or moderate use, while encouraging the use of local inputs.
- Improve genetic materials as a way of exploiting the productive potential in areas most suitable for production through the use of hybrid seeds and in areas of moderate and low productive potential, through the selection of native or local seeds. This indicates that soil fertility and genetic material are essential elements to obtain adequate and sufficient production for the producer.

DISCUSSION

Historical analysis of intervention strategies

It is increasingly evident that the strategies and models of technological intervention implemented for the generation and diffusion of technologies have evolved at both the international and national levels. These changes are based on principles and methodological foundations of diverse currents of thought that support to these strategies implemented by the diverse actors, like agencies and institutions, oriented to the agricultural development. The complexity of these practices in various parts of the world is also evident in Latin America (6, 11).

The analysis of the rationalities of the actors studied in this article demonstrates that the methodological and knowledge management tendencies respond to the influences of their contexts. Therefore, no strategy should be cataloged as superior to another, if not analyzed with a conceptual framework defined and appropriate for each specific case and context.

The evolution of intervention strategies for agricultural innovation through extension in Mexico (11, 25), and in particular what was found in the present study in relation to the MasAgro program, are already part of this historical line of approaches and intervention strategies in rural Mexico (Figure 5). The analysis of the most important elements of this process allows highlighting the following aspects that give an explanation and justification to the results presented previously.

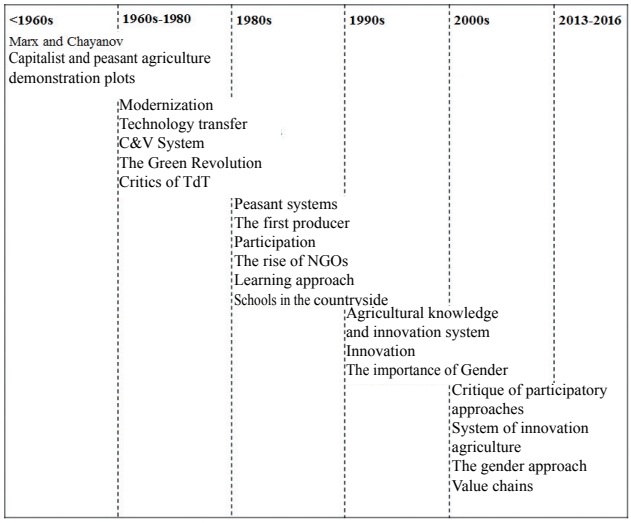

Figure 5. Timeline of intervention strategies for agricultural innovation (1960-2016), adapted from Ellis and Biggs (25)

To locate the different moments in the evolution of the intervention systems in a certain time line is a difficult effort (26). Therefore, evolutionary reconstruction represents a challenge and at the same time an interesting academic exercise, which from a systemic and flexible perspective can assume the permanent adaptation to the context in function of other evidences or documents that arise in the very process of its construction.

For academic purposes, an attempt has been made to establish a chronological order to address the most relevant issues in the evolution of intervention strategies. On this basis (5, 27, 28), they offer an overview to explore new perspectives and to understand interventions or models of technological development and extensionism.

Often, paradigms and approaches originate long before they are known and applied (29, 30) and consequently, in many times as at present, projects are implemented without a deep understanding of the underlying paradigm (3). This has also implied that in the last three decades of rural development practices in Mexico and other Latin American countries, in many cases, the dominant paradigms have not supported the practices of projects that aim to impact agricultural innovation through technology.

The beginning of the XXI century marked a growing worldwide concern about food security, environmental degradation and climate change. These challenges have raised new expectations for agriculture and thus for rural extension and development agencies. Increased productivity and poverty reduction remain central objectives in rural development, together with environmental concerns and their relationship to food security, which has given rise to new ideas and approaches to agricultural development (31-33).

At present, there is a consensus that improved interaction between stakeholders in agricultural development contributes significantly to innovation processes (6, 34). Therefore, improving the exchange of information, ideas and opportunities stimulates and facilitates the processes of innovation in networks of different actors that emerge around specific problems (5).

In recent years the need for an intermediary actor of innovation has been generalized to facilitate this process. That is, an individual or an organization whose main objective is to effectively foster information flows and collective learning among actors (10, 35, 36).

For its part, the incorporation of women in rural development; from its role, opinions and activities has also become an essential issue in the design and implementation of rural intervention strategies. Extension agents and others (including policy makers and local government officials) should also be equipped with the knowledge to manage and respond to demands on diversity based on the age of the farmer, gender, socio-economy, ethnic differences, livelihoods, among others (37). In this regard, there is growing evidence supporting the importance of integrating gender and generational equity for the success of interventions in agricultural innovations (38). This perspective confers greater development potential to the contexts and diversifies the alternatives of survival of less favored environments.

Finally, technological innovations generated by intervention strategies play a fundamental role in innovation systems, especially as a means to facilitate interaction and collective learning in agricultural processes.

CONCLUSIONS

- The proposed MaTCo allowed to understand the trends and domains of analysis for the understanding of the agricultural development processes implemented by the actors studied and their intervention strategies.
- These intervention strategies are part of a socio-productive rationality conditioned by the context, its problems and potentialities; but also of the defined guidelines and policies implemented by the country's development agencies.
- The final results allow the orientation of current or future interventions, as well as feedback to the actors that facilitate agricultural development processes, with the MaTCo methodological support with greater precision and depth.

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