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Analysis of the Tilapia (*Oreochromis* spp.) Value Chain in the State of Veracruz Rural Aquaculture for the Small Producer

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ABSTRACT

Objective: To analyze the importance of the aquaculture value chain links in the state of Veracruz, Mexico, especially those of production and marketing.

Methodology: The information was obtained in the six main tilapia (*Oreochromis* spp.) production regions in the state of Veracruz through poles based in a questionnaire that addresses key informants; variables related to each link and chain agent were considered; five juvenile producers, 41 tilapia producers and 12 marketers.

Results: A fish farming value chain map was generated with the description of distribution channels, production cost estimation and sales income, as well as the participation of producers in demand.

Implications: The implementation of integrative models is required in order to have a constant supply of inputs from suppliers in farms. Also, associative models that allow accessing markets in units where the high payment availability for the product should be developed.

Conclusions: Chain economic agents are related. Upon meeting the quality and performance required by marketers, there is potential to develop value aggregation strategies through associativity models, linked to service businesses such as restaurants.

Keywords: marketing, distribution, tilapia production

INTRODUCTION

Aquaculture is the technique that allows increasing the production of aquatic animals and plants for human consumption through certain control of organisms and their environment (FAO, 2014). Currently, this aquatic vegetation and animal species farming technique is one of the activities that demands more attention from cooperation organizations due to its capacity to reduce malnourishment and marginalization levels. Its growth has included small-scale units in the global value chain in Asia, where the activity's growth in recent

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years has been exponential. According to the National Geography and Statistics Institute (INEGI), in 2019 the state of Veracruz had 2321 fisheries and aquaculture units, which accounts to 9.5% with respect to the national total. Due to its production volume, tilapia (*Oreochromis* spp.) is positioned in the fifth position in Mexico and third in production value. The mean annual growth rate from 2009 to 2018 was of 9.08% (CONAPESCA, 2018). In 2017, 179 900 t of bream-tilapia were produced; out of these, 30 800 t account for sea bream captures and 149 100 t account for tilapia, of which 93 700 t are produced in aquaculture fisheries consisting in repopulating dams and inland water bodies; the rest is produced in controlled systems (Téllez, 2019). The four main tilapia producing states are Jalisco (20.51%), Chiapas (16.12%), Veracruz (11.25%) and Michoacán (9.45%) (CONAPESCA, 2018). The aquaculture gross domestic product for 2014 accounted for 3.3%, and it is the lowest economic activity in the country and does not represent significant growth (World Bank, 2015).

The value chain methodology applied to aquaculture has been useful in several regions of the world (Macfadyen *et al*., 2012). This model allows assessing problematic aspects of equal distribution and growth aspects that favors the poor, benchmarking assessment, costs and competitiveness, as well as critical points and action programs. Mayoux *et al*. (2007) propose a methodology guideline for the development of research with this approach. Among works of this kind, those of Veliu *et al*. (2009), Ndanga (2013), Engle & Stone (2013), Vivanco *et al*. (2010), El-Sayed *et al*. (2015) and Ponte *et al*., stand out (2014). As a baseline for the generation of market strategies that benefit tilapia value chain competitiveness in the state, the objective of analyzing the importance of aquaculture value chain links in the State of Veracruz with respect to production and marketing, through the value chain approach in the producing regions of the state of Veracruz is posed.

MATERIALS AND METHODS

The study was performed from September to October 2015 in six administrative regions of the state of Veracruz: Totonaca, Nautla, Capital, Sotavento, Papaloapan and Olmeca. 46 interviews were made to producers, biological input suppliers, tilapia feeders and marketers (Table 1) in the municipalities of Papantla, Atzalan, Martínez de la Torre, Tlapacoyan, Emiliano Zapata, Cotaxtla, Jamapa, La Antigua, Manlio Fabio Altamirano, Medellín de Bravo, Veracruz, Paso de Ovejas, Tlalixcoyan, Alvarado, Chacaltianguis and Minatitlán.

The methodological proposal was based on the input by Tallec & Bockel (2005) upon considering elements for a value chain analysis from a functional perspective, hence addressed through flow charts and a baseline economic analysis. Modernization proposals in economic agents foresee market strategies that correspond to market strategies posed by Sandhusen (2002).

Farms were classified based on Reta's typology (2009). The main aquaculture value chain links of *Oreochromis* spp. were identified and structured questionnaires were applied to key informants: producers, researchers, producer associations, technicians and biological input suppliers. Also, questionnaires structured with biological input supplier agents, feeding aquaculture farms and marketers were used to obtain detailed information of production volumes through different incurred

Table 1. Regions and municipalities where the types of interviewed producers live.

Region	Municipality	Questionnaires			
		Juvenile Producers	Tilapia Producers	Marketer	Total per Region
Totonaca	Papantla		1		1
Nautla	Atzalan		4		4
	Martínez de la Torre		4		4
	Tlapacoyan		1		1
Capital	Emiliano Zapata		2		2
Sotavento	Cotaxtla	1	1		2
	Jamapa		1		1
	La Antigua		3		3
	Manlio F. Altamirano		2		2
	Medellín de Bravo	1	11		12
	Veracruz		2	12	14
	Paso de Ovejas		1		1
	Tlalixcoyan	1	2		3
Papaloapan	Alvarado	2	4		6
	Chacaltianguis		1		1
Olmeca	Minatitlan		1		1
				Total	58

distribution channels, average sale price per kilogram and sales income.

Schematically, the research involved the following phases:

- Adjustment of research limits, as well as links and interviewed economic agents;
- Identification and description of activities performed by each economic agent, from the obtainment of raw materials up to the sale to the final consumer;
- Identification of aquaculture farms, depending on the proposed typology;
- Quantification of physical flows. Polls allowed estimating production volumes through different channels concurred by tilapia producers, as well as production costs and income from sales generated in each proposed typology for the study thereof.
- Estimation of local aquaculture participation in the demand of the fisheries market located in the municipality of Veracruz.
- Proposals of improvement for the aquaculture producer typology in Veracruz for the development of potential markets.

RESULTS AND DISCUSSION

Out of 58 questionnaires applied in 39 towns in 16 municipalities, 44 aquaculture farms were foreseen, two of which produce and feed juveniles and three prepare biological inputs (juveniles) only.

Chain Link Identification

Biological input suppliers: These are companies and producers that supply juveniles to tilapia feeders.

Tilapia feeder producer: There are three different levels. Industrial tilapia producer with productions above 41 000 kg per month. Entrepreneurial tilapia producer with production from 10 000 to 40 000 kg per month. Intermediate tilapia producer; those with a sales volume between 5000 and 10 000 kg per month. Small-scale tilapia producer with production from 1000 to 5000 kg per month. Starting tilapia producers are self-consumption producers who obtain from 1 to 1000 kg per month.

Wholesale Agent: They are marketers who have the capacity to purchase more than one tilapia ton per month by contract and supply retailers or mobile sales points, as well as restaurants.

Retailers: (Stationary tilapia sales point). Those retailers that condition an ideal environment to attain the survival of aquatic organisms (tilapia) purchased at feeding farms with the purpose of preserving them alive until the sale thereof.

Mobile tilapia sales point: They are merchants who purchase live products at feeding farms, which are placed in tanks with oxygen in order to transport them alive to rural communities, which generates a short-cycle process.

Integrated sales point: Stationary sales points installed as feeding aquaculture farm startup in order to distribute the products thereof.

Integrated restaurant: Venues part of feeding production units, where cooked products with added value are sold.

Restaurant: Businesses within rural communities that purchase products from feeding farms.

"Plaza del Mar" Seafood Market: The market where most of tilapia is distributed in the state. It is located in downtown Veracruz City.

Final farm gate consumer: Farm distribution channel that sells its products to its town's inhabitants as well as those from nearby zones.

Farm identification: 41 aquaculture farms were found; two produce juveniles and feed tilapia; three produce juveniles for local, state and national trade only. Table 2 shows the type and number of farms found in the state of Veracruz. Farms that produce juveniles are not included in the table.

Quantification of physical flows

The only production unit classified as industrial takes part with 64.5 % of the total live tilapia marketed by farms;

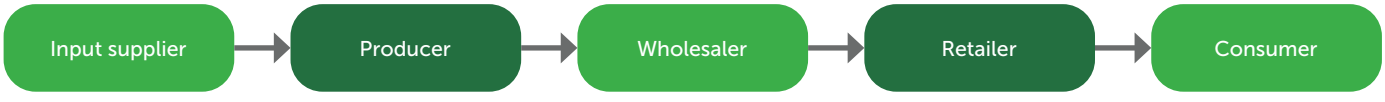

Figure 1. Tilapia value chain links identified in Veracruz.

Table 2. Classification and number of feeding aquaculture farms recorded in the research in the state of Veracruz.

Type of farm	Industrial	Entrepreneurial	Intermediary	Small-scale	Startup	Total
Number	1	14	8	3	12	38

that is, 66 666 kg per month. Entrepreneurial-type farms take part with 29.1% of the volume (30 118 kg per month); intermediate type participate with 3.6% (3700 kg per month); small-scale with 2.5% (2532 kg per month); self-consumption or startups barely participate with 0.3%.

Aquaculture farms generating biological inputs produce 3.3 million juveniles per month in the territory for the sale thereof here and in other states of the country. In tilapia feeding farms, industrial types destine 65.9% to wholesalers. That is, Plaza del Mar in Veracruz City. Entrepreneurial-type producers market 4.3% to the wholesale link and 4.0% to Plaza del Mar. The retailer link, which sales the product within the chain, accounts for 72.0%, comprising restaurants (6.1%), mobile sales points (36.9%); stationary sales points (7.2%); integrated sales points (9.3%) and restaurants integrated to production units (12.6%). Farm gate sale accounts for 23.6%.

Intermediate tilapia feeders supply 5.8% of the total production volume for wholesalers; these are represented by restaurants located in rural areas. Stationary tilapia sales points account for 10.8%, mobile sale points 6.5%, restaurants integrated to farms 14.1%, and farm gate sales 62.8%, and this distribution channel gets most of sales. Due to their low volume, small-scale producers are related to three distribution channels: in the retailer link, restaurants absorb 10.8%; in the retailer link, mobile sale points take 13.4%; finally, the final consumer farm gate sales account for 75.8% of sales. Startup or self-consumption producers consume their own tilapias.

Plaza del Mar sells 142.5 t of tilapia in the Veracruz-Boca del Río-Medellín metro area; aquaculture participation of the state in urban demand accounts for 40.8%; the only company of industrial type supplies 98.2% and entrepreneurial producers supply 1.8%. In Plaza del Mar, products supplied from outside the state come from Chiapas (43.1%), Nayarit (8.4%), Mexico City (La Viga Market, 2.3%), and other marketers (5.4%).

Table 3. Unitary production costs per state tilapia producer typology.

	Entrepreneurial	Intermediate	Small-scale
Average variable cost (MX$)	33.40	36.60	50.71
Average fixed cost (MX$)	8.28	19.66	14.74
Unitary total cost (MX$)	41.68	56.26	65.44
Average sale price (MX$)	51.66	68.17	50.46
Gross margin (MX$)	9.98	11.91	–14.98

Production costs

According to the Veracruz State Tilapia Master Plan, the main costs are: Variable costs, attributed to labor, food, juveniles (breeding), electricity, water, gasoline, maintenance and telephone; fixed costs refer to professional salaries, office expenses, construction and machinery.

Analysis of variable costs

Entrepreneurial-type producers destine 65% of their variable costs to fish food, which is the main input for production; intermediate producers destine 56.0% while small-scale ones destine up to 97.2%. In that same order, electric power accounts for 28.8%, 21.3% and 2.20% of variable costs. Last, the cost of juveniles considers 5.3%, 22.7% and 0.6% of costs, respectively. Some farms, mostly those far away from distribution centers, choose to reproduce their own offspring; in some cases, small-scale farms feed juveniles found in feeding ponds.

Sales income

Entrepreneurial typology producers. Eight links are found with entrepreneurial producers that market their production (Table 4). They have both mobile sales points and marketers, and these represents the highest sales income (31.48%) and their income adds up to MX$527 682 per month.

Intermediate typology producers. As shown in Table 5, intermediate production units showed commercial relations among five distribution channels; based on sales, the most relevant one is the farm gate sale, followed by restaurants integrated to aquaculture farms and, in third place, stationary sales points.

Small-scale typology producers

Small-scale producers market tilapia within three distribution channels. 8.52% for restaurants (MX$12 000). Mobile sales points account for 9.95% of their income (MX$14 000), and farm gate

Table 4. Monthly marketing in entrepreneurial typology producers.

Trade links	Average sale price (MX$)	Monthly sales (kg)	Income (%)	Sales income (MX$)
PVTVCP	43.00	100	0.25	4 300
Plaza del Mar	35.00	1200	2.50	42 000
Restaurant	38.60	1850	5.46	91 600
Mobile PVTV	47.00	11 100	31.48	527 682
Stationary PVTV	50.52	2175	6.71	112 525
Integrated PVTV	60.00	2800	10.24	168 000
Integrated restaurant	84.00	3796	20.30	340 261
Farm Gate	55.42	7097	23.24	389 525
Total	62.49	15 868	100.00	1 672 893

*PVTCP (Colegio de Postgraduados' Tilapia Sales Point), a rural innovation project with public financing implemented in certain towns of Veracruz to promote tilapia marketing and consumption. PVTV (Live Tilapia Sales Point).

Table 5. Monthly marketing in intermediate typology producers.

Trade links	Average sale price (MX$)	Sales volume (kg)	Income (%)	Sales income (MX$)
Restaurant	50.00	215	4.53	10 750
Mobile PVTV	50.52	240	6.07	18 000
Stationary PVTV	45.00	400	7.59	14 400
Integrated restaurant	84.00	520	28.52	67 600
Farm Gate	55.42	2325	53.26	126 225
Total	56.99	3700	100.00	236 975

Table 6. Monthly marketing in small-scale typology producers.

Trade links	Average sale price (MX$)	Sales volume (kg)	Income (%)	Sales income (MX$)
Restaurant	50.00	240	8.52	12 000
Mobile PVTV	47.00	300	9.95	14 000
Farm Gate	54.38	1692	81.52	114 691
Total	50.46	2232	100.00	140 691

sales account for the main income source (81.52 %). The total monthly sales amount to MX$140 691 for 2232 kg (Table 6).

DISCUSSION

The agent involved in the industrial typology tilapia value chain shows an orientation toward the wholesale market; the sale price that they get is the lowest one in all the above mentioned typologies and they access the Fisheries Market or Plaza del Mar in Veracruz City, which demand the highest production volumes in the state.

According to Trienekens (2011), market access sought by producers in developing countries depends mostly on technological capabilities, available infrastructures, negotiation capacity, as well as market knowledge and advice. The farm has a single-segment strategy, according to Stanton *et al*. (1980), which involves choosing the goal of a single open segment in the whole market, with a mixture of marketing in order to reach that single segment. Farms that manage to keep production through high investments decide to supply markets where the sale price is substantially lower (MX$20.00 cheaper) than the average pool gate price. In relation to the wholesale link, among entrepreneurial producers, on-farm sales account only to one fourth of sales. According to Asche *et al*. (2001), the market structure is important for the potential growth in aquaculture production, as the channels that demands lower tilapia volumes are those that offer a higher price for producers. Within the entrepreneurial typology, retail sales represent the most important link; mobile sale points contribute with 3/10 of the total income. These marketers have a rapid product capacity in rural areas and purchase live tilapia at aquaculture farms very frequently.

The sale price for final consumers in rural zones is higher than the one offered at the fisheries market. Tilapia sale points integrated to farms were identified. According to Sandhusen (2002) this is called an integrated growth strategy and occurs whenever the company increases its control on its distribution system. Also farms that provide added value to their products upon integrating restaurants to their production units were found. Intermediate typology tilapia producer sales are mostly made through the farm gate distribution channel. This represents half of the total income in the classification, as well as integrated restaurants that account for 3/10 of their income. This shows horizontal integration strategies

in a group of tilapia feeders upon purchasing live tilapias among themselves at a preferential price in case their farm stock were depleted. Small-scale aquaculture farms foresee most of their income from farm gate sales: Finally, starting producers produce only for their family's consumption and sale to neighbors from their own communities.

CONCLUSIONS

Aquaculture farmers determine the number of distribution channels depending on their sales volume. Upon having a farm gate sale incapacity when having a high production level; that is, when the offer outweighs the local demand, the amount of distribution channels and physical flows to each of them increases. Market strategies identified among producers seek to keep constant sales beyond the obtainment of higher income through the addition of value to production. The implementation of integration models may supply constant inputs to farms from suppliers. Also, association models that allow accessing or developing markets with a greater availability of better payments for products should be developed.

REFERENCES

Asche, F. T. Bjørndal, & J. A. Young. (2001). Market interactions for aquaculture products. Aquaculture Economics & Management, 5 (5-6): 303-318.

Banco Mundial. (2015). Economía y crecimiento. www.bancomundial.org

CONAPESCA (Comisión Nacional de Acuacultura y Pesca). (2018). Anuario Estadístico de Acuacultura y Pesca 2018. www.gob.mx/conapesca/documentos/anuario-estadistico-de-acuacultura-y-pesca

El-Sayed, A.F.M., Dickson, M.W. & El-Naggar, G.O. (2015). Value chain analysis of the aquaculture feed sector in Egypt. Aquaculture, 437: 92-101.

Engle, C.R., & Stone, N. M. (2013). Competitiveness of US aquaculture within the current US regulatory framework. Aquaculture Economics & Management, 17(3), 251-280.

FAO (Organización para la Alimentación y la Agricultura de las Naciones Unidad). (2014). El estado mundial de la pesca y la acuicultura. Oportunidades y desafíos. Roma. FAO. 274 p. www.fao.org/3/a-i3720s.pdf

INEGI (Instituto Nacional de Geografía y Estadística). (2019). Censos Económicos 2019. www.inegi.org.mx/programas/ce/2019/

Macfadyen, G., Nasr-Alla, A.M., Al-Kenaway, D., Fathi, M., Hebicha, H., Diab, A.M. & El-Naggar, G. (2012). Value-chain analysis: an assessment methodology to estimate Egyptian aquaculture sector performance. Aquaculture, 362: 18-27.

Mayoux, L., & Mackie, G. (2007). Making the strongest links: A practical guide to mainstreaming gender analysis in value chain development. www.ilo.org/empent/Publications/WCMS_106538/lang--en/index.htm

Ndanga, L.Z., Quagrainie, K.K., & Dennis, J.H. (2013). Economically feasible options for increased women participation in Kenyan aquaculture value chain.Aquaculture, 414: 183-190.

Ponte, S., Kelling, I., Jespersen, K.S. & Kruijssen, F. (2014). The blue revolution in Asia: upgrading and governance in aquaculture value chains. World Development, 64, 52-64.

Reta M, J.L. (2009). Programa maestro tilapia para el Estado de Veracruz. Colegio de Postgraduados-CONAPESCA. cadenasproductivas.conapesca.gob.mx/pdf_documentos/comites/csp/Programa_Maestro_Estatal_Tilapia_Veracruz.pdf

Sandhusen, R.L. (2002). Marketing. Mercadotecnia. México. Compañía Editorial Continente, S.A. (CECSA) 660 p.

Stanton, W.J., Etzel, M.J., Walker, B.J., Báez, E.P., Martínez, J.F.J.D., Nicolesco, J.D. & Garza, A.C. (1980). Fundamentos de marketing. México. McGraw-Hill. 680 p.

Tallec, F., & Bockel, L. (2005). Commodity chain analysis: constructing the commodity chain functional analysis and flow charts. Rome. Food and Agriculture Organization. 22 p. www.fao.org/3/a-bq645e.pdf

Téllez C., M. (2019). 12 de marzo de 2019, El Financiero. México D.F. 46 p.

Trienekens, J.H. (2011). Agricultural value chains in developing countries a framework for analysis. International Food and Agribusiness Management Review, 14(2): 51-82.

Veliu, A., N. Gessese, C., Ragasa, & C. Okali. (2009). Gender analysis of aquaculture value chain in northeast Vietnam and Nigeria. World Bank agriculture and rural development discussion paper, 44 p. www.fao.org/3/a-at243e.pdf

Vivanco A., M., Martínez C., F.J. & Taddei B., I.C. (2010). Análisis de competitividad de cuatro sistema-producto estatales de tilapia en México. Estudios Sociales 18(35): 165-207.