Bridging innovation demand and supply in the agricultural sector: the case of an Innovation Intermediary in Mexico

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Abstract:

The aim of this paper is to analyze the role of innovation intermediaries (II) in the technology and knowledge transfer process in the agricultural sector. We explore the case of an II in México, the Produce Foundation (PF), an important stakeholder in that sector, influencing the transformation of public research institutions which have had major and diverse impacts on the agricultural innovation and research system in México. In particular, we ask for their role in demand articulation, brokerage of networks and management of the innovation process of the agricultural sector in México. To do that, one of the most successful 32 PF was selected, the Produce Foundation Nuevo León (FUPNL).

Research is based on evidence collected by interviews with producers, researchers from public research institutions (PRIs) and managers of the PF. FUPNL reports and direct observation were also utilized. Main conclusions show that II are called to play a crucial task for the articulation of users and producers of knowledge and technical developments in the sector. They are also helping the building and maintenance of networks of innovator actors and have had highly positive impacts in the improvement of the management of the whole process.

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Introduction

Since about three decades now, developing countries´ agriculture has become more complex and diversified because of globalization, the emergence of high value agriculture and the deterioration of natural resources between other facts. These events have changed the dynamic of this sector; agricultural producers face challenges for meeting product quality and food safety standards required by international markets. In this scenery, innovation has become a key issue for agricultural producers for adapting to a more competitive and complex environment (World Bank 2007). Globalization and the consequent pressure on competitiveness, the reduced effectiveness of traditional policies in a new international context and the rapid expansion of knowledge-intensive sectors, have induced a reevaluation of the social and economic roles of science and technology (World Bank, 2006). In general the public research centers and extension institutions in developing countries were criticized for not participating in the emergence of the most dynamics agricultural markets. In recent years public research centres, producers, governmental agencies and other institutions involved with innovation in the agricultural sector have struggled to adapt to the new environment. In doing so they need to overcome the difficulties posed by shrinking budgets, strict public regulations, and a model of science that has hampered their integration into dynamic innovation processes (Ekboir et al, 2008). Developing countries have explored alternative policies and the creation of new institutions and mechanism to foster that process. One of those changes was the introduction of new funding schemes and the creation of new institutions to promote innovation in farming (Vera-Cruz et al, 2008). Matching demand and supply of knowledge and technical developments in the agricultural sector was and still is one of the main challenges. Innovations intermediaries seem to be called to play a crucial role to fill up that gap, being one of their main tasks to act as a bridge between demand and supply for knowledge and information to support innovation (Kleks and Leeuwis, 2008).

In the case of México, as it was in many other developing countries, until the early 1990s the public research institutions (PRIs)[3] were organized along the linear vision of science, which induced researchers to work in the experimental stations, discouraging them from linking with farmers (Eckboir et. al, 2009). Policy makers, researchers and other stakeholders realized that knowledge and techniques developed by the public agricultural research centers were not adopted by farmers. That situation induced major changes in the organization of the agricultural public research. By 1997, new funding schemes were introduced and new institutions were created to promote innovation in farming (Vera-Cruz et al, 2008). This paper analyses the experience of one of those institutions (Produce Foundation),[4] inquiring for its role as an innovation intermediary agent. In particular we explore their impact in the innovation process regarding three functions: a) Demand articulation; b) Network brokerage and c) Innovation process management. The case highlights the changes experienced in the relationships between users and producers of technical knowledge after the Produce Foundation (PF) came into the scenario.

The research is based on evidence collected by multiple sources such as interviews with farmers and researchers from public research centres and universities, technicians and managers of the PF, and different governmental agencies from the agricultural sector.

After this introduction, Section two briefly discusses the literature on innovation institutions to develop the framework for the analysis. Section three provides the background for the analysis and also a brief note on the metodological issues. Section four is devoted to the study of the role of the FUPN in the three fuctions already mentioned. Section five contains some conclusions.

[3] We use the term PRI to refer to public research centers, universities and other higher education institutions.

[4] The PF are civil society organizations managed by farmers, created by the middle 1990s to manage public funds for research and extension. The Spanish for PF is Fundación Produce; the term has not an easy translation to English, meaning roughtly Foundation Go Farm.

2. Innovation Intermediaries in the Agricultural Sector

Innovation is a complex process, in the pursuit of which different agents and organizations interact to gain, develop and exchange various kinds of knowledge, information and other resources. Organizations might be business firms, farmers research centres and universities, government ministries, etc.

The behaviour of organizations or actors are influenced by many factors, and shaped by different institutional contexts. Legal conditions, rules, and norms also significantly affect an organization´s inclination and possibility to innovate. Any notion of innovation as a system stresses processes of interaction. However, interactions between agents and organizations are not easy, particularly in developing countries which are characterized by weak, or absent key actors, and by frail and irregular interactions between them (Cimoli, 2000). Analysis of systems of innovation has led to the analysis of agents that might help the formation of linkages and the matching of suppliers and user of technology.

The first real interest in intermediaries of innovation was in the field of diffusion and technology (Howells, 2006). Intermediaries were seen as change agents with a powerful influence on the speed and diffusion of new products and services. From the point of view of studies of innovation management the analysis is more about intermediaries as organizations and the type of activities they are involved in. Technology transfer is acknowledged as a key function but brokering is highlighted as well. However, intermedition is not just about a linkage role, intermediaries role is also as a knowledge repository. The system of innovation literature has identified II as groups of organizations that help to link and transform relations within an innovation network or system. Such organizations may be both, public and private in nature (Lynn et al, 1996).

A wider institutional role for intermediary bodies is identified by other authors (Howell, 2006), which are in the strategic level between the policy and the operational level, and how they form an ecosystem of influences on other agents within the system. Howells (2006) defines Innovation Intermediaries as ‘‘an organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties.

Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations".

In the context of agricultural innovation systems, Klekx and Leeuwis (2008), have identified three main functions of the innovation intermediaries named demand articulation, network brokerage and innovation process management. Following these authors, the three functions are described below. Given the purpose of this work, these three functions will be the thread to conduct our analysis.

a) Demand Articulation

According to prior studies (Howells, 2006; Klekx and Lewis 2008) demand articulation is a key task for II, meaning the establishment of a dialogue between users and producers of knowledge. The role of II is to identify and satisfy the real needs of users by facilitating the knowledge creation and knowledge transfer processes. Without a clear demand it is difficult for the research institutions to be client oriented. Demand articulation comprises the diagnosis and analysis of problems, and articulation of latent needs. In the agricultural sector, producers often experience difficulties even to define what their problems are. Difficulties originate not only from technological but from organizational deficiencies of potential users of knowledge. II help to create bridges between suppliers and users of knowledge. In the case of agriculture, they help to cut down the cognitive distance between researchers and farmers, and that is particularly important for the case of small agricultural producers. Both formal and informal methods are utilized for demand articulation. .

b) Network Brokerage

A second key function of the II is to overcome market and system failures. They help to close existent information gaps by creating transparency on supply of R&D and technological services. II act as channels to make networks or external relations available to small firms or producers that otherwise would have limited chances to do it. In the case of the agricultural producers, intermediary agencies not only connect suppliers and users of technology and promote networking between actors involved in innovation; intermediation also implies a shift away from traditional agricultural

business support providers towards generic business support providers (Kleks and Leeuwis, 2008). Intermediation agencies organize platforms or meeting places for actors of the innovation system. In the case of the agricultural sector, II also help small farmers to find and access sources for financing innovation activities.

c) Innovation Process Management

Innovation is a process that implies the creation and management of effective linkages between the various actors and institutions integrating innovations systems and subsystems. Innovation agencies play a key role as organizers and managers of the networks during the innovation processes, by acting as lead operators and caretakers of the networks. Communicability is essential if knowledge is to be shared and diffused throughout a group of actors involved in innovation. II facilitates communication between producers/ diffusers and users of knowledge by fulfilling an interface management role. Knowledge and technology transfer from PRIs to small and medium farmer's s requires bridging cultural and cognitive gaps; management also includes the optimization of interactions between the innovation networks and the broader innovation system (Klein Wollthuis et al, 2005).

3. Contextual Framework and Methodology Utilized

Structured as civil society organizations, and managed by farmers, the Produce Fundations was founded in 1996 having as initial and main purpose the management of public funds for research and extension in the agricultural sector in México. However, the PF have evolved since then to become an institutional innovation of great importance in the Mexican innovation system and its agriculture. The creating of PFs continued until 1997; by that time every one of the 32 states integrating the Mexican country, with the exception of one, had created a foundation. As the country started a process of gradual economic and political liberalization, new opportunities and threats for agricultural producers came out. Farmers started to look for advanced technologies to compete in the new economic setting. When public research institutions (PRIs) were unable to respond to the producers needs, society questioned the way the system was working.

The foundations were created to induce changes in the agricultural research system to make in more responsive to the needs of farmers. The nature of these changes consisted essentially of establishing new ways of interacting with farmers and securing new resources for operational funds.

In the 2000s the PFs were already an important stakeholder in the agricultural sector in México, influencing not only sectoral and science policies but the design and implementation of agricultural policies (Ekboir, et al 2009). PFs introduced new concepts for the analysis and design of scientific and technological policies; they also gradually influenced research activities by opening channels of communication not only between producers and researchers but also between other actors of the agricultural sector such as federal and local governmental agencies.

The PF observable impacts on the agricultural research system went far-away from its original objective. This paper argues that the PFs have played the role of innovation intermediary in the agricultural research an innovation system. PFs have helped to create bridges between farmes and researchers. One of the basic objectives of the foundations was to build a platform to allow researcher to have direct links with the state´s farmers. As a result, PFs have promoted a demand-driven and problem-oriented research system. They have fostered networking formation between users and preoducers of knowledge, and betweeen other agents and organization from the agricultural sector. Finally, PFs have had an important impact also in the way innovaction in the agricultural sector is managed. They have helped the development of a culture of innovaction searching for ways to foster the emergence of innovation networks and to involve new actors in innovation processes. Based on the experience of the FUPNL, and in particular by asking researchers and producers linked to tha PF, we attempt to illustrate what we have pointed out.

Methodology

This paper is based on a case study of one of the 32 PF, located at the state of Nuevo León, México. Semi- structured interviews were applied to agricultural producers and researchers from PRI in the agricultural sectors, and managers from the produce

foundation Managers form COFUPRO, the central office coordinating the Produce Foundations also were interviewed

Altogether twelve interviews were applied. Available documentation, internal and external to the PF also was consulted. Data from different governmental agencies such as SAGARPA (Secretary of Agriculture, Livestock, Rural Development, Fisheries and Food); SEDESOL (Secretary of Social Development) and INEGI (National Institute of Statistics, Geography and Informatics) was utilized.

4. The Role of PFs as Innovation Intermediaries: evidence from the Produce Foundation Nuevo León (FUPNL)

4.1 Background and characteristics of the FUPNL

Located at Nuevo León, one of the most developed states of the north side of México, the FUPNL was founded in 1996. Nuevo León state shares about 1.8% of the country´s agricultural GDP and 2% of the national agricultural land. Principal products are vegetables, fruits (apples, oranges, and tangerines), potatoes, swine and cattle. Nuevo León is predominantly and industrial state.

FUPNL is considered one of the most successful PFs between the 32 PF operating all over the country. This foundation has made important contributions to the management and methods by which research funds are allocated. Changes proposed by FUPNL have been adopted by other foundations (e.g. calls for research proposals and for technology transfer projects, the administrative procedures to select which projects would be funded, and the utilization of information and communication technologies to speed administrative procedures and to share information). One of the factors explaining this success is previous experience and leadership of the presidents and managers who have leaded this institution. During it's almost 15 years of existence this foundation has been leaded by three presidents. Long term vision and the ability to identify opportunities are two of the main characteristic of the FUPL chairpersons. At the time they took over the running of the PF, all of them already had a long trajectory as producers, researchers or as leaders of some agricultural associations of the state.

The structure of most of the PF is minimal. FUPNL operates with five people performing the following functions: president, manager, assistant, accountant and an associated in charge of monitoring and evaluation of projects. It has a decentralized structure, with a strong leadership of the president, and a manager recognized by his technical capacity. Even though the small structure, FUPNL has managed to expand its operations and impact through a set of connections established with a diversity of regional, national and sectoral organizations. The involvement of FUPNL executives has enabled this PF to expand its presence between farmers and researchers. On the other hand, network formation has opened new opportunities for the PF to get access to infrastructural and organizational resources. Complementary and parallel organizations and associations from Nuevo León strengthen FUPNL.

4.2 The role of FUPL as demand- supply articulator and networking broker

A principal job performed by FUPNL is about matching demand and supply in the agricultural knowledge infrastructure. It provides a meeting place for researchers and producers; since 1997 linkages between public and private research institutions and agricultural and livestock producers have growth. There are three types of institutions conducting agricultural research in México: general PRC and universities, sectoral PRC and universities, and regional PRC and universities plus other institutes that also research non- agricultural topics. The first group embraces national and federal institutions like UNAM, IPN, UAM and CINVESTAV. They tackle a range of research issues including biology, chemistry, physics, social sciences, etc. Research related to agriculture includes biotechnology and biology. Sectoral universities and PRC works only on topics related to agriculture, including INIFAP, the Postgraduate College , Chapingo and Antonio Narro Universities. The third type of PRIs includes universities that may have a diversified research portfolio, but some of their activities deal with processing of agricultural products and post harvest activities.

The Nuevo León Produce Foundation has established relationships with a number of regional research institutions such as the Universities of Tamaulipas, Nuevo León and Coahuila, the Monterrey Technological Institute (ITESM); wit PRIs devoted to researching and teaching of agricultural subjects like Antonio Narro University and

INIFAP; with general universities and research centres like CINVESTAV, UNAM, IPN and with foreign universities (Texas University).[5]

The PFs have been an instrument to transform research from a supply-driven system to a demand-driven one. Two basic objectives of the foundations were to allow them to have a direct link with the state´s farmers and to convey their research needs and priorities in line with the process of political opening, and to increase flexibility in the use of research funds, freeing them from public sector controls. Before PFs emerged to the scenery, financing of research and innovation was based on the lineal model, and this was the model behind investment in agricultural research until the 1990s. According to this model the results from basic research serve as inputs for applied research, whose outputs are in turn used for technological development. So, governments just ought to finance basic research in PRIs and stimulate private investment in technological development. By the 1990s, the innovation model evolved into the system/ network integration model . Research activities were nodes of a wide network of knowledge creation and use (Faberger, 2005). The better understanding of the dynamics of research and innovation inspired STI policies. Funding of research institutions changed. Competitive mechanism were introduced by most research councils; researchers responded to calls for proposals issued by the institutions managing funding like PFs. This procedure lead research in agriculture from a supply demand system to a demand driven one. Demand identification methods were developed over the years. Subsequent methods were introduced to better identify real need of the farmers. The PFs increased research effectiveness by promoting the transfer of funds to the more productive researchers, mobilized additional funds and promoted a demand-driven and problem-oriented research system. Networking formation, use and maintenance has been at the centre of this process.

4.3 PFs networking brokerage: integration of parallel and complementary associations.

There is a significant synergy between different types of associations and the PFs. The experience of FUPNL with two organizations complementary to it can illustrate the

[5] There are more than 80 researchers related to the primary sector in the region.

importance and impact of networking expansion: a) the Northwest Technical Consortium and b) the GGAVATT in Nuevo León. PF has opened new channels of communication not only between researchers and farmers, but between them and federal and state authorities thought different sorts of associations sometimes created originally with purposes other than those related with technology/ knowledge transfer. FUPNL has developed and improved the networking function as it evolved and built management capabilities through a learning process. The examples are described below:

a) The Northwest Technical Consortium (*CTN, Consorcio Técnico del Noreste*).

The Northwest Technical Consortium (CTN) is a regional organization created in 1997 with the participation of various PRIs such as the Universities of the states of Tamaulipas, Nuevo León and Coahuila, INIFAP (National Institute for Forestry, Agricultural, and Livestock Reserach). Other organizations participating in the CTN are SAGARPA, the agriculture-related trust of the Central Bank of Mexico (FIRA), cattle rancher associations, and the governments of the three abovementioned states.CTN is a consortium focalised on technology transfer, farmer training and the provision of services rather than on research. CTN provides a platform or meeting place for researchers and producers. Since their formation, the relationships between researcher from the institutions mentioned and cattle ranchers have grown. CTN mainly attends needs from medium- sized cattle ranchers.

CTN is a flexible organization. The number of researchers and technicians who participates in it varies, with about 10 or 12 permanent collaborators, and a network of about 30 persons collaborating sporadically. Rather than to research, the consortium is focused on technology transfer, farmer training, and provision of services. In practice, the CTN works as a facilitator of linking researchers and university students with farmers. Most of the projects submitted by the CTN to the FUPNL involve adapting and transferring technologies from domestic and foreign institutions. The Nuevo Leon Foundation primarily supports extension events. Most of the CTN´s research is in the form or individual projects financed by the researcher´s universities and CONACYT (National Council for Science and Technology).

Within the CTN was created a Promotional Committee, which is a laboratory that offers services and undertakes R&D activities in the areas of animal health, diagnosis, geographic engineering, digitalization and wildlife. Five PhDs and various MCs collaborate in chemicals, toxic residuals, DNA for Cattle, and biotechnology. The Committee has agreements with INIFAP and the University of Nuevo León. It has submitted projects to CONACYT, SAGARPA and the Mixed Funds.

Main problems confronted by CTN are the lack of incentives for hiring researchers and technicians, a shortage of financial resources and aging researchers.

b) GGAVAT (Rancher´s Groups for Validation and Transfer of Technology)and GITs (Technological Exchange Groups)

GGAVATS are a form of associations organized to discuss technological matters. Following the experience of CREA (Argentine Regional Consortia for Agricultural Experimentation) groups, INIFAP researchers induced the creation of similar organizations. GGAVAT Nuevo Leon operates among swine and goat farmers. GITs are similar to GGAVATS, but they work in the agriculture area.

These two groups have encouraged the participation of producers who attend GGAVAT meetings to communicate their problems and to interchange experiences. GGAVATS have triggered farmers' confidence in the utilization of technology to solve those problems.

GGAVATS receive resources from the federal government and their relationship with PF Nuevo Leon is informal. Nevertheless, the interaction between researchers and farmers occurring in these groups have allowed the identification of common and potential problems among producers and the development of projects submitted to the PF. GITS have facilitated the PF´s establishment of technological validation plots and contributed to the adaptation and diffusion of technologies among farmers. The GGAVATS and GIT models aim to:

- Integrate a participative model for the transfer of technology

- Evaluate and validate technological solutions for the improvement of agricultural and livestock activities
- Promote the adaptation and diffusion of technologies
- Promote the utilization of technologies for alternative farming.

The experience of GGAVAT is particularly illustrative of the emergence of valuable experiences derived from interaction between PF´s and other organisations.

4.4 Innovation Management: The Role of FUPN as seen by the researchers and producers of Nuevo León.

If innovation is seen as a process of creating and managing effective linkages between different actors of the innovation system, a key role for intermediaries is the organization and management of innovation networks. FPUNL as an innovation intermediary facilitates communication between producers/ diffusers and users of knowledge by fulfilling an interface management role.

FUPNL has bridged cognitive and cultural gaps between PRI and farmers. PF´s help to optimize interactions between innovation networks and the broader innovation system. Throughout their existence, PFs accumulated experience and developed capabilities that enabled them to become key actors in the Mexican agricultural sector. The impacts of FUPNL in agricultural research system are summarized below, based on the perception of researchers and farmers. The improvements in the management of the agricultural innovation system are linked to a learning process.

According to the researchers of the region, the role of the FUPNL has been very important for getting funds for research and technology transfer projects. The PF´s have enabled them to carry out some projects that otherwise would not be supported by funds from sources like CONACYT and SAGARPA, especially technology transfer and technology adaptation projects. On the other hand, researcher's opinion is that basic research projects have had less fortune within the PF scheme. Projects approved by PF´s can get funds for 3 years as the maximum period. Basic research projects tend to take long to give results. PF´s calls for research proposals remove some topics from the list every time they are presented. These regulations sometimes have negative effects

particularly on the development of basic research projects, because researchers cannot renew or get extensions to their projects.[6]

From the researcher's perspective, some of the positive effects of the intermediation of PF's are:

1) PF´s calls for research proposals have allowed a direct participation of the farmers and livestock producers in the identification of problems and clarification of demands.

2) PFs facilitate researchers- producer's interactions and as a result, problem identification became a two way rather than a one way process. Researcher can best capture the requirements of the producers.

3) Membership of the farmers in the Produce Foundation has encouraged them to share information and knowledge with other farmers. It has enabled them to identify common problems and to solve them as a collective with the advice of researchers and technicians.

4) There is a stronger commitment of the researchers and technicians, regarding the outcomes of the projects. Projects clearly establish a series of activities and results to be delivered such as publications, technologies, training courses and events. PFs have introduced new management systems, including a better systematization and control of the processes and final results.

One of the main problems is the shortage of human resources for research in agricultural related issues and the lack of incentives to encourage young scholars to engage in the agricultural research system. There is a lack especially in areas such as biotechnology and agro business.

According to the producers, FUPNL has performed a variety of tasks that have not been performed before. They highlight the PF work particularly in the management of the

[6] Projects aimed to evaluate the effects of rotation of corps, silviculture projects or for the modification of species normally take more than three years time.

process to allocate research funds with the direct participation of farmers. As a result of the introduction of new ideas to foster interaction, producers consider that the knowledge and technology transfer process have had a greater impact on their production activities. Access to appropriate sources of information and knowledge, faster and closer response to their needs, enhanced credibility/ trustiness are between the more valuable PFs effects perceived by farmers. The positive effects of the intermediation of PF's according to them are:

1) The FUPNL has assisted the producers in coping with problems by opening a space for enhancing their relationships with researchers. Before PF´s it was more difficult for producers to think of solutions based on research and technology transfer
2) Diffusion and utilization of technological solutions by the farmers in now more widespread. A multiplier effect is noticeable regarding adoption and diffusion of technologies.
3) Producers trust the FUPNL because this intermediary agency maintains a high degree of autonomy regarding relations with governmental institutions. This has encourage an increasing participation of farmers and livestock producers in the PF´s activities.
4) PFs has helped to allocate funds for research in the agricultural sector in a more efficient manner. PFs has avoided duplication of research projects and also has promoted a major impact derived from them by talking common problems of the producers.
5) PFs have introduced mechanism of participations such as technical meetings with farmers, demonstration days and demonstration plots of land have been valuable for technology diffusion.

5. Conclusions

The PFs constitutes an institutional innovation. The foundations were created to induce changes in the agricultural research system to make in more responsive to the needs of farmers. The nature of these changes consisted essentially of establishing new ways of interacting with farmers and securing new resources for operational funds. However, the PF observable impacts on the farmer production routines go far-away the original

objective. PFs have developed functions typical of innovation intermediaries. In the case of the Produce Foundation Nuevo León, three of the II key functions were identified: articulation of demand, network brokerage and innovation process management.

The FUPNL indicates that this type of innovation intermediary institutions is called to play a crucial task for the articulation of users and producers of knowledge and technical developments in the Mexican agricultural sector. PFs have also helped to build and keep working networks of other innovator actors and have had highly positive impacts in the improvement of the management of the whole process. PFs promote an agricultural research system oriented towards the solution of real problems of the farmers and livestock producers, by establishing a dialog between them and the innovator agents of the system. FUPNL has organized platforms for innovation system actors. It has been able to articulate different types of associations, causing a significant synergy, GGAVATS (Rancher´s Groups for Validation and Transfer of Technology) and the CTN (Northwest Technical Consortium) illustrate the importance and impact of networking expansion by these means.

Between the impacts derived from the functioning of FUPNL as innovation intermediary from the analysis done we can draw attention to the following:

- FUPNL has fostered networks between actors involved in agricultural innovation, particularly between rearchers and farmers
- FUPNL facilitates comunication between organizations and actors of the agricultural resarch and innovation system
- It has promoted a demand-driven and problem-oriented research system
- This II has increased research effectiveness by promoting the transfer of funds to the more productive researchers
- FUPNL fostered change in the research institutions and the valoration of research ann technology by farmers
- It has mobilized additional funds for innovation

Although the case revealed various possitive contributions of PF as innovation intermediaries, a detailed analysis of how these agents have learned, and how the leaning process has permeated both the supply and the demand side of the agricultural innoation system is required. Further analysis regarding policy issues, especially addresing the lessons to be learned from the experience of the agricultural sector by agents and organizations from other sectors.

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