

Tilapia marketing network of small-scale aquaculturist in Oaxaca, Mexico

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ABSTRACT

Objective: To identify and describe the type of short food supply chains (SFSC) in the tilapia marketing network's core localities, where the small-scale aquaculturists (SSA) carry out their activity.

Design/Methodology/Approach: An instrument was designed to be applied to the main head of the production unit, based on the conceptual framework of SFSC. The information was coded, and network analysis (NA) was performed.

Results: The SFSC are the primary method of marketing of the SSA; we identified, according to the conceptual framework, six types of short supply chains: Farm-selling, local markets, point of sale, delivery, consumption on the production site, and one intermediary. The core localities of the tilapia marketing network have the highest values in degree and betweenness and were identified as articulation points, due to the relations of purchase-sale at local level and the interaction with actors of other localities.

Limitations on study/Implications: The work was developed only with SSA registered by the Oaxacan Aquaculture Committee of Health and Safety.

Findings/Conclusions: The isolated SMA develops SFSC at local level, while the SMA located in better-linked regions constructs mixed purchase and sale relationships from other locations. It was identifying a regional network of tilapia marketing, specifically related to Veracruz state.

Keywords: Small-scale aquaculture, Network analysis, Short food supply chains.

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INTRODUCTION

The products of small-scale aquaculturists are relegated from the conventional marketing channels, mostly in rural areas. According to the Food and Agriculture Organization of the United Nations (FAO) (2013), the fast development of the industrialized commercial aquaculture in the exportation markets placed the SSA in a position of limited development, and centered subsidy policies. Consequently, the activity maintains long-term characteristics such as low technification, family or community labor, and dependency of governmental programs. In addition, Vázquez-Vera and Chávez-Carreño (2022) and FAO (2016) mention that SSA have difficulties accessing private financial methods. For this reason, the financial programs for the governments are important to the SSA because they are one of the few alternatives to access to biological inputs, equipment, technical assistance, subsidies, and credits.

As the FAO (2014) points out, the SSA relationship with the markets is adverse because they have low productivity, low capacity for negotiation, isolated location, and scarce market information. In this respect, the Oaxaca SSA seek access to alternatives allowing them to market the tilapia (*Oreochromis* sp. y *Tilapia* sp) in nearby localities or in the state to increase their income and to support their families and community activity.

In this work the SFSC is applied to describe market relationships, identifying the actors who participate in the market, the types of SFSC, and the localities that constitute the network. Authors like Infante, C. and Suarez, M. (2020), Caracciolo, M. (2016) assert the SFSC helps to improve the marketing of the products and increase the incomes of the small-scale producers while generating direct relationship of purchase-sale between the small-scale producers and final consumer, and in some cases with only one intermediary.

In addition to what precedes, this work proposes network analysis as a methodology to identify the core localities of the tilapia marketing network. According to Dettmer (2019), this method helps to build a network of exchange of resources and identify the main actors in a marketing network. Therefore, the network analysis in this work is used to construct the tilapia marketing network created by the SFSC of SSA.

The literature review evidence that researchers use NA and SFSC as instruments to study tilapia aquaculturists and the marketing of products such as honey. For example, Villaseñor (2017), uses the NA to identify the key actors that transfer information related to technical support, governmental programs and supplies to tilapia aquaculturists in Morelos; concerning SFSC only, affirms that the main chain of marketing of the tilapia producers is the on-farm selling. Similarly, Carrazco *et al.* (2024) use the NA methodology to describe the governmental strategy related to the transfer of information on COVID-19 to shrimp aquaculturists in Sinaloa. In other matters, Ramirez *et al.* (2022) identify main actors in the marketing network of honey and use the NA as visual instrument to describe the network and the type of marketing channels as SFSC and long food supply chains.

In this context, NA and SFSC can be used as means to understand the marketing network of tilapia, but also as an instrument to propose to the aquaculturists localities to improve the marketing of tilapia at the local level and enhance the welfare of the SSA in the rural areas of Oaxaca.

MATERIALS AND METHODS

Study Area

The study was conducted with 30 small-scale aquaculturists, which are in Oaxaca, México localities, between August of 2023 to July of 2024. The aquaculturists are distributed in five regions of Oaxaca, mainly in the Papaloapan and Istmo regions (Figure 1).

Instrument Design

The instrument to obtain the information was designed and divided into three dimensions: General characteristics, production, and marketing. The information in this work comes from the marketing dimension to allow us to recognize the actors who participated in the marketing of tilapia and who are the actors that built the short food supply chain.

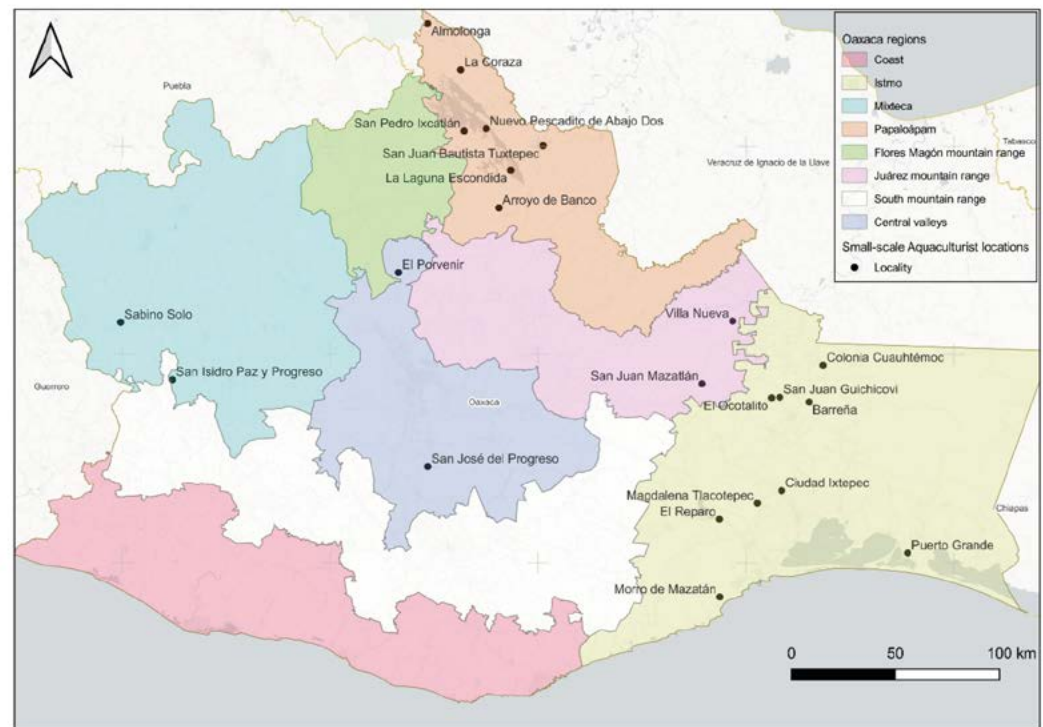


Figure 1. Small-scale aquaculturist location in Oaxaca by Region.

To identify and describe SFSC in the locations of Oaxaca, Renting *et al.* (2003) were used as a reference, and Boucher *et al.* (2018) to distinguish the actors who compose these marketing chains; thus, the authors established only three actors that participate in the SFSC: producers, one intermediary and the final consumer. Then, according to Boucher y Riveros-Cañaz (2017), Gonzalez *et al.* (2013), and CEPAL (2013), it was observed that the types of SFSC that exist are: direct sales in local markets, on-farm, fair of sales, point of sales, supermarkets, stores, delivery, online, sales, sales to governmental institutions, direct consume on the space of production and fair-trade exportation scheme.

Data Analysis

The network analysis was performed in this study to identify the core localities in the marketing network by taking the degree, betweenness and articulations points as key variables. The degree (Dg) is defined “as the number of connections of a node” (Reina-Usuga *et al.*, 2022, p.102) in this case, it is interpreted as the number of trade interactions made by the actors in the localities that participated in the network. The betweenness is a frequency measure that estimates how a node is on the shortest path between two nodes (Borgatti *et al.*, 2013); hence, in this research, it is interpreted as the grade of how a locality functions as a nexus with other localities due to the trade relationship between SSA, direct consumers or intermediaries. Finally, the articulation point is a node whose removal disconnects the network (Lian T. *et al.*, 2017). In this work were taken such as the

localities that help to build the network connecting with other localities as a consequence of the trades made by the actors located in them.

We performed the network analysis in RStudio software version 4.3.3. It is important to note that although the information of this research comes from the head of SSA, it is taken as a reference (node) the localities to build the marketing network; we took these actions to keep safe the identity of the head of the SSA due to the insecurity problems in the regions.

RESULTS AND DISCUSSION

The marketing network of tilapia of the SSA is formed by 47 nodes (localities); the network identified three types of nodes (Figure 2): the short food supply chain locality (SFSC) with a total 22 nodes and six types of SFSC: On-farm selling, local markets, point of sale, delivery, consume on the production site and one intermediary sale.

The second type of nodes are the Intermediary locality (ITL), with 24 localities where the intermediaries are sited. Thus, intermediaries usually travel to SFSC to buy wholesale from SSA. Another characteristic is that intermediaries are identified as possible customers, but the trade relationship is already in negotiations. The last one is the AL locality; this type of location has the activity of a SSA and doesn't have relationships with consumers or intermediaries at the local level.

Furthermore, the singularity of reciprocity between the edges in the network can result from the nature of the trade relationship between actors participating in the network;

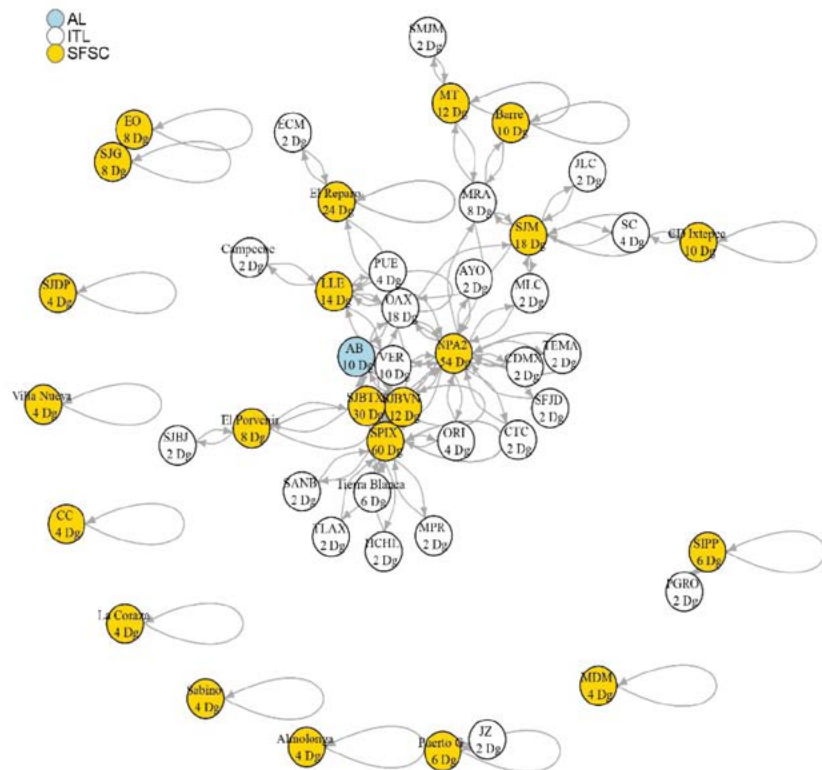


Figure 2. Marketing network of tilapia in Oaxaca by type of location and degree

there is a trade between SSA and consumers or intermediaries. Hence, it is a bidirectional relationship. The presence of loops in the network (Figure 2) also occurs when the node is connected with itself; in this case, the loops are generated by the development of trade activity at the local level by the SSA.

Concerning the preceding, Merelo *et al.* (2024) point out that loops rarely appear and are used. However, this can express crucial information of the network and exemplifies a freight traffic network where the loops represent the inner traffic of goods at the local level. In this regard, the loops in this network represent the inner trades at the local level, showing SFSC generated by SSA in a locality.

One of the main features of the SFSC is that prices to producers are fairer without intermediaries (Garzón *et al.*, 2022). SSA from Oaxaca seek to sell their products directly to the consumer because they increase their income rather than sell it to intermediaries. Nonetheless, some SSA prefer to sell to intermediaries because they represent an assured income and wholesale transaction, even though the intermediaries haggle over prices.

The core locations of the marketing network of tilapia (Table 1), are identified as articulations points and have the highest betweenness and degree values from the network. Only Matias Romero doesn't have one of the highest degree values in the network.

The core localities are configured mainly by SFSC like El Nuevo Pescadito de Abajo Dos, San Pedro Ixcatlán, San Juan Mazatlán, San Juan Bautista Tuxtepec, La Laguna Escondida, El Reparo and Matías Romero Avendaño. On the other hand, Oaxaca de Juárez is the only core location identified as ITL. The applied methodology allowed the identification of other articulation points like Salina Cruz (SC), El Porvenir, and Magdalena de Tlacotepec (MT).

The main characteristic of the SSA in the core SFSC is that they sell through SFSC, but there are cases that also use intermediaries as marketing channels. This feature of the SSA allows the expansion of the network beyond the limits of Oaxaca state (Figure 3).

The expansion of the network is related mainly to the intermediaries from Oaxaca and Veracruz, particularly those from Veracruz that trade tilapia with the SSA located in the Papaloapan region like NPA2, SPIX and SJBTX. The geographic proximity enables the trade with the intermediaries from the state mentioned above and intermediaries

Table 1. Core locations of the marketing network of tilapia.

| Locations | Betweenness | Articulation point |
|----------------------------------------|-------------|--------------------|
| El Nuevo Pescadito de Abajo Dos (NPA2) | 562.73 | ✓ |
| San Pedro Ixcatlán (SPIX) | 355.13 | ✓ |
| Oaxaca de Juárez (OAX) | 329.74 | ✓ |
| San Juan Mazatlán (SJM) | 204.26 | ✓ |
| Matías Romero Avendaño (MRA) | 203.68 | ✓ |
| San Juan Bautista Tuxtepec (SJBTX) | 144.91 | ✓ |
| La Laguna Escondida (LLE) | 73.92 | ✓ |
| El Reparo | 64.00 | ✓ |

Source: Prepared by the authors on basis of recollected data.

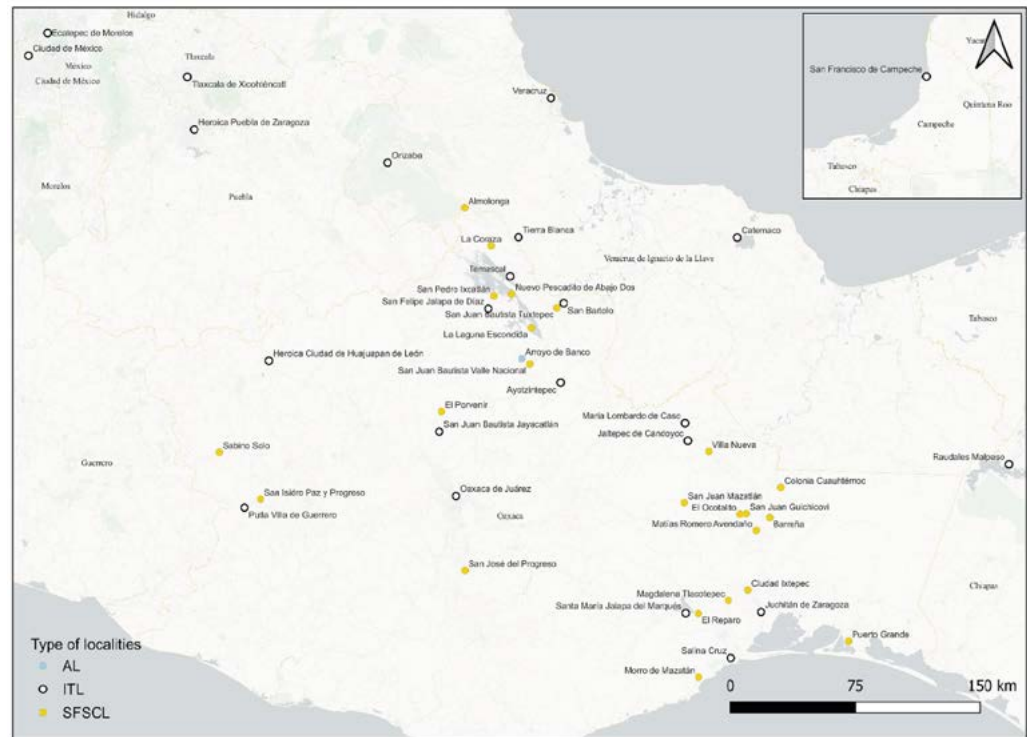


Figure 3. Localities involved in the marketing network.

from the states of Chiapas, Tlaxcala, Puebla, Campeche and Mexico City. Regarding Oaxaca de Juárez being identified as an ITL, at least nine SSA point out that they have an intermediary from Oaxaca or are negotiating the trade of tilapia with an intermediary from that location. The SSA mentions that Oaxaca de Juárez could be a good alternative for selling the product, but the high cost of the logistics is the main barrier to selling in this location.

Paciarotti and Torregiani (2020) mention the significant problems on logistics in the SFSC: limited resources budget, limited commercial organization, high logistics and transportation costs and connectivity difficulties with the conventional distribution systems. In this respect, we found that there are nodes isolated from the principal network (Figure 2); the SSA from these locations doesn't have connections with intermediaries or prefers to sell at the local level to the consumers because of they don't have enough budget to transport and sold in local markets, restaurant or intermediaries; another producer pointed out that they prefer to sell at the local level since this way they can sell the product at a fair price to the consumer and thus support the local economy, but the principal reason is that the intermediaries penalize the prices in the negotiations, as consequently, their income decreases.

It's important to point out that according to the SSA, the SFSC can be caused by the trade with local intermediaries that sell locally in goods stores, fish markets, or restaurants. There are two SFSC with the particularity that do not have aquaculturists in the locality and they travel to other locations to sell tilapia in local markets or delivery; these localities

are San Juan Baustista de Valle Nacional (SJBVN) and Matias Romero. So, there are three ITL with a special attribute; these localities are connected to the network because only the SSA is in negotiations with intermediaries from Ecatepec de Morelos (ECM), San Juan Bautista Jayacatlán (SBJJ) and Heroica Ciudad Huajuapán de León (HCHL).

CONCLUSIONS

The application of network analysis and the short food supply chains approach are useful to visualize marketing interactions of small-scale aquaculturist in Oaxaca. The analysis allows us to identify how isolated small scale aquaculturist can create short food supply chains at local level, while those in better-linked regions like the Papaloapan, construct mixed purchase and sale relationship due to the proximity of the intermediaries to the localities.

Network analysis helps to highlight the economic activity generated in the region by the small-scale aquaculturists. Due to the characteristics of the regional marketing network formed by these producers, it's a network with the potential to be strengthened, particularly the marketing network with the actors of Veracruz state.

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