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Article

Agricultural resilience in small agave producers in Oaxaca

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Abstract

The adaptive capacity of small rural producers from the state of Oaxaca, Mexico in the face of the growing demand for agave-mezcal was analyzed. These producers have historically been characterized by using traditional techniques associated with subsistence or small-scale agriculture, so recently they raise doubts about their possibility of articulation with the change in the demand for agave for mezcal distillation. The research adopted a qualitative design with the use of participant observation and semi-structured interviews conducted in five regions of Oaxaca during 2019. The effects of changes in the market and the strategies that small producers are implementing in the face of these were explored and analyzed. The analytical approach was based on the factors of socioecological resilience, namely buffering, self-organization, learning and adaptation. The results show that, contrary to expectations, agave producers are registering changes articulated with the increase in demand through the combination of traditional knowledge and practices with innovative adaptations; for example, the reactivation of planting areas, the incursion into new links of the agave-mezcal value chain; new forms of microregional organization and communication, or leases under the communal land ownership regime. The findings indicate the presence of resilient capacities in agave production that could favor the transition from the profile of subsistence producers to a market-oriented profile.

Keywords: subsistence production, market, mezcal.

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Introduction

The adaptation of small agricultural producers to market changes has been a recurring theme in the academic literature (Damiani, 2005; David *et al*., 2010; Eakin *et al*., 2011; Macías, 2013). However, there is still not enough empirical evidence to explain the factors and processes that small producers follow to adapt to these changes, who are usually characterized by the use of traditional production practices and low knowledge of competition strategies to insert themselves in the global market, especially in increasingly demanding segments.

The literature indicates that small producers have implemented ways of responding to changes in demand through innovation practices, which imply an evolutionary or radical change to remain competitive. Nevertheless, this seems unlikely for a sector that has traditionally been characterized precisely by its difficulties in innovating, even when it frequently operates in changing environments (Keelan *et al*., 2009; Sezgin, 2010; Castillo *et al*., 2014; Schulz *et al*., 2014; Masud *et al*., 2015; Awudzi *et al*., 2016; Tong *et al*., 2016; Zhong *et al*., 2016).

Evidence has been found that technical and financial market information has enabled small producers to be resilient to market changes and environmental shocks (Eakin *et al*., 2011). For their part, Birthal *et al*. (2007) point out that the formation of cooperatives, previous contracts and the association of producers are adaptation factors that allow small producers to be linked to markets. However, there is still not enough empirical evidence in studies to describe how small producers adapt to changes in an external market and how they learn new management and organizational processes to maintain their traditional production practices on the one hand and change their position in the market on the other.

The adaptation of agricultural producers to contextual changes has been addressed in the literature from the perspective of socioecological resilience, which suggests that systems can respond positively to external risks, absorbing impacts without changing their fundamental functions, learning, adapting, recovering, reorganizing and evolving towards a new state that allows facing external tensions more efficiently (López-Marrero and Tschakert, 2011). Also tolerating and adapting to changing social or environmental conditions (Cinner and Barnes, 2019) and reducing vulnerability to producer stress and external shocks to maintain the productivity of a system (Jacobi *et al*., 2014; Osuna-Ceja *et al*., 2019).

Holling (1973) introduced the concept of resilience into the ecological literature as a perspective for understanding the processes through which ecosystems maintain themselves and persist in the face of shocks and changes. Other authors have associated resilience as a property of the dynamics of an ecological system and of a social system as a whole (Carpenter *et al*., 2005; Escalera-Reyes and Ruiz-Ballesteros, 2011; Berkes, 2017; Sterk *et al*., 2017).

The literature mentions three characteristics associated with the resilience process: a) buffering, as the ability of a system to retain control in its functions and structures; b) self-organization, as the degree to which the system is capable of self-management; and c) learning and adaptation to change (Carpenter *et al*., 2001; Milestad and Darnhofer, 2003; Jacobi *et al*., 2014, 2018; Sterk *et*

al., 2017). The degree to which these characteristics are expressed depends on both the resources and the level of knowledge and the ability to learn and manage of the actors and their institutions (Balvanera *et al*., 2017).

In recent years, producers have faced a market change associated with the increase in demand for agave, as a result of the increase in the national and international commercialization of mezcal (the main derivative of the plant).

According to the above, these sectoral changes test the adaptive capacity of the agave-mezcal production system. To analyze this process, a qualitative study was designed that explores the changes in the market and the resilient strategies that small producers are implementing. The three factors of socioecological resilience were studied, namely: buffering, self-organization and learning and adaptation.

Materials and methods

A qualitative and descriptive case study was designed. Data were collected and analyzed by applying thirty-five semi-structured interviews to the same number of small agave-mezcal producers in five regions of Oaxaca (Table 1). The participant observation technique was also used, keeping a record of field notes. Data collection was carried out in the period of January and September 2019.

Description of the sample and collection of information

The sampling was intentional due to the lack of a register of producers. According to data from the Agrifood and Fisheries Information System (SIAP, 2021), there are 141 producing municipalities in the period 2008-2017. These were taken as a register and fifteen municipalities from five agave-mezcal producing regions in the state were selected through a random process without replacement. The size was convenient according to criteria of time and resources available for field work, which represented approximately 11% of the total municipalities with agave crops (Table 1).

Table 1. Regions and municipalities selected in the sample.

Region	Municipality	Region	Municipality
Valles Centrales	Tlacolula San Martín Tilcajete Santa Catarina Quiané Cuilapam de Guerrero San Bartolomé Quialana Ocotlán de Morelos Yogana	Sierra Norte Mixteca	Villa Hidalgo Yalalag Santiago Zoochila Fresnillo de Trujano San Nicolás de Hidalgo
Sierra Sur	Xitlapehua San Ildefonso Amatlán San Luis de Amatlán	Istmo	San Miguel Tenango

For the collection of information, the municipal seats of each of the fifteen municipalities were visited, contact was sought with the first producers through the municipal authority or the residents of the place, who gave us to the location of the informants in the municipal seat itself and in the localities of the municipality. The snowball method was used, through which some producers gave us references and contact of the remaining informants. Semi-structured face-to-face interviews were applied, and the coverage criterion was that of information saturation (Saunders *et al*., 2018).

The interview script included questions addressing the variable of market changes, adapted from the study by Nenonen *et al*. (2018) and the variable of socioecological resilience, adapted from the study by Jacobi *et al*. (2018).

Interpretative content analysis was performed on the data. This analysis is defined as a qualitative technique in which researcher-generated interpretations are used rather than word counts or other quantitative methods (Drisko and Maschi, 2016). Through this analysis, both manifest and latent or contextual contents were encoded. Data analysis and interpretation was performed using the statistical package, Atlas.ti version 8.4.5. Audios of interviews, field notes and observed descriptive information were transcribed.

Results and discussion

Changes in the agave market

In its 2021 report, the Mezcal Regulatory Council (CRM, 2021) reported that production (liters) increased by 800% between 2011 and 2020 (Figure 1), Oaxaca is the main producing state in the country, with a participation of 92.7% of total production, 86.7% of packaged product for the domestic market and 75.5% for export.

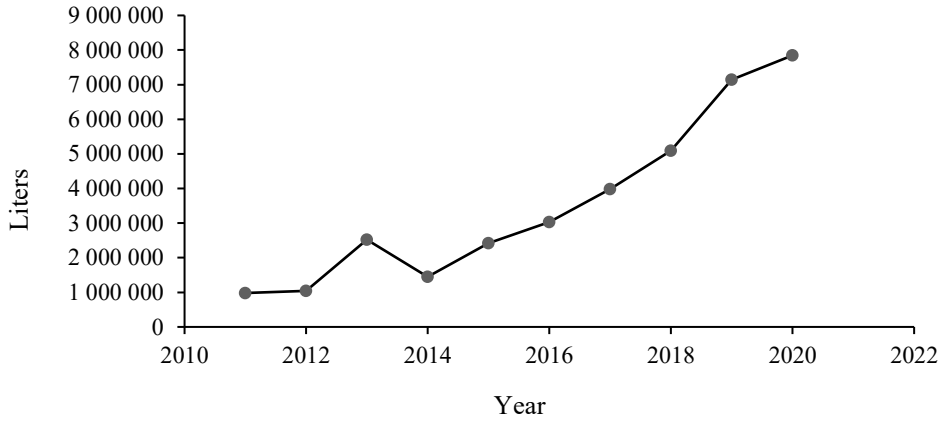

Figure 1. Annual production of mezcal in Mexico during the last ten years. With data from the Mezcal Regulatory Council (2021).

As of 2014, Figure 1 shows a growing trend in mezcal production, this derived from an increase in its price. Similarly, agave production began a new stage of expansion. According to data from (SIAP, 2021), in the last 3 years the area sown has increased by 30% and the harvested area by

79%. Nonetheless, there is uncertainty about the adaptive capacity of the agave-mezcal chain in Oaxaca and about the possibility of generating a plant shortage problem that would affect the next link in the chain, which are mezcal distillers (Toledo-López *et al*., 2020).

Resilience of small producers

Contrary to what might be expected, the results show that producers are being resilient in the face of increased demand for agave. This appears to be associated with the development of the building blocks of resilience (Figure 2).

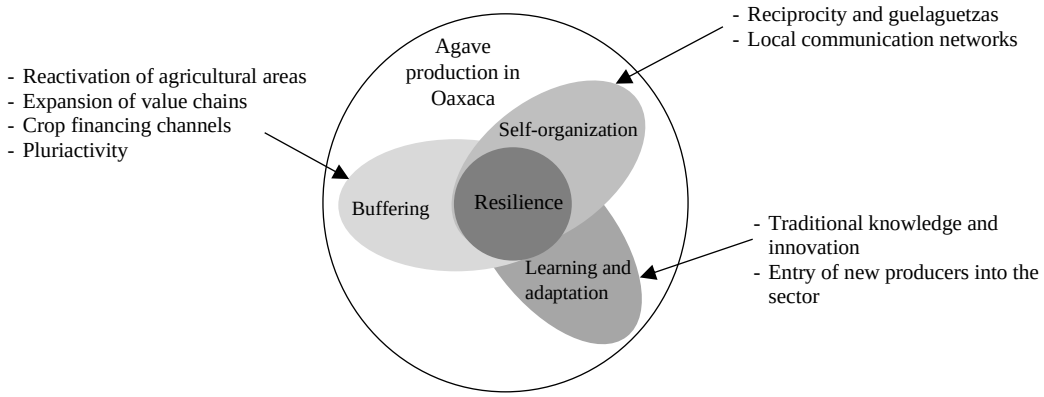

Figure 2. Resilience model and its components in the agave production system.

Buffering

Reactivation of agricultural areas

The rate of emigration of Mexicans to the United States increased considerably between 1991 and 2000 (Fox and Haight, 2010). In Oaxaca, this caused part of the agricultural area to be abandoned and left idle. This is how the reactivation of areas began in 2014, due to the increase in local, regional and national demand for agave and mezcal.

Throughout the Oaxacan territory, there is an extensive increase in agave planting in places where it had not been seen in recent years. This is noticeable even on the roadsides where one can see a large number of agaves with an average of two to three years of maturation. A producer from the Istmo region mentioned ‘if there is an area available to plant agave, due to the communal situation of the land, there is enough land on the roadsides, they are slopes, but there is’ (García, Per. Comunn., 2019).

Expansion of value chains

According to Palma *et al*. (2016), in the agave-mezcal value chain, five actors are considered in a linear interaction that follows this sequence: 1) producer of suckers in nursery (nurseryman); 2) open-field agave producer; 3) mezcal distiller; 4) mezcal packer; and 5) marketer. However, it is increasingly common to see that actors venture into more than one link in the chain. Although

nurserymen have traditionally been scarce, the data obtained suggest that this segment is increasing. These are residents who are learning or expanding the extraction and maintenance of suckers to later commercialize them. Likewise, traditional producers are also developing backyard nurseries to ensure the supply of plants for the expansion of crops or for commercialization, obtaining extra income.

The multiplication of nurserymen in the value chain ensures the supply of suckers, since they cultivate the plants that are the main sources of raw material for distillers. For their part, distillers sell their production to packers and marketers, who perform the function of bringing mezcal to distributors or final consumers (Autor, 2020). The expansion of the value chain is also reflected in the emergence of mezcal distillers who are venturing into agave planting as part of a strategy to ensure the supply of raw material in the future.

Crop financing channels

The financial situation of producers is inconvenient to assume an easy expansion and intensification of crops according to growing demand. However, in the field, the adoption of various sui generis financing strategies is observed, one of these is remittances, a product of international migration. It is common to find farmers who have migrated to the United States of America with the aim of generating income to invest in the countryside. In the same vein, a producer from Valles Centrales commented: ‘we have children, but they went looking for a life [emigrated], each young man has his mind different. They send us money to invest’ (Isabel, Per. Commun., 2019).

Regarding government institutions, it is indicated that there has been support with agave plants and fertilizers through the PROCAMPO program. A young producer from the municipality of Ocotlán de Morelos mentioned: ‘we have received support only through projects, there are projects [sic] where they give you agave suckers or technical advice or natural liquids to fumigate and they give you the fertilizer for worms, but it is little. All the investment we make is on our own’ (Angeles, Per. Comunn., 2019).

Another means of financing has been the so-called share-farming contracts between plant producers and mezcal distillers. These are lease agreements whereby the landowner rents the land to a distiller, who bears the costs of the crop and at the end of the cycle they divide the harvest in half, considering these agreements as a win-win. These contracts are a strategy adopted by micro, medium or large distilling companies. In the case of the latter, the owner of the land is hired as a day laborer, in addition to financing all the expenses derived from the crop. The guaranteed sale of the harvest is the most attractive economic factor for producers (Herrera-Pérez *et al*., 2018).

Regarding these contracts, the operating staff of a distilling company mention that: ‘the dynamic consists of looking for owners accessible to the way of working, who are open to business, since we are currently managing contracts between 6 and 8 years. Companies come with a view to being self-sustainable: planting agave, creating nurseries, having their own producers, having the closed

cycle. Production is in a process of expansion, however, it will grow based on the decision of the countrymen [ie., residents], because the communal tenure of the land does not allow free cultivation' (Mal de Amores, Per. Comunn., 2019).

Pluriactivity

Small producers carry out agricultural and non-agricultural activities, that is, according to the nature of the crop, the maturation process of the agave (from 5 to 10 years) allows them to engage in other economic activities. According to Antonio and Ramírez (2008), complementary non-agricultural activities are: emigration, sale of labor force, small businesses and handicraft making. The diversification of activities is not a recent process, due to the low profitability and productivity of agriculture, small producers have sought complementary activities to ensure their socioeconomic reproduction.

Self-organization

Reciprocity and Guelaguetzas

In the communities of Oaxaca, a system of cooperation or reciprocal support that the residents use especially in the harvests or construction of houses is called 'Guelaguetza' (from the Zapoteco language *guendalizaa* 'to cooperate'). In agave production these rules of reciprocity or trust facilitate work, reduce costs and provide the basis for creating informal social networks. About that, a producer mentions: 'now as we have the association, we work together we have prominence in the work and we plant more maguey' (Brena, Per. Comun., 2019).

According to Maldonado (2016), the Guelaguetza is usually present as an aid in labor, inputs and economic resources. In the context of agave, different producers, especially in the Sierra Norte, indicated that they resort to the Guelaguetza for planting or plant care work. This organization consists of working in groups in the crop of each of the producers; so, after the rotating order, all the lands are worked.

Local communication networks

Personal communication networks have traditionally operated at the microregional level. These networks facilitate the exchange of information on the evolution of the sector. Likewise, they are functioning as channels for the dissemination of knowledge and experiences. A producer from the Sierra Norte mentioned: 'I attend the events and there one meets producers from the Valle [Central] and from various parts and there we talk, we exchange experiences of the process, how they do it there and how we do it here and so one gets to know and learn' (Zoochila, Per. Comunn., 2019).

It is increasingly common to create meetings or events where local producers come to learn about the dynamics of trade and price behavior and exchange information.

Learning and adaptation

Traditional knowledge and innovation

The producers work following an ancient traditional knowledge of the crop that has been transmitted from generation to generation. According to Antonio and Smith (2012), the knowledge and traditional agricultural practices that are carried out in the production of agave intrinsically have the function of conserving and renewing the productive capacity of the soils, associated with the socioeconomic and cultural characteristics, configuring a basic system of ecological conservation.

Innovation in the traditional mode of production does not refer to a modification in known practices, but to an adaptation or assimilation to expand crops. In this way, in addition to the aforementioned polycultures and alternative forms of financing, reforestation practices or seed banks of the agaves species best paid on the market or those that have been overexploited are being generated and adopted.

Entry of new producers into the sector

The perception of a growing market and the improvement in the price disseminated through local communication networks are encouraging the entry of new producers into the sector. In the interviews, the interest of young people in venturing into the cultivation of agave is recorded. In this regard, a producer from the Sierra Norte mentioned: 'right now they are investing in the countryside to plant agave, there are several young men who are cleaning their land, they have already realized [the increase in demand and the price]. If they do not know the whole process of producing mezcal, they can sell their pineapples and now the price is high with external buyers' (Zoochila, Per. Comunn., 2019).

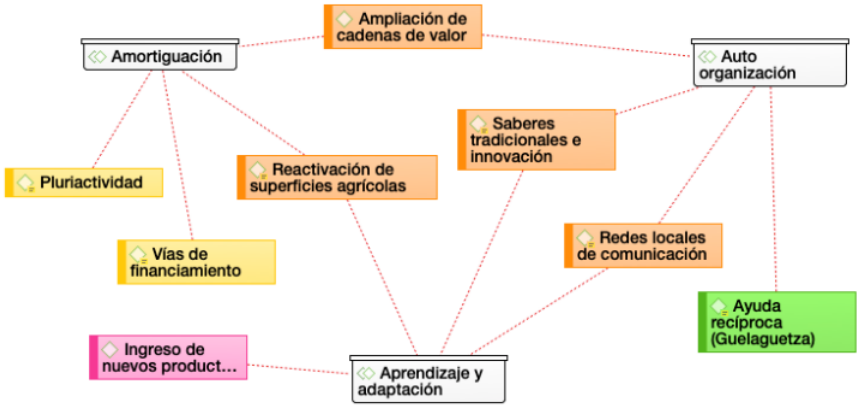

Figure 3. Interaction of the components of socioecological resilience and the strategies applied. With data obtained in the interviews, with the support of the Atlas.ti software.

Four strategies (in orange) that are the result of the interaction of the 3 components of resilience can be observed, Figure 3. Therefore, we can suggest that at least five problems posed by the expansion of the crop are being addressed (Table 2). For this, producers are reactivating land by

working with traditional agricultural practices and relying on reciprocal labor (guelaguetza). Likewise, they are venturing into two or more links of the agave mezcal chain. Pluriactivity and external financing channels that make producers resilient are highlighted. The strengthening of local communication networks has caused the incursion of new producers into the sector.

Table 2. Problems, situation and responses for the expansion of agave crops in Oaxaca.

Problems	Situation or response
Agricultural area	The state has available area to expand farmland. Producers are partnering with landowners to reactivate idle land.
Agricultural knowledge	Producers have the appropriate traditional knowledge for cultivation. There is an adaptation of traditional processes with a view to improving the process. Knowledge is being disseminated through microregional personal networks.
Partnering	There is the knowledge and willingness to create groups or cooperatives, which are convenient to request institutional or governmental support.
Labor	Producers rely on family labor, reciprocal community support and, to a lesser extent, the hiring of laborers. Other producers are venturing into the crop for the first time.
Profitability-financing	The price per kilogram has increased. In 2006 the price was around $ 2.00 per kilogram, and currently it is between $ 12.00 and $ 15.00 per kilogram (2020). In addition to agave, producers are engaged in other economic activities such as handicrafts, tourism, gastronomy, labor and emigration. Leases are being promoted.

On the other hand, the development of resilient capacities in the face of changes in demand dynamics potentially shows a scenario that would lead small subsistence producers to adopt a market-oriented profile in the medium term; this as a consequence of the reinforcement or maturation of the value chain. The findings allow arguing that small producers have an interest in participating in the growing market and therefore they adopt strategies to increase their production, diversify their crop and create a more stable relationship with buyers.

Discussion of results

We agree with Antonio and Ramírez (2008) that until now the main source of income for some agave-producing families had been emigration and non-agricultural activities, such as small commerce and handicrafts; however, the data suggest that, in the medium term, possible positive impacts on the family economy of producers can be observed. The emergence of lease contracts as a strategy for crop financing requires legal knowledge, so, individually or in association, producers will have to acquire them to strengthen the contractual relationship with external agents, shareholders, investors, institutions and peers.

The practices and strategies that producers report show that a possible shortage of agave is being mitigated and opportunities for economic growth are being generating, while one of the characteristics of resilience is the ability of systems to face changes, not to resist them and preserve the initial structure and identity (Cinner and Barnes, 2019). In addition, it is noteworthy that agave production has traditional practices (soil rotation, manual planting and weeding, polycultures) that are not being replaced, rather they are being adapting to be able to expand and improve the production that the market is requiring.

Pointing out that resilience is the responsibility of producers, self-organization is a factor that needs to be paid attention to. There is a need for collective management at the community level, that allows the creation of adequate channels of communication, that facilitates the transmission of production and marketing information (Barrett *et al*., 2001), as well as the formation of groups or cooperatives that encourage collective action that allows formulating joint initiatives (Milestad and Darnhofer, 2003). Producers are grasping the messages that the market and experiences have provided them. This allows the system to prevent and benefit from situations, managing to adapt to a new context (Young *et al*., 2006).

Environmentally, derived from the increase in demand, there is a risk due to the excessive extraction of wild agaves; however, producers are carrying out reproduction and reforestation activities, although it does not compensate for the levels of extraction. Also, there is no interest in the excessive use of fertilizers, knowing that these could affect the quality of agave.

The presence of resilience favors the interaction between Oaxacan communities and their ecological environment, obtaining a reciprocal collective benefit, the social sector contributes sustainable agricultural strategies towards the ecological environment and this in turn provides raw materials to the social sector, achieving sustainability (Sterk *et al*., 2017). Being self-sufficient is the short-term goal of agave producers.

The socioecological resilience approach has been used to record how agricultural systems respond to social, economic and environmental shocks. Similar results are reported by Barrientos-Rivera *et al*. (2020), in which the presence of resilience suggests that agricultural systems have the capacity to survive and be reborn from a natural or anthropic shock. In this sense, this can generate new opportunities for producers, adapting and evolving to improve their socioeconomic conditions, without losing their identity and traditional practices.

Conclusions

Small agave producers in Oaxaca are experiencing a change in the way of growing and marketing agave, due to the increase in mezcal consumption. The production of mezcal has increased by 800%, which has generated an expansion of cultivation areas and the entry of new producers.

Agave production is in a process of expansion, reactivating planting areas and adapting its traditional cultivation techniques, with the aim of supplying the growing demand. The socioecological resilience approach has allowed ordering their strategies through their three indicators: buffering has allowed them to maintain themselves with the reactivation of planting areas, the pluriactivity of producers, as well as the participation of producers in two or more links of the value chain.

Self-organization is showing the integration of forms of management and work. That at the individual level is shown in employment contracts with landowners, financing contracts with companies and distillers, as well as more reliable forms of commercialization, reducing risks. The adaptation of producers suggests the creation of local organizations that strengthen links with external agents, investors, institutions and peers.

The presence of socioecological resilience in the agave production system in Oaxaca is generating strategies and practices that are helping to mitigate the effects of market growth. It is seeking to supply regional demand, as well as to generate surpluses to market with external buyers; that is, to venture into the national market. This could allow the transition of small subsistence producers to a market-oriented production profile.

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