MedCrave
Step into the World of Research

Open Access Journal of Science

Fostering innovation in the agriculture sector: The case of intermediary organisations in Mexico

Abstract

The study of Innovation Intermediary Organisations (IIOs) has gained great interest; these are perceived as important agents in connecting knowledge supply and demand in the context of national systems of innovation (NSI).[1] This topic has been incorporated into the agricultural sector analysis, particularly in developed countries.[2–4] Accordingly, IIOs must meet a set of specific functions. The aim of this paper is to propose a classification of functions more akin to the characteristics of the Mexican agriculture innovation system, and test this classification with the Produce Foundations (PFs), a specific type of IIO operating in the Mexican agricultural sector. The data for this paper is based on a survey applied to the managers of PFs. Composite indicators are constructed and kernel density graphs are employed. This paper argues that the PFs fulfil some functions that are similar to those of other IIOs in the agricultural sector in developed economies such as the articulation of the demand, intermediation and network formation, and managing innovation. However, a new function emerges as relevant, which is the identification and integration of the offer of R&D and technological solutions, and the PFs also have to fulfil some specific activities that are related to the content of developing countries, such as diffusion of the understanding of the existence of knowledge supply and demand markets, and the promotion of collective learning in order to achieve higher levels of innovativeness. After the introduction, section 2 reviews the literature related to IIOs and their functions in the agricultural sector. Section 3 describes the main features of the PFs as IIOs; Section 4 discusses conceptual framework; Section 5 describes the research methods; Section 6 presents the results and discusses, and finally Section 7 concludes.

Keywords: innovation intermediaries, learning, innovation systems, innovation policy, agricultural sector

Research Article

Volume 2 Issue 2 - 2018

Gabriela Dutrénit, Alexandre O Vera-Cruz
Management and Policy of Innovation, Metropolitan Autonomous University, Mexico

Correspondence: Gabriela Dutrénit, Management and Policy of Innovation Posgraduate Program Metropolitan Autonomous University, Calzada del Hueso 1100, Colonia Villa Quietud, Coyoacán, CDMX, Mexico, Tel +525554837279, Email gabrieladutrenit@gmail.com

Received: February 07, 2018 | **Published:** March 02, 2018

Abbreviations: PFs, produce foundations; NSI, National systems of innovation; IIOs, innovation intermediary organisations

Introduction

As a result of the importance acquired by the approach to the innovation systems in theory and policy,[5,6] in recent years, the study of Innovation Intermediary Organisations (IIOs) has gained great interest. The OIIs are perceived as important agents in connecting knowledge supply and demand in the national systems of innovation (NSI).[1] The authors highlight some functions that these organisations must meet to make these connections happen. This topic has been incorporated into the analysis of the agricultural sector, particularly in developed countries.[7] It is argued that in order to act as an intermediary in the agricultural sector, IIOs must also meet a set of specific functions, in some cases different from those generally set for other NSIs. In the case of the agricultural sector in developed countries, where agricultural innovation systems are more articulated than in developing countries, those authors place more emphasis on the generation and transfer of new knowledge, and the articulation between producers and knowledge-intensive organisations. In contrast, in Mexico, as well as in many developing countries, the agricultural innovation system is to some extent still in its infancy, with a greater development of the public research system but weakly linked with farmers. There exists great heterogeneity among farmers, and those who have not mastered the best-known technology packages predominate. Therefore, innovation in this context refers more to the introduction of existing knowledge rather than the search for new knowledge at national or global levels. In this context, the functions of IIOs may observe specificities.

The aim of this paper is to propose a classification of functions more akin to the characteristics of the Mexican agricultural innovation system, and test this classification with the Produce Foundations (PFs), a specific type of IIO operating in the Mexican agricultural sector. PFs are IIOs, which are publicly-funded to finance research and technology transfer in the agricultural sector; they are managed by the farmers themselves. There are 32 PFs, one in each state of the country. The classification of functions is based on anecdotal evidence obtained through case studies of PFs, interviews with different agents and surveys of researchers in the sector. The data for testing the classification of functions is based on a survey conducted among the managers of the PFs. In order to differentiate the PF groups according to the functions they execute as IIOs, kernel density graphs were employed as a suitable methodology to identify those critical points where changes on basic functions determine different population groups. After the introduction, section 2 reviews the literature related to IIOs and their functions in the agricultural sector. Section

3 describes the main features of the PFs as IIOs; Section 4 discusses conceptual framework; Section 5 describes the research methods; Section 6 presents the results and discusses, and finally Section 7 concludes.

Innovation intermediaries in the agricultural sector: the literature

The systems of innovation approach has led to the identification of a set of actors known as IIOs, who perform a variety of tasks within the innovation process. While the first studies of intermediaries in relation to innovation emphasised their role in correcting market failures such as information asymmetry, public goods and uncertainty, their role in transforming knowledge and influencing the policy arena has been recently acknowledged.[8–10] This section reviews literature on IIOs.

What is an innovation intermediary organisation?

Innovation is a complex phenomenon developed in an environment characterized by uncertainty and an accelerated rhythm of technological progress. It is defined as the introduction to the market of a product (good or service), process, marketing method or new or significantly improved organizational method, by an organization.[10] Recently, business models have been included as another type of innovation. By employing a broad definition of innovation, the innovation process includes different activities, ranging from the conception of the idea, research and development, to the transfer, production and marketing of goods and services. Initially the literature focused on the analysis of innovation in the manufacturing sector, and the object of analysis was the business firm. Gradually the analysis has been extended to different sectors, including the agricultural sector.[12–14] This led to consider other productive actors, such as cooperatives, individual producers, or organizations in the social sector. Beyond these advances, there is still no consensus on how to measure innovation in the agricultural sector. In this context, competitiveness depends increasingly on the capacity that those who supply and demand knowledge have to establish co-operation links in order to acquire new knowledge and capacities, develop innovations and introduce them into the market. It is within this framework that IIOs are enrolled.[15] The growing importance of intermediary organisations lies in the fact that they reduce uncertainty of innovative agents by connecting them with reliable partners who possess the necessary skills for innovation. In other words, intermediary organisations reduce cognitive, information and knowledge gaps among the components of an innovation system, facilitating the flow of knowledge, and then innovation.

The concept of intermediary organisations has been incorporated into the analysis of the innovation process in several ways.[1] attempts to gather the variety of approaches about the notion of intermediary organisations in the context of innovation, which has led to concepts such as *brokers*, information intermediaries, limit organisations,[43] and[16] have attempted to reduce the conceptual ambiguity regarding the role of intermediary organisations in innovation and to summarise the existent knowledge on the subject. As a result of this effort, the concept of *innovation intermediaries* has arisen for addressing an "organisation or body, which acts as an agent or intermediary between two or more parts in any aspect of the innovation process". This paper follows this definition. The classifications of IIOs have evolved from that of,[17] which distinguishes functions such as provision of support for innovative companies (eg. incubation), the financing of innovation and commercialisation activities of new knowledge, and providing consultancy, to further comprehensive classifications as, focused on the supply and demand of knowledge. Additionally, other authors distinguish the approach of the IIOs according to the type of property.[18,19] point out that public IIOs should focus on the main content of intermediation, that is, on the linking of supply and demand for knowledge, as well as on the production of 'public goods', while private ones should focus mainly on the process of intermediation, that is, in the support of learning processes between different actors, as well as in the production of 'club goods. They also argue that the role of public IIOs in developing countries is particularly important in addressing the systemic flaws that exist in these countries[20,21] have introduced the notion of innovation intermediary into the study of innovation systems in the agricultural sector. According to past decades, the knowledge infrastructure[1] of the Agricultural Innovation Systems has been modified due to the structural change in agricultural markets (eg. they have moved on from producing commodities to generating differentiated products) and to the privatisation of the public agriculture knowledge infrastructure (eg. knowledge-intensive businesses have arisen as well as private agricultural I+D). These changes experienced have led to the emergence and growth of innovation intermediaries in the sector, which substituted the traditional extension system. The later respond to a quite linear vision of science, instead the new intermediaries have a systemic model view. The objective of these intermediaries is to establish a bridge between the component of the new knowledge infrastructure in order to overcome the information, management, cultural and cognitive gaps that have opened between them.

The functions of IIOs in the agricultural sector

Innovation intermediaries are identified as another main component of the innovation system. Following,[21] it is necessary to establish their participation in the dynamics of these systems, specifying the activities that they perform. Along this line, describe a classification of activities that these organisations perform in order to support the process of innovation. This classification consists of three general functions.

Demand articulation

This is characterised as an iterative process in which participants try to unravel the preferences and direction of what they perceive as important characteristics of an emergent innovation. The articulation of demand takes place when the thoughts of those who are interested, in terms of content and positioning (for or against) become explicit, making other actors act accordingly. The purpose of articulation of demand is to reduce the "cognitive distance" or "cognitive gap" between those who supply and those who demand the technological transfer. This gap or distance is primarily related to the fact that both actors are so different that they have problems learning together, and second, to the fact that both actors have too much "theoretical baggage" to communicate effectively; that is, that such actors have such different values, norms and incentive systems that they hinder effective communication. In order to perform this function, innovation intermediaries develop two activities: (i) to clarify demand, and (ii) to clarify the supply.

Network brokerage

The objectives of this function are on the one hand, to facilitate linkages between the relevant actors of an innovation network by

[1]Knowledge infrastructure is understood to mean a complex of private and public organisations whose function is to produce, maintain, distribute, manage and protect knowledge.

Citation: Dutrénit G, Vera-Cruz AO. Fostering innovation in the agriculture sector: The case of intermediary organisations in Mexico. *Open Access J Sci.* 2018;2(2):95-107. DOI: 10.15406/oajs.2018.02.00052

reducing "information gaps"; that is, facilitating/encouraging co-operation among the actors by providing information about the benefits that each one can offer/put forward; and on the other, to overcome systemic failures through discouraging networks such as those of "*weak ties*" and fostering the formation of "*strong ties*" networks. According to "*weak ties*" networks reduce the possibilities of establishing synergistic linkages, increase the possibility of redundancies and limit the feedback among the components of the network; whereas "*strong ties*" networks are comparatively more "open". In order to carry out this general function, innovation intermediaries perform four activities: (i) making the I&D and the Knowledge Intensive Business Services (KIBS)[2] markets more transparent, (ii) substituting the type of counselling that innovative agents receive, (iii) organising meeting platforms, and (iv) securing funding and subsidies for innovation.

Innovation process management

In order to increase the propensity to innovate (defined by the authors as the effectiveness of an innovation system in encouraging the creation of innovations), it is necessary to manage the process of innovation well. This implies, on the one hand, creating and managing effective linkages within the sub-systems (or innovation networks) which conform the innovation system, and on the other, optimising the interaction between the innovation networks and the NSI, which includes, among other things, the physical infrastructure, the system of rewards and sanctions, the legislation and the financial system. In order to fulfil this function, IIOs perform activities such as:

(i) being the main operator in the network,

(ii) taking care of the network,

(iii) being the knowledge intermediary, and

(iv) Optimising the relationship between a network and the NSI.[7] carried out explorative case studies of 22 IIOs in the Kenyan agricultural sector.

Based on the three functions described above, they found that these organisations accomplish functions oriented to distribute and use knowledge, but also fostering integration and interaction among the diverse actors engaged in innovation networks. Based on these findings they identify 4 types of intermediary arrangements (including technology brokers, systemic brokers, enterprise development support and input access support). Innovation brokering resulted a key function. Analyse the mechanisms used by agricultural extension to articulate knowledge offer and demand and innovation. Matching new forms of extension with OII, and based on four case study of different type of intermediaries in the Mexican agricultural sector, the authors analyse different extension strategies. They distinguish four types of intermediaries: managers, mediators, facilitators and implementers, more in line with the classification provided.[18] They argued that the four profiles of intermediaries are needed to foster innovation in this sector. Acknowledge that the focus of their research, i.e. final users of knowledge, are organised farmers with the capacity to influence the institutions related to agriculture research, as well as agro-industry. Moreover, demand-driven research is funded either by farmers themselves or by government institutions in which farmers are given decision-making authority in research planning. This context is clearly different from that of developing countries, including Mexico, as analysed below.

The context: Mexican agricultural innovation system and the produce foundations

The Mexican agriculture innovation system is comprised of a set of agents:

(i) producers of knowledge: General Universities with an area on agricultural sciences, specialised Universities on the agricultural sector, Technological Institutes, and public research centres, the most important being the INIFAP,[3] located all over the country;

(ii) demanders of knowledge: farmers, a high percentage of whom come from the social sector (*ejidos*)[4], small private farmers and sons of *ejido* members, all of them producing on a small scale, a few large firms, and Product System (the set of elements and agents of concurrent agricultural and livestock production processes), and Technological service providers (which are not KIBS):

(iii) the Government: the science and technology national agency (CONACYT), States' Council for Science and Technology, the Mexican Ministry of Agriculture, Livestock Rural Development, Fisheries and Food (SAGARPA) and the National System for Innovation and Technology Transfer (SNITT for its Spanish acronym); and

(iv) Intermediaries: the Produce Foundations and other organisations such as non-governmental organisations, technology transfer offices of higher education institutions and research centres.

Links between agents are limited.[22–26] University-farmer links are observed in some product systems, for instance: corn (INIFAP and UNAM, a federal university), palm oil (INIFAP), honey (ECOSUR, a research centre), sugar cane (Colegio de Posgraduados, a research centre), but not in the case of tomato, as there are few researchers specialised in this product in the state and the farmers are still at an immature stage. Links between technological services providers and farmers are focused on technology transfer activities related to existing knowledge. The Produce Foundations (PFs) are the main OII operating in the Mexican agriculture innovation system. They were created in 1996 as non-profit organisations to manage public funds for research and extension. Even though the Federal and State Governments participated in their creation, they are farmers associations and were able develop some degree of independence over time. They have a demand-driven focus for two reasons; farmers manage them and the projects they administrate are defined according

[2]As knowledge intensity of the economies has increased, some service industries emerge as high tech and highly innovative. These services rely heavily upon professional knowledge, are themselves primary sources of information and knowledge or use their knowledge to produce intermediary services for their clients' production processes, amongts others. They constitute Knowledge Intensive Business Services (KIBS). Even though some of these are traditional professional services, others are new technology based services,[36] which are mainly concerned with providing knowledge-intensive support for the business processes of other organizations. They have presence in the agriculture sector, mostly in developed countries.

[3]INIFAP is the Mexican NARO (National Agricultural Research Organisation), which operates as a public research centre.

[4]The ejidos is a type of social property of land that comes from the land reform in the 1930s.

to the farmers' demands. Hence, agricultural innovation in Mexico has followed international trends with respect to the promotion of demand-driven research and the privatisation of the public extension system; however, the main source of financing of innovation and extension is still the federal government. At present, there are 32 PFs, one in each Mexican state, and a national co-ordinating body (COFUPRO is its Spanish acronym). Each PF is governed by a President, who is a leading farmer, and a board of farmers, leaders of farmers associations, and representatives from the federal and state governments. A professional manager directs operations. COFUPRO, in turn, has a board composed of presidents of some PFs and a professional management team.[27]

PFs and COFUPRO interact with the public research system and individual researchers, primarily through competitive funds.[5] The PFs focus on technology transfer while COFUPRO is more concerned with knowledge generation according to the national needs of the sector. In this line, each PF funds short to mid-term projects focussed on local demands of farmers. Each PF submits a call for proposals. Researchers, technological services suppliers and consultants submit project proposals and there is a peer review process for the proposals. The regional/national fund operates in the same way, but in this case jointly managed by SAGARPA, CONACYT and COFUPRO[6] and with a more basic science focus.[28] It is important to note that in order to promote innovation at every level of the value chain, the PFs have the mandate of addressing the demands of the Product System.[7] Projects require matching funds from the producers. Usually, PFs contribute fresh resources for the projects while the contribution of the producers is based on work-time and land. For example, when setting the demonstration plots, the PFs fund the training, one of the producers provides the land and the others participate in the training, dedicating their time to the project. There is no doubt that the PFs are IIOs;[29] however, contrary to the IIOs analysed by, whose activities are funded by the farmers, the PFs are funded by SAGARPA and the state governments. Some PFs were authorised by the Ministry of Finance to receive cash donations, but this is only a small number of cases. The PFs have been allowed to operate a multi-annual budget in order to fund projects requiring longer than a year for obtaining results and for paying staff wages.

The PFs have advanced over time. They initially funded traditional research and extension programmes, and have gradually evolved into the exploration of instruments to promote innovation. The most important changes introduced were: improving attention to the needs of farmers; relaxing cost controls, starting to control the quality of research results and exploring alternative mechanisms to encourage innovation. In addition, COFUPRO has sought to create a structure to monitor the experiences addressed by individual foundations, to identify successful instruments and strengthen the collective capacity to explore more effective instruments.[17–25] While a variety of mechanisms tend to be used to operate today, its most important activities revolve around meetings identifying demand and calls for projects.[25] Even though there are other IIOs in the agricultural innovation system in Mexico, as mentioned above, the PFs are those better oriented to foster innovation. The PFs perform some of the functions and activities described in the literature of IIOs; however, some differences emerge in their behaviour. They seem to be associated with the specificities of this type of IIO and the context in which it operates. These specificities should be taken into account.

Conceptual framework: rethinking the functions of IIOs

From the proposal presented on the functions of the organisations in the agricultural sector in the Netherlands, and based on evidence resulting from a set of previously-conducted case studies on PF,[29,30] interviews and surveys conducted with researchers of the sector, with other agents and with many PFs. Vera-Cruz (2012) and Dutrénit, Rocha and Vera-Cruz (2012) propose a classification of functions and activities appropriate for the study of the activities of IIOs in the Mexican Agricultural Innovation System.[8] Table 1 lists the proposed classification.

This classification differs from that proposed by[2] in two main aspects. First, it identifies four basic functions instead of three, as the basic function of "Demand articulation" proposed by these authors was split into two functions: "Identification and integration of the offer of R&D and technological solutions" and "Articulation of farmers' demands". This allows, on the one hand, information of a different nature to be obtained: that which is derived from the activities of technology suppliers and that which comes from the demand of technology, and on the other, greater importance to be assigned to the role of offer articulation. The latter acquires a more relevant role in a context where scientific capabilities are still limited. Second, in terms of the activities of each basic function, the classification adopted does not include some activities proposed by the authors cited, adding other activities. Concerning to the basic function of "Identification and integration of the offer of R&D and technological solutions", two new activities were included to help technology suppliers to identify complementarities with others, as well as gaps in relevant research topics, and to identify promising technologies and technology road-mapping. Two new activities were also added to the function "Articulation of farmers' demands": helping producers identify issues in demand that have not been expressed, ie, incipient or latent needs, and helping farmers to evolve in their demands from primary to post-harvest production and commercialization. The former takes into account that a crucial role of IIOs in agriculture is the articulation of farmers' demands, and that the role of IIOs in acknowledging and "translating" current as well as incipient and latent demands into R&D and service demands is far from evident when knowledge gaps exist such as those between developing countries' farmers and researchers. The latter refers to the need to support farmers to orient their demands towards innovation.

[5]Several authors have highlighted the limitations of this instrument to allocate resources,[26 28] this is particularly so in a country with a small public research system, relative to the size of the country[40]

[6]Recently the SNITT substituted COFUPRO in the management of this fund.

[7]The Product Systems are defined by law as "…the set of elements and agents of concurrent agricultural and livestock production processes, including the supply of technical equipment, supplies and services for primary production, stockpiling, processing, distribution and marketing..." (Sustainable Rural Development Act, Art. 3o, section XXXI). Producers may be individual farmers, firms or other forms of production organisation.

[8]This classification was prepared by the team of the research project entitled "Mejorando la Administración del Conocimiento en el Sistema de Innovación Agropecuario Mediante el Fortalecimiento de las Capacidades de las Fundaciones Produce, el SNITT e Institutos de Investigación" (SAGARPA-CONACYT, N. 2006-C01-48511)[42]. The team was made up of Alexandre O. Vera-Cruz, René Caballero, Gabriela Dutrénit, Javier Ekboir and Alma Rocha. For a detailed analysis of the differences between existing classifications[23]

Table 1 Classification of basic functions and main activities of IIOs in the agricultural sector[22,23]

Basic Functions	Activities
Identification and integration of the offer of R&D and technological solutions (supply-oriented)	Helping technology providers to: ☐ identify and properly respond to the demands of technology ☐ identify complementary elements between them, as well as gaps in relevant research topics ☐ identify promising technologies and technology road-mapping
Articulation of farmers' demands (demand-oriented)	Helping farmers to: ☐ identify and articulate their technological, organisational and strategic needs with technology providers such as universities, research centres, professional service providers, consultancies, etc. ☐ identify incipient or latent needs ☐ evolve in their demands: from primary production to post-harvest and commercialisation
Matching of demand with the offer of technological solutions and R&D, and network brokerage (matching supply and demand)	☐ Making clear that there is a market of technological knowledge and solutions guided by prices ☐ Promoting dialogue between farmers and providers of technology and technological solutions ☐ Contributing to the establishment of links between farmers and providers of technology and technological solutions ☐ Helping farmers to access financing for innovation ☐ Functioning as lead operator of the network, by linking farmers in order to form an innovation network
Managing innovation (innovation management-oriented)	☐ Functioning as a caretaker, working to maintain the integrity of the network, distributing information and monitoring the links related to the network operation ☐ Promoting collective learning in order to achieve higher levels of innovation ☐ Working as a knowledge broker, looking to protect the property and to commercialise the outcomes of collaboration ☐ Linking the network with the innovation system

Source: Vera-Cruz, Caballero and Rocha (2011) and Caballero and Vera-Cruz (2016), based on Klerkx and Leeuwis (2008b).

The basic function of "Matching of demand with the offer of technological solutions and R&D, and network brokerage" underwent significant modification with regard to the function of "Network brokerage".[15] First, some of the proposals from these authors were reformulated, leading to the activity "Helping farmers to access financing for innovation". In some way, the PFs in Mexico are the gateway for obtaining subsidies for innovation, but other innovation intermediaries help farmers to access funds for the acquisition of capital goods and inputs. Second, the following activities were included: Making clear that there is a market of technological knowledge and solutions guided by prices, Promoting the dialogue between technology farmers and providers of technology and technological solutions, and Contributing to the establishment of links between farmers and providers of technology and technological solutions. As argued by,[22–29] besides the problem of information asymmetry, after decades of government-funded extension, farmers are usually not willing to pay for technological services. Additionally, they also call into question the usefulness of the knowledge they are being provided. In this situation, an IIO ought to guarantee the quality of the services to promote the notion that costs are worth it. Finally, the most important change introduced in the function of "Managing innovation" is that the activity of promoting collective learning in order to get to higher levels of innovativeness was added. The idea behind this is that farmers connected with the PFs have different technological and managerial skills, use technological packages that include different degrees of innovation novelty and have different adversity to introduced changes. These farmers are predominantly far from being technologically up to date, and technology transfer is scarce, either from higher education institution and research centres or from KIBS. In this sense, a major goal is to promote innovation based on existing knowledge and diffuse it across the sector. It can be argued that the role of IIOs as promoters of collective learning to achieve higher levels of innovation is more relevant than promoting the introduction of new knowledge based on R&D. Based on a detailed case study of the role of the PF in the tomato-system in Chiapas (Mexico),[25] explore this classification of basic function, and confirm their utility. This paper empirically explores this classification of functions through a survey of 27 PFs.

Research methods

The data for this paper is based on a survey of the managers of PFs. In order to differentiate the PF groups according to the functions they execute as IIOs, composite indicators and kernel density graphs were employed.

The questionnaire

Based on the classification of functions and activities proposed in section 4, a questionnaire was prepared, aimed at the PF managers. This questionnaire was formulated with options so that the managers could choose one or several mechanisms through which each activity is performed. They were also asked to assign a value to each answer, according to the importance that each activity had for their Foundation. The suggested values were: very important, important, of little importance, not important. In this way, the answers obtained informed about whether the surveyed PFs performed the activities of IIO or not, and the level of importance assigned to each activity. The first part of the questionnaire was dedicated to investigating how the PFs help technology suppliers, on the one side to identify and adequately meet the needs of those who demand the technology, and on the other to identify complementarities and voids in relevant subjects of research or technological solutions. The second part of the questionnaire was oriented towards knowing how the PFs help farmers to identify their strategic, organisational and technological needs, and to express them clearly to the technology providers. The third section was designed to investigate how the PFs contribute to the linkage of supply and demand and to the forming of networks. The final section of the questionnaire was oriented towards the investigation of the actions carried out by the PFs in order to improve innovation management, including the optimisation of the interaction between networks and the whole innovation system.The survey was run during the 2nd Semester of 2011, and the questionnaire was applied to managers of the PFs. 27 answers were received, which represents a response rate of 84.4%.

Analysis of data

In order to identify PF's different behaviour patterns, a full description of the sample is considered the best approach. This choice is based on two reasons. First, the response rate is quite high: almost the whole population is contained in the dataset, making it unnecessary to undertake statistical inference techniques to explain its properties.[30,31] Second, we are dealing with proprietary data, which has been collected as part of an applied research project: instead of presenting a pre-determined model of relationships, we prefer to show a clean image of PFs' behaviour by applying a "letting the data speak" approach. A kernel density graph is a non-parametric way to estimate the probability density function of a random variable; it shows how a variable is distributed across the whole sample.[30,31] In our case, kernel density graphs allow us to identify the critical points that mark population changes in terms of their basic functions. PFs basic functions are constituted by different activities surveyed in our questionnaire; because of this multidimensional quality, composite indicators were used to represent in a single measure how high each PF ranks. We constructed four composite indicators, methodologhy[8] one per function, by applying an equal weighting and linear aggregation methodology,[9] since we did not want to take any kind of prior assumption about the relative importance of each activity. The final step was to produce the kernel graphs of each composite indicator and observe where the inflexion points are located: this marked the critical points to determine the different groups of PFs based on their revealed performance in each function.

[9]Normalization was not required since all the indicators included in the analysis are measured using the same scale.

Results and discussion

Based on the collected data from the survey, the consequent construction of the composite indicators and their related kernel density graphs, it was possible to identify groups of PFs for each basic function, as follows:

I. Three groups were defined for these basic functions:

   a. demand-oriented

   b. matching supply and demand

   c. innovation management-oriented

II. Two groups were defined for the following basic function:

   a. supply-oriented

Graph 1 shows the kernel density graphs that support the determination of these groups per each basic function; red vertical lines indicate where the inflection points were selected. Table 2 lists the groups of functions belonging to each of the PFs. The groups were grouped so that group 3 includes those PFs that assigned the highest values of importance to the activities that characterise the function analysed (called Active group). Group 2 is dominated by those PFs that assign low importance values (called Developing group). At the bottom of the ranking, we find Group 1, which is constituted by those PFs with the lowest performance level (called Passive group). A first look at the results listed in Table 2 shows that the PFs tend to comply with all functions of an IIO, but the effort they put into each one is different. In three functions (demand-oriented, matching supply and demand, and innovation management-oriented), groups 2 and 3 are composed of a greater number of PFs than group 1, indicating that the majority of PFs believe that those three functions are the most important to them. Likewise, none PF is clustered in the active group of the supply-oriented function, indicating that either this function is not relevant for them or they have an area of opportunity to improve their behaviour. Table 1A in the Annexe contains the main characteristics of the identified groups, which are approached through the specific activities that the PF develops and that are associated with each function. Based on these results, it is possible to extract some regularity concerning to the activities of these IIOs in the Mexican agricultural sector.

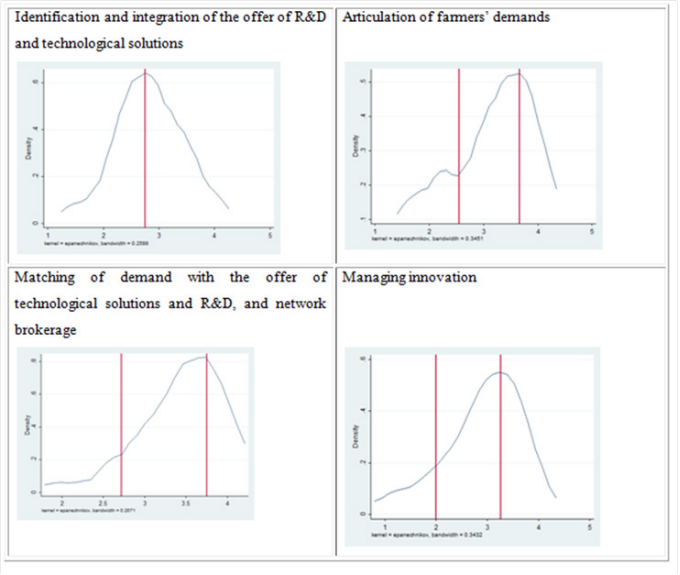
Different profiles of PFs

There are two PFs noted for giving high importance to three functions (Querétaro and Veracruz), as they are clustered in the active group in them (demand-oriented, matching supply and demand, and innovation management-oriented). Other seven PFs give importance to two of these functions, and belong to the developing group in the other function (Tabasco, Puebla, Baja California Sur, Durango, Sinaloa, Nuevo León and Morelos). These nine PFs are more balanced in the sense of having a better perception of the importance of the four functions. In this regard, it could be argued that these PFs would be more mature as IIOs. In contrast, two PFs were clustered in the passive groups in the four functions (Distrito Federal and Jalisco). Their role as IIOs seems to be weak. The profile of other PFs combines a high

importance assigned to innovation management with either demand-oriented or matching supply and demand. It has to be noted that in all cases the supply–oriented function is less relevant. The PFs slightly differ their behaviour concerning to the functions of matching demand and supply, and the innovation management oriented. Twenty-five and twenty-two PFs behave as active or developing in this regard, respectively, and were clustered into groups 2 and 3, and only two and three PFs, respectively, assigned limited importance to this function. This suggests that the relationship between supply and demand and the innovation management activities are the quintessential functions for PFs, so there is consistency in the perception of its importance. Nonetheless, it has to be remarked that this analysis does not distinguish how effective the PFs are in fulfilling these functions, since it only relies on the managers' perception of the importance assigned to roles.

Differences in perceived importance of the functions

While twelve PFs are integrated into either the active or the developing groups in the four functions, the relative importance they assigned to these functions (and the activities through which they operate) differs significantly. The same happens when they assign low importance to these functions (and activities). Table 3 lists the inflection points that were used to determine the groups the PFs belong to, and the number of PFs per group by function. When considering the levels of both inflection points, we found that the matching supply and demand function presents the highest level in the inflection point 2, to determine those clustered into group 3 (3.75), and one of the highest in the inflection point 1, to determine those PFs belonging to group 2 (2.72), with a marginal difference in relation to the supply-oriented function. This reveals that the PF tend to assign more importance to this function than to others. In the functions of innovation management-oriented and matching supply and demand, the number of PFs that are over the inflection point 2, and are clustered in the active group, is higher than in the other two functions. In addition, they show the lowest number of PFs that are below the inflection point 1, and are clustered into group 1. This suggests that there is more agreement between the PFs regarding the importance of these functions; while in relation to the other two functions, there are more differences in perception. There are some interesting remarks regarding to the empty box of group 3 of the supply-oriented function, and the high number of PFs that are below inflection point 1, reflecting the comparative lower importance assigned to this function. As mentioned above, none PF behaves as an active player in this function. In addition, all the PFs behave better regarding to the demand-oriented function than to the supply-oriented one.



Graph 1 Kernel graphs.

Table 2 Groups of PFs according to their functions

Produce Foundation	supply-oriented	demand-oriented	matching supply and demand	innovation management-oriented
Aguascalientes	2	3	2	2
Baja California Sur	2	2	3	3
Campeche	1	2	2	2
Chiapas	1	1	2	2
Chihuahua	2	2	3	2
Colima	1	2	2	2
Distrito Federal	1	1	1	1
Durango	2	2	3	3
Guanajuato	2	2	2	3
Guerrero	1	1	2	2
Hidalgo	1	2	2	2
Jalisco	1	1	1	1
Mexico	1	1	2	3
Michoacan	1	2	3	2
Morelos	1	2	3	3

Table Continued.....

Produce Foundation	supply-oriented	demand-oriented	matching supply and demand	innovation management-oriented
Nayarit	2	3	2	2
Nuevo León	1	3	2	3
Puebla	2	3	2	3
Queretaro	2	3	3	3
Quintana Roo	1	1	2	1
San Luis Potosi	2	3	2	2
Sinaloa	2	2	3	3
Sonora	1	2	2	2
Tabasco	2	3	3	2
Veracruz	2	3	3	3
Yucatan	1	2	2	2
Zacatecas	1	2	2	2

Source: authors' results, see Table A2 in Annexe.

Table 3 Inflection points to determine the groups and number of PFs per group

Basic Functions	Number of PF in Group 3	Inflection 2	Number of PF in Group 2	Inflection 1	Number of PF in Group 1
supply-oriented	NA	NA	12	2.75	15
demand-oriented	8	3.66	13	2.55	6
matching supply and demand	9	3.75	16	2.72	2
innovation management-oriented	10	3.26	14	2	3

Table 4 Number of activities where 80% of PF assign a high score

Basic Functions	Group 3	Group 2	Group 1
supply-oriented	N/A	4/3	4/1
demand-oriented	4/4	4/3	4/1
matching supply and demand	5/5	5/4	5/1
innovation management-oriented	7/5	7/3	0/7

Source: authors' results, see Table A2 in Annexe

This could have different explanation. First, according to changes in the rules of operation, PFs virtually do not finance basic research, but mainly technology transfer projects, which could contribute to explain their low concern for the integration of supply of R&D and technological solutions. However, to the extent that there is not a structured knowledge market in the country, most advanced PFs, which are located in states with the most innovative producers, or where a more consolidated public research system exists, attach importance to this function, thus it is important to meet the latent demands of knowledge. Second, the public research system may be not strong in the state; hence the PFs are not motivated to interact with knowledge suppliers. Third, they have not understood the importance of their role to articulate demand and supply, and they have a traditionally demand-side approach. Fourth, they may have limited understanding of the innovation system, which requires all agents (suppliers and demanders of knowledge). If we consider the number of PF belonging to group 3, the most important function for the PF is innovation management-oriented, followed by matching supply and demand. These two functions are also reported as important in the Dutch case. Contrarily to these authors, the classification of functions used in this document allows to distinguish between the supply-oriented and demand-oriented functions. This reveals that while for some PFs, the function of articulation of demands is very important, they pay less attention to their role in the identification and integration of offers.

Differences in the activities perceived as important in each function

A more detailed analysis of the activities considered important for each PF in every function allows other characteristics of these IIOs

to be identified. Table 4 lists the number of activities implemented by the PFs in each group where more than 80% of the PFs assigned a score of 3 or 4 (important or very important). It is noted that PFs comprising the active group in functions of demand-oriented, matching supply and demand and innovation management oriented, and the developing group of the supply oriented function (the highest score), tend to consider important, and them carry out them, a variety of activities. For instance, four of four activities in demand oriented, faced to help collective of farmers to identify and express their technology needs, five of five in matching supply and demand, which are centred on promoting in the knowledge demanders and suppliers an understanding that there is a market for technology solutions mediated by prices and promoting the dialogue and the links between technology farmers and providers of technology and technological solutions, five of seven in innovation management oriented, which focus on promoting innovation networks, promoting of collective learning in order to achieve higher levels of innovativeness and participating in outreach activities with other agents. Conversely, those PFs that comprise group 1 (passive) in any of the functions only considered a few activities as important. For instance, one of four by group 1 of supply-oriented, which focus on the identification of the suppliers of knowledge that can effectively respond to the demands of producers, one of four for demand-oriented, etc. On the end, in the function of being innovation management-oriented, no activity was considered important for more than 80% of the PFs included in the passive group.[32]

The activity associated with the demand identification meetings received high scores (important and very important) in all the groups (Table 2A). This has been the most important activity since the origins of the PFs, because the demand was not explicit. As the farmers had difficulties clarifying it, these IIOs had to act to do so. These meetings were an important input for designing the call for projects. In the early days of PFs, they were closely related to INIFAP (the NARO),[33–35] and it could be said that the knowledge offer practically was given, hence the PFs had to focus on the identification of the demand. As PFs evolve, new actors joined from the supply side. It became more complex to identify the demand and new activities needed to be developed for that. But, as shown by the score assigned to this activity in all groups, many PFs have not diversified their activities, and have remained tied to the demand identification meetings. Even though these activities contribute to identifying the farmers' current needs and to matching supply with this type of demand, limitations are observed in dealing with latent demands. Recently, there is a low and sporadic participation of researchers in these meetings, which makes it difficult to move the discussion about the farmers' needs forward.[22–28]

Specific features of the PFs as IIOs

The PFs are engaged in activities specific to the Mexican context, which are not conducted by IIOs for agriculture in developed countries. An important activity of the PFs is related to the innovation-management oriented function and consists of supporting producers for advancing in the introduction of technological packages to reach a higher degree of innovativeness. The Mexican agricultural sector is highly heterogeneous. On one side, there is a group of farmers working within the technological frontier that is engaged in exports to the United States, for example, those producing vegetables. Such a group is more connected to the American than to the Mexican knowledge market. In contrast, there are an important number of potentially commercial farmers still in the stage of introducing improvements to the technological package they are using.[36] The PFs play an important role in stimulating the organisation of such farmers and in promoting collective learning in order to achieve higher levels of innovation. In this vein, the PFs assigned a score of important to the promotion of innovation in the technological package by the farmers.[37,38] Another distinctive action of the Mexican PFs refers to the promotion of the understanding that there is a market of knowledge and technological solutions among farmers, and that this is guided by price mechanisms. Historically in Mexico, knowledge production and technology transfer have followed a supply-sided model consisting of the government financing R&D as well as extension activities.[39,40] This has led farmers to have difficulties in understanding that there is a cost associated with knowledge generation activities and accepting that they are expected to cover some of those costs. Moreover, many of those who generate knowledge keep doing so without fully understanding the demand. Unlike the more established markets analysed by,[41] in the case of Mexico, understanding the existence of markets is an important activity for the PFs as IIOs. The evidence reveals that the PFs mostly develop this activity through the dissemination of printed material.[42,43]

Conclusion

This paper has tested a classification of functions to be executed by IIOs operating in the agricultural sector in the context of a developing/emerging country like Mexico. The classification was built on anecdotal evidence obtained through case studies of the PFs, a type of IIO operating in the Mexican agricultural sector, interviews with different agents of the sector, and surveys of researchers. The evidence related to the fulfilment of the IIOs functions is based on a survey to the PFs' managers. The PFs fulfil some functions that are similar to those developed by other IIOs in the agricultural sector in developed economies such as the articulation of demand, intermediation and network formation, and managing innovation[2,3,4], and the articulation between actors is as important as it was noticed by[7] for Kenya. However, a more detailed analysis of these functions allows the emergence of some specific activities that are related to the context of developing countries, such as the identification and integration of offers of R&D and technological solutions, and activities associated with the diffusion of understanding about the existence of supply and demand of knowledge markets, and the promotion of collective learning in order to achieve higher levels of innovation. These activities are hardly analysed for other authors, who focuses on evidence from developed countries. In this sense, this paper enriches the contributions of Klerkx and Leeuwis (2008ab, 2009) by giving a broader approach to the functions of IIOs, in a context where the market for knowledge is still under construction. It also enriches the work by Kilelu et al. (2011) on the Kenyan agricultural sector, confirming that the function of promoting interaction is key in developing countries.

The PFs are a hybrid type of IIOs, which combines the public and private sectors. They are funded by the public sector, but they are managed by the private sector. These hybrid organisations, operating in the agriculture sector, enrich the role described in the literature on IIOs operating in the manufacture sector[18]. The analysis suggests that the most successful PFs in terms of their functions as IIOs differ from the rest in:

(i) Having a more balanced variety of functions, including the supply-oriented function,

(ii) Using a variety of activities in each function and not just the demand identification meetings,

(iii) Helping farmers to move towards "more innovative applications",

(iv) Conferring importance to their role in promoting collective learning in order to achieve higher levels of innovation. Some policy recommendations emerge from this study, both at PFs and Agricultural System of Innovation levels.

First, it is important to promote the existence of OIIs to articulate the market for knowledge of the agricultural sector and to incite changes in the behaviour of farmers towards activities with higher degree of innovativeness. Second, it is necessary to recognise the existence of heterogeneity among the profile of the IIOs, which is related to their experience and learning trajectory, but also to the capabilities and vocations of the states where they are located. Hence, the policies to promote these organisations, and their impact evaluation, may consider differences in the basic functions that they have to accomplish, in line with the approach that "one size does not fit all". As recognize, there are several organizational arrangements of innovation intermediaries that may play the role of intermediation. In addition, as found in The Netherlands, the functions may not be evenly distributed over all participants in an innovation network. Building more integrated and efficient innovation systems in the agriculture sector require better IIOs, both public and private led, and also hybrid ones. This is clear for the case of Mexico, but ithe lessons can be used for other developing countries and emerging economies. This work opens several lines of future research, including analysing the efficiency of these organisations in fulfilling their functions, collecting the perspective of suppliers and demanders of knowledge, and testing this classification of functions in other developing countries or emerging economies.

Acknowledgements

This paper is part of the research project entitled "Mejorando la Administración del Conocimiento en el Sistema de Innovación Agropecuario Mediante el Fortalecimiento de las Capacidades de las Fundaciones Produce, el SNITT e Institutos de Investigación" (*Improving Knowledge Management in the Agricultural Innovation System through the Strengthening of Capabilities of Fundaciones Produce, the SNITT and Research Institutes*), carried out at the Universidad Autónoma Metropolitana-Xochimilco (Metropolitan Autonomous University, Xochimilco Campus) and funded by SAGARPA-CONACYT (Num. 2006-C01-48511). We acknowledge the support of Diego Cruz and Ignacio Ponce for the systematisation of information and statistical analysis. We would like to thank Dr José Miguel Natera for his comments and suggestions concerning to the statistical analysis.

Conflict of interest

We do not have any conflict of interest.

References

1. Howells J. Intermediation and the role of intermediaries in innovation. *Research Policy*. 2006;35:715–728.
2. Klerkx L, Leeuwis C. Institutionalizing end user demand steering in agricultural R&D: Farmer levy-funding of R&D in the Netherlands. *Research Policy*. 2008a;37(3):460–472.
3. Klerkx L, Leeuwis C. Matching demand and supply in the agricultural knowledge infrastructure: experience with innovation intermediaries. *Food Policy*. (2008b);33(3):260–276.
4. Klerkx L, Leeuwis C. Operationalizing demand-driven agricultural research: Institutional influences in a public and private system research planning in the Netherlands. *Journal of Agricultural Education and Extension*. 2009;15(2):161–175.
5. Lundvall BA. National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. Pinter, London. 1992. 342 p.
6. Lundvall BÅ, Joseph KJ, Chaminade C, et al. Handbook of innovation systems and developing countries. Building domestic capabilities in a global setting. Edward Elgar, Cheltenham. 2009. 416 p.
7. Kilelu CW, Klerkx L, Leeuwis C, et al. Beyond knowledge brokering: an exploratory study on innovation intermediaries in an evolving smallholder agricultural system in Kenya. *Knowledge Management for Development Journal*. 2011;7(1):84–108.
8. Bessant J, Rush H. Building bridges for innovation: the role of consultants in technology transfer. *Research Policy*. 1995;24(1):97–114.
9. Hargadon A, Sutton RI. Technology brokering and innovation in a product development firm. *Administrative Science Quarterly* 1997;42(4):718–749.
10. Czartnitski D, Spielkamp A. Business services in Germany: bridges for innovation. *Service Industries Journal*. 2005;23(2):1–31.
11. OECD. Handbook on constructing composite indicators: methodology and user guide. OECD and European Commission, Joint Research Centre (Online service), OECD, Paris. 2008:1–162.
12. Ekboir J. Research and technology policies in innovation systems: zero tillage in Brazil. Research Policy. 2003;32(4): 573–586.
13. Hall A, Dijkman J, Sulaiman R. Research into use: Investigating the relationship between agricultural research and innovation. UNU-Merit Working Paper Series, Maastricht. 2010.
14. Christoplos I. Mobilizing the potential of rural and agricultural extension. FAO, Rome; 2010.
15. Kirkels Y, Duysters G. Brokerage in SME networks. *Research policy*. 2014;39(3):375–385.
16. Johnson D. Métodos multivariados Aplicados al Análisis de Datos. International Thomson Editores, Mexico. 2008.
17. Edquist C, Hommen L. Small Country Innovation Systems: globalization, change and policy in Asia and Europe. Edward Elgar. Cheltenham, editors. 2009:1–56.
18. Intarakumnerd P, Chaoroenporn P. The roles of intermediaries and the development of their capabilities in sectoral innovation systems: a case study of Thailand. *Asian Journal of Technology Innovation*. 2013;21(suppl 2):99–114.
19. Petersen LH, Kruss G, McGrath S, et al. Bridging skills demand and supply in South Africa: The role of public and private intermediaries. *Development Southern Africa*. 2016;33(3):407–423.
20. UNCTAD. Curso de formación en políticas de CTI: Módulo 5. Fomento de los vínculos para la innovación. Geneve, UNCTAD/DTL/STICT/2017/17. 2017:1–84.
21. Edquist C. Systems of Innovation: Technologies, Institutions and Organizations. Pinter, London. 1997:1–446.
22. Vera-Cruz AO, Dutrénit G. Sistema de innovación del sector agropecuario en México: tendiendo puentes entre los actores de la innovación. Miguel Angel Porrúa/UAM, Mexico City; 2016.
23. Caballero Hernández R, Vera-Cruz AO. Las organizaciones

intermediarias de innovación en el Sistema de Innovación Agropecuario Mexicano: una definición de las funciones básicas, In: Vera-Cruz AO, and Dutrénit G, editors. *Sistema de Innovación del sector agropecuario: Tendiendo puentes entre actors*. Miguel Angel Porrúa/UAM, CDXM, Mexico, p. 207–228 2016.

24. Dutrénit G, Capdevielle M, Corona Alcantar J, et al. El sistema nacional de innovación mexicano: estructuras, políticas, desempeño y desafíos. UAM/Textual, Mexico, 446 p 2010.
25. Dutrénit G, Rocha A, Vera-Cruz AO. Functions of the Intermediary Organisations for Agricultural Innovation in Mexico: The Chiapas Produce Foundation. *Review of Policy Research*. 2012;29(6):693–712.
26. Echeverría RG, Elliot H. *Financing agricultural research by competitive funds*, In: Byerlee D, Echeverría RG, et al. editors. Agricultural Research Policy in an Era of Privatization. CABI Publishing, Wallingford, UK, 2002:265–285.
27. Ekboir JM, Dutrénit G, Martínez VG, et al. Successful Organizational Learning in the Management of Agricultural Research and Innovation: The Mexican Produce Foundations. IPFRI: Research Report Series, Washington. 2009. p. 153.
28. Vera-Cruz AO, Dutrénit G, Ekboir J, et al. Virtues and limits of competitive funds to finance research and innovation: the case of Mexican agriculture. *Science and Public Policy*. 2008;35(7):501–513.
29. Ekboir JM, Vera-Cruz AO. Intermediary organisations to foster the agricultural system of innovation: the Mexican Produce Foundation. *Int Journal of Technological Learning, Innovation and Development*. 2012;5(1/2):111–125.
30. Fox J, Long JS. Modern methods of data analysis. Sage Publications, Newbury Park, CA. *AORN Journal*. 1991;14(1):74–76.
31. Silverman BW. Density estimation for statistics and data analysis. CRC press; 1986.
32. Hermans F, Stuiverc M, Beersd PJ, et al. The distribution of roles and functions for up scaling and out scaling innovations in agricultural innovation systems. *Agricultural Systems*. 2013;115:117–128.
33. Jensen M, Johnson B, Lorenz E, et al. Forms of knowledge and modes of innovation. *Research Policy*. 2017;36(5):680–693.
34. Johnson, D. Métodos multivariados Aplicados al Análisis de Datos. International Thomson Editores, Mexico, 2000.
35. Johnson W. Roles, resources and benefits of intermediate organizations supporting triple helix collaborative R&D: The case of Precarn. *Technovation*. 2008;28(8):495–505.
36. Miles I, Kastrinos N, Bilderbeek R, et al. Knowledge-Intensive Business Services: Their Roles as Users, Carriers and Sources of Innovation. Report, DG13 SPRINT-EIMS. 1995.
37. OCDE. Manual de Oslo. 3rd edition. TRAGSA/OCDE, Paris; 2005.
38. Peña D. Análisis de Datos Multivariantes. Mc-Graw-Hill, Spain; 2003.
39. Rendón-Medel R, Díaz-José J, Hernández-Hernández B, et al. Modelos de intermediación en la extensión agrícola. *Revista Mexicana de Ciencias Agrícolas*. 2015;6(1):139–150.
40. Rivera R, Dutrénit G, Ekboir J, et al. Do linkages between farmers and academic researchers influence researcher productivity? The Mexican case. *Research Policy*. 2011;40(7):932–942.
41. Vera-Cruz, Alexandre O, Caballero R, et al. Innovation intermediary organisations in the agriculture sector in Mexico. Globelics conference, Buenos Aires; 2011.
42. Vera-Cruz AO. *Informe de actividades, Proyecto "Mejorando la Administración del Conocimiento en el Sistema de Innovación Agropecuario Mediante el Fortalecimiento de las Capacidades de las Fundaciones Produce*. SNITT Institutos de Investigación" (SAGARPA-CONACYT, N. 2006-C01-48511), UAM, Mexico; 2012.
43. Winch G, Courtney R. The organisation of innovation brokers: An International Study. *Technology Analysis and Strategic Management*. 2007;19(6):747–763.

Table A1 Number of PFs assigning high values to each of the specific activities of every function

Basic functions	Specific activities	Group 3	Group 2	Group 1
Identification and integration of the offer of R&D and technological solutions	Performing internet searches	NA	5	2
	Issuing calls for proposals		12	11
	Inviting researchers to participate in demand-identification meetings		12	12
	Maintaining informal relationships with researchers		12	4
	Number of PFs per Group	**NA**	**12**	**15**
Articulation of farmers' demands	Organization of demonstration plots to open spaces for interaction		11	0
	Diffusing successful cases that illustrate the role of supply and demand	8	13	1
	Demand-identification meetings	8	13	5
	Organizing technological tours	8	4	0
	Number of PFs per Group	**8**	**13**	**6**
Matching of demand with the offer of technological solutions and R&D, and network brokerage	Distributing printed material	9	12	1
	Building a common language	9	13	0

Table Continued.....

Basic functions	Specific activities	Group 3	Group 2	Group 1
	Organizing demonstration plots in order to show obtained benefits from the technological package	9	14	1
	Call for projects on the basis of the identified demands	9	15	2
	Encouraging participation of producers and a closer relationship with experts	9	13	0
	Number of PFs per Group	**9**	**16**	**2**
Managing Innovation	Supporting innovations in the technology package	10	13	1
	Diffusing information on new developments among network members	7	3	0
	Helping to implement the technology transfer projects and avoiding results not being transferred to the farmers	10	12	1
	Supporting the protection of the intellectual property of the projects	6	6	0
	Linking with other product systems	10	9	0
	Linking with universities and public research centers	10	12	0
	Linking with SAGARPA	9	8	1
	Number of PFs per Group	**10**	**14**	**3**

Note. This table includes only those PFs that assigned a high score to the activities.

Table A2 Value of the composite indicator per function and PF membership to each group

Produce Foundation	Supply-oriented		Demand-oriented		Matching supply and demand		Innovation management-oriented	
	Value	Group	Value	Group	Value	Group	Value	Group
Aguascalientes	3.75	2	4.00	3	3.60	2	3.00	2
Baja California Sur	3.25	2	3.25	2	4.00	3	3.57	3
Campeche	2.25	1	3.25	2	3.60	2	2.43	2
Chiapas	2.25	1	1.75	1	3.20	2	3.14	2
Chihuahua	3.25	2	3.50	2	3.80	3	2.86	2
Colima	2.25	1	2.75	2	3.40	2	2.29	2
Distrito Federal	2.50	1	2.00	1	2.60	1	1.14	1
Durango	3.25	2	3.50	2	4.00	3	3.43	3
Guanajuato	3.50	2	3.25	2	3.60	2	3.43	3
Guerrero	1.75	1	1.75	1	2.80	2	2.29	2
Hidalgo	2.50	1	2.75	2	3.20	2	2.57	2
Jalisco	1.50	1	2.00	1	2.00	1	1.71	1
Mexico	2.75	1	2.50	1	2.80	2	3.43	3
Michoacan	2.75	1	3.50	2	4.00	3	3.14	2
Morelos	2.75	1	3.50	2	3.80	3	3.43	3
Nayarit	3.25	2	4.00	3	3.40	2	2.14	2
Nuevo León	2.50	1	3.75	3	3.60	2	3.71	3

Citation: Dutrénit G, Vera-Cruz AO. Fostering innovation in the agriculture sector: The case of intermediary organisations in Mexico. *Open Access J Sci.* 2018;2(2):95-107. DOI: 10.15406/oajs.2018.02.00052

Table Continued.....

Produce Foundation	Supply-oriented		Demand-oriented		Matching supply and demand		Innovation management-oriented	
Puebla	3.00	2	3.75	3	3.40	2	3.86	3
Queretaro	4.00	2	4.00	3	4.00	3	3.57	3
Quintana Roo	2.50	1	1.75	1	2.80	2	1.29	1
San Luis Potosi	3.00	2	3.75	3	3.60	2	2.86	2
Sinaloa	3.00	2	3.25	2	3.80	3	4.00	3
Sonora	2.75	1	2.75	2	3.20	2	3.14	2
Tabasco	3.75	2	4.00	3	4.00	3	3.14	2
Veracruz	3.25	2	4.00	3	3.80	3	3.29	3
Yucatan	2.50	1	2.75	2	3.40	2	3.14	2
Zacatecas	2.50	1	3.50	2	3.20	2	2.57	2

Citation: Dutrénit G, Vera-Cruz AO. Fostering innovation in the agriculture sector: The case of intermediary organisations in Mexico. *Open Access J Sci.* 2018;2(2):95-107. DOI: 10.15406/oajs.2018.02.00052