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An application of network theory to territorial analysis: The case of Yaqui Valley networks (2006 and 2016)

Una aplicación de la teoría de redes al análisis territorial: El caso de las redes del Valle del Yaqui (2006 y 2016)

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Abstract

The Yaqui Valley territory in the northwest of Mexico was analyzed using networks theory that determines the flows density and actors centrality among the agricultural sector. These networks were those of public, financial, commercial, technical, and social policy management. The current research has been carried out with the general objective of identifying the actors that make up the networks in the Yaqui territory and their change in densities as one of the factors that determine the effectiveness of the policy applied in the territory, comparing two samples of 2006 and 2016. Linked to this objective, it is proposed to describe the obstacles for the densification of networks that favor the agricultural producers labor in the Yaqui Valley territory. The obtained results indicate a clear disarticulation in the different networks of study that can elicit serious social problems of inequality among the actors that are active in the agricultural sector. The networks found in the territory of the Yaqui Valley have been disarticulated over time, because ten years after being analyzed for the first time, the calculation of densities has been reduced by 24% on average, and the truss of the social sector practically tends to disappear.

Keywords
networks • effectiveness of public policies • inequality • territory • Yaqui Valley

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Resumen

Se analizó el territorio del Valle del Yaqui, en el noroeste de México, utilizando la teoría de redes que permiten determinar la densidad de flujos y centralidad de actores del sector agrícola. Estas redes fueron las de gestión de política pública, financiera, comercial, técnica y social. La presente investigación se ha llevado a cabo con el objetivo general de identificar los actores que conforman las redes en el territorio Yaqui y su cambio en las densidades como uno de los factores que determinan la eficacia de la política aplicada en el territorio, comparando dos muestras de 2006 y 2016. Vinculado a este objetivo se plantea describir los obstáculos para la densificación de las redes que favorezcan el trabajo de los productores agrícolas en el territorio del valle del Yaqui. Los resultados obtenidos indican una clara desarticulación en las diferentes redes, que puede provocar serios problemas sociales de desigualdad entre los actores que se encuentran activos en el sector agrícola. Las redes encontradas en el territorio del Valle del Yaqui, han ido desarticulándose a través del tiempo, debido a que, a diez años de haberse analizado por primera vez, el cálculo de las densidades se ha reducido en un 24% en promedio, y el entramado del sector social prácticamente tiende a desaparecer.

Palabras clave
redes • eficacia de las políticas públicas • desigualdad • territorio • Valle del Yaqui

Introduction

The relationship among people, societies, cultures, companies, and institutions allows opportunities for growth in labor, production, politics, and economics; that leads to the establishment of relationships in all areas, or rather a new interaction network.

The networks concept was widely used during the sixties and seventies; from the results of various investigations, other concepts were minted, such as exchange networks and power networks (20, 21). Currently, different applications and meanings are attributed to the network concept, such as information and collaboration networks (14, 15), collaborative social network in the commercial field (11) or production networks (37, 38), which include the Silicon Valley which allow to shorten the production cycles and technological change, to partnerships with suppliers, collaborative networks, and institutionalized forms of learning. Others are the innovation networks DeBresson and Amesse (1991), Aguilar-Ávila (2010), Aguilar *et al.* (2016, 2017), actors and socio-technical networks (7), knowledge networks (21), marketing networks, financial networks, techniques, and management (27), value networks or cluster (28).

In 2010 Muñoz and Santoyo designed a methodology for networks analysis that has been widely used in Mexico, based on this experience they propose a political and public agenda in relation to the Mexican countryside (30). At the same time, this theory has served as an analytical framework for multiple thematic applications.

"Networks are forms of social interaction, defined as a dynamic exchange between people, groups, and institutions in contexts of complexity. An open and permanent construction system that involves groups that identify with the same needs and problems and that are organized to enhance their resources. A fragmented society in isolated minorities, discriminated against, that has devitalized their networks with citizens lacking protagonism in transforming processes, it sentences itself to a limited democracy. The network intervention is a reflective and organizing attempt of those interactions and exchanges, where the subject is based on himself, differentiating himself from others" (36).

In this article, it is made a study of the possible obstacles that hinder the effective application of rural development policies in a territory, through the networks analysis.

Flores (2007) indicates that Pecqueur (2001) differentiates between a given territory, which is the one that defines a political-administrative decision, and a territory that arises from a meeting of social actors, that is, a determined geographical space that seeks to solve a common problem. This description of territory is similar to the networks definition that is explained as the interaction of actors that meet around a common objective or to solve a common problem. In this sense, the built territory is considered as a space of social relations where there is a sense of belonging, an identity built and associated with the space of collective action, where bonds of solidarity emerge.

For their part, the analysis of graphs allows to identify the different structures of the analyzed networks, to, through the calculation of the basic indicators, identify which are the key actors of the networks, how the different actors intervene, and what are their organizational arrangements. Specifically, the present investigation is focused on the case of the Yaqui Valley territory, where it is interesting to establish if a deficient structure of networks has been able to cause imbalances in the distribution of aid for rural development.

The analyzed territory corresponds to the Yaqui Valley (figure 1, page 314), partially covers the municipalities of Cajeme, Bácum, San Ignacio Río Muerto, Benito Juárez, Etchojoa, and Navojoa. This territory forms a plain that begins in the foothills of the Sierra Madre Occidental mountain range and extends westward to the beaches of the Gulf of California.

The main activity of the area is agriculture; of the different municipalities that make up the Yaqui Valley, Cajeme stands out for its cultivable area of approximately 81 thousand 750 hectares, of the 220 thousand that this territory comprises. It is located in the center of the region and its head city is Ciudad Obregón.

The studied territory is characterized by a high concentration of public support to the agrarian sector, since 86% of the resources coming from the programs "Oportunidades, Procampo, Agro, Progan", which structure the public policy related to productive supports for the primary sector and have a higher incidence in rural environment in Sonora, that is applied in two regions: Coast Region and Yaqui and Mayo Valley Regions.

In addition, it is estimated that 97.9% of Procampo's support is applied in favor of 10% of the producers with the highest income in the territory, as is the case with 98.6% of other programs such as Agro and Progan (10). This situation exacerbates inequality and poverty conditions in rural areas.

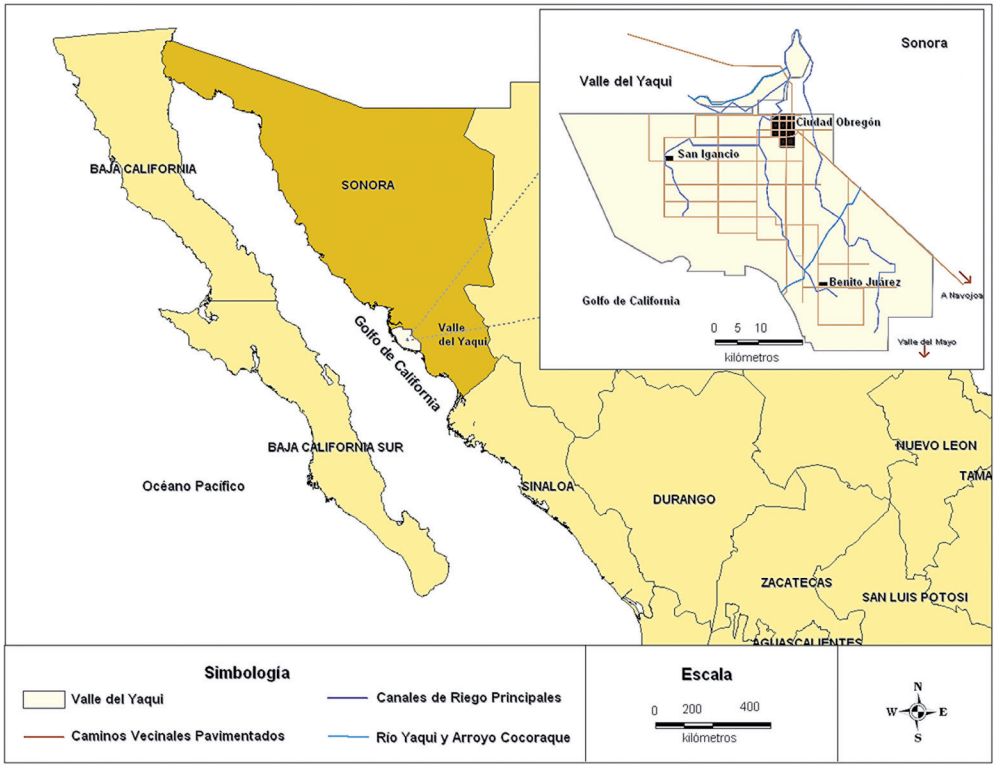

Figure 1. Yaqui Valley territory, Sonora.
Figura 1. Territorio del Valle del Yaqui, Sonora.

The most affected territory includes the Yaqui and Mayo Valleys with 58.7% of households in total poverty and 25% in food poverty (10).

However, this region occupies the second place in the perception of subsidies in the State, as the concentration of aid in higher income producers has already been considered, it prevents balanced development and slows down the progress of the most vulnerable producers.

This situation of asymmetry justifies the need to return to sight at the origin for the analysis of the causes of a situation that is a proof of the lack of effectiveness of a policy that is proposed as an objective of poverty reduction. It has to do with productivity, but also with redistribution and capacity creation. In this difficult context, the articulation in producers networks of the different sectors (social and private) could favor their situation, allowing them to face in better conditions their access to financing, technical assistance, market, and public support to consolidate itself as a true social network that allows the construction of its territory based on the activity it performs, counting with the structure that favors the conditions necessary for development.

For some authors, network analysis began with the publication of Moreno

(1934) entitled "Who Shall Survive?", who developed a technique for a classification process that is calculated, among other things, to bring together individuals who are capable to have harmonious interpersonal relationships, and thus create a social group that can function with maximum efficiency, and with the minimum of trends and descriptive processes.

The network as a social field where each person is related to a certain number of individuals. A visual representation of these networks is added in which people are represented with points, and relationships between people are represented with lines to each other (24, 25).

The networks can be studied from a national, regional (that is associated to the cluster) or international perspective, which refers to the global chains of products (Carrillo and Novick, 2005). Due to the above, the approaches of Porter (1990) were also used, where networks are formed from the relationship between the actors that are located in a specific territory.

The theory of networks has been applied in various studies on agricultural products in Mexico. These studies combine several analysis techniques, including graphs, which are graphical representations of the network, which are constructed from the nodes (which are individual or collective actors that are represented by geometric figures) and the type of links (consisting of relationships that are established between agents around a common goal), which makes it possible to map the social structure that makes up the territory.

In this difficult context, the articulation in networks of the producers of the called social sector of wheat production in the Yaqui Valley, could favor their situation allowing them to face in better conditions their access both to the market and to public support.

Bott (1990) extended the concept to the economic and labor field, and this reading was considered one of the most advanced contributions of her time in the study of social networks, according to placing them in a social-historical context. The author incorporated the concepts of connectivity (number of connections or amplitude of the network), dispersed networks (with little connection), and high association network (which refers to a greater number of relationships).

Later Vásquez (1999), when applying the concept to territorial development defines the network as "a system of relationships and/or contacts that link the companies or actors to each other whose content can refer to material goods, information, and technology". These relationships can be reciprocal, interdependent, multi-linked, and weak links, and strengthen the network by the exchange of information, as well as by the dissemination of innovation.

For Hannesman (2000), a social network is a set of actors (or points, nodes or agents) between which there are links or relationships. A node is an actor or group of actors represented in a network.

The nodes are usually represented through geometric figures such as circles, triangles or squares. Relationships are represented by lines that connect the nodes. These relationships can be separated into symmetric or directed. A symmetric relationship involves that two actors mention each other; a directed relationship involves that one actor refers to another, but they do not refer to each other. The number of relationships maintained by an actor will define the level of centrality of the same and therefore its influence on the network.

Méndez (2001) indicates from the context of the economic, technological and political-institutional transformations

of the last decades, that innovation acquires a strategic importance and in its promotion the characteristics of each territory, the presence of local actors, and the creation of formal and informal cooperation networks result essential, capable of promoting sustainable territorial development processes.

The author analyzes the theory of the innovative environment and, from it, presents the possibilities and obstacles to promote innovation in peripheral territories dominated by the presence of small companies and traditional activities, suggesting some reflections based on empirical researches conducted in Spain.

According to Casas (2003), networks can be classified by type of morphology, based on two elements: a) the type of involved actors (which can be networks between offerors or providers and users), and b) the objective they pursue, which is reflected in agreements and cooperation agreements, research, and services. The issue is to identify the actors that take initiatives in the construction of networks and the processes that are developed in the conformation, organization, and mechanisms that integrate the networks.

The formation of networks or value chains are conceptually simple but operationally difficult. The difficulty lies in determining where the network starts and ends. The decision will be taken by the researcher and will depend on the research objectives.

Based on the above, it is clear that a loss of social structure and territory deterioration in the Yaqui Valley, in terms of organization in the agrarian and rural areas, hinders the effectiveness and efficiency of agricultural policies with incidence in this territory, originating big imbalances. Added to the inefficiency in the production processes, management, and irrigation water driving Olmedo Vázquez *et al.* (2017), pose challenges for the Yaqui Valley territory.

In addition to the internal factors that condition the territory, externally it must be adapted like any other member of the WTO and FTA. González *et al.* (2016) points out that in Spain as a product of the WTO negotiations, it has focused its efforts on the search of its internal and external policies based on the sustainable management of natural resources, territorial balance, and rural diversity, taking care of the aspect of food security in a context of market instability.

The current research has been carried out with the general objective of identifying the actors that make up the networks in the Yaqui territory and their change in densities as one of the factors that determine the effectiveness of the policy applied in the territory, comparing two samples of 2006 and 2016. "Linked to this objective, it is proposed to describe the obstacles for the densification of networks that favor the agricultural producers labor in the Yaqui Valley territory".

It is based on the hypothesis that exists a growing disarticulation of the actors that make up the territory networks that favors inequality.

Material and methods

For the development in the current study, it was carried out in a survey applied to 156 organized and independent producers (73 organized producers and 83 independent producers). This survey was divided into six points that consisted of: 1) Identification, 2) Organizational development, 3) Support, 4) Problems, 5) Innovation dynamics and 6) Network analysis.

The survey was complemented by interviews with organizations representatives, which allowed to understand how the strategies developed in the different networks are working, the integration, and types of networks, number of partners, production surface, technical assistance, obtained volume, product price, local, regional, national, and export market, production costs per cycle; networks advantages, what they do to make them work, infrastructure, and received supports.

To identify the main producer organizations and actors involved in the different networks, visits, interviews, and surveys were carried out with representatives and producers of the following Credit Unions: Yaqui Valley's Agricultors Association, Cajeme's Agricultural Credit Union, S.A. of C.V., Yaqui's Agricultural Credit Union, Yaqui Valley's Agricultural and Industrial Credit Union, Huatabampo's Agricultural Credit Union, Of the Yaqui Mayo Valleys and Guaymas A.R.I.C. of R.I. and Pases A.R., Agricultor Organisms Association of Southern Sonora, Agriculture, Livestock, Rural Development, Fishing, and Feeding Secretariat; Yaqui River's Irrigation District, Grains of Sonora, Tepeyac and Instituted Trusts Related to Agriculture.

When interviewing the producers, they were asked questions that allowed identifying their main suppliers and their customers, which could detect a larger group of actors made up of commercial houses, government institutions, private institutions, credit institutions, industrial, and intermediaries, as well as their social relationship in different events where they attend.

The network mapping and the calculation of its indicators as centrality and density were made through the program "Ucinet 6.8e" Borgatti *el al.* (2002) for network analysis. This program contains a platform for the management of arrays that represent the interactions between the different actors of a network, as well as allowing to graph the interactions between the actors, which is more accessible and facilitates their interpretation. Each network comes from a matrix composed of rows and columns where the keys representing the surveyed producers and the actors with whom they are related in the different networks are placed.

Depending on the type of relationship, a key was assigned (1: public policy management, 2: financial, 3: technical, 4: management ...), the resulting arrays were initially worked on in Excel and then they were imported into Ucinet where the networks that resulted from the survey applied to wheat producers were elaborated.

The matrix is composed of rows and columns that represent each of the actors identified during the fieldwork phase that includes the 156 producers surveyed; the organization representatives; and to other types of actors such as customers, suppliers, and support institutions that participate in the production process. The columns contain the type of links that the surveyed producers maintain with the actors in the network.

The main basic indicators on which the study focuses for the network analysis are density and centrality. These indicators are applied to the complete network, and for the nodes the centrality, intermediation, and proximity are calculated.

The *density* represents the network connection level, which results from dividing the number of existing relationships between the total of possible relationships in %. This calculation indicates the level of network connectivity.

The *centrality* represents the number of actors, to which an actor is directly linked. The level of centrality is divided into input level and output level. These levels depend on the flow direction.

The *output* level, indicates the number of relationships that the actors say they have with the others. For example, a producer says that he markets through a marketing company, which delivers the wheat production to an agent who is responsible for marketing (producer organization, marketing company, marketing committee, and credit union) or directly to the agroindustrial, for which the output level will depend on the number of agents with whom it is related during the production and commercialization process. The input level is the number of relationships referred to an actor by a surveyed producer.

The network *size* is given by the number of nodes or actors that consist of people or groups of people, which are related to a common goal (public policy management). In the current study, the nodes represent producers and organizations represented with circles.

The *centralization* level indicates how close the network is to behave as a star network, which is negative since it indicates that a single actor controls the entire network. The ideal is to have networks with a low centralization degree well connected where the actors are properly interrelated.

Results

The results obtained in the study are presented in a diagram with the actors and interactions of the Yaqui territory. These actors identified from the interview with key actors and the producers survey from three sectors (private, social, and independent) are those who make up the different types of networks, so that the same actor can appear in several structures performing different functions.

In the table 1, can be seen the different analyzed networks, as well as the nodes number, existing relationships, their possible relationships, and their density, which allows to determine that the five networks have a low density.

Public policy management network

Figure 2 (page 319), shows the main network (general), which allows to determine the disconnection in the truss of studied networks: public, financial, commercial, technical, and social policy management, which are presented with greater force in the private sector.

The networks are exemplified by the role of actors in the Yaqui territory, and most of them were referred by the surveyed actors as sources for agricultural production.

Table 1. Yaqui Valley: nodes number, existing relationships, possible relationships, and their density.

Tabla 1. Valle del Yaqui: número de nodos, relaciones existentes, relaciones posibles y su densidad.

Networks	Nodes	Existing relationships	Possible relationships	Density	Density (%)
Public policy network	492	149	241,572	0.00061	0.061
Financial network	492	137	241,572	0.00056	0.056
Marketing network	492	157	241,572	0.00064	0.064
Technical network	492	174	241,572	0.00072	0.072
Social network	492	79	241,572	0.00032	0.032

Source: own elaboration with field work data, 2016. / Fuente: elaboración propia con datos de trabajo campo, 2016.

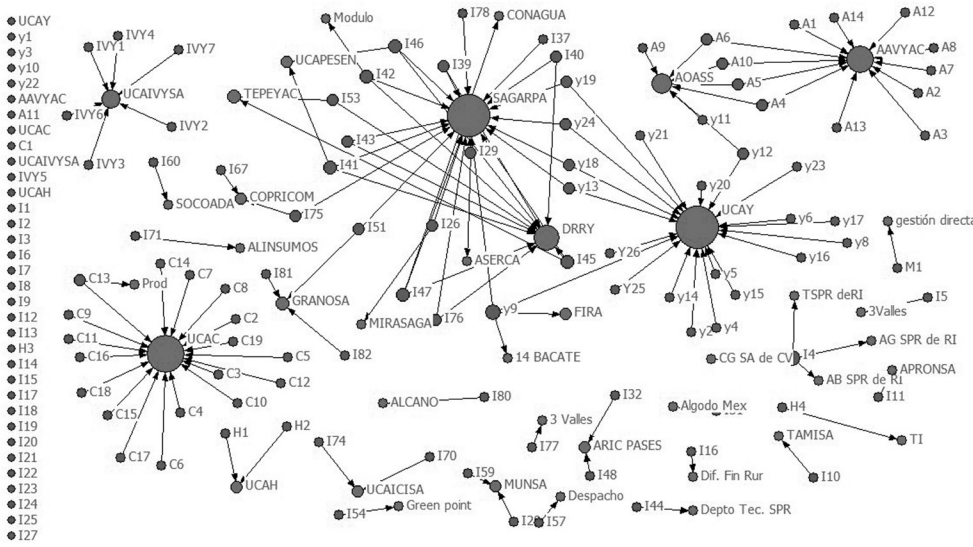

Figure 2. Public policy management network in the Yaqui Valley: Producers network and main actors.

Figura 2. Red de gestión de política pública en el Valle del Yaqui: redes de productores y principales actores.

The fact that the centrality falls on the agricultural policy management network, and is the one that unites the other existing networks, allows to establish that both private producers organizations, as well as the parafinancial companies that operate in the territory, agglutinate the majority of the actors that have a truss with the production link in the agricultural sector; offering different forms of cohesion, with an instability trend.

One of the most important problems is that small producers have less relationship in this network due to various factors such as economic production capacity, a smaller area, lower commitments in leverage, and lower management capacity in all areas, or little interest in having relationships that allow them to streamline their activity.

The public policy management network is characterized by having 492 nodes and 149 relations with a density of social structure in the territory study of 0.061%, obtained from the division of the relationships number over the total of possible relationships, representing a limitation for the management of public policies. This limitation does not allow to articulate the social structure, there are important gaps in the timely support arrival, as well as little or no other supports negotiation that could allow them to have better production conditions, and make their agricultural activity more competitive and profitable.

In terms of its centrality, a way to summarize the relationship patterns to manage programs that structure the support policy such as PROCAMPO and other programs, is by mapping the analysis of the agricultural policy management network, allowing to identify the main actors visually by the node size, which depends on the number of times they were referred, by the interviewed actors, as responsible for managing the supports.

Most of the responsible organizations for managing the various support programs correspond to private sector organizations, listed below are the actors and some institutions, among the most referred are UCAY with 21 references, UCAC 18, AOOAS 7, SAGARPA 21, AAVYAC 12, DRRY 11, UCAYVISA 6, Tepeyac 3, Granosa 3, UCAH 2, FIRA 2 and the rest of the organizations with a single reference which confirms even more the disarticulation with the existing organizations, making the actors their management in a personal way.

It can be determined that the main connections are at the level of captive actors, linked to each of the organizations, meaning a centrality control, which does not allow them to cohere with any other type of truss in the territory. Or, there is a closer influence with their organization than with the others that are in the same territory. Thus, with such disjointed networks it is difficult to accomplish with the territory construction, which is essential for the agricultural management policy for the benefit of the same actors in the territory in general.

Financial network

A main factor that allows the agricultural sector to be active in the territory of study, is the financial network. Therefore its importance, where it is observed that there are various banking institutions and organizations created precisely to solve the actors need, and there is a link between them; the truth is that once again there is a control centrality, which makes it impossible for the social structure to cohere as can be seen in figure 3 (page 321). This network is characterized by 492 nodes and 137 relationships with a density of social structure in the territory of 0.056%, which reflects the poor articulation of its truss. This network has a great importance, because it is the one that provides the economic resources for all activities, since the production process is integrated by tasks such as soil preparation, planting, fertilization, cultural work, irrigation, and drainage (cost of water, channels cleaning, construction and repair of showers, pre sowing irrigation, aid irrigation, furrows stick).

Since water management, for agricultural production in irrigation district No. 041, Río Yaqui, in northwestern Mexico, is one of the main factors to analyze, to make you efficient and competitive in the activity (Olmedo Vázquez, *et al.* 2017), plagues and diseases control, harvest, and commercialization. All these processes are not only complex, but have a high production cost derived from the inputs and labor required to carry them out.

Commercial network

In relation to the results obtained for this network, the existence of a poorly articulated network was detected, which does not necessarily represent a weakness, since it allows for greater interaction between different actors, and producers have the possibility of establishing marketing agreements and arrangements with the actors that provide the greatest support for production and commercialization.

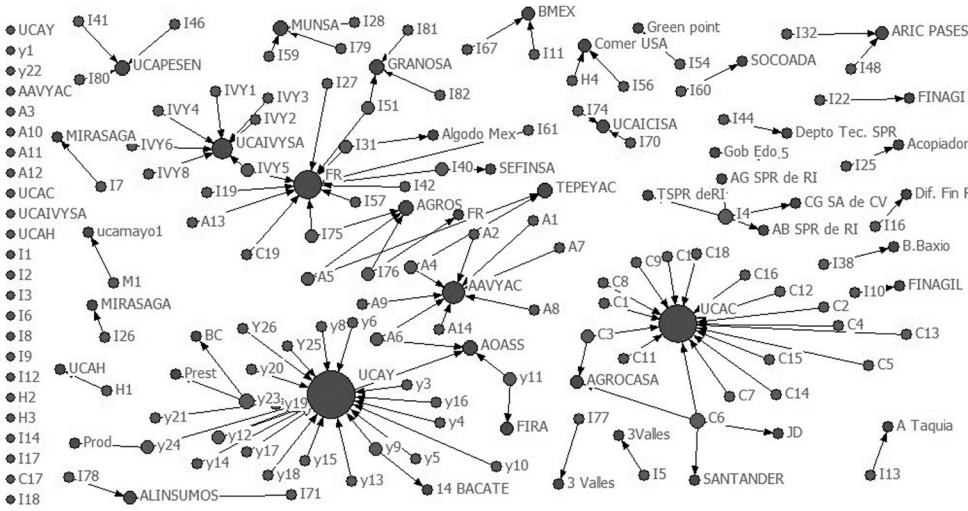

Figure 3. Financial network in the Yaqui Valley: producers network and credit organizations.

Figura 3. Red financiera en el Valle del Yaqui: redes de productores y organizaciones crediticias.

Also, this low articulation allows a greater exchange of information and prevents a single agent from monopolizing the market of agricultural products generated in the territory. This network is characterized by 492 nodes and 157 relationships with a density of social structure in the study territory of 0.064%.

To answer the question of who the producers relate to in marketing, the central actors were identified by the greatest number of relationships. These actors were the most referred by the producers, such as those through which the marketing is carried out. In that sense, it was found that most of the organized producers are related to the organization to which they are affiliated to market.

In turn, the organizations that relate to each other to carry out marketing are mainly those of the private sector, giving a greater disarticulation in the social sector, as shown in figure 4 (page 322).

Technical network

The technical network is the result of interaction between producers and technicians, whose main function is to improve production and increase its competitiveness. Outstanding technicians (OT) stand out as the main technical assistance provider, followed by private sector organizations such as UCAC, UCAY and AAVYAC in order of importance. This network is characterized by 492 nodes and 174 relationships with a density of social structure in the territory of 0.072%, as shown in figure 5 (page 322).

Social network

The social network that is characterized by having an extension of 492 nodes and 79 relationships (figure 6, page 323), considering it as a fragmented network, where it is observed that the four most connected nodes represent private sector organizations including UCAY, UCAC, UCAYVISA, AAVYAC.

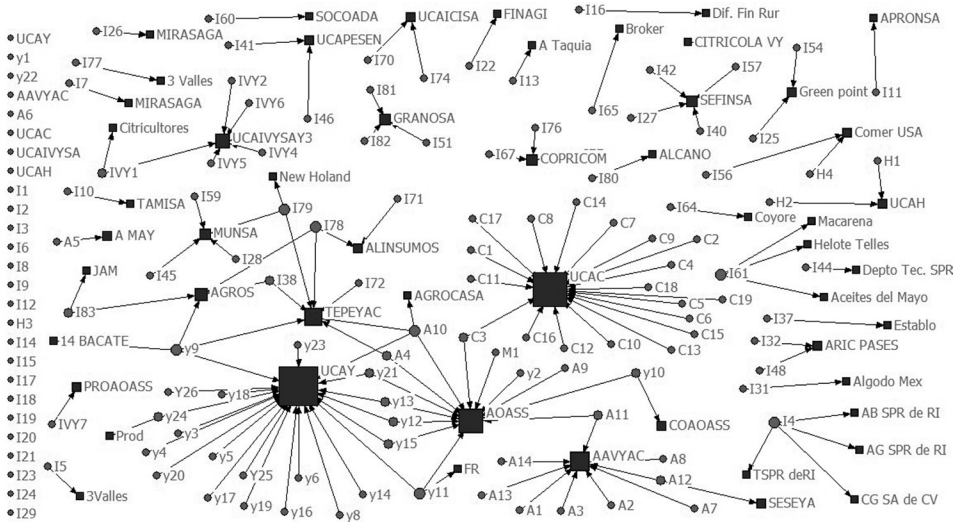

Figure 4. Marketing network in the Yaqui Valley: producers network and organizations.

Figura 4. Red de comercialización en el Valle del Yaqui: redes de productores y organizaciones.

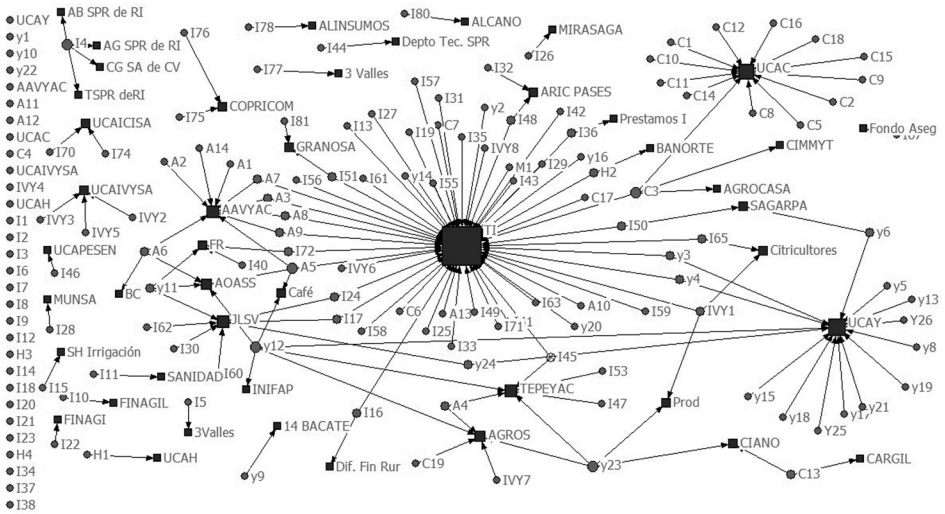

Figure 5. Technical Network in the Yaqui Valley: producers network and organization.

Figura 5. Red Técnica en el Valle del Yaqui: redes de productores y organizaciones.

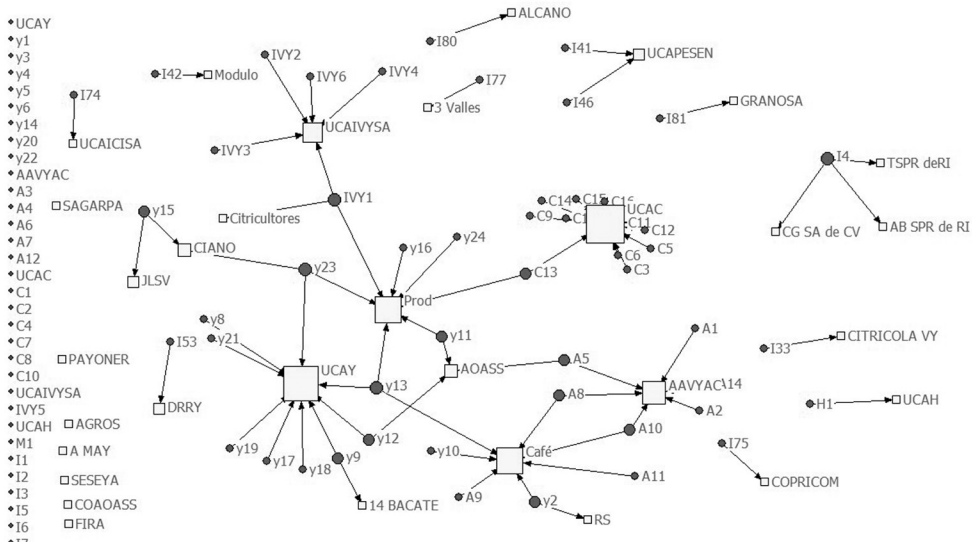

Figura 6. Social Network in the Yaqui Valley: producers network and organization.
Figura 6. Red Social en el Valle del Yaqui: redes de productores y organizaciones.

When disconnecting these nodes most of the existing relationships are lost. An important node in this network is coffee as a meeting point where experiences are shared, related to the activities carried out by the actors.

Although the social network analysis method uses a vocabulary to describe connectivity and distance, it is, in fact, very simple and easy to learn the properties of a network, for example the density of 0.032% represents a low density, and the level of connection of the network of actors. These are the relationships between the actors that make up the network that can be driven, having multiple links, the information that can be extracted from this network is that no reciprocal relationships are observed, where most of the actors are disconnected.

Boza *et al.* (2016), considers that it is necessary to identify and analyze the producers attitudes in the face of the public policy actions carried out or to be carried out, it constitutes a relevant tool in its design, monitoring, and evaluation; that strengthens the social network of the territory. Sánchez-Toledano *et al.* (2017) indicates that, if one intends to understand the adoption behavior of technological innovations, it is necessary to understand the farmers heterogeneity considering not only their socioeconomic characteristics and those of their farms, but also their opinions, attitudes, preferences, and objectives.

Successive times

Machín (2011) recommends compiling information for successive times, with the purpose of having a representation in the temporal evolution. In this study, field data are available for the year 2006 and 2016; from which the networks were mapped, and their indicators were

calculated in UCINET-6 in order to make a comparison of the densities of the social structure. This is due to the fact that the territory was defined as a social construction, where the networks theory and the graph method allow to analyze the characteristics of said structure. The graphs represent an intuitive observation and in constant movement.

The density shows us the high or low connectivity of the network expressed as a percentage of the quotient between the number of existing relationships with the possible ones. In the case in question, the density is 0.34 in 2006 and 0.06 in 2016 with 149 leagues and a standard deviation of 0.025.

The network cohesion level is reduced by the decrease in the total average density of 24%. That is distributed in a fall of 52.47% in the technical network density, 75% in the financial network, 86.41% in the commercial network, and 81.79% in the agricultural policy management network, unlike the social network that registered 76.21% of increasing, however, it is the smallest network and less leagues, in 2006 it was scarcely linked.

This sequence clearly shows the disarticulation of the networks; especially in the case of the social sector where most of the organizations identified in 2006 do not appear in 2016. In addition, networks of lower density were found than those detected in the study of 2006, which represent the restructuring of the social structure in the territory; where the causes can be multiple, for example: deficient and delayed supports, concentrated in a small sector that has the highest territory incomes. The effects can be also multiple, so it is necessary to analyze them to counteract the territory deterioration.

In the table 2, shows a percentage value comparison, and represents the deterioration of the social structure of the territory over a period of ten years.

The reduction of density in most of the networks that make up the territory is an indicator of low connectivity, whose causes and socioeconomic effects and in terms of agricultural policy management must be analyzed.

Based on the results of the survey applied to 156 actors, who are part of the Yaqui Valley networks, they point out among the main obstacles for the network densification, the high production costs (85.9%), low prices of crops (83.97%), late and insufficient support (81.41%), obsolete machinery (64.10%), low labor availability (58.97%), credit availability (58.3%), among others.

Table 2. Density by type of network (technical, financial, commercial, policy, and social) 2006, 2016.

Tabla 2. Densidad por tipo de red (técnica, financiera, comercial, política y social) 2006, 2016.

Year	Technical	Financial	Commercial	Policy	Social	Average
2006	0.15	0.23	0.48	0.34	0.01	0.24
2016	0.07	0.06	0.06	0.06	0.03	0.06
Rate of exchange (%)	-52.47	-75.56	-86.41	-81.79	176.21	-24.00

Source: elaborated with field data in the Yaqui Valley, 2006 y 2016.

Fuente: elaborada con datos de campo en el Valle del Yaqui, 2006 y 2016.

Centrality

To identify through whom the agricultural policy supports are managed, and based on the applied survey in 2006 and 2016, the central actors were identified by the greatest number of relationships. These actors were the most referred by the survey respondents as those through which the agricultural policy supports are managed.

In this sense, it was found that most of the survey respondents manage their support through the organization to which they belong and in some cases they manage directly with the responsible institution such as SAGARPA, ASERCA, however, the majority refers to the organization among those that stand out the organizations of the private sector (table 3).

Table 3. Yaqui Valley: agricultural policy management network and central actors 2006 y 2016.

Tabla 3. Valle del Yaqui: red de gestión de política agrícola y actores centrales 2006 y 2016.

Actor	2006	Actor	2016
ASERCA	52	UCAY	21
SAGARPA	45	SAGARPA	21
GE	7	UCAC	18
UCAC	6	AAVYAC	12
UCAY	5	DRRY	11
GF	5	AOASS	7
PASES	4	UCAIVYSA	6
UCAIVYSA	4	TEPEYAC	3
AAVYAC	3	GRANOSA	3
Social Company	3	UCAH	2
FIRA	3	FIRA	2
G 3 VALLES	2	MUNSA	2
COPRICOM	2	ARIC PASES	2
FP	1	UCAPESEN	2

Source: elaborated with field work, 2006 y 2016. / Fuente: elaborada con trabajo de campo, 2006 y 2016.

Centralization

The 100% centralization index indicates that there are many more central actors than others, and it resembles the behavior of a star network. On the other hand, completely the opposite, to the star network would be low values in this indicator, which would indicate the absence of clearly central actors.

Within the analysis of networks there are input and output centralization levels; the use of one or the other will depend on the need for specific results of each network.

The table 4 presents the results of the input and output centrality levels of the agricultural policy management network and it is observed that in 2006, the network was closer to behaving as a star type network with a centralization level of 50% compared to 4.22% registered in 2016.

The first implies that one or two actors play a central role in the control of the entire network; unlike the 2016 that is far from that behavior, which is more favorable because this allude of a better connected network.

Table 4. Yaqui Valley: centralization of the policy management network, 2006 y 2016.

Tabla 4. Valle del Yaqui: centralización de la red de gestión de política, 2006 y 2016.

Centralization	2006	2016
	(%)	
Output	3,576	2,795
Input	50,106	4,224

Source: elaborated with field work 2006 y 2016.
Fuente: elaborado con trabajo de campo 2006 y 2016.

Discussion

To interpret the territory it is necessary to understand the way it emerges, the networks that sustain it, the organizations, groups or networks of intertwined firms within the production systems; and that depend not only on the territory context but also on the greater or lesser relationship that the actors maintain among themselves.

Territories can be characterized by strong or weak and scattered relationships. Where the subjects of the process should be seen as reflexive human actors both individually and collectively (39).

All the identified networks in the research present a low articulation measured from the densities that according to Wron (1961), represents weak ties, which it is not necessarily negative but can serve as a channel for the emergence of new structures and from the economic point of view a society with many networks can be more efficient than a society with many static networks (16).

Based on the results of the comparative analysis in the 2006 and 2016 densities, and given the average reduction of 24%, the hypothesis that exists a growing disarticulation of the actors that make up the networks that favors inequality in the territory is corroborated.

Conclusions

The studied territory has very few relationships among the main actors, so with networks of such characteristics it is very difficult to build a vision of short, medium, and long term commitments. It is essential to strengthen the bonds between the actors that make up the different networks, otherwise the territory will continue to suffer the effects of disarticulation in space and time, where local actors can take effective actions to build a socially fair territory, economically viable and suitable to live in harmony.

It is necessary to strengthen the networks of local actors, enabling them to design support plans and programs based on the territory potential, and the objectives agreed upon by their members; counting on a dense social structure and promoting articulation in the various socioeconomic sectors that are able to reconstruct the structure, and turn it into a territory with greater opportunities for social equality.

Considering the type of structure of the networks that make up the socio-economic structure of the territory under study, such as producer organizations, where the private sector creates instances at the mesolevel through lobbying practices in federal offices directly, which can exclude others within the territory itself, without the need for the intervention of a dominant group or external factors; since the actions at the national level determine the results at the territorial level, and reinforce the stereotypes that in the light of the work that concerns us is represented by the agricultural programs and policies that arrive to the territory, which reproduce and reinforce the conditions of inequality in the rural environment.

By continuing to rely on networks that are disjointed, and that due to their low density are unable to manage better support or affect the agricultural policies of the federal government, the benefit of the territory in general will be untenable.

The networks found in the territory of the Yaqui Valley have been disarticulated

over time, because ten years after being analyzed for the first time, the calculation of densities has been reduced by 24% on average, and the truss of the social sector practically tends to disappear.

To improve the networks articulation, it is necessary to eradicate the main obstacles; as: high production costs, low prices of crops, late and insufficient support, obsolete machinery, low labor availability, credit availability, among others.

It should be noted that the relationship between poverty and social inequality is complex; since a reduction of the first is compatible with a significant increase of the second (19).

The wealth concentration in the Yaqui Valley, analyzed through the different types of income, government support, and land resources, is compatible with a low density of the networks. Apparently there is a greater concentration of resources in a smaller number of actors in the network, however, this should be tested in a forth-coming study.

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