VULNERABILITY, INNOVATION AND SOCIAL RESILIENCE IN THE MAIZE (*Zea mays* L.) PRODUCTION: THE CASE OF THE CONSERVATION TILLAGE CLUB OF CHIAPAS, MEXICO[†]

[VULNERABILIDAD, INNOVACIÓN Y RESILIENCIA SOCIAL EN LA PRODUCCIÓN DE MAIZ (*Zea mays* L.): EL CASO DEL CLUB DE LABRANZA DE CONSERVACIÓN EN CHIAPAS, MÉXICO]

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SUMMARY

Many Mexican farmers have formed organizations to work toward common objectives, for example obtaining subsidies and training. The mechanisms that these groups use to achieve their goals and confront situations of change and vulnerability have not been studied in detail. The objective of this study was to analyze the organizational model used by a group of farmers –from the Frailesca region of Chiapas, Mexico– to confront situations of vulnerability and carry out social innovation processes. Using qualitative methods, we analyzed the influence on group performance of: public policy, relationships by which knowledge is exchanged, and values and norms. Results indicate that knowledge exchange within the group, as well as by group members toward other actors, is important for improving production; however, the following are also necessary: effective mechanisms of coordinating collective decision making, experience and capability of developing and implementing sustainable agricultural practices, a facilitator who promotes group cohesion and coordination, and social mechanisms (collective norms, values, sanctions) that provide the organization with legitimacy. The principal conclusion of this study is that a group with effective organizational mechanisms is capable of confronting situations of vulnerability through knowledge, cooperation, and social innovation.

Keywords: social innovation; social resilience; networks; conservation agriculture

RESUMEN

En el sector rural de México se han identificado grupos de trabajo que se asocian en torno a un objetivo común, por ejemplo, para gestionar subsidios y capacitación; sin embargo, no se han estudiado a detalle los mecanismos que estos grupos utilizan para trabajar y enfrentar situaciones de cambio y vulnerabilidad. Este estudio tuvo como objetivo analizar el modelo de trabajo del Club de Labranza de Conservación, un grupo de productores ubicado en la región Frailesca de Chiapas, México. Con base en herramientas cualitativas, se analizaron la influencia de las políticas públicas, las relaciones de intercambio de conocimiento, así como el papel que juegan los valores y normas no establecidas en el desempeño del grupo. Los resultados indican que el intercambio de conocimiento, tanto al interior como al exterior del grupo, es importante para obtener mejores resultados productivos; adicionalmente se

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requiere contar con mecanismos de coordinación efectivos relacionados con la toma de decisiones en forma compartida, poseer experiencia y capacidad para gestionar y aplicar nuevas prácticas, tener un líder que promueva la cohesión y coordinación, así como promover el uso de mecanismos sociales (normas, valores, sanciones colectivas) que den legitimidad a la organización. La principal conclusión indica que una organización con resultados efectivos es capaz de establecer mecanismos basados en la cooperación y el conocimiento, donde la innovación social juega un papel importante para enfrentar situaciones de vulnerabilidad de los grupos organizados.
Palabras clave: innovación social; resiliencia social; redes; agricultura de conservación.

INTRODUCTION

Global concerns exist regarding how to respond to changing patterns in food consumption; how to feed a growing population that increasingly demands more food while agricultural systems are being affected by climate change; and how to influence public policy to resolve food insecurity by optimizing available resources than simply increasing food production (Pretty *et al*., 2010). In Mexico, smallholder farmers constitute nearly 70% of the farms and they largely determine the success or failure in poverty reduction, rural livelihoods, food security and nutrition. Across the world, agricultural production face numerous risks including pest and disease outbreaks, extreme weather events, market shocks, high input prices, low technology and information access, which increase the smallholder farmers' vulnerability and can have significant impacts on their well-being (Harvey *et al*., 2014). Furthermore, economic growth and market liberalization have benefitted some consumers, for example as a result of lower prices; however, this has involved externalizing environmental and social costs in detriment to the most disadvantaged sectors of the population (Cunha *et al.,* 2015) such as the smallholder farmers.

Many such disadvantaged groups and communities attempt to overcome their vulnerability through innovation and social resilience. Social vulnerability is a result of exposure of groups of people to situations of stress as a result of changes in their environment (Adger, 2000). This position of uncertainty causes insecurity, in turn leading these social groups to adopt strategies to confront their vulnerable situation. Social resilience refers to the capacity of these groups or communities to confront changes, adapt themselves to future challenges, and transform those challenges into paths toward improving their situation (Adger, 2000; Keck and Sakdapolrak, 2013). According to Keck and Sakdapolrak (2013), social resilience involves the ability of social actors to: i) confront and surmount all types of adversities; ii) learn from experience and adapt to future challenges; and iii) create new institutions capable of responding to such challenges. Thus, resilience is the ability to absorb disturbances without changing the system's function in order to take advantage of available resources and learn, innovate, and change (Adger *et al*., 2011). Social innovation leads to resilience, and resilience may also lead to social innovation (Westley, 2013) which allows for confronting situations of vulnerability. The idea of social resilience implies that adversities can be taken as opportunities for doing new things, for innovation and development (Keck and Sakdapolrak, 2013).

The concept of innovation has been widely discussed in recent years. While studies on social innovation cover a variety of topics, much of the literature has focused on economic and technological innovation. However, the ability to innovate through new social practices, forms of organization and modes of behavior allows to improve the effectiveness of group efforts (Hochgerner, 2011), and in turn affects the economy and technological development. Thus, social innovation involves establishment of new social practices for confronting social problems such as vulnerability, exclusion, and –in recent years– climate change. It involves a social change mechanism that is central to social change theory, by which a wide variety of inventions on the "micro" level influence group behavior toward modifying social practices (Howaldt *et al*., 2015). Social innovation arises from "the grassroots" in order to resolve needs and create value in the face of market failure. Social innovation may consist of a product, a production process, or a new technology, though it may also be a principle, idea, social movement, action, or a combination of these (Phills *et al*., 2008). Studies on social innovation and social resilience should take into account concentration of power and the complexity of relationships within groups and in the broader social structure which produce inequalities and contribute to vulnerability (Bernier and Meinzen-Dick, 2014; Wellman, 1983).

In Mexico, smallholder farmers have formed organizations to seek common objectives, such as responding to their situation of vulnerability as a result of changes in public policy, attending market needs and demands, and seeking technological solutions that improve their production processes. One such group is the Conservation Tillage Club (CTC) –a farmers' organization founded in 1999 in the Frailesca region of the state of Chiapas–, which is locally renowned for its organizational model as well as for members´ agricultural practices. There is a need for studies of such organizations, so that other

farmers´ organizations may learn from them, and to better design and implement public policy, as well as government and private initiatives to promote innovation and collaboration in the broader agricultural sector. The objective of this study was to analyze the organizational model by which CTC confronts new challenges and implement social and technical practices that allow them to improve their production and organization under a social innovation approach. For this, we analyzed the different challenges that CTC has experienced during the last decade, the group's response to those situations and how they implemented social innovation practices such as the formation, coordination and knowledge exchange alliances in order to obtain new resources and adapt to external changes in public policy.

MATERIALS AND METHODS

This study used a qualitative approach involving fieldwork and bibliographical review. In analyzing CTC's organizational model, several theoretical and practical aspects were taken into account. First, we analyzed the way in which the group is organized (Dhanarai and Parkhe, 2006), and second, their model of governance (Provan and Kenis, 2007), as well as their strategy of group coordination to deal with situations of vulnerability, to maintain stability, and to achieve "innovation coherence" –alignment between innovation practices and outputs of the group– (Hurmelinna-Laukkanen *et al.*, 2012; Nambisan and Sawhney, 2011). Third, we identified flows of knowledge within the group and with other actors (Roper and Hewitt-Dundas, 2015).

Fieldwork consisted of semi-structured interviews, attending CTC meetings, field visits and talking with other key actors in the region, such as extension agents, businesses providing technical services, researchers and professors who had worked with the group. Meetings and interviews of group members allowed for identifying how the group is organized, as well as their strategy for coordinating the group; while interviews with other actors provided information regarding relationships of exchange and knowledge exchange. The semi-structured interview focused on topics such as: farmers` activities, the role of each farmer in the group, their interactions with extension agents, and the relationships they establish within the group to exchange information, products and services. We also constructed a timeline including the most important events in the group`s history. A timeline allows to record and reflect an innovation process from the historical perspective and explain much of the current configuration in an organization; it also allows to reveal successes, conflicts, mistakes and other sensitive issues(Douthwaite and Ashby, 2005).

Discourse analysis was used to gather information, identifying actors with whom both the leader and CTC have a connection. An ego network was built, consist of a focal node (the ego) and the nodes to whom ego is directly connected (also called "alters") (Gonzalez-Pardo *et al.*, 2017).

RESULTS AND DISCUSION

The Conservation Tillage Club and its vulnerability

CTC is an informal organization of maize farmers from the ejido (communal land tenure system) Francisco Villa in the municipality of Villaflores, Chiapas. It was founded in 1999 by farmers who sought to carry out sustainable agricultural practices. In recent years, CTC members have modified their agricultural practices, resulting in improved yields and soil fertility; they have adopted, adapted and developed alternative practices through experimentation, for example incorporating harvest waste into the soil rather than burning it, refraining from turning over the soil, the use of green manures, and using hybrid seeds; other practices are presented in the body of the paper. CTC's main focus is practicing minimum tillage, which is a requisite for belonging to the group. The group has worked closely with universities, government departments, and private business that provide agricultural inputs. It should be noted that while several conservation agriculture practitioners, and CTC in particular, use many sustainable agricultural practices, they tend to use chemical fertilizers, pesticides as well as hybrid seeds, and therefore have received criticism from proponents of agroecology. CTC has used a participatory decision making approach in fundraising and seeking donations of agricultural inputs, and has established strategic alliances with research centers. Besides planting maize, they raise livestock, and some of them work other jobs to obtain further income.

These farmers mentioned they joined CTC for two reasons. First, they sought ways of responding to changes in Mexico`s agricultural policy –for example reduction in agricultural subsidies– early in the decade of 1990; and second, as a result of public and private initiatives and programs to promote maize production. In this sense, MASECA© industry promoted the formation of "maize clubs" to increase the supply of maize, while the Agricultural Department of Chiapas promoted no-till practices. This gave rise to the name's group as Conservation Tillage Club.

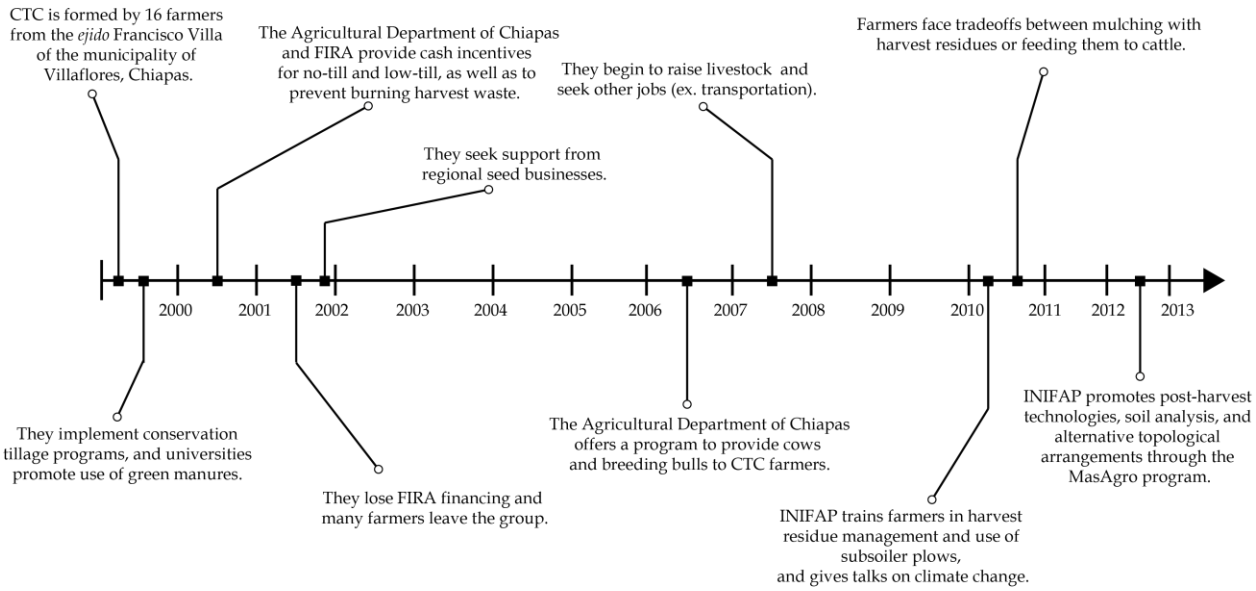

Figure 1. Timeline of the Conservation Tillage Club (CTC). Other acronyms: FIRA: Trust Funds for Rural Development; INIFAP: National Institute of Forestry, Agricultural, and Livestock Research; MasAgro: Sustainable Modernization of Traditional Agriculture Program.

Over the last years, different vulnerability situations have affected CTC's approach to organization and decision making, as a result from the restructured agricultural policy, the emergence of market and technology intermediaries and the initiatives implemented to increase the agricultural productivity. Three vulnerability situations have affected CTC's approach to organization and decision making. They explain how challenges resulting from external changes influenced individual and group decisions. First, as was the case with many maize producers in Mexico, CTC members faced restructuring of agricultural policy in the early 1990s; Mexico's agricultural market was transformed from a situation with strong government support for production and marketing, into a free market, which to this day continues to undergo restructuring (Appendini, 2014). Second, upon restructuring the market according to neoliberal policies, private companies assumed the intermediary role that the State no longer fulfilled by establishing initiatives to improve production. In this case, "MASECA Group" company encouraged farmers to create "Maize Clubs" to increase yields and improve maize quality by establishing financial, commercial and technological alliances with farmers. Third, since the disincorporation of public agricultural extension service in the 1990s, that strongly affected peasants (Hellin, 2012), the Mexican government developed a series of social-technical approaches to counteract the natural resource degradation resulting from intensive commercial agriculture (Marsden, 2011; Smith *et al.*, 2005). Furthermore, in accordance with international climate change treaties, the government has implemented programs to mitigate the effects of commercial agriculture; for example, the second-tier development bank Trust Funds for Rural Development[2] (FIRA) has promoted conservation agriculture since the early 1990s; while government research institutes, such as the National Institute of Forestry, Agricultural, and Livestock Research (INIFAP) have implemented research and technology transfer projects. CTC farmers have also worked with researchers of regional universities including the UNACH (Autonomous University of Chiapas) and ECOSUR (El Colegio de la Frontera Sur). More recently, the program Sustainable Modernization of Traditional Agriculture (MasAgro) of the International Maize and Wheat Improvement Center (CIMMYT) has promoted sustainable agricultural practices to mitigate the effects of climate change. These initiatives, as well as farmers organizing to improve maize production, have influenced CTC organization and formation (Figure 1).

CTC: an innovation and learning concept

CTC was integrated as a community of practice or community of innovation. Wenger *et al.* (2002) define communities of practice as "groups of people who share a concern, set of problems, or passion about a topic, who expand their knowledge and expertise in this area by interacting on an ongoing basis". In this case, CTC was formed to practice the

[2] *All acronyms for names of institutions are according to their Spanish initials.*

principle of "no tillage" in agriculture and to share similar problems and concerns related to the maize production in their region. Individuals who integrate the group are described by researchers and technical advisors as "*very good producers, always taking the initiative and working on different pathways*". In this sense, specific attributes such as technical capabilities or individual reputation have been shown to be crucial predictors of an organization's propensity to form links with other individual or groups (Kim *et al*., 2016) that finally influence the formation of different ties, which explain a significant proportion of the group's performance.

According to McDonald (2015), communities of practice have three qualities that allow for innovation and learning: i) a shared practice by community members, which in this case is agriculture; ii) a set of activities which they jointly carry out and/or common knowledge, that creates a sense of identity, such as "no tillage"; and iii) a sense of caring by group members about those activities and/or knowledge. In this case, CTC members share a series of activities related to their agricultural systems, which are based on livestock raising as well as monocultures and/or crop associations such as maize-beans, maize-beans-squash, or beans-sorghum. Crops and livestock provide most of these families` income and create a sense of group identity. However, some CTC members feel that many farmers try to join the group only to obtain economic benefits and agricultural inputs, even when they are not committed to the group work or to the undergoing training to improve their technical capacities and truly seek sustainable solutions to their problems. CTC's organizational model is based on trust and active participation in decision making, although the group is coordinated by an extension agent who is also a CTC farmer-member and who helps guide knowledge generation within the group. CTC members state that minimum or no tillage has reduced production costs, improved the soil and increased yield. Nevertheless, they lack the necessary equipment to further improve crop management. The outreach of minimum or no tillage to other farmers has been limited, as CTC farmers are reluctant to share it and another farmers interest is almost null.

Burt (2004) argues that people`s opinions and behavior are more homogenous within a group than among groups, and therefore those members of a group that develop relationships with people outside their group are presented with more alternatives to think and act differently than accustomed within their own group; consequently, such people will have more opportunities to innovate. One would expect that in the absence of external relationships, strong intra-group relationships would be associated with low levels of innovation, while connections with the outside world would lead to more innovation. Martinez and Aldrich (2011) stress the importance of a balance between a group's internal and external relationships; is very important to maintain strong relationships of trust, particularly in societies in which citizens have little institutional support. To address the balance between the importance of cohesion within a group and openness and connections with external actors, this study builds on the position of Portes and Vickstrom (2011), who indicate that understanding and acceptance of a common set of norms and roles is essential for a group to maintain internal cohesion and also interact with external agents.

Model of coordination

CTC and its leader have established a wide range of relationships with different actors to manage resources of different types such as information, subsidies, new agricultural practices, among others (Figure 2). Those activities require good coordination, where the leading producer has been crucial for managing and negotiating with external actors. Important advantages derived from a good coordination within groups, as well as with other individuals and organizations are the efficient use of resources, increased capacity to plan and to address complex problems, and better competitiveness (Provan and Kenis, 2007). Given the nature of the relationships among group members, the CTC might be defined as a participatory governance network (Provan and Kenis, 2007), in which group members share responsibility in decision making and work collaboratively. However, despite their participatory decision making, that is quite informal, a group facilitator (in this case the leading producer) coordinates the group's activities and directs management of resources.

Several authors mention that to promote the functioning of some communities of practice, they allow one or more actors to help group cohesion, to coordinate the development of new ideas and to undertake projects. In general, communities of practice require coordination; individuals who play this role –albeit informally– have been termed champions of innovation (Coakes and Smith, 2007; Klerkx and Aarts, 2013), development intermediaries (De Sardan, 1995) or facilitators of processes (Klerkx and Leeuwis, 2009). These actors tend to have personalities and other traits that help them to coordinate group processes. According to Howell (2005), such people are capable of transmitting security and enthusiasm to others, are persistent in the face of adversity, and –when appropriate– promote participation of others outside the group that may contribute to the group. In the CTC, this role is played by its facilitator, who is also a farmer that also acts as

an extension agent, and has been responsible for obtaining a large part of CTC's funding. Figure 3 delineates internal and external factors that influence formation and management of the CTC, which is similar to many other communities of practice.

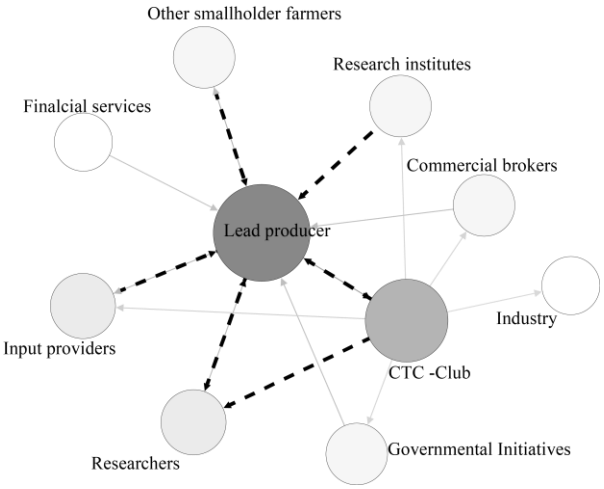

Figure 2. Ego-network for the Conservation Tillage Club. Size of circle = importance of the node or actor in the ego-network. Black-dashed arrows = strong relationship between two actors (Gonzalez-Pardo *et al*., 2017).

Information and knowledge exchange

The concept "open innovation" (Chesbrough, 2006) refers to an organization's use of external as well as internal resources to obtain the greatest amount of information and knowledge possible (West *et al.*, 2014). In recent years, open innovation participates on the influence of external resources and information on innovation (West *et al*., 2014). These flows of information depend on the exchange relationships of the group, which determine their possibility of acquiring knowledge.

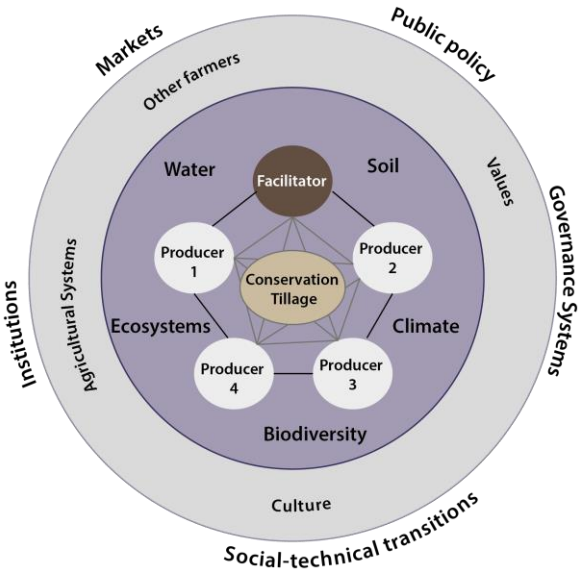

Figure 3. Factors involved in formation of the Conservation Tillage Club, as well as other similar communities of practice.

Local practices, level of experimentation and strategic alliances, as well as members' personal attributes shape the group`s agricultural and organizational capacities and define the ways in which they manage knowledge. Table 1 describes some factors involved in the construction of knowledge as a capital within the CTC, and describes the CTC's capacities for establishing working relationships, individual members' attributes and group context.

Table 1. Factors defining the knowledge of the Conservation Tillage Club as a capital.

Local practices	Level of experimentation	Alliances	Group members' personal attributes
Maize production using unsustainable management practices is common in the region (burning crop residues)	Farmers participation in government programs to establish demonstrative and experimental plots* improve their agricultural practices, and share their results	Strategic alliances with local universities, research centers (UNACh, INIFAP), agro-industry (MASECA), and financial institutions (FIRA, FIRCO, etc.) have broadened opportunities to innovate (implementing conservation agriculture)	A facilitator trained as an extension agent, who is able to help solving technical problems; farmers` cumulative experience enables the group to evaluate possible benefits of new technologies

*Demonstrative plot, used by extension agents, government representatives, research centers and businesses to promote agricultural inputs. Experimental plots established by research centers to evaluate seed varieties and technologies.

Another factor shaping their capacities and the way they manage knowledge is the strategies of external actors to transfer information on farm management and conservation practices. Different types of external actors have influenced CTC's work: research centers gave workshops; demonstrative and experimental plots, and farm tours were done to exchange information and provide outreach regarding alternative practices; government agencies provided economic incentives and financing; and the company that purchases the farmers' maize worked with other companies providing agricultural inputs that improve the quality and lower the prices of these inputs (Table 2).

According to Erden *et al.* (2014), in the long run the investment of an organization in promoting flows of knowledge determines its knowledge as a capital, and therefore its capacity to innovate. Roper *et al.* (2013) indicate that as a capital, (external as well as internal) knowledge is a determining factor for the success of innovation processes. As a type of capital for the CTC, knowledge has emerged from exchanging information, from farmers experimenting in their plots, from challenges that farmers have confronted in their organization, and from interacting with markets and diversifying their economic activities.

The phenomenon of embeddedness is the manner in which an organization networks obtains various types of resources from other actors or institutions. It plays a fundamental role in the CTC's relationships of knowledge and information exchange. Moran (2005) explains that two types of embeddedness exist: structural and relational. Structural embeddedness refers to the quantity of resources that a person or organization has access, while relational embeddedness refers to their actual ability to access those resources. This author states that while an actor may have access to many potential sources of information and knowledge, establishing meaningful relationship with them will depend on personal experience and the quality of their previous relationships with the different potential actors. This may determine the success of the CTC to obtain information and resources through their social, technical, and commercial relationships.

Vulnerability, resilience and social innovation

Since the implementation of the North American Free Trade Agreement (NAFTA), different studies conducted in Mexico coincide that traditional market-oriented small growers were the most vulnerable (Appendini, 2014). Our results show that policy actions are reflected and propagated through transmission mechanisms that affect the levels of inequality of the population that is in a situation of vulnerability. However, social resilience that results from the application of social innovative practices is fundamental to face changes, adapt to new processes and in general improve the situation at the individual and collective level. Although the phenomenon of vulnerability from a socioeconomic perspective has been little studied, the strategies of how to deal with this type of situation is of the utmost importance.

Table 2. External strategies influencing the Conservation Tillage Club.

Actor/Resource	Technology	Methodology	Contribution
SAGARPA: Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food	Conservation tillage, minimum tillage, mulching with harvest residues	Participatory workshops, technical talks and assistance, informative meetings	Cash incentives for mulching with harvest residues instead of burning, knowledge
BANCRISA: Rural Credit Bank of the Isthmus	Mulching with harvest residues instead of burning	Talks, technological packages	Economic support
FIRA: Trust Funds for Agriculture	Economic support	Field demonstrations, visits	Credit
MASECA Group	Classification of maize according to quality, mulch, soil conservation	Demonstrative farm visits	Knowledge, covering farm visit expenses
Seed businesses/Private sector	Hybrid seed	Field demonstrations	Free seed samples
ECOSUR: El Colegio de la Frontera Sur	Green manures, other agroecological practices	Experimentation, talks	Green manure, seeds, videos, knowledge
INIFAP: National Institute of Forestry, Agricultural, and Livestock Research	Testing maize varieties	Field days, diagnostic studies, experimental plots	Alternative technologies, knowledge

Source: Interviews and literature review of technology outreach models.

In response to those changes facing modern societies, the notion of social innovation has emerged as a new social policy perspective and have been developed into a major perspective in today's debates. The findings in relation to the role played by the group's leading producer coincide with the study carried out by Hellin (2012) in Chiapas, who argues that the role of a central facilitator is crucial as a catalyst for collective action, since it improves access to information and technical assistance, developing skills and capacities in the group as strategy to improve production and access to better markets.

Upon applying the concept of open innovation (Chesbrough, 2006) to this informal organization, flows of external information were found to positively influence the behavior of CTC. Factors affecting the behavior of the group as an organization include experience that allows obtaining and applying new knowledge, a flexible organizational model and social mechanisms (values, norms, collective sanctions and reputation) which allow the achievement of group legitimacy. These factors have led the recognition of CTC by others as a successful group and the collaboration with other actors.

Analysis of CTC provides several lessons. First, the group has developed a "social innovation process" that involves collective creation: group members acquire knowledge and/or generate new rules related to a social practice, and in turn acquire cognitive and organizational skills (Howaldt and Schwarz, 2010) that let them create social value and promote community development. This process has allowed them to confront situations of vulnerability, such as changes in public policy and opening of markets, as well as to propose practical, sustainable solutions to problems with food production. Second, the success of CTC (despite not being a legally registered organization) shows that rural organizations in Mexico do not necessarily require formal hierarchical legal mechanisms in order to manage knowledge and resources, and to confront challenges, as it is often assumed in developing nations. People do not always seek to maximize their own short term benefits, but may also foment cooperation to produce shared long term benefits, as CTC has done. Nevertheless, Mexican agricultural policy has fomented creation of an exaggerated number of formal organizations with the sole purpose of obtaining government subsidies, which are not always provided. Third, groups require external as well as internal sources of information for learning and experimenting; these will determine their capital of knowledge, as well as their capacity to successfully undertake projects. Mexican growers learn in different manners: trial and error; interaction with research centers, universities, and private businesses; mediation and negotiation; and risk taking, but in all of these, the grower is the principal source of experimentation and learning. Therefore, there is a need to foment interaction and trust among the different actors in a group to achieve collaboration within groups and outreach of new practices, prioritizing social capital and diversity within the group.

Our results lead us to a factor that has been key to collaboration within CTC, as well as with external actors: legitimacy. According to Human and Provan (2000), legitimacy is the credibility needed to form alliances, and is achieved by establishing the group's organizational structure, identity and mode of interaction. Regarding to organizational structure, legitimacy is furthered when members accept the group's organizational model; CTC has achieved this through social mechanisms defined by values and social norms. With respect to identity, legitimacy is promoted when group members recognize each other, as well as when external actors recognize the group, providing the group with an identity that allows members to collaborate with each other, as well as with others. Finally, legitimacy is favored in the mode of interaction, when a group is capable of interacting with various types of actors to manage and guarantee sufficient funds, infrastructure and human resources.

Despite the success of the group management, challenges to share and spread knowledge remains. Greenhalgh *et al*. (2004) distinguish two approaches for outreach of an innovation: Pure outreach involves spreading an innovation in an unplanned, informal, horizontal manner; while active dissemination is a formal, planned, centralized process involving hierarchies, by which technologies are spread from above to below. CTC has allowed their practices results to be spread by pure outreach. Nevertheless, not all community members practice all agricultural techniques that the group proposes. Even more, after 13 years of experience, the knowledge developed by CTC has not impacted more than its members.

CONCLUSION

As an organization, the Conservation Tillage Club has had the capability to confront and adapt to changes, and to transform itself over time. This group has applied the principles of social innovation to build a resilient system that has allowed them to overcome adversity, learn from experience, and create new relationships in order to improve its members' well-being. Thus, CTC provides an example of how social innovation may lead to resilience, and *vice versa*.

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