Chapter 5

The Key Role of Integral Extension in Socio-Environmental Innovation towards Sustainable Rural Development

Aida Huerta-Barrientos

Additional information is available at the end of the chapter

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Abstract

In Mexico, traditional extension models have been linear, also they lack orientation towards the demands of the producers and the demands of the markets, the approach has been in general paternalistic and the attention is by individual producers. These extension models have not been sufficiently effective in promoting and adopting socio-environmental innovations to create value along the supply chain. The principal purpose of this chapter is to understand, on the one hand, the elements of a novel integral extension model, and on the other hand, its key role in socio-environmental innovation for contributing to achieve sustainable development in rural areas in Mexico. The integral extension model proposes the participation of extension workers as facilitators of the learning process to orient the change of attitudes and behaviors of local/regional actors, carrying out the socio-technical-environmental support to producers throughout the value chain perspective. Also, traditional and science-based knowledge need to interact synergistically ensuring that further value is added to traditional knowledge of local producers. In conclusion, integral extension system plays a crucial role in the implementation of strategies for sustainable rural development in Mexico because it promotes models of interactions among local/regional actors consistently with future as well as present needs.

Keywords: extension systems, value chain, socio environmental innovation, rural development

1. Introduction

Extension has been defined as a system aimed at facilitating producers, their organizations and other market actors, access to knowledge, information and technologies [1]. The extension is

intended to facilitate its interaction with its strategic partners in research, education, agribusiness and other relevant institutions, supporting them to develop their own technical, organizational and managerial skills and practices. At the global level, it has been recognized that extension systems constitute the most effective path to creatively reconstruct the entrepreneurial, social and ecological capacities of people in rural areas to successfully engage in production and livelihood activities that demand competitive orientation and sensitivity about the environment [2]. Extension in the world started in the sixteenth century, but until the nineteenth century, it was documented, particularly in Cuba where teaching process was developed in order to help small producers (SP) with last advances in science and technology. In fact, many conferences were promoted to SP in Europe and the United States [3]. As observed by Dart et al. [4], along time agricultural extension, has shifted from a focus on production to productivity-based agriculture and more recently, it emphasizes sustainability aspects. Also, institutional changes and participatory learning process have led the empowerment of local capacities [5]. In the 1950s decade, different programs were established worldwide based on recommended technology packages but without taking into account the farmer point of view [6]. Later, in the mid-1980s decade, the Farming Systems Research and Extension approach was introduced integrating the participation of farmers through the identification of their own needs and solutions [5]. Additionally, at this time, professionals were viewed as experts, so new technologies were passed from the scientific community to farmers via extension workers [7]. More recently, in the 1990s decade, rural development programs worldwide recognized the local participation of inhabitants as crucial to the sustainable adoption of new technologies [5]. Studies presented in [8–11] indicate that the main focus of extension work during the last decades has been the increment of food production and the diffusion of the benfits for adopting best practices. On the one hand, Allahyari [12] observed in Middle Eastern countries that the model for transferring technology was the prevalent practice for developing and spreading innovations, under the assumption that both transfer of technology and scientific knowledge to farmers will trigger the development. On the other hand, Garforth and Lawrence [13] observed in Asia that although extension programs had included the adoption of new technologies, the extension approaches and methods in the public sector continued to reflect the technology transfer paradigm.

Particularly, in Mexico, the traditional extension public service was established in the mid-1950s, oriented mainly by the federal government priorities with interest on basic crops to diffuse new technologies generated by agricultural research through a network of small producers [3]. Mexico started to shape its agricultural extension model by adopting some characteristics of the prevailing system in the United States [14]. The extension model was called "training and visit". This model was followed up by the beginning of the 1990s. In 1995, the National System of Training and Integral Rural Extension (SINDER) was established under the scheme based on the incorporation of technicians paid through subsidies to small producers and oriented to the attention of production systems with national priority. Within this framework, two programs were established and operated until the year 2000: Special Training and Extension Program (PECE) and Elemental Technical Assistance Program (PEAT). In these cases, the main role of extension workers was to reduce technological gaps through technical advice, exchange tours, demonstration plots and training workshops, that is, the same as in

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traditional extension. The result of such programs in terms of innovation was limited, given the lack of specific technical structures by the government agencies related to the rural environment, these began to occupy extension workers as managers of the programs. Another disadvantage of such programs was the low flexibility of interventions due to bureaucratic barriers. In addition to the dispersion of activities carried out by PEAT and PCE technicians, as well as the lack of justification for maintaining two independent extension programs. Six years later, the SINDER was canceled and a new extension model emerged, largely known as the Special Professional Services Program (PESPRO). The fundamental difference with the previous scheme was the design and implementation, suggested by PESPRO, of business productive projects taking into account the population served. The training and follow-up program was established through the INCA-Rural (National Training and Rural Technical Assistance Service). At the beginning of 2010, Chapingo Autonomous University and Postgraduate College carried out a study on the analysis on the Mexican Technical Assistance and Training Component operated by the Agriculture, Livestock, Rural Development, Fishery and Food Secretariat (Secretaría de Agricultura, Ganaderia, Desarrollo Rural, Pesca y Alimentación, SAGARPA) in the 32 federal states of Mexico. In this study, it was concluded that the Mexican extension system has had a low incidence in the capacity development of the actors involved in productive activities. Such conclusion was based on the occurrence of facts such as the perception that the extension system has not provided sufficient value to the actors involved, the low valuation of its capacity development and the low quality of the knowledge flows throughout the system [14]. One year later, in 2011, the OCDE carried out another study on the extension system in Mexico [15]. Among other conclusions, the OCDE highlighted that although Mexico has had many or all of the components of an innovation system such as PSPs (professional service providers), research centers, universities, etc., it was lacked of interaction among governmental institutions and collaboration and feedback channels that are characteristic of effective innovation systems.

According to Osorno Magaña [16], nowadays Mexico has all the elements for a rural extension system, but it cannot be considered as a system since there is no link between research and extension services. In this direction, the central problems of Mexican extension system are the lack of experience in articulation instances functionality, the poor strategic planning for extension and innovation, the isolated intervention of extension agents and other knowledge services, the strategies with lack of definition in their relevance, the lack of focus on training, extension and innovation actions, professionals with limited capacities to meet the needs of the rural population, strategies inadequate to the needs of rural territories, the limited change in technological or organizational practices. The negative effects that cause the problems before described are the following: lack of competitiveness of territorial agri-food chains, agricultural, livestock, fishery and aquaculture activities with low productivity and income, disruption among the public, social and private actors in rural extension and innovation [3]. Traditional extension models in Mexico have been linear, also they lack of orientation towards the demands of the producers and the demands of the markets, the approach is, in general, paternalistic and the attention is by individual producers [17]. This kind of extension models has not been sufficiently effective in promoting and adopting socio-environmental innovations to create value along the supply chain. So, it is necessary to develop and implement an

integral extension model in Mexico. The principal purpose of this chapter is to understand, on the one hand, the elements of integral extension model, and on the other hand, its key role in socio-environmental innovation for contributing to achieve sustainable development in rural areas in Mexico. Although public extension services suffer from restricted financial and human resources, it plays a crucial role in the implementation of strategies for sustainable rural development [18] because most developing countries have rural-based economies whose sustainability and productivity are linked to natural resources and management [5]. Within the sustainability paradigm, organizations must become a learning-adaptive organization where their learning-adaptive agents must able to respond to changes due to interactions with the complex environment. In this direction, new Weltanschauung, concepts, values, methods and behavior will emerge from the interactions among learning-adaptive agents.

The chapter is divided into five main sections. In Section 2, the current situation of Mexican extension systems is highlighted. The model of integral extension system in Mexico is described in Section 3. The key role of integral extension in socio-environmental innovation is analyzed in Section 4. Finally, the conclusions are drawn in Section 5.

2. The current situation of Mexican extension system

In Mexico, there are 117 million inhabitants of which 26–36 million counts as rural inhabitants. According to Dominguez Vizcarra [19], in Mexico, there are 4.34 million small producers of which 3.9 million have low access to technology, self-consumption and subsistence, whereas 442 thousand are in transition. As OCDE [20] states, in Mexico, the Article 27 of the Constitution recognizes two forms of land property:

- Small property also called the private property that is regulated by the civil right and controlled by the public registry of the property.
- Social property that is regulated by the agrarian right and controlled by National Agrarian Registry (RAN) structured in two modalities:
    - Ejidos, characterized by the fact that their origin is derived from the agrarian distribution of land, whose owner can dispose also for common use.
    - Communal land, characterized by the fact that its origin derives from the confirmation or restitution of land to indigenous communities that originally were established there and made use of them.

Figure 1 shows the distribution of land property regimen in Mexico. As it is observed, 52% of the land in Mexico is considered social property and just 38% is considered as private property.

Recently, it has become necessary to rethink a new model of extension in Mexico as one of the fundamental elements to overcome the conditions of poverty and marginalization suffered by many rural inhabitants, as well as to increase food production and conserve natural resources. For this reason, the SAGARPA through the Subsecretariat of Rural Development in conjunction with INCA-Rural, have been given the task of developing and making available the System of

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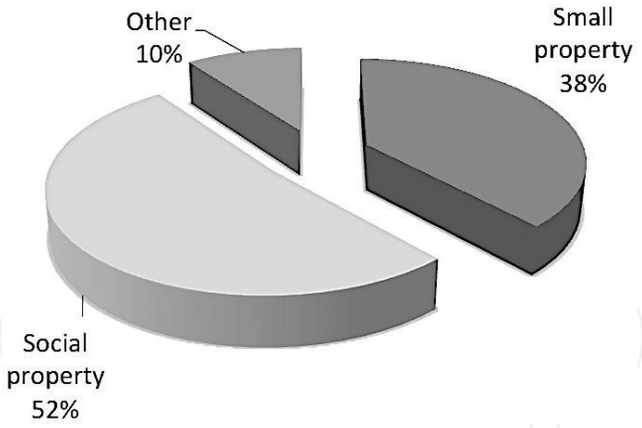

Figure 1. Distribution of land property regime in Mexico.

Mexican Rural Extension called SERMexicano (S = System ER = Rural Extension M = Mexican), as a useful tool in the promotion and socialization of services and results inherent to the new Mexican rural extension. SERMexicano system rescues, in essence, the useful elements of traditional extension and incorporates innovative actions and tools to form the new Rural Integral Extension, taking as a guiding axis, the work and leadership of extension workers [21]. The operation and implementation of SERMexicano are intended to bring the following benefits:

- To adequately orient the lines of action to promote and consolidate the new Mexican rural Extension through a meeting space, knowledge management, debate, exchange of experiences and collaborative work among actors involved in the Component of Extension and Productive Innovation, assisting producers in the solution of their specific problems classified by region, climate and product.
- Stakeholders, including farmers and producers, will be users of information flows since they are directly linked to the processes of rural development policies.

As Lopez Barbosa [22] explains: in Mexico, there are almost 4000 extension workers with contract, more than 100 extension workers-coordinators with contract and almost 400 university-extension workers (see **Figure 2**).

Figure 3 illustrates the distribution of extension workers by gender in the Northern, Central and Southern regions in Mexico. The participation of women in extension is prevalent in the Central region. Contrary, the participation of men in extension works is prevalent in Northern and Southern regions.

The technical skills of extension workers are shown in **Table 1** and **Figure 4**. The technical training is predominantly on agricultural sciences and veterinary. Additionally, extension workers have been invited to participate in certification programs in order to improve their qualifications in areas [22] such as:

- Provision of training courses for human capital in a group face-to-face manner.
- Formulation of rural investment project design.

- Formation of trainers for sustainable rural development.
- Facilitation of processes of innovation of competitive improvement with people.
- Design of collective human capital training courses face-to-face.
- Design of in-person training courses.
- Coordination of actions for the implementation of rural sector investment projects.
- Coordination of actions for sustainable rural municipal development.
- Consultancy for rural companies.
- Calibration of fertilizer planter for conservation tillage.
- Consulting.
- Application of good use and management of agrochemicals field section.

On the one hand, OCDE [15], in a study of the Analysis of Agricultural Extension in Mexico, argues that there is no specific agricultural extension service as such. Rather, farmers have technical assistance in accessing the various SAGARPA support programs as an integral

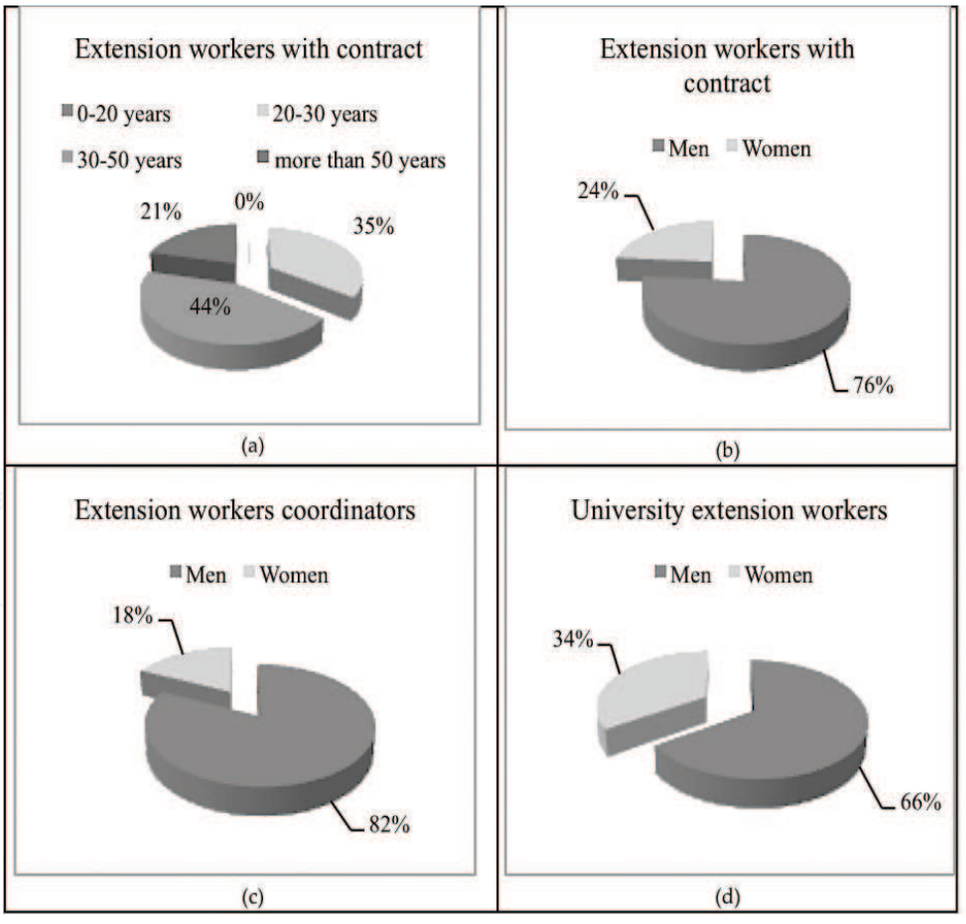

Figure 2. Distribution of (a) extension workers with contract by age, (b) extension workers with contract by gender, (c) extension workers-coordinators by gender and (d) university extension workers by gender.

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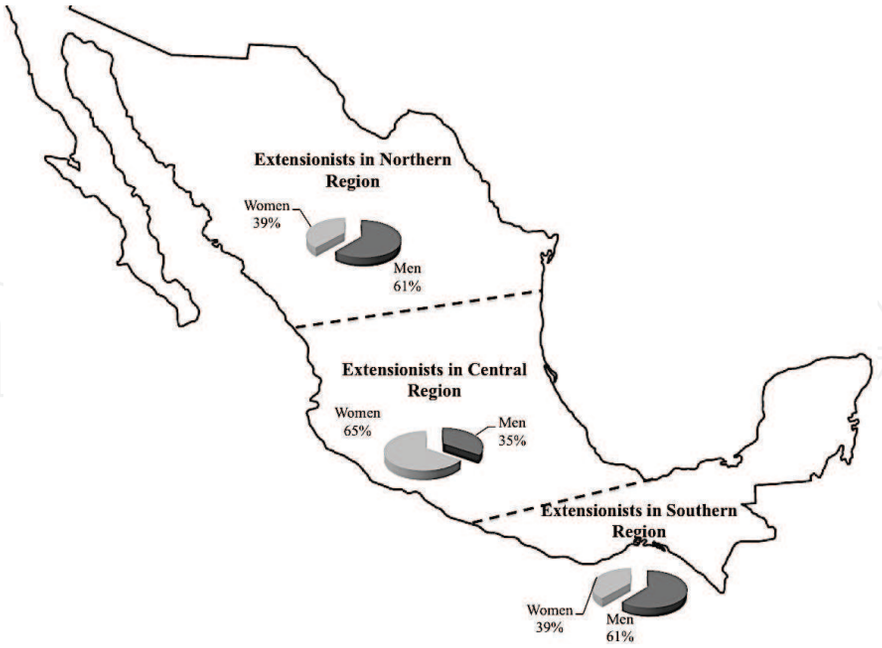

Figure 3. Distribution of extension workers by gender in the northern, central and southern regions in Mexico.

Technical skill	Percentage
Agricultural sciences	56.1
Vet	20.2
Biologist	5.8
Management	4.5
Other	4.4
Industrial production and food	2.3
Accounting	1.7
Fishing	1.5
Commerce	0.9
Forest sciences	0.7
Managerial information	0.6
Building	0.4
Social service	0.4
Farm equipment	0.3
Electricity and electronic	0.1
Travel services	0.1

Table 1. Technical skills of extension workers in Mexico.

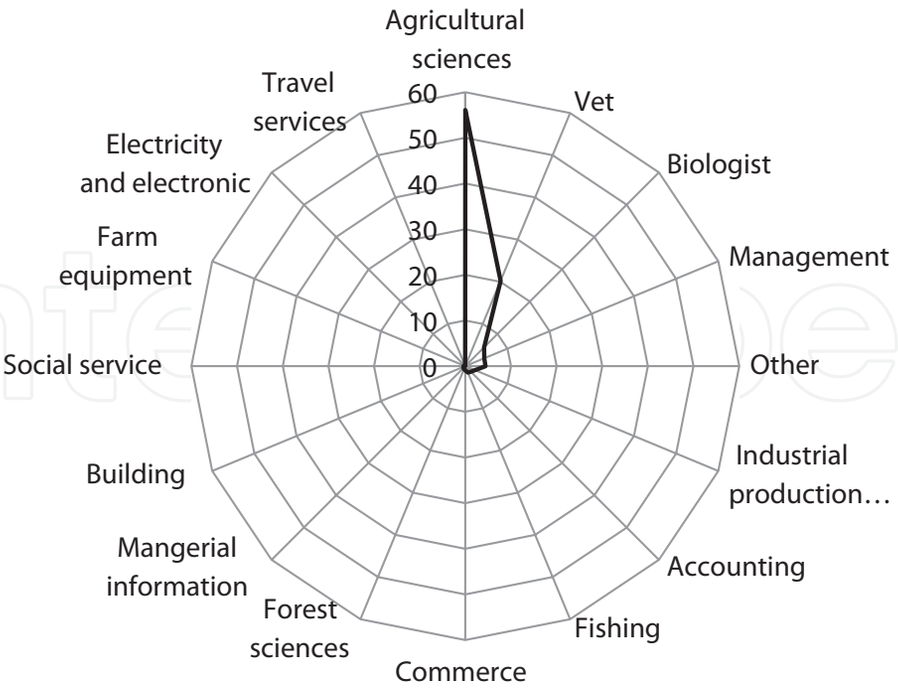

Figure 4. Technical skills of extension workers in Mexico.

part of them. Also, technical assistance is provided through private sector contractors, i.e. professional service providers (PSP), whose function is to implement the programs at the farm level. Then, professional services defined for this purpose include strategic planning, project formulation, access to public resources, technical advice, business strategies and training, among others and its objective is to support farmers to increase their efficiency and facilitate their incorporation into value chains. On the other hand, Robles Berlanga [23] makes the point that the technical assistance and training services of extension in Mexico remain disconnected from results, the range of population included in the extension program is still small, even lower than those granted in 1991, the support for production, technical services and financing are decoupled, and the training system is inefficient, that means high cost in relation to its coverage and poor quality of service. Finally, security is missing for service providers. In consequence, small producers have not access to productive water, improved seeds, fertilizers and technology, their participation in organizations to prevent economies of scale for production, marketing and access to public goods, is weak. As reported by Vega [24], although extension service has changed in Mexico, now as a private service with public payment, with more flexible work programs and a significant budget, however, it has not yet established itself as an important element of socio-environmental innovation.

3. A model of integral extension system in Mexico

In Ref. [22], the main characteristics of integral extension work in Mexico are proposed to be as follows:

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- The rural producer must be human before an economic agent.
- Collaboration among actors to expand and strengthen actions.
- Incorporation of technological tools for the registration, selection and monitoring of the activity of extension worker.
- Promotion of innovation and technological development.
- Creation of competent markets.
- Development of human, social and economic capacities.
- Innovative vision on the market, process, product, social, institutional and personal.
- Strengthen the roots of the earth.
- Orientation to the change of attitudes and behaviors.
- Transformation of public welfare policies towards productivity.
- Encourage partnership among rural producers.

In this direction, the training needs of extension workers must arise from the innovation needs of the value chain to which they provide their services [19]. So, the role of extension workers needs to change from transferring knowledge and technology to consultants and facilitators of the learning process [25].

As Villareal [26] states, the five basic elements of the global value chain are innovation, supply chain, manufacturing, logistic distribution and marketing. The basic elements must be conceived as processes within a system, so none of them functions in isolation as is shown in **Figure 5**. Thus, Villareal [26] adds that in the first place, commercial capital is linked to intel-

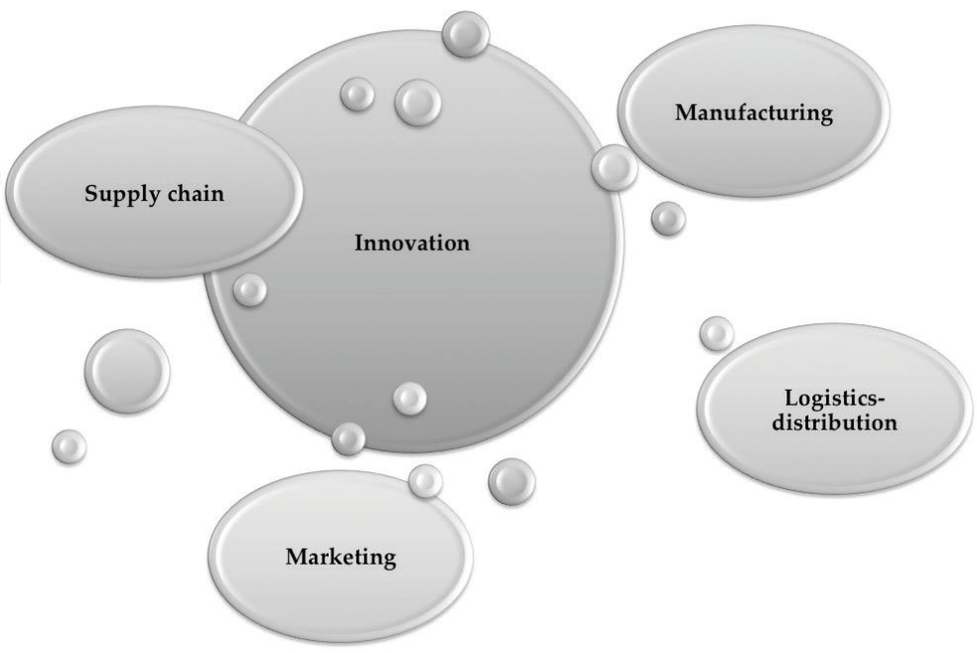

Figure 5. The five basic elements of the global value chain [26].

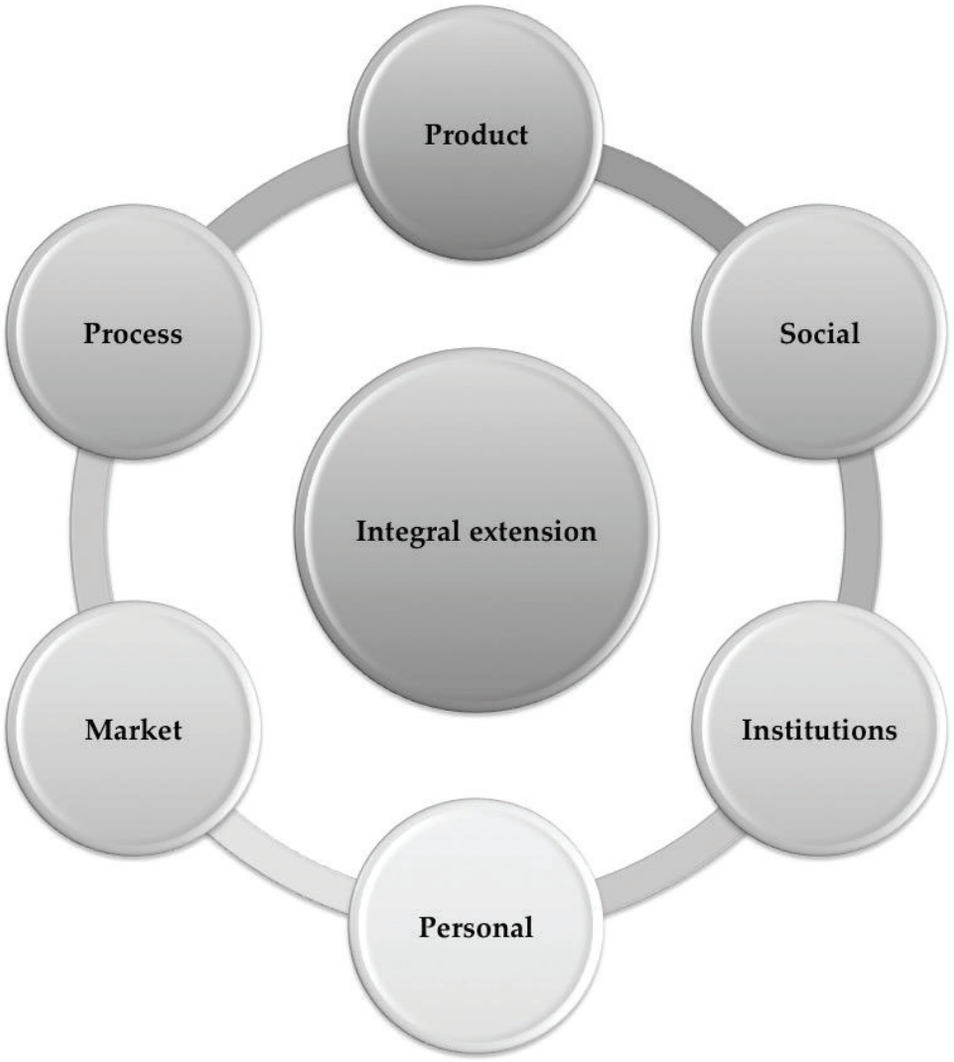

Figure 6. Innovation dimensions for supporting the value chain proposal.

lectual capital, establishing a close link among all the links in the chain. Second, supply chain, distribution and logistics systems must be responsive and reliable to put the right product on the counter before the competition does. Thirdly, manufacturing must be flexible in order to be able to rapidly adapt the production system. Finally, the articulation of a value chain must be effective and efficient.

According to SAGARPA, the extension workers should have an integral vision, carrying out the technical support to producers, throughout the value chain perspective supported by six innovation dimensions illustrates in **Figure 6**. The product dimension includes the improvement of the primary production and transformation processes. The social dimension promotes the improvement in association among rural producers. The institutions dimension promotes the innovation in the design and implementation of public policies generating synergy among all actors. The personal dimension promotes increasing the belonging feeling of rural producers with respect to their own communities. The market dimension promotes to produce what is sold. Finally, the process dimension promotes attending the real demand of products.

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4. The key role of integral extension system in socio-environmental innovation

In Ref. [27], the socio-environmental innovation is defined as a process of gradual change through action research in localized territories, which implies that a set of actors, based on their own interests, mission and capacity, participate in specific activities (scientific, technological, environmental, cultural, organizational, financial and commercial) whose orientation is not only to give a creative answer to linked problems of rural development and conservation of natural resources, but also to generate learning that lead to the autonomy of the actors and structural transformations that are reflected in the collective benefit. Following Ref. [27], the socio-environmental innovation seeks to generate a flow of relevant information through channels and networks of interaction, promote the process of generation and diffusion of innovations and emphasize as a central aspect the interconnection of these channels and networks. In this direction, the participation of extension workers in the socio-environmental innovation process needs to be as facilitators of the learning process to orient the change of attitudes and behaviors of local actors, promoting the adoption of innovations for local/regional development.

FAO [3] has made some recommendations, including the need to change the focus on the type of extension needed to develop the capacities of producers and to promote innovation, and points out that this approach should consider, among other things:

- Multi-disciplinary, with the transfer of research technologies, towards access to markets and climate change.
- The research and extension system must respond more to the needs and demands of producers to motivate innovation.
- Education institutions should be involved in this process, with the development of training materials on productive management, marketing, cooperation, etc.

The FAO-Capacity Development Framework [28] discusses functional and technical capacities across three levels: individuals, organizations and the political-institutional environment. For instance, the individual technical capacities include the competences for the evaluation of the diagnosis of the innovation capacity of systems, the technical and functional capabilities to promote appropriate innovations and technologies, the understanding of participatory approaches, the training in organization and associativity, the understanding of markets and value chains, the understanding of changing forms on climate, social and economic vulnerability and the use of new information and communication technologies (ICT). While the individual functional capacities include the mobilization of communities, the development of farmers' organizations, the directed self-reflection training, the expert advice to achieve improvement, the reflective learning, the mediation in conflicts, the negotiation, the intermediation in the creation of relations among a wide range of actors, the development of networks and associations, the changes in policies and institutions, the leadership ability to inspire and motivate, the resource management (human and financial), the critical thinking, the problem-solving, self-reflection and learning based on errors, the mentality of service; accountability, responsibility; commitment to work in multi-organizational and working with rural women.

Traditional knowledge is a cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment [29]. These sophisticated sets of understanding, interpretations and meanings are part and parcel of a cultural complex that encompasses language, naming and classification systems, resource use practices, ritual, spirituality and worldview. Following Ref. [29], traditional knowledge supports the decision-making at local level about aspects of day-to-day life such as hunting, fishing, gathering, agriculture, preparation, conservation and distribution of food, location, collection and storage of water, coping with disease and injury, interpretation of meteorological and climatic phenomena, manufacture of clothing and tools, construction and maintenance of shelter, management of ecological relationship of society and nature and adaptation. It is important to note that at the local level in territories, traditional and science-based knowledge should interact synergistically in the socio-environmental technology-based innovation and other creative processes, ensuring that further value is added to traditional knowledge being relied upon by small producers [30]. In this direction, traditional knowledge must be revalorized for providing local people with the strategic capacity for the harnessing of extra-local forces in a market economy [31]. In Ref. [32], the following principles for the use of traditional knowledge in achieving goals relating to sustainable development:

- Ensure the full and effective participation of traditional knowledge holders during all stages of elaboration of sustainable development policies, plans and programs, alongside the scientific and technological community.
- Acknowledge and respect the social and cultural bases, including the authority structures within which traditional knowledge is embedded.
- Recognize the rights of traditional people to own, regulate access and share benefits of their unique sets of knowledge, resources and products.
- Ensure that traditional knowledge holders are fully informed of potential partnerships and that these are only entered into with prior informed consent.
- Promote models for environmental and sustainable governance that incorporate principles of genuine partnership and collaboration between scientific and traditional knowledge;
- Promote training to better equip young scientists and indigenous people to carry out research on traditional knowledge.

5. Concluding remarks

Extension, worldwide started in the sixteenth century, has been defined as a system aimed at facilitating producers, their organizations and other market actors, access to knowledge, information, new technologies and last advances in science. Extension systems have been considered as the most effective path to creatively reconstruct the entrepreneurial, social and ecological capacities of people in rural areas to successfully engage in production and livelihood activities that demand competitive orientation. However, in Mexico, some prob-

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lematic situations such as the isolated intervention of extension workers, the lack of focus on training, extension and innovation actions, the extension workers with limited capacities to meet the needs of the rural population, etc., have delayed the adoption of innovations in rural areas. This chapter presented the elements of a novel integral extension model and described its key role in socio-environmental innovation for contributing to achieve sustainable development in rural areas. The importance of the integral extension system is based on the collaboration among local/regional actors for incorporating technological advances and promoting the adoption of innovations. In this case, extension workers must act as facilitators of the learning process of local/regional actors, carrying out the socio-technical-environmental support to small producers, throughout the value chain perspective. So, the training needs of extension workers must arise from the innovation needs of the value chain to which they provide their extension services. In conclusion, integral extension system plays a crucial role in the implementation of strategies for sustainable development in rural areas in Mexico because it promotes models of interactions among local/regional that incorporate principles of exploitation of resources, the direction of investment, the orientation of technological development and institutional change consistently with future as well as present needs.

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Author details

Aida Huerta-Barrientos

Address all correspondence to: aida.huerta@comunidad.unam.mx

1 Faculty of Engineering, National Autonomous University of Mexico, Mexico City, Mexico

2 The Complexity Sciences Center, National Autonomous University of Mexico, Mexico City, Mexico

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