International Journal of Research in Commerce and Management Studies

ISSN 2582-2292

Vol. 3, No. 06 Nov-Dec; 2021 Page. No. 238-248

To cite this article: Héctor Terrazas-Valenzuela, Dr. J. Emilio Méndez-González*, M.A.R.H. Enrique Guzmán-Nieves and M.A.R.H. Liliana Álvarez-Loya (2021). FEASIBILITY OF INSTALLING A TILAPIA PRODUCING FISH FARM, International Journal of Research in Commerce and Management Studies (IJRCMS) 3 (6): 238-248

FEASIBILITY OF INSTALLING A TILAPIA PRODUCING FISH FARM

M.B.A. Héctor Terrazas-Valenzuela[1], Dr. J. Emilio Méndez-González[2]*, M.A.R.H. Enrique Guzmán-Nieves[3] and M.A.R.H. Liliana Álvarez-Loya[4]

[1]-Master's degree in Business Administration; [2, 3]and [4] - Fulltime Teachers in Strategic Management, Administrative Audit, Entrepreneurship and Management in Autonomous University of Chihuahua, México

DOI: http://dx.doi.org/10.38193/IJRCMS.2021.3615

ABSTRACT

The feasibility of installation and implementation of a tilapia production fish farm was raised considering the best practices of the sector in order to be able to identify and apply them to it, for this objective an exhaustive analysis of documentary sources, statistics, books and other available resources was carried out, the types of fish production were analyzed as well as their characteristics, determining intensive production as the best option, likewise it was possible to identify the recommendations on the selection of the hatchlings, the chain activity stages, in addition to being outstanding the innovative technology to improve the efficiency of the production, known as Biofloc Systems.

KEYWORDS: Pisciculture, Fish Farming, Biofloc Systems, Entrepreneurship Feasibility

1. INTRODUCTION

In Mexico, activities dedicated to fishing and aquaculture reported a total production of 33,963,871 thousand pesos, of which 35% corresponds to aquaculture, while the average profitability rate for wholesale trade is 34.5% and retail of 31.9% (INEGI, 2021), fish production in 2018 was 1,939 tons with a growth projection to 2030 of 5.7% with a proportion of aquaculture of 247 tons, but with a growth projection of 47.7 % (FAO, 2020, p. 198). Regarding the production of tilapia, Mexico occupies the ninth place worldwide with a total of 163,714 tons per year with a value of 3,284 million pesos with Jalisco as the main producer with 18.5%, followed by Chiapas 15.2% and Michoacán with the 12.1% (SENASICA, 2018), (Bertsch, 2021), the 2020 statistics reflect that the largest aquaculture producer was Chiapas with 30,912 tons (SADER, 2021), positioning tilapia as one of the products with the highest demand and increasing consumption While the local market is insufficient (Téllez Castañeda, 2019) this highlights the opportunity to increase the national offer with the sustainable cultivation of tilapia.

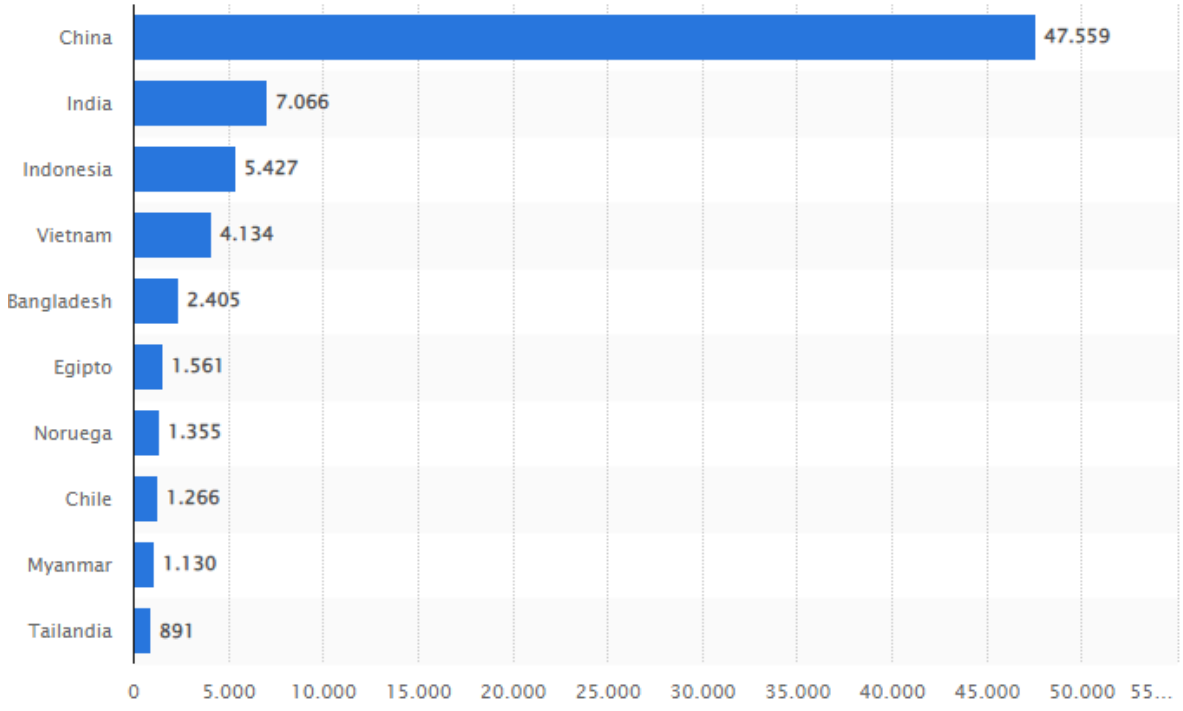
In Mexico, tilapia was introduced in 1964, in the Temascal fish farm, Oaxaca and its cultivation is one

International Journal of Research in Commerce and Management Studies

ISSN 2582-2292

Vol. 3, No. 06 Nov-Dec; 2021 Page. No. 238-248

of the most widespread and highly productive due to the attributes of the species (INAPESCA, 2018) worldwide, the leading countries in fish production they are Asian, with China in the first place well above the second, which is shown in Figure 1.



Production in thousands of metric tons

Figure 1. Leading countries in fish production
Source: (STATISTA, 2020)

Materials and methods

The research was of an applied type based on the fact that it aims to establish what are the elements that determine the feasibility of installation and commissioning of a fish farm with intensive production values, specifically tilapia (Oreochromis spp), it was of a quantitative type since, it describes and explains which are the processes that have demonstrated greater effectiveness and / or productivity, the design was of a non-experimental transitional type where a specific period of time was reviewed in order to evaluate modern practices through an exhaustive analysis of contents of documentary sources, statistics, articles, databases and books on the subject.

International Journal of Research in Commerce and Management Studies

ISSN 2582-2292

Vol. 3, No. 06 Nov-Dec; 2021 Page. No. 238-248

RESULTS AND DISCUSSION

It is necessary to start with a terminological precision on the general concepts of the subject, such as aquaculture, aquaculture and fish farming, where the first two terms can be used synonymously, and is defined as “the set of activities, techniques and knowledge of raising fish. aquatic plant and animal species ”(INAES, 2018), for its part FAO (2021) mentions that“ it is the cultivation of aquatic organisms both in coastal and inland areas that implies interventions in the breeding process to increase production ”another definition is provided by Parrado Sanabria, (2012) as "the cultivation of hydrobiological species through appropriate techniques in natural or artificial environments and, generally under control", for its part fish farming is defined as the "set of techniques and knowledge related to the industrial farming of fish and shellfish ”(Real Academia Española, 2021), while the National Institute of Statistics and Census of Panama mentioned It states that this aims at the rational cultivation of fish, the control of their growth and reproduction, monitoring and regulating multiplication (National Institute of Statistics and Census, 2021), so it is valid to mention that aquaculture is the genus while fish farming is the species, the first uses the knowledge of biology, engineering and ecology to help solve the nutritional problem, and according to the class of organisms that are cultivated, it has been divided into several types, one of the most developed being fish farming or fish farming (Cifuentes Lemus, Torres-García, & Frías Mondragón, 1997).

It is expected that by 2025, the world population will reach 8.1 billion, given the scarcity of resources and social inequality, it is a necessity that business models have sustainability as a mandatory rule (IFFO, 2020) and contribute to the elimination of the hunger and poverty without putting the available resources at risk and without affecting the environment, the FAO, through the Code of Conduct for Responsible Fishing, establishes in its ninth article that the States must formulate plans and strategies for the development of aquaculture in order to ensure that it is ecologically sustainable and allows the rational use of the resources shared by it as well as regulate chemical inputs that could be harmful to health and the environment (1995).

The production of tilapia in Mexico is guaranteed in quality and safety through inter-institutional and interdisciplinary working groups with members of the production chain, researchers, SAGARPA and state governments that work to strengthen the biosecurity of the product and ensure the sustained growth of this product., which has shown an average growth of 16.1% in the last six years (SENASICA, 2018)

In order to seek an adequate development of the aquaculture activity, it is necessary to keep up with technological advances, identifying the best practices and describing the key processes for fish production, in the case of tilapia the general stages of production are: sowing of fingerlings, raising, fattening and harvesting (Rueda Barrios, Bohórquez Farfán, & Reyes Figueroa, 2021)

International Journal of Research in Commerce and Management Studies

ISSN 2582-2292

Vol. 3, No. 06 Nov-Dec; 2021 Page. No. 238-248

Project Engineering

The selection of the type of culture system will be based on several factors such as the density of the hatchery, the productivity obtained, the fish sown per cubic (Nicho Valdez, 2021) meter, among others, so, 4 types of fish farming can be considered as shown in table 1.

Table 1. Types of Pisciculture and characteristics

Type of Pisciculture -Fish Farming-					
Classification	**Density**	**Pond Size**	**Type of Pond**	**Production**	**Type of Food**
Extensive	Low 1 pez 5-10 m^2	Large natural extensions	Natural water mirrors such as lagoons, reservoirs, reservoirs or dams	Low 10 a 25 Tons x hec/año	Natural
Semi-Intensive	Low 1 a 3 peces m^2	200 a 2500 m^2	Man-made ponds or reservoirs	Medium-Low 25 a 50 Tons x hec/year	Natural and Concentrated
Intensive	High 5 a 20 peces m^2	According to the required water turnover rate according to the species	Pond on land or geomembranes with aeration or oxygenation system	High 50 a 150 Tons x hec/year	Concentrated
Super-Intensive	60 Trout m^3 y 120-160 Tilapia m^3	A high level of water exchange	Floating cages in lakes or reservoirs	High 800 a 1000 Tons x hec/year	Concentrated

Source: (Rueda Barrios, Bohórquez Farfán & Reyes Figueroa, 2021, p. 54)

According to table 1, for intensive fish farming, the type of pond will be on land or with geomembranes with aeration system and high production, as a first element it is necessary to have the physical space where it is intended to operate, the which is a property located 75 km southwest of the capital of

International Journal of Research in Commerce and Management Studies

ISSN 2582-2292

Vol. 3, No. 06 Nov-Dec; 2021 Page. No. 238-248

Chihuahua with coordinates 28.0817 of north latitude and 105.2908 of west longitude, at a height of 1,206 meters above sea level (masl), the recommended values being between 850 at 2,000 masl (Saavedra Martínez, 2006, p. 9)

The second factor of great importance is the availability of water for which it does not represent a problem since the aforementioned property has a well and has sufficient supply capacity for the operation, this is one of the factors of great importance, since the quality of water has a direct impact on the life cycle of tilapia, a problem with well water is that oxygen levels are lower compared to water in streams, rivers and lakes, but it can be compensated with use of aerators so that oxygen enters the water by diffusion and those that have proven to be the most efficient are of the paddle type (Vidal-Martínez, et al., 2017)

Water quality

Good water quality must present conditions of temperature, dissolved oxygen, nitrate and PH (Nicho Valdéz, 2021), (Rueda Barrios, Bohórquez Farfán, & Reyes Figueroa, 2021) the physicochemical parameters are shown in table 2.

Table 2. Physico-chemical parameters of water

Parameter	Optimal	Limits
Temperature	24°C-29°C	>22 <32°C
Dissolved Oxygen	<5 mg/l	>3 mg/5
pH	7.5	>6.5 - <8.5
CO2	<30	<50
Ammonium	0.1	<0.1 mg/l
Nitrites	4.6	<5 mg/l
Salinity	<20*	<20
Turbidity	25	<30

Source: (DOF, 2021)

* The salinity will depend on the species or line of tilapia or on a previous process of acclimatization of the offspring to a certain salinity.

It is important to monitor these values since, with temperatures below 15 ° C there will be no growth (Saavedra Martínez, 2006), current technology presents sophisticated equipment such as the spectrophotometer, sensors with ZigBee technologies with wireless communication, replacement systems and water aeration, Biofloc and disruptive technologies with intelligent detection, robotic cages, drones, 3D printing of robotic fish for monitoring, among other developments (Rueda Barrios,

International Journal of Research in Commerce and Management Studies

ISSN 2582-2292

Vol. 3, No. 06 Nov-Dec; 2021 Page. No. 238-248

Bohórquez Farfán, & Reyes Figueroa, 2021), the negative effects on growth that could cause temperature variations between day-night can be corrected by supplying foods with high percentages of protein (30%, 32%) and the use of greenhouse-type coatings should be considered in order to maintain a stable temperature (Nicovita, nd), the more intensive the cultivation, the greater the need for proper water quality management.

Tanks

The project projection includes the construction of four production lines with five geomembrane tanks each 12.5 m in diameter and 1.30 m high, with a minimum water column of 1 m; a pre-breeding tank, two breeding tanks and two grow-out tanks. The recommended depth is between 1 and 1.5 meters to "minimize thermal stratification and reduce the growth of aquatic weeds at the bottom" (Vidal-Martínez, et al., 2017) other advantages of tanks is that they allow their mobility, they have a minimal impact on the environment and the efficiency of water use is improved.

Sowing

The stocking of fingerlings is when the reproduction and breeding of the species is carried out, the success of the cultivation and the economic viability depend on the selection of the highest quality genetic material, one of the way to guarantee it is, prior to the purchase the sanitary certificate that accredits them as free of pathogens of mandatory declaration of the OIE is required, in addition to that prior to sowing it is recommended to keep under observation in a quarantine pond for at least one week (Vidal-Martínez, et al., 2017)

Once the quality of the seed has been verified, it is necessary to carry out the acclimatization process that takes around 15 to 30 minutes, so the plastic bags containing the fry will be left floating on the surface of the water where they will be released and for no reason. The fish should be thrown into the new environment from any height, only allow them to swim calmly towards the new water (Saavedra Martínez, 2006) the population density will be 100 to 150 fish per m2 (Nicovita, nd)

In tilapia farming it is preferable to cultivate a monosexual population of males, which can be achieved through a sexual reversal at an early age by feeding them the hormone 17α-methyltestosterone, which works to increase the production of tilapia (Ribatto Albino, Seixas Alencar, Dantas Souza, & Karinne, 2020)

Feeding

Proper nutrition and good feeding practices are two of the most important requirements for successful and sustainable fish production in intensive farming operations. Without an adequate intake of nutritionally balanced diets, fish cannot optimally grow, reproduce and maintain the ability to resist

International Journal of Research in Commerce and Management Studies

ISSN 2582-2292

Vol. 3, No. 06 Nov-Dec; 2021 Page. No. 238-248

stress and resist disease-causing agents (Lim, Webster, & Lee, 2015), this diet can be reinforced by adding intestinal conditioning pro-nutrients to optimize organ function and allow for greater growth and more uniform size (Bertsch, 2021)

According to IFFO, supplementing aquaculture feed with fishmeal increases feed efficiency and growth through better feed palatability, improved nutrient uptake and absorption, provides a balanced amount of all amino acids, minerals, Phospholipids and essential fatty acids for the optimization of development, growth and reproduction, especially of the larval stocks of reproducers, it also helps to reduce the pollution of effluent waters by providing a better digestibility of nutrients (IFFO, 2020)

Biofloc System

Traditional geomembrane tank systems establish a variable water exchange depending on the stage; fingerlings 10% per day, juveniles 15% per day and fattening from 40 to 50% per day (Nicho Valdéz, 2021); (Nicovita, nd) this implies a greater consumption of water in such a way that a technology of zero water exchange has emerged, called Biofloc, which consists of a previous preparation of the water with bacteria and microorganisms of larger zoo size and phytoplankton to that proliferate until the water turns brown and has a lumpy texture (BIOAQUAFLOC, 2018), another explanation of the system is offered by (Hernández Mancipe, Londoño Velez, Hernández García, & Torres Hernández, 2019) as "a conglomerate aggregation of microbial communities (fl ocules) made up of phytoplankton, bacteria and living and dead particulate organic matter, suspended in the pond water. "This system increases the intensity of the culture, improves the rate of ingestion, digestion, absorption, feed conversion, growth, positive effects on the Digestive enzymatic activity, generates important probiotic action to the culture organisms, generates an increase in the biosecurity of the farm, reduces cost os, allows sustainable productions with culture densities between 180 and 120 fish / m3 among others, these microbial populations are known as "bioreactors" since they convert nitrogenous compounds, such as ammonia, nitrite and nitrate into high quality microbial protein that works as food for fish and improves the quality of the water by fixing said nitrogen compounds (Hernández Mancipe, Londoño Velez, Hernández García, & Torres Hernández, 2019). Not all species are susceptible to this system, however, tilapia can support large percentages of dissolved organic matter, is resistant to diseases, supports a high crop density (Saavedra Martínez, 2006) and tolerates low concentrations of oxygen (Nicovita, nd). Some of the drawbacks that this system could present is that the efficient use of aerators is more important in order to maintain oxygen levels, since there is a greater demand for it, the tanks with Biofloc must be aerated non-stop throughout the year, It also implies having an emergency electricity generation system, the water parameters with this system are shown in table 3.

International Journal of Research in Commerce and Management Studies

ISSN 2582-2292

Vol. 3, No. 06 Nov-Dec; 2021 Page. No. 238-248

Table 3. Water quality parameters in Biofloc technology

Parameter	Value
Oxygenation	>6 mg/L
Oxygen Saturation	>60%
Temperature	20-30°C
Ph	7-9 ppm
Alkalinity	400-1000 mg/L $CaCO_3$
Total suspended solids	400-1000 mg/L

Source: (Hernández Mancipe, Londoño Vélez, Hernández García, & Torres Hernández, 2019)

CONCLUSIONS

The determining factors for the design and installation of the fish farming project are directly related to environmental parameters and biotechnological aspects, one of them is the climate that can affect the temperature of the water, the property in question is located in a plain at an altitude that It favors the prevalence of a semi-warm climate for much of the year and the installation of greenhouse-type coatings is considered. Another factor is the availability of water, which is also satisfactorily met due to the existence of the well within the same property. In the planning, aerators were considered, having an electric power service, as well as a generating plant for emergencies, the construction of geomembrane tanks, the acquisition of fingerlings from certified laboratories, the necessary technology to carry out a correct monitoring of the quality of water in all its physical-chemical elements.

Integrating new technologies into the project makes a quality contribution, such as the Biofloc System, since it reduces production costs, generates savings in water and food, as well as serving to increase the farm's production.

Carrying out a project with these characteristics is feasible from the point of view of technical requirements and resources, while, in order to determine the viability, in terms of its profitability, another investigation will be necessary where a detailed list of costs is made. of each of the necessary elements, permits and response times.

REFERENCES

Bertsch, G. L. (September 2021). Pro-nutrients to improve intestinal well-being and tilapia productivity. Aquaculture industry: aquaculture and business in Mexico, v. 17 (n.6), 30-31. Retrieved from; https://issuu.com/industriaacuicola/docs/web_revista_industria_17.6_

BIOAQUAFLOC. (2018, August 30). Advantages and disadvantages of biofloc technology. Retrieved from Bioaquafloc: https://www.bioaquafloc.com/biofloc/ventajas-y-desventajas-de-la-tecnologia-biofloc/

Cifuentes Lemus, J. L., Torres-García, M. D., & Frías Mondragón, M. (1997). The ocean and its resources XI: aquaculture (2nd ed. Ed.). Mexico: FCE. Retrieved from: http://bibliotecadigital.ilce.edu.mx/sites/ciencia/volumen2/ciencia3/090/html/sec_7.html

DOF. (April 15, 2021). AGREEMENT by which the updating of the National Aquaculture Charter is approved. Retrieved from the Official Gazette of the Federation: http://www.dof.gob.mx/nota_detalle.php?codigo=5615929&fecha=15/04/2021

FAO. (1995). Code of conduct for responsible fishing. Retrieved from Food and Agriculture Organization of the United Nations: https://www.fao.org/3/v9878s/V9878S.pdf

FAO. (2020). The State of World Fisheries and Aquaculture 2020: Sustainability in Action. Rome: FAO. Retrieved from: https://www.fao.org/3/ca9229es/ca9229es.pdf

FAO. (2021). Aquaculture. Retrieved from the Food and Agriculture Organization of the United Nations: https://www.fao.org/aquaculture/es/

Hernández Mancipe, L. E., Londoño Velez, J. I., Hernández García, K. A., & Torres Hernández, L. C. (2019). Biofloc systems: an efficient strategy in aquaculture production. CES Journal Veterinary medicine and zootechnics, v. 14 (n.1), 70-99. Retrieved from: https://www.researchgate.net/publication/336649745_Los_sistemas_biofloc_una_estrategia_eficiente_en_la_produccion_acuicola

IFFO. (2020). Benefits of using marine ingredients. Retrieved from IFFO. The organization of marine ingredients: https://www.iffo.com/es/node/93

IFFO. (2020). Who are we? Retrieved from IFFO. The organization of marine ingredients: https://www.iffo.com/es/QuienesSomos

INAES. (May 04, 2018). Aquaculture, history and current affairs in Mexico. Retrieved from the National Institute of Social Economy: https://www.gob.mx/inaes/es/articulos/acuicultura-historia-y-actualidad-en-mexico?idiom=es

INAPESCA. (March 21, 2018). Commercial aquaculture. Retrieved from the National Fisheries Institute: https://www.gob.mx/inapesca/acciones-y-programas/acuacultura-tilapia

INEGI. (2021). Fisheries and aquaculture: Economic censuses 2019. Retrieved from the National Institute of Statistics and Geography: https://inegi.org.mx/contenidos/productos/prod_serv/contenidos/espanol/bvinegi/productos/nueva_estruc/702825198978.pdf

National Institute of Statistics and Census. (2021). Fish farming. Retrieved from the National

Institute of Statistics and Census - Panama: https://www.inec.gob.pa/Archivos/P2051PISCICULTURA.pdf

Lim, C., Webster, C. D., & Lee, C.-S. (2015). Feeding Practices and Fish Health. In Dietary Nutrients, Additives and Fish Health (págs. 333-346). John Wiley & Sons. Retrieved from: https://ebookcentral.proquest.com/lib/udemex/reader.action?docID=1895899&ppg=351

Nicho Valdez, J. J. (2021). Feasibility study for the commercial production of gray tilapia in warm areas of the province of Huaura Lima region. [master's thesis. Universidad Nacional José Faustino Sánchez Carrión], Huacho, Peru. Retrieved from: http://repositorio.unjfsc.edu.pe/bitstream/handle/UNJFSC/5366/JUAN%20JOS%c3%89%20NICHO%20VALDEZ.pdf?sequence=1&isAllowed=y

Nicovita. (n.d.). Manual of tilapia breeding. Retrieved from Aquaculture Industry: http://www.industriaacuicola.com/biblioteca/Tilapia/Manual%20de%20crianza%20de%20tilapia.pdf

Parrado Sanabria, Y. A. (2012). History of Aquaculture in Colombia. AquaTIC Magazine (n. 37), 60-77. Retrieved from: http://www.revistaaquatic.com/ojs/index.php/aquatic/article/view/146/135 #

Royal Spanish Academy. (2021). Fish farming. Retrieved December 15, 2021, from Dictionary of the Spanish Language: https://dle.rae.es/piscicultura

Ribatto Albino, F., Seixas Alencar, B., Dantas Souza, K. L., & Karinne, T. (January-July, 2020). Sexual reversal of Nile tilapia (Oreochromis niloticus) through hormonal treatment. Revista PesquisAgro, v. 3 (n. 1), 102-109. doi:10.33912/pagro.v3i1.662

Rueda Barrios, G. E., Bohórquez Farfán, L., & Reyes Figueroa, J.C. (2021). Characterization of fish farming in Santander. Medellín, Colombia: UPB. Retrieved from: https://repository.upb.edu.co/bitstream/handle/20.500.11912/9782/Caracterizacion%20Piscicultura%20en%20Santander.pdf

Saavedra Martinez, M. A. (2006). Management of tilapia cultivation. Retrieved from The Univertisty of Rhode Island: https://www.crc.uri.edu/download/MANEJO-DEL-CULTIVO-DE-TILAPIA-CIDEA.pdf

SADER. (April 09, 2021). Conapesca promotes the production and consumption of tilapia in the country. Retrieved from the Ministry of Agriculture and Rural Development: https://www.gob.mx/agricultura/yucatan/articulos/la-conapesca-promueve-la-produccion-y-consumo-de-tilapia-en-el-pais

SENASICA. (August 23, 2018). Mexico produces healthy, safe and high-quality tilapia: its consumption is safe. Retrieved from the National Service of Health, Safety and Agri-food Quality: https://www.gob.mx/senasica/prensa/mexico-produce-tilapia-sana-inocua-y-de-alta-calidad-su-consumo-es-seguro

STATISTA. (November 2020). Leading countries in fish farming production worldwide in 2018 (in thousands of metric tons). Retrieved from STATISTA: https://es.statista.com/estadisticas/634874/paises-lideres-en-produccion-de-piscicultura/

Téllez Castañeda, M. (March 12, 2019). Perspectives in the tilapia cultivation industry in Mexico (II). The Economist. Retrieved from: https://www.eleconomista.com.mx/opinion/Perspectivas-en-la-industria-del-cultivo-de-tilapia-en-Mexico-II-20190312-0128.html

Vidal-Martínez, V.M., Olvera-Novoa, M. A., Morales, V., Cuéllar-Anjel, J., Riofrio Montero, A., Morales Rodríguez, R., . . . Montoya Rodriguez, L. (2017). Manual of good management practices for freshwater fish farming. OIRSA-OSPESCA. Retrieved from: https://www.researchgate.net/publication/322498075_Manual_de_Buenas_Practicas_de_Manejo_para_la_Piscicultura_en_Agua_Dulce