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Rural agricultural development and extension in Mexico: Analysis of public and private extension agents

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Agricultural extension in Mexico significantly favors rural development and considers agriculture as a means of promoting economic development by solving problems associated with poverty and food security. The Mexican extension system, as in other Latin American countries, has been transformed into services provided by extensionists (also known as extension agents, or professional service providers). Due to the social, economic and political relevance of the subject, there is increased interest in proposing new studies focusing on the key roles of extension agents given their importance in achieving rural development objectives through training and providing technical assistance to producers. The present work compares opinions of public and private agricultural extension agents regarding the current extension system in Mexico, and inquires about developed activities, problems faced in daily practice, as well as continuous training actions and capacities. The present study methodology was a mix of qualitative (participant observations) and quantitative (structured questionnaires) information. The study population comprised of 44 extension professionals, 17 from the public (government) and 27 from the private (advisory offices) sectors. Analysis of the results report similarities in socio-demographic data; high academic levels and training in the agricultural sciences, and extensive experience in extension services. Both groups of extension agents had the same activities, while private providers also designed projects to obtain financing. Problems faced by both groups were politico-institutional and related to marketing. Both groups were interested in continuous updating with practical methods, and were seen as having outstanding competencies to perform their functions.

Key words: Rural extension, extension agent, public, private, Mexico.

INTRODUCTION

Globalization continues to compel humanity to face great challenges regarding a sustainable future. Most countries agree on the importance of reducing poverty, improving health, providing universal education, and promoting

knowledge and skills. In terms of the environment, for example, primary efforts have been to reduce the loss of biodiversity and improve our understanding of climate change and the necessary responses by society to

reduce the severity of its impacts (GM, 2013; ONU, 2015). These action areas are lines of rural development that seek to improve the living conditions of human society (CEPAL, 2015).

In rural areas, agriculture is a primary economic activity and constitutes the core livelihood of the people inhabiting these areas. Internationally, two of the strategies to reduce inequalities among people are promoting greater social inclusion, and promoting sustainable rural development through training, technical assistance and technology transfer to agricultural producers; agricultural extension (Cristovão et al., 2012).

Agricultural extension is highly important for innovation in the rural sector, and is considered a tool that favors rural development processes by promoting agriculture as an engine for economic development. Its strategy is to reduce poverty and improve food security (Aguirre, 2012; Báez, 2013; Ramjattan et al., 2017) by providing a link between administrators, technicians, researchers, and the rural social structure objective.

In Latin America, the public policies of each country reflect their interest in the issues. Several authors have approached the subject by discussing their definitions of extension or communication (Freire, 1973), historical context (Muñoz and Santoyo, 2010; McMahon et al., 2011; Rendón et al., 2015), and changes in models of extension. These efforts have strengthened public extension and rural innovation systems, and integrated them into public policies according to country.

Due to its social, economic and political relevance, the extension theme over time has generated new studies. Currently, extension agents are responsible for promoting development, implementing training and providing technical assistance. These individuals, in rural areas, disseminate scientific knowledge and provide technologies to producers to improve field production, thus providing a link between science and producers to improve sustainable rural development. Research exists that addresses the extension agent profile to determine their characteristics and training (Landini, 2013b; Mayoral et al., 2015; Monsalvo et al., 2017). As well, there are studies that address extension needs, skills, competencies and perceptions of extension agents (Russo, 2009; Vera and Rodríguez, 2011; Ramjattan et al., 2017).

In Mexico and other Latin American nations, agricultural extension has been transformed (Table 1) into systems with services provided by professional service providers. These individuals provide training, technical assistance and technology transfer services through a public and private extension market with the purpose of encouraging the development of producer

capacities and skills to improve their production processes, thus increasing yields and economic income.

Agricultural policy in Mexico is based on the Sustainable Rural Development Law [Ley de Desarrollo Rural Sustentable; Diario Oficial de la Federación (DOF), 2001, which is applied by the Secretary of Agriculture, Livestock, Rural Development, Fisheries and Food [Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA)]. The objectives of the law focus on research, technology generation, experimentation, and agricultural extension (McMahon et al., 2011).

The recent national strategy (2012-2018) has been to resume agricultural extension by providing credit, financial services and advice to small-scale producers to boost capacity development. Its purpose is to move towards a society and economy of knowledge through technology and innovation, and promoting extension with professional service providers. Thus, there is a network of more than 7,000 extension agents in the country aimed at providing support services to producers in various value-chains (SAGARPA, 2013).

International cooperation agreements have also been formalized with different institutions to share knowledge, strategies and experiences in order to improve the quality of life in rural communities. As well, national public and private universities have been incorporated through the Extension and National University Innovation Network.

The transformation of agricultural extension services demands changes in the attitudes, skills and capacities of extension agents (Ramjattan et al., 2017). For this reason, SAGARPA proposed a new extension approach, adopting an innovative vision for value-chains called Holistic Extension, based on developing potential, skills and knowledge. The program contains 4298 extension professionals who serve the 32 states of Mexico to benefit 300,000 producers through service provided by specialists in agriculture, livestock, fisheries and aquaculture (SAGARPA, 2015-2016; Rendón et al., 2015).

The demand for extension services are satisfied by two types of professionals: public: providing services to producers through government advisory programs linked to SAGARPA; Private: using advisory offices to obtain resources from producers to self-manage projects with the federal government.

The present study asks: Are there differences between the two groups of agricultural extension agents in the eastern portion of the State of Mexico regarding their opinions about the current national extension system? Answering the question requires contrasting the characteristics and opinions of public and private

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Table 1. Evolution of Agricultural Extension in Mexico.

Year	Event
1950	Mexico initiates its Agricultural Extension Model (Modelo de Extensión Agrícola)
1960	The National Institute for Agricultural Research (Instituto Nacional de Investigación Agrícola; INIA) begins
1960-1970	Extension system oriented to solve agronomic problems; Green Revolution
1980	Traditional Agricultural Extension model is removed
1990	North American Free Trade Agreement (NAFTA)
1996	The General Directorate of Agricultural Extension (Dirección General de Extensión Agrícola) is removed
	Restoration of the National System of Extension and Technology Development (Sistema Nacional de Extensionismo y Desarrollo Tecnológico, SINDER)
	Ley de Desarrollo Rural Sustentable, 2001 (Ley de Desarrollo Rural Sustentable)
	Sectoral Program for Agriculture, Livestock, Rural Development, Fisheries and Food 2001-2006 (Programa Sectorial de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación)
2000-2010	National System of Research and Technology Transfer for Sustainable Rural Development (Sistema Nacional de Investigación y Transferencia Tecnológica para el Desarrollo Rural Sustentable; SNIIT) and the National System of Training and Integral Technical Assistance (Sistema Nacional de Capacitación y Asistencia Técnica Integral; SINACATRI)
	Private Extension Service arises; Professional Services Providers, 2002
	OCDE Diagnostic "Analysis of Agricultural Extensionism in Mexico", 2011.
2011-2013	National Strategy: New Vision of Rural Extension in Mexico, Integrated Extension System (Sistema de Extensión Integral)
	International Cooperation Agreements
2014-2017	Incorporation of public and private universities, Extension Network and National University Innovation (Red de Extensión e Innovación Nacional Universitaria, REINU)
	Holistic Extension: New Extensionist Profile (skills, abilities, values and knowledge)
	Regional Extension Centers (technical and methodological support)

Sources: Aguirre (2012), Muñoz and Santoyo (2010), McMahon et al. (2011), Rendón et al. (2015).

agricultural extension agents on the extension system in Mexico. To address this, the activities developed, problems faced on the job, ongoing training activities, and potential skills for the performance of their profession are characterized.

MATERIALS AND METHODS

The study area is located in the central region of the State of Mexico, which is one of 32 states comprising Mexico, and represents 1.1% of the national territory. The state is politically divided into 125 municipalities grouped into 16 regions. The present study was conducted within Region XI, which corresponds to the eastern portion of the State of Mexico, and contains seven municipalities: Atenco, Chiautla, Chiconcuac, Papalotla, Tepetlaoxtoc, Texcoco and Tezoyuca. The population of the study area is 407,694 inhabitants in an area of 727.3 km², representing 2.69% of the state population [Comité de Planeación para el Desarrollo del Estado de México (COPLADEM), 2012].

The study methodology used a mix of qualitative and quantitative approaches, and is a comparative-descriptive study (Hernández, 2010). The population under study contains two groups of agricultural and livestock extension agents, public and private, working with agricultural producers based in the eastern region of the State of Mexico. The total sample was composed of 44 extension professionals.

In the case of public professionals, the total number of federal employees (17) who worked in SAGARPA participated. They attend to agricultural producers in the State of Mexico, advising on five production chains (Table 2).

In relation to private service providers, the sample is non-probabilistic incidental (Infante et al., 1984), because the answers

depended on extension agent interest and willingness to participate (27).

The qualitative method used social research techniques, including participant observation, attendance at labor meetings, extension forums, and field visits with producers. The observed events are recorded in field diaries.

The quantitative data was collected using a questionnaire (123 questions) coded with different types of questions (open, dichotomous, multiple choice and Likert scale) regarding socio-demographic variables (gender, age, education level, institution of study, study specialty, work experience, working conditions, time dedicated to work, place of residence, place of work, and languages spoken), work functions performed, problems encountered during daily work, self-evaluation of competencies and training needs. The questionnaire design includes some ideas from extension projects applied in other Latin American nations. Several tests were performed, including expert reviews, pilot, content validity, and Cronbach Alpha reliability, which reported a value of 0.895 with a maximum value of 1, and is reliable according to Hernández (2010).

The questionnaire was given to public and private extension agents personally and *via* E-mail. The data was entered into the spreadsheet software Microsoft Excel Version 2010. Data analysis used non-parametric statistical methods [Statistical Package for the Social Sciences (SPSS) version 15.0] such as descriptive statistics (minimum, maximum, average, median, standard deviation and graphs), independent sample comparison tests (Mann Whitney U-test) and bivariate correlations (Spearman).

RESULTS AND DISCUSSION

Results obtained are presented in four sections, and

Table 2. Public Extension and Technical Assistance Services 2016-2017.

Production chain	Extension agents	Producers assisted
Vegetables	7	180
Milking Cows	4	120
Sheep	2	60
Maguey	2	60
Wheat	2	90
Total	17	510

Source: Secretaría de Desarrollo Agropecuario (SEDAGRO, 2016).

Table 3. Socio-demographic and specialty data.

Variable		Public	Private
Gender	Male	64.7%	61.5%
	Female	35.30%	38.5%
Age range		26-60 years	25-65 years
Average age		36 years	35 years
Academic training	Bachelors Degree	70.6%	57.7%
	Postgraduate	29.4%	42.3%
Degree-granting institution	UACH	52.9%	42.3%
	CP	23.5%	38.46%
	UAM	5.9%	0
	UNAM	0	11.54%
	Other	ITSON (5.9%)	Lasalle (3.9%)
Specialty areas	Agriculture	35.3%	23.07%
	Livestock	35.5%	19.23%
	Forestry	-	19.23%
	Rural Development	-	15.4%
	Nutrition	5.9%	3.8%
	Education	5.9%	-
	Other	17.6%	19.3%
Work experience		1-15 years	1-33 years
Full-time extension agents		100%	48.15%

UACH, Universidad Autónoma de Chapingo; CP, Colegio de Postgraduados; UAM, Universidad Autónoma Metropolitana; UNAM, Universidad Nacional Autónoma de México; ITSON, Instituto Tecnológico de Sonora; Lasalle, Universidad Lasalle.

contrast responses provided by extension agents: 1) Analysis of Socio-demographic Data of Both Groups; 2) Information about Extension Agent Functions and Problems; 3) Formative/Development Needs, and 4) Extension Agent Competencies (Table 3).

In both groups of extension agents, male labor participation (more than 60%) stands out, although female participation is higher in the private sector (38.5%). Women experts in field agricultural activities stand out; their expertise is increasing noticeably (FAO, 2011). Ages reported over both groups range from 25 to 65 and the mean age is 35 years. These results agree with those of Mayoral et al. (2015) who mention that it is the range for productive ages.

Regarding academic training, private professionals have a higher level of study, and both groups have bachelor's degrees. Both groups predominantly come from Mexican academic institutions specializing in the agricultural sciences: Universidad Autónoma de Chapingo (UACH) and Colegio de Postgraduados (CP). The rest come from other public institutions: Universidad Autónoma Metropolitana (UAM), Universidad Nacional Autónoma de México (UNAM), Instituto Tecnológico de Sonora (ITSON), and Universidad Lasalle (a private university).

Regarding areas of specialization, both groups are experts in agricultural and livestock sciences, including forestry, rural development, nutrition, education,

Table 4. Socio-demographic correlations.

Variables 1	Variables 2	Rho	Pr>F	SIG
Age	Extension experience	0.714	0.000	**
	Maximum level of education	0.480	0.001	**
Type of Extension Agent	Working conditions	0.608	0.000	**
	Full-time extension work	0.542	0.000	**
Graduating Institution	Maximum level of education	0.387	0.009	**
	Specialty area	0.348	0.020	*
Laboral conditions	Full-time extension work	0.500	0.001	**

*Significant correlation; **highly significant correlation.

Table 5. Laboral activities.

Frequency	Public	Private
Always	Offering technical assistance	
	Group training	
	Technology transfer	Design productive projects
	Training in multiple areas	
	Work with social groups*	
Frequently		Identify demands
	Design productive projects	Elaborate plans
	Identify demands	Group training
	Develop training materials	Technical assistance
	Promote producer self-management	Work with social groups*
		Promote producer self-management

*Work with social groups such as the young, handicapped, women, and seniors.

agroindustry, agribusiness, biotechnology, botany and economics. These academic profiles are consistent with the training and technical assistance activities carried out in extension service (Landini, 2016a). Both groups have extensive work experience, with private agents having more experience (1 to 33 years); suggesting greater knowledge of producers, and a better extension service environment.

Correlation analysis results show that older extension agents have more experience. Labor conditions determine the type of extension agent; public professionals are employees of the federal government and work full time (Table 4). In contrast, the private sector has advisory offices, their activities arise from producer demands and availability of projects, and they do not work full-time (Table 5). There is a relationship between academic institution and educational level; Bachelor's degrees at the Universidad Autónoma de Chapingo, and Master's degrees in Science and Doctorates in Agricultural Sciences at Colegio de Postgraduados in Mexico State.

The guidelines governing the day-to-day activities of public extension agents are registered in the Programa de Desarrollo de Capacidades y Extensionismo Rural de SAGARPA (Capacity Development and Rural Extension Program), with public funding for their work development. The primary activity of private extension agents is to design projects based on perceived needs, then obtain financial resources from the producer and government sources. Subsequently, they develop their extension tasks.

Aguirre (2012) points out that the time and transformations developed under the Mexican extension system continue as the main axes for promotion and transfer of new technologies, technical assistance, advisory services, and producer training.

Agricultural professionals, during their work with producers and extension practice, face various problems that reduce the impact of their actions (Uzeda, 2005). From the perspective of both professional groups, interviews show coincidences in problems that can be generalized: 1) Public policies and changing development

Table 6. Problems encountered.

Difficulties	Opinions
<p>Public Extension Agents</p> <p>1). Changing rural development and extension policies and projects</p> <p>2). Difficulty in marketing and linking to the market</p>	<p>Extension agents mention that there is no continuity in programs, and extension work must be supported and given continuity from the moment progress with producers is truncated, because there is no follow-up. Extension and producer participation should be strengthened. Production costs are very high and there are no marketing channels. There is unfair competition and lack of credit.</p>
<p>Private Extension Agents</p> <p>1). Changing rural development and extension policies and projects</p> <p>2). Difficulty in marketing and linking to the market</p> <p>3). Individualism, distrust, lack of producer associations</p> <p>4). Poor public and institutional support</p> <p>5). Projects and initiatives do not respond to the needs of beneficiaries</p> <p>6). Little adoption of technology</p>	<p>Producers are not trusted, so there is reluctance to learn because of the negative influences against them. Programs have lost credibility, so producers become indifferent. There is a shortage of public resources and most are focused on the most vulnerable sectors. There is a bureaucratic barrier for investment, and any process a producer wants to carry out can lead to loss of interest in continuing. The problem exists between producers, government technicians and policy, requiring structural changes, where program approaches are by specialists in the field.</p>

projects, and 2) Problems marketing products and linking to the market (Table 6). These observations are political-institutional in nature, some of them generated by government policies and administrations that are changing over time.

According to Landini (2013a), rural development policies have been a recurrent problem from the extension perspective, not only in Mexico but in other Latin American countries. McMahon et al. (2011) point out that bureaucratic structures are inflexible and do not respond to a changing sector. Therefore, the level of organization by farmers is low, and must be taken into account when designing government policies.

In addition to these problems, statistical tests by type of extension worker (Correlations and Mann-Whitney U-test) show other recurrent problems for private extension agents, such as poor public and institutional support, projects that do not respond to beneficiary needs, and little adoption of technology.

Training is fundamental in the institutional area, and the government executes actions to promote the formation of capacities through institutions linked to the agricultural sector. It is a national public policy instrument that boosts rural development to meet the challenges of the agricultural sector (DOF, 2001).

Both groups of extension professionals are in constant training, with public service providers showing greater interest in their continuous training (94.1%). The highest percentage of training has been provided by public institutions (INCA RURAL) over semi-annual and annual periods. Financing is related to the type of extension (private service providers pay for their training), and the preferred forms are personal (face-to-face) and semi-

personal, and private individuals are more familiar with on-line courses (42.3%). The demand for training is in response to the importance of the technicians who receive it, and includes practical methods such as field trips, participatory workshops with producers, and meetings with technicians to exchange experiences (Table 7).

The areas of interest differ in both groups with public professionals preferring training in training methodology and rural extension. These results are similar to those of Valentinuz (2003), Ardila (2010), and Landini (2013c), where they address how technicians should work, and where more training is required for extension workers and analysis of their needs. Private services providers prefer improved management of financial resources to carry out productive projects and to highlight marketing issues.

Some studies mention that the government, in collaboration with organizations, is dedicated to training rural peoples. However, there are doubts regarding the quality and coverage of rural education services. This situation is due to the lack of coordination of projects, and resources, and scarce planning over the medium to long-term. The programs are designed based on the offer, without ensuring a balance based on the needs of rural actors (Aguirre, 2012).

In this context, public sector organizations establish strategies in rural areas to create capacities, skills, values and knowledge in extension agents because they are knowledge managers. Adequate training, extension of individual autonomy and updating of extension workers is a fundamental element for the success of their tasks and improvement of the quality of life of their beneficiaries

The results indicate that both groups of professionals

Table 7. Training and development needs.

Training and development		Public (%)	Private
Training		94.1	84.6
	SAGARPA	41.2	23.1
	INCA RURAL	82.4	30.8
	FIRA	11.8	15.4
	DGETA	23.5	3.8
Institutions	ICAMEX	-	3.8
	INIFAP	29.4	11.5
	CP	29.4	19.2
	UACH	58.8	38.5
	Other	-	34.6
	3 months	23.5	15.4
	6 months	-	38.5
Period	Annual	58.8	26.9
	Occasional	17.6	-
	Personal (Face-to-face)	100	61.6
Form	Semi-personal	88	73.1
	On-line	53	42.3
	Practicals	100	92.3
	Field visits	100	84.7
Method	Workshops	94.1	73.1
	Theories	70.6	46.1
	Integrating TIC	94.1	73.1
Areas of interest	Training and rural extension methods		Management of financial resources for projects Design of productive projects Commercialization

SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación; INCA RURAL, Instituto Nacional para el Desarrollo de Capacidades del Sector Rural; FIRA, Fideicomisos Instituidos en Relación con la Agricultura; DGETA, Dirección General de Educación Tecnológica Agropecuaria; ICAMEX, Investigación y Capacitación Agropecuaria; INIFAP, Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias; TIC, Tecnologías de la Información y Comunicación.

have a positive perception about their abilities, values, skills and knowledge (Table 8), and their leadership skills, values and ethics (responsibility, respect, group integration and personal growth). They are considered very skilled in communicating with producers, generating empathy and confidence (Landini, 2016b).

The people interviewed have a skill profile of learning to learn, practicing creative and innovative thinking, decision-making and problem-solving. Thus, they are competent at organizing, managing resources, working as teams, coexisting, understanding reality, and incorporating technologies. These skills coincide with those proposed by Cano (2004): 1) learning to learn; 2) ability to communicate; 3) ability to coexist (live with others); 4) decision-making; 5) ability to organize; and 6) managing personal and collective development initiatives.

Russo (2009) includes reading, writing, cognitive reasoning, and use of technology. The primary difference is that public extension agents show more knowledge of current Mexican laws and regulations.

CONCLUSIONS AND RECOMMENDATION

Extension is a public good, significant element of innovation in the rural sector, a tool with great potential to favor local development processes by promoting agriculture and rural development, thus reducing poverty and improving food security. Thus, strengthening the capacities and skills of extension agents as promoters of such development is very important.

There is greater male participation in both extension groups, even though female participation in agricultural

Table 8. Extension agent competencies.

Category	Public*	Private*
Training		
Learning to learn	A	A
Creative thinking and innovation	A	A
Decision-making	A	A
Problem-solving	A	A
Leadership	A	A
Ethics	VA	VA
Values		
Responsibility	VA	VA
Respect	VA	VA
Group integration	VA	VA
Personal growth and development	VA	VA
Changing people's attitudes	A	A
Strengthening respect for the land	VA	A
Abilities		
Organization	A	A
Management	A	A
Team-work	VA	A
Living together	VA	A
Communication	A	VA
Reality comprehension	A	A
Empathy for and trust of producers	VA	VA
Technology incorporation	VA	A
Knowledge		
Methods of production	A	A
Rules and laws	A	LA
Research for problem-solving	A	A

Sources: SAGARPA (2015-2016), Méndez (2006), Field Work (Spring - summer, 2016). *Evaluation according to the median, where 3 = Little Ability (LA), 4 = Able (A), and 5 = Very Able (VA).

extension activities is important. High academic levels (postgraduate) and training in the agricultural sciences (agronomists and zoo-technicians) and extensive work experience means that professionals provide continuity to their extension services.

Both groups of professionals emphasize their training, technical assistance and technology transfer abilities, while the private extension agents also design productive projects to obtain financing. Both groups detect the same problems, changing rural development and extension policies, and difficulty in marketing and linking to the market.

Both extension groups require continuous training and interest in rural (public) training and extension methodologies, project design, financial resource management, group management, and marketing (private). Regarding self-assessment of competencies, both groups emphasize their abilities, values, skills and knowledge. They show leadership are skilled in communicating, and generate empathy and trust with producers.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests

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