

# “Live Tilapia”: Diversifying Livelihoods for Rural Communities in México

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## Abstract

This study documents the socioeconomic impact of an innovation based on the marketing of live aquaculture products in rural communities as the Live Tilapia Points of Sales (LTPOS). A case study research conducted where the participatory strategy of “Simultaneous Production Growth Groups” (SPGG) was applied for technology innovation, which includes technology modules, organizational strategy and operational management. The results were evaluated socially and economically. In 14 months, 3531.50 kg of live tilapia were distributed in four local places for sale and self-consumption. The system obtained a BCR of 1.23 and offered as well to the rural population an alternative of fish consumption in better freshness conditions than the regular fish supply. It brings up an extra income to the main market chain participants and development of aquaculture capabilities. Therefore, the LTPOS is a viable option for diversifying livelihoods and improving regional rural population income.

**Keywords:** aquaculture, innovation, marketing, rural development, rural enterprises

## 1. Introduction

The main challenge for the economic development of emerging countries is the poverty in which the rural population lives (Sen, 2000), since traditional livelihoods like temporary farming and dual purpose cattle have lost profitability to the technically advanced systems of agricultural and livestock production, accessible only to those who can afford it. Hence, it highlights the need to find alternatives with technical, economic and social viability to raise the income level of these people.

Aquaculture has been an alternative to develop cost-effective means of life for rural people through production, processing and marketing of high-value aquaculture and market acceptance species (Mártir-Mendoza, 2006; Zetina, Reta, Olguín, Acosta, & Espinoza, 2006). The tilapia is one of the most important commercial species due to their biological, production and market characteristics (Fitzsimmons, Martinez-Garcia, & Gonzalez-Alanis, 2011). Its cultivation, processing and marketing have increased rates of economic development of rural people who have sought better incomes (Dey & Ahmed, 2005). Considering that innovation in rural areas goes beyond technological change, it also involves changes in how they handle their income (Berdegué, 2005). Accordingly, Live Tilapia Points of Sales are an innovation to traditional rural communities on how additional resources are available to expand the rural nonfarm economy.

Therefore, the aim of this study was to document the social and economic impact of the establishment and operation of a tilapia-marketing network through points of sale established in rural communities whose economy is based on traditional farming. The research work identified economic and social impacts obtained through a case study research using participatory research and trade repositories, where positive economic results are observed, through sales revenue, social organization for the marketing of live fish and aquaculture capabilities development among operators of points of sale.

### 1.1 Poverty in Rural Areas

Poverty is a multifactorial condition that increases in agricultural areas located in unfavorable geographic regions (López-Olguín, 1994). The inhabitants of these regions are dependent on income from low-profit seasonal farming or subsistence and low-paid salaried activities (Juárez, Tablada, López, Albarado, & Fajersson, 2008); hence their welfare is threatened by not having sufficient income to produce or purchase goods and services to ensure their human development (Eide, Oshaug, & Eide, 1991).

### 1.2 Livelihood

In the absence of opportunities for integration into the regional economy, people create their own coping mechanisms, these strategies depend on the decisions of individuals on the use of natural, physical, human and social resources (Kay & Montalvo, 2007). Therefore, its decisions may extend or restrict the diversification of their livelihoods. Innovation by non-agricultural productive activities expands the options for development and welfare for its actors (Pérez, Vázquez, Daumás, Hernández, & Toral, 2009) and can be used as a rapid response mechanism to periods of temporary or permanent economic crisis (Richards, 1989).

### 1.3 Innovation

Achieving innovation in rural areas goes beyond technology development and includes new uses of available resources, such as water, the backyard where they usually install their venture, local knowledge and the productive environment, plus the introduction of new processes, products, systems, resources and methodologies in the daily life of rural residents. The innovation is accomplished through transfer tools that reach a change in the attitude and behavior of people, according to this, the paradigm of Rural Innovation Processes (RIP), seeks the transformation of actors by promoting teamwork and participation at different levels (Reta, Mena, Asiain, & Suárez, 2011; Salazar & Rosabal, 2007). The SPGG are based on this approach and are interpreted as “solidarity groups looking to adopt and transfer technology through communication, producer to producer” (Hernández-Mogica, Reta-Mendiola, Gallardo-Lopez, & Nava-Tablada, 2002). This tool promotes technological innovation generated, used and evaluated by development actors (Abato-Zárate et al., 2011).

### 1.4 Aquaculture

Aquaculture is an innovation generated by man to produce food and build livelihood for a large number of people (Mártir-Mendoza, 2006). Fish consumption is a traditional practice in rural communities near water bodies in the state of Veracruz (García, Godínez, M. Montes, M. Montes, & Ortiz, 2004). However, changes in ecological environment, overfishing and trade policies have made fish an essential commercial food resource and therefore only available in large cities (FAO, 2009; García-Ulloa, 2010). The commercial tilapia *Oreochromis spp.* is an African tropical *cichlid* subjected to a process of adaptation to culture conditions (Canónico, Arthington, McCrary, & Thieme, 2005). Meanwhile, transportation and life support technologies have been developed to keep fish without deterioration in their physical and biological states (Timmons, Beeline, Wheaton, Summerfelt, & Vinci, 2002).

### 1.5 LTPOS

Under the agroecosystem approach, the LTPOS as part of its aquaculture food chain is a place of trade and information exchange between the main chain actors, such as producer, marketer and consumer. It is composed by three subsystems intended for retail sales: the aquaculture system, which keeps in top physical and biological conditions the fish until sold; the processing system, which keeps the value-added product; and the trade system, intended for customer service. All this, in order to meet local demand for healthy, harmless and sufficient fish to benefit the economy of the marketer and his family, which is organized, operated and managed as a micro family business.

## 2. Method

### 2.1 Study Area

In the state of Veracruz, rural communities converge in Sotavento Region territories where marginalization and poverty are concentrated by the presence of illiteracy, lack of urban services and earning less than two minimum wages (CONAPO, 2005). In addition to, unfavorable climatic and geographical factors restrict agricultural activities and cause isolation (Juárez et al., 2008; Olguín, 2000). The economy of the inhabitants of this region focuses on breeding dual purpose cattle under semi-extensive management and seasonal planting corn (Bautista-Tolentino, López-Ortiz, Pérez-Hernández, Vargas-Mendoza, & Gallardo-López, 2011).

Due to cultural, geographic and economic issues, the per capita fish consumption in the state of Veracruz is low as it is in the rest of the country (12 kg) (INEGI, 2012), nevertheless their proximity to sources of production and

extraction of seafood. The inhabitants of the rural population do not have access to all presentations of seafood available in urban markets and can only find fresh fish when it is sold by street sellers or captured by residents in nearby rivers (Lango-Reynoso, 2011).

Most of the state corporate farms, which grow live tilapia, are located in the Sotavento Region, whose annual production is between 10 and 70 thousand tons per year (Mena, 2011), this offer has encouraged the establishment of an underdeveloped market of live tilapia in rural communities near farms in the region (Lango-Reynoso, 2011).

The social group under study is based on communities of Angostillo, Loma del Nanche and Xocotitla, they are established in the municipality of Paso de Ovejas, Veracruz, located between the coordinates 19°13'N latitude and 96°34'W longitude. The climate of this region is sub-humid with summer rains  $AW_0$  (w) (INEGI, 2009).

### 2.2 SPGG Integration

In April 2010, a social organization for innovation was initiated through the SPGG; monthly training *in situ* activities were conducted during 16 months for the development of aquaculture skills among the participants. A questionnaire with general profile was developed, considering gender, age, occupation, education, number and age of family members, as well as the structure of the family's monthly income.

### 2.3 Technology Modules

Two modules were established in Xocotitla (Xocotitla1 and Xocotitla 2), one in Loma del Nanche and another one in Angostillo. Their construction was carried out during the month of May 2010. The basic engineering design to keep alive a batch of 50 kg of tilapia consisted of a high-density polyethylene circular tank with a concave bottom and a capacity of 3.80 m<sup>3</sup>. It contain 4" PVC pipes with central drainage connected to a container of 0.2 m, where a mechanical filter and a 30 W submersible pump with 1.2 m<sup>3</sup>/h of capacity were placed for water recirculation. Regional materials were used to provide shade to the ponds. Hand nets and cast nets were the equipment needed for catching fish.

The design, construction and adaptation of processing facilities, service areas and fishing gear were executed according to resources and areas available in each field. An effort was made to stick the processing practices to the rules of good sanitation and hygiene practices in accordance with the equipment available, as these were of different materials to which the rule states.

### 2.4 Operations in LTPOS

During the months of June 2010 to September 2011, an amount of tilapia was bought from four farms according to product availability. Gray tilapia *Oreochromis niloticus* (Linnaeus, 1758) was handled with a 0.5 kg individual average weight. A vehicle with platform and four high-density plastic containers of 0.2 m<sup>3</sup> were used to transfer live fish to the points of sale. In December 2010, a business alliance was established which allowed the delivery of fish door to door. The fish were sacrificed, cleaned and packed for each sale to the consumer.

Four campaigns of direct promotion were implemented, performed by the families of the owners. Those included placing ads in high traffic areas of each population and an ad aired regularly on the local network sound. The selling prices were set according to the criteria of each owner and market prices in the region. Subsistence operations, sale of tilapia and other inputs were recorded in a binnacle for each point of sale, based on these records the following economic variables were calculated (Table 1).

Table 1. Definition of economic variables

Variable	Unit	Definition
Purchases	kg	Total quantity purchased
Sales	kg	Total quantity sold
Self-consumption	kg	Total amount consumed
Sales	USD	Multiplication purchases by the sale price
Cost	USD	Multiplication purchases for the purchase price
Utility	USD	Difference between Sales and Cost
Profit / trade cost	Indicator	Relationship between Sales and Cost
Self-consumption	USD	Multiplication own consumption by the sale price
Self-consumption cost	USD	Multiplication own consumption by purchase price
Saving	USD	Difference between the sales price and the purchase price multiplied by the volume of consumption
Family income	USD	Sum of sales plus saving
Familiar profit / trade cost	Indicator	Relationship between family income and cost

The operation of a marketing network with the four PTVT was conducted from June to September 2010. Due to the impact of Hurricane "Karl", modules in the region were closed during October and November. In December 2010, LTPOS Agostillo was reopened and operated during the following 12 months; in January 2011 the Loma del Nanche LTPOS operated for two weeks. The PTVT located in Xocotitla did not resume activities.

### 3. Results

#### 3.1 Social Organization for Innovation

The intention of the participants in the study was to find an alternative to traditional employment that offered higher returns for their farming, so the venture led to the establishment of four LTPOS located in the communities of Angostillo, Loma del Nanche and two in Xocotitla. The socioeconomic characteristics that identify the participants are as follows (Table 2).

Table 2. Socioeconomic profile of participants

Village	Age (Years)	Education (years)	Family size (People)	Family type	Occupation	Monthly income USD	Size backyard (m <sup>2</sup> )
Angostillo	54	4	5	Extended	Farmer/mason	134.21	400
Xocotitla 1	55	3	2	Nuclear	Farmer	67.10	1000
Xocotitla 2	67	3	8	Extended	Farmer	107.37	50
Loma del Nanche	57	2	5	Extended	Farmer	187.90	400

Participants in the study were male subjects between 54 and 67 years old, with basic school level average of three years, engaged in dual-purpose cattle, temporary corn crop and eventual masonry. Their families are composed on average of five people aged between 5 years to 90 years; two families are extended to include second-line family or in-laws. The average monthly family income is \$124.14 USD (\$1850 MXN).

#### 3.2 Operation in LTPOS

Systems showed that the optimum density to keep tilapia in good physical conditions in LTPOS is 5.3 kg/m<sup>3</sup>. The group performed consolidated weekly purchases and sales during the weekends using family labor. During the first three months the purchases were made in cash, the provider subsequently granted a loan with a commitment fee of eight days. The routes of 63 km which were needed to make transfers and weekly deliveries of batches of tilapia were made in two hours without using aeration equipment in them, an approximate mortality of 10% occurred mainly due to postharvest handling on farm, since fish showed bumps and flaking. On those

supply trips between 20 and 30 kg of live tilapia were placed in each plastic container filled with water previously provided by the farm.

The preference for the main supplier settled in the perception that marketers had on the physical characteristics of the product and customer service. Based on the application and customer interaction, it was established that tilapia weighing between 0.5 kg to 0.9 kg are preferred by consumers in this region; the facility representing to remove bones from meat and split it into pieces of “good size” made the difference. The selling price accepted ranged from \$3.02 USD (\$45.00 MXN) to \$3.69 USD (\$55.00 MXN) *per* kg. The propaganda “word of mouth” was useful because it was used only three times, its usefulness was verified by asking customers how they had learned of the sale of tilapia. Local consumers flocked to stores to buy without propaganda, while posters attracted consumers in transit to other locations.

### 3.3 Economic Aspects

#### 3.3.1 Displaced Volume

The displaced volume of tilapia fish farms in the area had a variation among communities according to market of each LTPOS and to the operation period. Angostillo bought 3000 kg, 564% more product than the others because its LTPOS operated for 14 months, with a downtime of two months. Xocotitla establishments operated for four months, failed to reopen the establishments after Hurricane “Karl”, due to lack of water supply to the community. Loma del Nanche also remained closed due to lack of water, however it operated for two weeks in January 2011. Altogether, the amount bought on Xocotitla 1 was 193 kg, in Xocotitla 2 was 65 kg and Loma de Nanche was 273.50 kg. The total volume of tilapia moved to the area was 3531.50 kg with a commercial value of \$11 714 USD (\$174 563.00 MXN) (Table 3) thereof benefiting farms with revenues of \$8643.32 USD (\$128 797.56 MXN).

Table 3. Economic results of the operation of LTPOS 2010-2011

Variable	Unit	Loma del Nanche	Angostillo	Xocotitla 1	Xocotitla 2	Total
Purchases	kg	273.50	3000.00	193.00	65.00	3531.50
Sales	kg	241.50	2892.50	163.00	51.00	3348.00
Self-consumption	kg	32.00	107.50	30.00	14.00	183.50
Sales	USD	810.32	9657.65	601.62	171.12	11 240.72
Cost*	USD	679.76	7877.78	479.88	162.06	9199.50
Utility	USD	130.55	1779.86	121.73	9.06	2041
Profit / trade cost	Indicator	1.19	1.23	1.25	1.06	1.22
Self-consumption	USD	107.37	354.83	110.72	46.97	619.90
Self-consumption cost	USD	79.59	277.99	74.62	34.89	467.10
Saving	USD	27.78	77.04	36.10	12.07	152.80
Family income	USD	838.10	9734.48	637.72	183.20	11 393.52
Familiar profit / trade cost	Indicator	1.23	1.24	1.33	1.13	1.24
Purchase price average**	USD	2.58	2.58	2.58	2.58	2.58
Sales price average**	USD	3.35	3.26	3.69	3.35	3.41

Note. Exchange rate: \$1.00 MXN = 14.90 USD; \*: Includes freight costs in the purchase price per kilo of live tilapia; \*\*: The price fluctuations were considered during the 14 months of operation.

#### 3.3.2 Sales

Sales were related to the operation time, geographic location and type of market, defined by the number of inhabitants in each population and purchasing power. Angostillo developed a significant market since their location was at the intersection of important roads, for having the largest population and a long period of market operations. Loma del Nanche compared to Xocotitla 1, which operated for a similar period, had higher sales through placing their point of sales in a spot with more vehicle movement, and they also had a larger population with higher income. During the period of activity of the group Loma del Nanche was the LTPOS with

best-selling in volume and frequency, allowing to observe that this city was the market that had better features.

Figure 1 shows the beginning of operation period with an accelerated growth of live tilapia monthly sales, in august 2010 a decrease began coinciding with the start of school, where most of the family income goes to education. At the end of this period, the trend of the accelerated growth sales was recovered, significant fluctuations were presented until march 2011; there was a peak in May sales, which was related to days off in the month. In June and July the sales volume remained with little change, in august began a decline in sales to match last year, so it is possible to mark a trend of lower sales for two months a year.

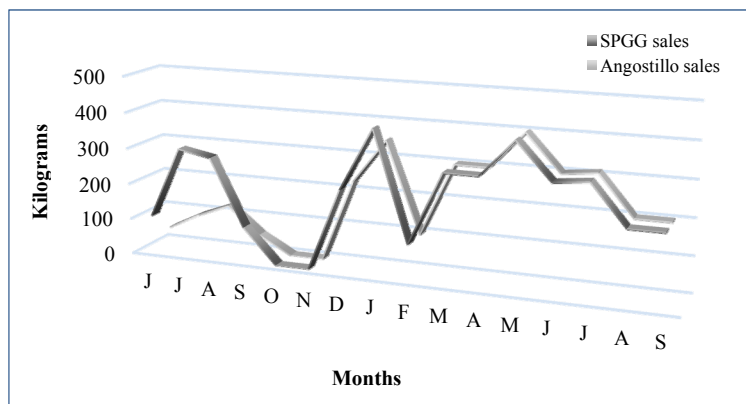


Figure 1. Live tilapia sold by the SPGG in 2010-2011

Sixteen months after the product live tilapia was introduced to the market, it has not reached yet its stability. However, since January 2011, there has not been a single period with lower monthly sales than 100 kg. According to sales performance, the average volume ranges from 300 to 350 kg of tilapia per month. In the period from december to september 2010-2011, the displaced volume was mainly from LTPOS Angostillo.

Total sales by population (Table 3) were 2892.50 kg for Angostillo, 241.50 kg for Loma del Nanche, 163 kg for Xocotitla 1 and 51 kg for Xocotitla 2, with a total of 3348 kg. The income derived from the total sales was \$11 240.72 USD (\$167 502.50 MXN). In the four LTPOS some sporadic actions were performed that resulted in added value for their product since they raided into its preparation to be sold and consumed fried.

### 3.3.3 Self Consumption

The total self-consumption of households (Table 3) was 183.50 kg, which generated savings in household expenditure of \$152.80 USD (\$2277.00 MXN) and represented 5% of the total displaced tilapia (Figure 2).

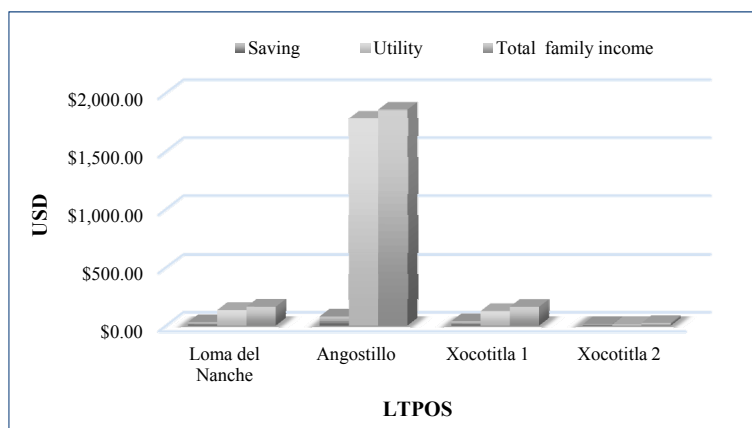


Figure 2. Live tilapia sold by the SPGG in 2010-2011

The rate of self-consumption of tilapia had variations for each LTPOS, the largest self-consumption occurred in Xocotitla 2 with 22%, followed by Xocotitla 1 with 16% and Loma del Nanche with 12%, Angostillo consumed 4% of the total tilapia purchased. The consumption trend is contrary to the sales as the biggest selling LTPOS got the least consumption, while the one achieving fewer sales is the one that used the most tilapia in the family diet.

#### 3.3.4 Earnings per LTPOS

The utility derived from marketing varied according to price policies set by each retailer, the profit generated by the sale of live tilapia was \$860.12 USD (\$12 817.00 MXN) (Table 3), with a BCR of 1.19; reflecting that this form of marketing of aquaculture products in traditional farming communities is profitable. Profits were used for reinvestment, keeping the point of sale and household spending.

The profitability in the family system, considering the consumption, was 1.23 on average. During the first four months of operation, the four owners, who continued their regular activities, accepted the LTPOSs. Later on, only one just continued working on his own LTPOS, plus his own farming activities.

#### 3.4 Capability Development

By sharing knowledge during SPGG meetings held along the 16-month intervention, the owners were able to develop basic skills in aquaculture capabilities for fish maintenance and administrative management for a LTPOS. This through observation of the behavior of organisms and their biological requirements, understanding of the physical qualities of the water and the operation of its modules, as well as advice from facilitators or technical expertise in various areas related to LTPOS.

#### 3.5 Continuity Reasoning

When evaluating if the operation of LTPOS continues or not, an uncertainty arises about LTPOS maintenance and closing. Factors influencing retention were water shortages, lack of own transport, capital loss and lack of entrepreneurial attitude.

The hydraulic system that supplies communities was lost and it took over three months to recover thus affecting all agricultural activity in the region, so that the supply of water to the land depended on the transfer of water from other sites by tanker trucks and various containers. The discontinuity of operations caused the use of the reinvestment capital in the coverage of family needs. The LTPOS Angostillo was adapted to function as a repository for the supply of the other LTPOS due to its geographical location. Since the transportation that the farm granted was limited to the minimum carrying batches of 100 kg per delivery, the volume of purchasing from the local stores at that time ranged from 30 kg to 50 kg so it was not feasible direct door delivery. This situation led to the need for self-sufficiency by borrowed or rented vehicles.

The continuity of the LTPOS Angostillo is due to the change in attitude and behavior that the marketer has had and to the resilience to temporary shocks arising during the first four months. All this because the marketer has developed the confidence to invest their own resources in the reopening of its establishment and has been able to cope with the loss of their main income derived from farming. However at the end of the three establishments, the organizational process was not abandoned, the SPGG continued to work with the four marketers.

### 4. Discussion

#### 4.1 Social Organization for Innovation

There are different tools for innovation processes in the aquaculture sector, among them the SPGG that have proven to be effective to integrate producer groups seeking to develop capabilities for growing tilapia (Hernández-Mogica et al., 2002), so its use in the transfer of technology of live tilapia marketing is feasible since it provides technical matches. Besides attending generalities focused on leveraging the capabilities and skills of family members to maximize the creative potential of their people, promoting the training and development of various skills (Feito, 2010), which favor diversification in the lifestyles of the members of the group (Pérez et al., 2009). The working methodology of SPGG implies a strong social interaction between group members, facilitators and the accompanying institution was the guiding principle in the innovation process (Rogers, 1983).

#### 4.2 Operation of LTPOS

The key to success, for a company with similar characteristics to the LTPOS ventures, is to know the factors which influence companies of different nature, where internal and external factors have particular relevance (Guasch & De Durán, 2006). Internal factors that depend on the decisions and control of the company managers are those that influence the success of the operation itself (Guasch & De Durán, 2006). The fact of choosing providers of live tilapia by marketers, based on the characteristics of the product they offer in terms of quality, presentation, stable supply, good prices and customer service (Alceste & Jorry, 2009), started the development of

aquaculture specialist suppliers for this market and an incipient linkage (Torres, 2007).

Marketers used the competitive advantages conferred upon them the physical environment, personal skills, product quality and food habits of the communities, to create a new market (Pérez et al., 2009). They used in their favor the proximity to entrepreneurial fish farms as main suppliers, the size and the social cohesion of the community for the diffusion of entrepreneurship, the quality of the product offered to differentiate those from other fish to which the population could have access. In addition to the tradition of eating seafood on weekends for social and economic reasons such as family gatherings, celebrations, sporting events and payment of wages. The development of this marketing rural channel strengthened the economy of aquaculture marketers and producers in the region (Issaly, Decara, Peralta, Vigliocco, & Sandoval, 2010).

#### *4.3 Economic Aspects*

##### *4.3.1 Sales*

The way in which sales evolved in SPGG coincide with the general behavior of the life cycle of a product identified by Sandhusen (2002) where accelerated sales growth occurs during its release to the market, a sustained rapid growth, a slowdown or decline in sales growth and finally the decrease in product demand. The product life cycle is influenced by instabilities in the supply, demand and technological change (Munuera & Rodríguez, 1998). The rapidly growing conditions were favored by seasons with high consumption of fish as Lent during march and april, holidays in may and school holiday periods in june, july and december; on the other hand the decrease in demand coincided with the beginning of the school period where most of the family income is allocated to be spent on education. This reveals that the consumption of live tilapia in rural communities is strongly associated with social reasons (Issaly et al., 2010).

The market for live tilapia in this area is in an embryonic stage of development and uncertainty is still present. There is little competition and a large number of failures have led to the closure of three out of the four companies previously mentioned (Rosenfeld, 2002). The LTPOS Angostillo was a specialist pioneering enterprise, since it imposed its product form and maintained a monopoly for long enough to position itself as a market leader in time (Porter, 1990).

##### *4.3.2 Self-Consumption*

Even though LTPOS are not rural tilapia farming systems they can be set as aquaculture rural life support systems for marketing live tilapia, therefore they are part of rural aquaculture. Which can also be used both for consumption and for marketing (Vega-Villasante et al., 2010). Although the LTPOS do not produce high-quality protein, it becomes accessible in better conditions for both families and the community, so the LTPOS represented a significant option of self-supply of fish and savings for people possessing these establishments (Edwards, Little, & Demaine, 2002). The SPGG had self-consumption, which generated savings in household spending that helped in improving the quality of life through food security and poverty reduction (Vega-Villasante et al., 2010).

##### *4.3.3 Earnings per LTPOS*

Regardless of the social organization, it is important to get a “good business” for people and to be a source of steady income (Giraldo, 2010) and a viable and sustainable option for work (Zetina et al., 2006). The group results showed that it is possible for these systems to generate profits for people in rural areas as opposed to breeding farm systems where it is common to work with losses (Solís et al., 2011) as the reduced use of inputs allows a better control on expenses. While these commercial systems can be sustainable by their nature, limited resources and rural character, the injection of seed capital from institutions and funding providers during its early stages is necessary.

When you add LTPOS to the sources of family income, livelihood strategies of the group are diversified (Pérez et al., 2009) and the profitability of it (Zetina et al., 2006). Therefore, the LTPOSs have the ability to establish themselves as profitable rural nonfarm family enterprises, as they provide income to significantly contribute to the family economy and expand the options for development of people (Pérez et al., 2009). These options can be potentiated about the possibility to add aggregate value to the product through the basic and traditional processing of tilapia (“Fried Mojarra”) to generate greater profits.

##### *4.3.4 Development of Capabilities*

The process of sharing experiences conducted by the SPGG through the monthly meetings and interaction with facilitators or technical expertise in various areas related to LTPOS (Abato-Zárate et al., 2011; Hernández-Mogica et al., 2002; Reta et al., 2011), led to the development of various aquaculture capacities,



among them are live fish transport, control and maintenance of water quality, feeding of organisms, harvest and postharvest handling. All these capabilities were needed to keep fish alive in the points of sale and in the integrated management system.

This body of aquaculture knowledge was the result of social construction (Fumero, 2001) and their own consolidation among members of SPGG created the opportunity to venture into tilapia culture (Pérez et al., 2009). Since experience through innovation provided the owners with the capacity to start a new activity, thereby expanding its range of development opportunities (Salazar & Rosabal, 2007).

#### 4.3.5 Continuity Reasoning

The continuity of LTPOS operations was affected by material and economic factors. However, the decisions made about the physical limitations (Guasch & De Durán, 2006), based on ideological-cultural and economic behavior construction faced were the decisive factor for reopening or permanent closure of establishments (Amit, Glisten, & Muller, 1993).

Those whose establishments were not reactivated, lacked the culture of entrepreneurship and management skills to overcome the limitations and transform their context (Duarte & Tibana, 2009). They remained dependent on external help to get the means that would make possible the reopening of their businesses (Sen, 2000), following an old tradition, consistent with the current policy of agricultural development, which forces them to rely of obtaining grants for the agricultural production of low incomes. The entrepreneurial capacity of the operator LTPOS Angostillo was a feature of its own, since the areas of training in the SPGG considered only technological aspects.

For LTPOS Angostillo, rehabilitation thereof was a rapid response mechanism to the crisis caused by the loss of hydraulic infrastructure (Richards, 1989). The rehabilitation gave it the character of sustainable livelihood, because through the provision of water by a tank car and by an adaptation in the circulation system, that maintained the water apt for longer, which enabled recovery from the crisis (FAO, 2013).

The disaster strengthened the research group when they realized the need to work on developing entrepreneurial skills of rural people (Narayan, Chambers, Shah, & Petesch, 2000), since they lack them, so they could see themselves as capable of keeping their businesses in rural areas and generate organizational, financial and cognitive resources to boost their productive activity (Feito, 2010).

#### 4. Conclusions

The innovation tool of the SPGG succeeded in doing the technology transference however, teamwork must be considered in social aspects related with local culture, since this factor limited the group's operations' continuity. The exerted influence by LTPOS is positive among traders as to the profits earned, acquired skills and experiences with which they will be able to make an informed choice about the implementation of aquaculture activities in their communities.

With respect to population, the supply of fish in the area was improved with a constant supply of high quality fish and better hygienic conditions and harmlessness. Achieving with it a diversification on the daily diet of the inhabitants of these communities.

In the same way, the regional producers had positive results reflected directly in their monthly incomes and the return of investment. In addition to foreseeing a long-term rentable option to aim to their entire tilapia production to a market with better sale prices, previous specialization of their productive processes to satisfy the required quality needs of the fish sold in the points of sales.

According to the experience gained from the operation of LTPOS it can be inferred that this strategy of commercial innovation can be used to improve areas with similar characteristics to the analyzed. Livelihoods based on livestock and traditional rain-fed agriculture expands since its presence. Additionally, this innovation can be used as a model of aquaculture development through which producers and traders, via productive specialization, will be able to offer a differentiated product to the market that allows them reach better ones.

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