

A large photograph of several tilapia fish packed in a blue woven basket, set against a background of blue lotus leaves. The fish are fresh and have silvery scales with some reddish-orange fins.

PHILIPPINE TILAPIA INDUSTRY

ROADMAP 2022-2025



PHILIPPINE
TILAPIA
INDUSTRY
ROADMAP 2022-2025



DEPARTMENT OF AGRICULTURE
BUREAU OF FISHERIES AND AQUATIC RESOURCES
"Tagapagtaguyod ng Malinis at Masaganang Karagatan"
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The Philippine Tilapia Industry Roadmap (2022-2025)

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ACRONYMS AND ABBREVIATIONS

ACPC	Agricultural Credit Policy Council
ADB	Asian Development Bank
AO	Administrative Order
ASF	African Swine Fever
BARMM	Bangsamoro Autonomous Region of Muslim Mindanao
BASIL	<i>Balik Sigla sa Ilog at Lawa</i>
BFAR-FIDSSD	Bureau of Fisheries and Aquatic Resources – Fisheries Industry Development Support Services Division
BFAR-FIMC	Bureau of Fisheries and Aquatic Resources – Fisheries Information Management Center
BFAR-FIQD	Bureau of Fisheries and Aquatic Resources – Fisheries Inspection and Quarantine Division
BFAR-FPSSD	Bureau of Fisheries and Aquatic Resources – Fisheries Production and Support Services Division
BFAR-FRLD	Bureau of Fisheries and Aquatic Resources – Fisheries Regulatory and Licensing Division
BFAR-IFAD	Bureau of Fisheries and Aquatic Resources – Inland Fisheries and Aquaculture Division
BFAR-NFFTC	Bureau of Fisheries and Aquatic Resources – National Freshwater Fisheries Technology Center
BFAR-NFLD	Bureau of Fisheries and Aquatic Resources – National Fisheries Laboratory Division

BFAR-NIFTDC	Bureau of Fisheries and Aquatic Resources – National Integrated Fisheries Technology Development Center
BFAR-PHTD	Bureau of Fisheries and Aquatic Resources – Post Harvest Technology Division
BFAR-RFL	Bureau of Fisheries and Aquatic Resources – Regional Fisheries Laboratory
BFAR-RO	Bureau of Fisheries and Aquatic Resources – Regional Office
BFAR-TOS	Bureau of Fisheries and Aquatic Resources – Technology Outreach Station
BOC	Bureau of Customs
CDA	Cooperative Development Authority
CLSU	Central Luzon State University
COA	Commission on Audit
DA	Department of Agriculture
DA-AMAS	Department of Agriculture – Agribusiness and Marketing Assistance Service
DA-ATI	Department of Agriculture – Agricultural Training Institute
DA-BAR	Department of Agriculture – Bureau of Agricultural Research
DA-BFAR	Department of Agriculture – Bureau of Fisheries and Aquatic Resources
DENR	Department of Environment and Natural Resources
DOST	Department of Science and Technology
DOST-PCAARRD	Department of Science and Technology-Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development
DTI	Department of Trade and Industry
FAC	Freshwater Aquaculture Center
FAO	Food and Agriculture Organization
FAST	Freshwater Aquaculture Center Selected Tilapia Strain
FOO	Fisheries Office Order
GAqP	Good Aquaculture Practices

GET-EXCEL	Genetically Enhanced Tilapia-EXcellent strain that has Comparable advantage with other tilapia strain for Entrepreneurial Livelihood projects
GIFT	Genetically Improved Farmed Tilapia
GIFT FII	Genetically Improved Farmed Tilapia Foundation International Incorporation
GMP	Good Manufacturing Practices
GMT	Genetically Male Tilapia
GST	Genomar Supreme Tilapia
HACCP	Hazard Analysis Critical Control Point
HEI	Higher Education Institution
IADP	Inclusive Agribusiness Development Program
iBEST	Improved Brackish Water Enhanced Selected Tilapia
KADIWA	Kadiwa ni Ani at Kita Market
LBP	Landbank of the Philippines
LGU	Local Government Unit
MAS	Marker Assisted Selection
MSME	Micro, Small & Medium Enterprises
MT	Metric Ton
NAFC	National Agriculture and Fisheries Council
NBC	National Breeding Nucleus
NCR	National Capital Region
NFARMC	National Fisheries and Aquatic Resources Management Council
NFRDI	National Fisheries Research Development Institute
NFRDI-FBC	National Fisheries Research and Development Institute – Fisheries Biotechnology Center

NGA	National Government Agency
NGO	Non-Government Organization
NIA	National Irrigation Administration
PAFES	Province-led Agriculture and Fishery Extension System
PCAF	Philippine Council for Agriculture and Fisheries
PCIC	Philippine Crop Insurance Corporation
PFDA	Philippine Fisheries and Development Authority
PFO	Provincial Fishery Office
PHILMECH	Philippine Center for Postharvest Development and Mechanization
PRC	Professional Regulation Commission
PRDP	Philippine Rural Development Project
PSA	Philippine Statistics Authority
PTIR	Philippine Tilapia Industry Roadmap
PTR-SC	Philippine Tilapia Roadmap-Steering Committee
R4D	Research for Development
RDl	Research and Development Institution
RFO	Regional Fishery Office
S&T	Science and Technology
SEAFDEC/AQD	Southeast Asian Fisheries Development Center/ Aquaculture Department
SRT	Sex Reversed Tilapia
SSR	Self Sufficiency Ratio
SWIP	Small Water Impoundment
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TESDA	Technical Education and Skills Development Authority
TiLV	Tilapia Lake Virus
TLaAI	Taal Lake Aquaculture Alliance Incorporated

MESSAGE

Filipinos have relied on Tilapia as a staple and cheap source of fish protein since it was introduced in the Philippines in the 1950s. Over the past two decades, we have seen an exponential growth of the tilapia industry as it continues to produce one of the most important aquaculture commodities in the country. The Philippines was ranked the 6th largest producer of farmed tilapias in the world in 2019.

The Department of Agriculture's (DA's) National Tilapia Industry Roadmap contains plans and programs for the tilapia industry that will guarantee a globally competitive and sustainable tilapia industry that is private sector-led and market-oriented.

This roadmap is a collaborative effort among key government agencies, industry leaders, experts, and stakeholders, and takes into consideration the many challenges that have hobbled the industry over the years. It contains short-term plans for increasing production, medium-term plans for improving support systems for tilapia enterprises; and long-term plans for producing more resilient breeds, modernizing marketing systems, and the production of globally competitive tilapia products.

We are confident that this roadmap will serve as a blueprint for the sustainable development of the industry even as helps us achieve our shared vision of a food-secure Philippines with prosperous farmers and fisherfolk.

Tungo sa Masaganang Ani at Mataas na Kita!



WILLIAM D. DAR, Ph.D.

Secretary
Department of Agriculture



FOREWORD

Our country teems with ecologically and economically important fisheries resources. Recently, the Department of Agriculture has intensified its efforts in crafting management plans for priority commodities to ensure their sustainable utilization.

Following the Comprehensive National Fisheries Development Program, we have launched several management plans for important marine commodities. And now, we are honored to present to you the Industry Roadmaps for Priority Aquaculture Commodities including Seaweed, Milkfish, Tilapia, Shrimp, and Shellfish. These roadmaps are a product of a wide participatory process led by the Department of Agriculture's Bureau of Fisheries and Aquatic Resources and the Philippine Council for Agriculture and Fisheries, and participated in by industry leaders, stakeholders, and experts from the academe.

These roadmaps take into consideration the challenges faced by the sectors in previous years and the corresponding strategic actions to address these issues, from short to long-term actions designed to address problems from the production to the trade level. We are positive that with the appropriate support from the government, and active participation by our stakeholders, these roadmaps will be instrumental in developing the Seaweed, Milkfish, Tilapia, Shrimp and Shellfish Industries into globally competitive, inclusive, and resilient industries.

Guided by the OneDA Reform Agenda, the Department of Agriculture will continue harmonizing its efforts with all stakeholders to achieve a food-secure Philippines and *Masaganang Ani at Mataas na Kita* for our fisherfolk.



CHERYL MARIE NATIVIDAD - CABALLERO

**Undersecretary for Agri-Industrialization and for Fisheries
Department of Agriculture**



MESSAGE



One of the most familiar fish on the table of every Filipino household also happens to be one of the most farmed fishes in the country-the tilapia. In fact, the Philippines was hailed as the 6th major producer of farmed tilapia worldwide in 2019. In 2020, production of tilapia contributed 6.91% to the country's total fisheries production. Despite its impressive performance, the industry is constantly plagued with challenges such as climate change and pollution-related problems, diseases, and most especially, the increasing cost of production inputs.

The National Tilapia Industry Roadmap is a product of a wide participatory process among the tilapia stakeholders to address pressing issues and concerns in every chain segment within the industry - from input supply, production, post-harvest and processing, marketing and distribution, and other cross-cutting challenges.

The vision for the tilapia industry is to become a globally competitive and sustainable tilapia industry that contributes to the improvement of the quality of life of Filipinos. This roadmap serves as a guide for the government and private stakeholders in taking collaborative efforts to increase the tilapia production, ensure quality and traceability of the inputs and outputs, develop and utilize cost-effective feeds, reduce post-harvest losses and improve the marketing system of tilapia industry.

The Department of Agriculture's Bureau of Fisheries and Aquatic Resources commits its full support in the implementation of this roadmap, towards creating a meaningful contribution for our shared vision of a food-secure Philippines, with prosperous fisherfolk, free from hunger and poverty.

Maraming salamat at Mabuhay ang Industriya ng Pangisdaan!

A handwritten signature in black ink, appearing to be 'E. B. Gongona', written in a cursive style.

COMMODORE EDUARDO B. GONGONA, PCG (Ret.)
Director, Bureau of Fisheries and Aquatic Resources
Department of Agriculture

PREFACE



It was a privilege and pleasure for me to have served as Team Leader of the Department of Agriculture's Commodity Industry Roadmap for Tilapia (2022-2025). The Tilapia Industry Roadmap was prepared by the concerted effort of the tilapia stakeholders from both government institutions and private associations/cooperatives/individual who are engaged in tilapia farming. The preparation of the roadmap was spearheaded by the Technical Working Group from the Bureau of Fisheries and Aquatic Resources and the National Fisheries Research and Development Institute, reviewed and discussed by our Team and other Resource Persons and the final output was found to be acceptable with comments/suggestions considered.

We are thankful to DA Secretary William D. Dar for giving priority to tilapia as a major food commodity in our country. We also commend everybody who had been involved for a job well done.

I am therefore gladly endorsing the Tilapia Industry Roadmap to the various tilapia industry stakeholders and beneficiaries throughout the country.

A handwritten signature in black ink, appearing to be 'R. Guerrero III', written over a light blue circular stamp.

RAFAEL D. GUERRERO III, Ph.D., DOST

Team Leader

Tilapia Industry Roadmap Development Team



EXECUTIVE SUMMARY

The Philippine Tilapia Industry Roadmap serves as the blueprint for a sustainable development of the industry. The plans that were formulated and identified are inclusive, attainable, market-driven, and attuned to the needs of the industry. They seek to address three general questions: where are we? where do we want to go? and who will do it?

The report presents the vision, mission, goals, plans, and targets of the industry. It is a product of industry consultations (virtual consultation and meeting with bureau heads of BFAR Regional Fisheries Production and Support Services Division and Technology Outreach Stations and tilapia focal persons nationwide), interviews of key informants and industry survey from the hatchery and grow out operators, and feed and fish processors were also undertaken.

Where Are We?

Tilapia is presently identified as one of the priority species in Philippine aquaculture as it is considered the second most farmed species next to milkfish (*Chanos chanos*). Nile tilapia (*Oreochromis niloticus*) and its hybrids are cultured in freshwater and brackish water environments. The industry was hailed as the 6th major producer of farmed tilapias in the world in 2019 with a total production of 279,385.9MT which accounted for the 4.5% of the total world tilapia production. In 2020, the tilapia industry registered a 6.91% contribution (304,326.59) to the country's total fisheries production of 4,400,373.01 MT.

A ninety-nine percent increase was observed in tilapia production over the span of 18 years from 152,985.0 MT in 2002 to 304,326.59 MT in 2020. Majority of the production was from Central Luzon, having extensive fishpond areas for culture. Alone, it contributed 45.73% to the total tilapia production in 2020. The CALABARZON region is next where

supply mostly comes from cages situated in Taal Lake. The annual per capita consumption of tilapia in 2019 was 2.9 Kg per year. The industry has been able to export tilapia with a total volume of 8,165 MT from 2005-2019. It was sold on a wholesale price of PhP 80.60/kg and on a retail price of PhP 109.00/kg.

In terms of supply/value chain, tilapias goes through the different marketing layers –from producers, bakuleras/viajeros, processors, and retailers including the institutional buyers before it reaches the consumers. It is sold primarily in the domestic market either fresh or live.

SWOT analysis revealed that the availability of quality broodstock and tilapia strains from BFAR, easy access to latest breeding and farming technologies, and established market linkages mechanisms and subsidies from government are the strengths of the industry. In contrast, the identified weaknesses of the industry are the high cost of raw materials (fish meal) and equipment for tilapia feed production, high production costs particularly in feed inputs, weak mechanism for product traceability, numerous marketing layers, and weak credit access. The roadmap identifies opportunities that would further enhance the industry such as the availability of local agri-by-products/agricultural wastes as potential raw materials for feeds and supplemental feeding, adoption of green water technology in the production of tilapia, increase of export demand in international market, and increasing interest to engage in tilapia production, processing and marketing. Lastly, the identified threats along the chain segment is the erratic climatic and weather conditions and the occurrence of natural calamities, emergence of new diseases and volatility of farm gate price.

The average production cost to operate a one-hectare tilapia fishpond farm in 2019 is PhP 302,000, accounting 256,959 (85%) to the total cash cost. Feed, on the other hand, costs 172,033 accounting for the 56.9% of the total production costs. These inputs correspond to the net return of PhP 184,490 per hectare.

The benchmarking analysis of the Philippine tilapia industry (hatchery and grow-out operations) was done both locally and internationally in terms of production system, farm practices, labor capacity, and technological and machinery capacity and productivity. Likewise, a competitive analysis was done based on local and international data. The performances (hatchery and grow-out operations) that were measured are fingerlings selling costs, supply reliability, and marketing strategies.

It is observed through the benchmarking that modern farms normally have more advanced facilities, labor and technological capacities, and higher production volume than typical farms. Comparing the state of the Philippine tilapia industry to that of China, the latter has invested on more advanced facilities and technological and production capacities.

The identified strengths of the Philippine Tilapia Industry are the full support of government and the availability and easy access to quality seedstocks. On the other hand, high production costs and too many marketing layers are among the identified weaknesses in the industry. Further support from the government and high cost of raw materials and equipment, respectively, are some the opportunities and threats.

Where Do We Want To Go?

The collective vision, mission and goals of the Philippine tilapia industry are as follows:

Vision: A globally competitive and sustainable tilapia industry that is private sector-led and market-oriented, with strong government support that will improve the quality of life of Filipinos.

Mission: Development of a globally competitive, eco-sensitive and climate resilient Tilapia Industry that is private sector-led, client driven, supply-reliable following an innovative value chain that is based on sustainable standards.

Goals: (1) to increase tilapia production from 304,326.59 MT (2020) to 352,797.9 MT (2025), (2) to ensure quality and traceability of inputs and outputs, (3) to promote use of

environment friendly tilapia feeds and reduce cost of feed production by utilizing locally sourced raw materials, (4) to reduce fishery postharvest losses from 25% to 10% in five years and (5) to develop and/or improve a more efficient marketing system for the tilapia industry.

To accomplish the goals of the short-term plans of the roadmap: (1) to increase tilapia production from 304,326.59 MT (2020) to 352,797.9 MT (2025), through the following strategies: (a) broodstock improvement for resilient tilapia strain, (b) broodstock development and maintenance, (c) fingerling production and distribution, (d) modernization of BFAR Tilapia Central, Satellite Hatcheries and National Centers and private sector, (e) technology dissemination (f) province-led agriculture and extension system, (g) diversification, (h) research for development for increase production, (i) agri-industrial business corridors, (j) expansion of culture areas, and (k) fisheries career system, (2) ensure quality and traceability of inputs and outputs through: (a) food safety and regulation (e.g. promotion of GAqP, biosecurity measures, registration and accreditation of tilapia aquafarms), (b) R4Ds on emerging diseases, (c) monitoring, control and surveillance of diseases, (3) promote use of environment friendly tilapia feeds and reduce cost of feed production by utilizing locally sourced raw materials through: (a) R4Ds and transfer of technologies on the feeding management, strategies and development of low-cost feeds, (b) R4Ds on nutrigenomics, and (c) collective action/cooperative development (4) reduce fishery postharvest losses from 25% to 10% in five years through: (a) improvement of the quality of the fishery products, and (b) improve the traceability of tilapia export products; and (5) improve and/or develop a more efficient marketing system for the tilapia industry through: (a) equitable access and strengthen local market network, (b) accessible credit and loan programs by financing institutions, and (c) regulation of tilapia market price.

Moreover, the medium-term plan is to contribute to the increase in fisheries production, food sufficiency and ensure food security for the Filipino people by (1) development of climate resilient tilapia, (2) implementation of Good Aquaculture Practices (GAqP), (3) mechanization of tilapia farming, (4) application of biotechnology in tilapia disease diagnosis and treatment, (5) continue improvement of cold chain technology, (6) development of value-added products for the local and international markets, and

(7) development of cost-effective feeds using locally available ingredients and (8) implementation of electronic marketing adoption.

Finally, the long-term plan on the Philippine Tilapia Industry Roadmap is to sustain resilient breed of Tilapia, modernized marketing system and globally competitive tilapia products for a food secured Filipinos by (1) enhancement of fish immunity (vaccination and formulation of immunostimulants), (2) isolation and cryoconservation of somatic cells, (3) formulation ready-to-eat tilapia products, (4) improvement of electronic marketing system (5) exportation of fish fillet and value added products, and (6) application of genomics and marker assisted selection (MAS) in tilapia breeding and production.

Who Will Do It?

The implementation of the Philippine Tilapia Industry Roadmap shall be directly supervised by the Philippine Council for Agriculture and Fisheries (PCAF). A Philippine Tilapia Roadmap-Steering Committee (PTR-SC) shall be created to ensure that all programs are implemented and targets are accomplished accordingly. It shall be composed of the following:

- Tilapia Growers
- Tilapia Industry Associations/Cooperatives
- Tilapia Processors Group
- Association of Feed Companies
- Philippine Council for Agriculture and Fisheries (PCAF)
- Department of Agriculture (DA)
- DA-Bureau of Fisheries and Aquatic Resources (DA-BFAR)
- DA-Bureau of Agricultural Research (DA-BAR)
- DA-National Fisheries Research and Development Institute (DA-NFRDI)
- Department of Science and Technology-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCARRD)
- Department of Environment and Natural Resources (DENR)

- Department of Trade and Industry (DTI)
- Local Government Unit (LGU)
- Southeast Asian Fisheries Development Center/ Aquaculture Department (SEAFDEC/AQD)
- Higher Education Institutions (HEIs)
- Philippine Fisheries Development Authority (PFDA)
- Philippine Center for Postharvest Development and Mechanization (PHilMech)
- National Irrigation Administration (NIA)
- Technical Education and Skills Development Authority (TESDA)

Seven Technical Working Groups (TWG) shall be created and these are – (1) Production; (2) Training and Extension; (3) Infrastructure; (4) Product Development; (5) Regulatory; (6) Marketing, Credit and Insurance Program; and (7) Research and Development. Each group shall be in-charge of the implementation of their respective programs. Each group shall be composed of representatives from the tilapia industry associations, feed companies, fish processors, DA (BFAR, BAR, NFRDI, PCAF) DTI, HEIs, DOST-PCARRD and LGUs.

To ensure the smooth implementation of the plans and programs for the attainment of targets, the PTR-SC, the National Fisheries and Aquatic Resources Management Council (NFARMC) and National Agriculture and Fisheries Council (NAFC) will be responsible for monitoring the progress of each program.

Monitoring teams shall also be created at the regional and provincial levels under the Regional and Provincial Agricultural and Fishery Coordinators. Representatives from the industry associations, National Government agencies such as BFAR Regional Offices and Higher Education Institutions (HEIs) will form part of the team.

INTRODUCTION

Rationale

Fisheries is an important industry in the Philippines. Its importance is underscored by the fact that the Philippine ranks 8th among the top fish producing countries in the world in 2018 with 4,354,000 MT production (Philippine Fisheries Profile, 2019). Philippines is also one of the world's largest producers of aquatic plants (including Tilapias) having produced a total of 1,478,000 MT, ranking 4th just behind China, Indonesia, and the Republic of Korea. Among farmed aquaculture species in the country, Tilapia is the second most important cultured fish next to milkfish. It is even considered as the nation's economic barometer, replacing the once famous galunggong (round scads). In 2020, production from the Tilapia industry contributed 263,871.29 MT or 11.4% to the total national fisheries aquaculture production of 2,324,000 MT (Philippines Statistics Authority, 2021).

About 93% of total Tilapia production came from freshwater and the remaining 7% came from brackish and marine water (PSA,2021). The increasing interest in Tilapia farming is attributed to its bright economic prospects, continuous research on the development of improved Tilapia species, and the available commercial technologies. Central Luzon (Region III) leads in production, having produced a total of 139,153.84 MT which accounted for the 45.71%, followed by Calabarzon (Region IV-A) with 23.84% and Bangsamoro Autonomous Region of Muslim Mindanao with 6.37% share to the total Tilapia production 304,420.63 MT in 2020 (PSA, 2021).

Tilapia farming became attractive which led entrepreneurs to invest in tilapia processed products. However, despite its impressive performance, it is beset with problems and challenges. Pollution-related problems like diseases and insufficient water supply, source of good quality fingerlings, increasing cost of inputs, capital, and marketing are among the problems and challenges the industry faces thus adversely affecting its competitiveness.

The Tilapia Industry Roadmap aims to present the status of the Tilapia industry in terms of the performance, resources, support industries, government programs and projects, and issues confronting the industry (where are we?); The strategy setting (where do we want to go?) and how to achieve the goals set (who will do it?).

Objectives

Philippine Tilapia Industry Roadmap serves as blueprint for the sustainable development of the industry. The plan formulated are inclusive, attainable, market-driven and attuned to the needs of the industry. Specifically, the roadmap aims to:

- a. Present the current status of the tilapia industry in the country;
- b. Analyze the supply/value chain and market trends;
- c. Analyze determinants of global competitiveness in terms of technical parameters of production, price and cost faced by the tilapia producers and stakeholders across farms and countries;
- d. Set goals, strategies, and targets on how to achieve a competitive and sustainable tilapia industry; and,
- e. Recommend strategic directions and action programs to enhance the Philippine tilapia Industry.

Definition of Terms

Aquaculture

fishery operations involving all forms of raising and culturing fish and other fishery species in fresh, brackish and marine areas

Biosecurity

a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) for analysing and managing relevant risks to human, animal and plant life and health, and associated risks to environments

Fish fingerlings	a stage in the life cycle of fish measuring about 6-13 cm, depending on the species
Fish fry	a stage at which a fish has just been hatched usually with sizes from 1-2.5 cm long. In tilapia, the fry measures 0.8-1.0 cm long
Fish pen	an artificial enclosure constructed within a body of water for culturing fish and fishery/aquatic resources made up of poles closely arranged in an enclosure with wooden materials and screen or nylon netting to prevent escape of fish
Fish cage	refers to an enclosure which is either stationary or floating, made up of nets or screens sewn or fastened together and installed in the water with opening at the surface or covered and held in place by wooden/bamboo post or various types of anchors and floats
Fisherfolk	people directly or personally and physically engaged in taking and/or culturing and processing fishery and/or aquatic resources
Fisherfolk cooperative	a duly registered association of fisherfolks with common bond of interest, who voluntarily joined together to achieve a lawful common social or economic end, making equitable contribution to the capital requirement accepting a fair share of the risks and benefits of the undertakings in accordance to the universally accepted cooperative principles
Fisherfolk organization	an institution group, association, federation, alliance or an institutions of fisherfolk which has at least fifteen (15) members, a set of officers, a constitutions and by-laws, and an organizational structure and a program of action
Fish pond	a land-based facility enclosed with earthen or stone materials to impound water for growing fish
Food security	refers to any plan, or strategy aimed at ensuring adequate supplies of appropriate food at affordable prices. Food security may be achieved through self-sufficiency (i.e. ensuring adequate food supplies from domestic production), through self-reliance (i.e. ensuring adequate food supplies through a combination of domestic production and importation), or through pure importation

Lake	an inland body of water, an expanded part of a river, a reservoir formed by a dam, or a lake basin intermittently or formerly covered by the water.
Non-governmental organization	an agency, institution, a foundation or a group of persons whose purpose is to assist people's organization/ associations in various ways including, but not limited to, organizing, education, training, research and/or resource accessing.
Post-harvest facilities for fisheries	these facilities include, but not limited to, fishport, fishlanding, ice plants, cold storages and fish processing plants.

Data Sources

The data used in this roadmap are primary and secondary data. The primary data were obtained through formulation of online survey questionnaire responded by stakeholders (conducted on July 14, 2020 and February 18, 2021 by 38 and 65 respondents, respectively), phone interviews of tilapia hatchery and grow-out operators, and consultation meeting with BFAR Regional Fisheries Production and Support Services Division (FPSSD) Heads, Technology Outreach Station (TOS) Heads, and Regional tilapia Focal Persons Nationwide held on February 23, 2021 via Zoom meeting platform. The secondary data were sourced from the website of Philippine Statistics Authority (PSA), Department of Agriculture (DA), DA-Bureau of Fisheries and Aquatic Resources (DA-BFAR), Food and Agriculture (FAO) of the United Nations, published and un-published research works, and through various internet searches.



INDUSTRY SITUATION AND OUTLOOK

Structure

Industry Definition

Tilapia is presently identified as a priority fish in aquaculture production, considered the second most farmed species in the country. It is an important food item in the Philippines and is widely consumed in many areas of the country. In 2020, tilapia production registered a 6.9% (304,326.59 MT) contribution to the total fisheries production of 4,403,709.08 MT (PSA, 2021).

Tilapias belong to the family Cichlidae. Three genera are named *Oreochromis*, *Tilapia* and *Sarotherodon*. Nile Tilapia belongs to genus *Oreochromis*. This specie is naturally distributed in Palestine, the Nile River, as well as in most part of African river and lakes. Tilapias are native only to Africa and the eastern Mediterranean region. The first tilapia introduced to the Philippines was the Mozambique tilapia (*Oreochromis mossambicus*) imported from Thailand in 1950. The Nile tilapia (*O. niloticus*) was first introduced to the Philippines in 1972 and rapidly gained popularity with farmers and consumers (Asian Development Bank, 2004). Its rising popularity is due to their hardiness, resistance to disease, ease in breeding, reasonable growth rate, good taste, and tolerance to a wide range of environmental conditions including temperature and salinity. Tilapia grows rapidly and is fairly resistant to stress and diseases making it suitable for aquaculture (Alal, 2018). It is now the main species of tilapia farmed in the Philippines and throughout tropical Asia and the Pacific. It is called aquatic chicken suitable for farming in diverse systems, from backyard ponds to large commercial ponds and cages. There are no other native species with comparable characteristics for aquaculture in the Philippines.

The growing popularity of tilapia as food fish for Filipinos resulted to increase in demand for tilapia fingerlings. Different institutions work together through Science and Technology (S&T) interventions in improving strain of tilapia using genetic selection, and improving technology in production and culture of tilapia to sustain the local industry's growth (The Tilapia Technical Committee, 2017). All verified technologies (product of research) are disseminated to fish farmers through hands-on training, seminars, and on-farm extension services in coordination with the Local Government Units (LGU), Non-Government Organizations (NGO), fisherfolk organization and other institutions (DA-BFAR). Tilapia is among the five potential commodities identified by the Bureau of Fisheries and Aquatic Resources (BFAR) that will contribute greatly to local aquaculture production. BFAR-National Freshwater Fisheries Technology Center (BFAR-NFFTC) serves as the National Breeding Nucleus (NBC) of tilapia that provides foundation stocks and parent lines to Central and Satellite Hatcheries of the country.

There are different strains of tilapia fry and fingerlings available for grow-out culture in freshwater and brackish water environment. The BFAR-National Freshwater Fisheries Technology Center (BFAR-NFFTC), Freshwater Aquaculture Center of the Central Luzon State University (FAC-CLSU), Genomar Supreme Philippines (continued the breeding program after formal agreement with GIFT Foundation International Incorporation (GIFT FII)) and PhilFishGen successfully created an improved strain of tilapia, these are GET-EXCEL (Genetically Enhanced Tilapia - EXcellent strain that has Comparable advantage with other tilapia strain for Entrepreneurial Livelihood projects in support to aquaculture for rural development), FaST (Freshwater Aquaculture Center Selected Strain), GST (Genomar Supreme Tilapia) and GMT (Genetically Male Tilapia), respectively (Eguia & Romana-Eguia, 2007). Aside from tilapia strains for freshwater environment, saline tolerant tilapia is also developed for stocking in brackish water environment. These are the improved Brackish water Enhanced Selected Tilapia (iBEST), hybrid cross of *O. mossambicus* and *O. niloticus* commonly known as "Molobicus", and Red Tilapia. In addition, other well-known strains that are developed in the Philippines are Cold-tolerant tilapia, SEAFDEC strain, hybrid of *O. hornorum*, and BEST 200 developed by San Miguel Corporation (Romana-Eguia, Eguia, & Pakingking, 2020).

Census on Tilapia Hatcheries, Grow-out Farms, Processors, and Aquafeed Millers in the Philippines (Figure 1) shows that the Philippines currently has a total of 623 hatcheries of which 125 are government-operated and the majority or 498 are owned by private individuals. Grow-out farms on the other hand have reached 60,056 farms located around the country. Most of the grow-out farms are located in Regions II, III and in CAR. Meanwhile, there are around 15 processors of tilapia operating nationwide and 48 aquafeed millers that are manufacturing tilapia feeds (BFAR-Regional Offices stakeholder directory, 2021).

FIGURE 1: CENSUS ON TILAPIA HATCHERIES, GROW-OUT FARMS, PROCESSORS AND AQUAFEED MILLERS IN THE PHILIPPINES



In terms of hatcheries, PSA reported that there were 224 tilapia hatcheries in 2012. Most of them are located in Region IV-A (49), III (46) and XII (30). Recently, based from the data gathered from BFAR-Regional Offices (BFAR-ROs), there are 623 existing hatcheries nationwide and most of them are located in Region XII (202), Region IV-A (115) and Region III (69) (Table 1).

TABLE 1: CENSUS OF TILAPIA HATCHERIES IN 2012 AND 2021

Region	Number of Tilapia Hatcheries	
	2012/a	2021/b
NCR	0	--
CAR	*	47
I	*	25
II	28	18
III	47	69
IV-A	49	115
IV-B	*	8
V	*	26
VI	11	21
VII	*	2
VIII	10	16
IX	*	9
X	*	11
XI	*	23
XII	30	202
XIII	*	31
BARMM	*	--
Total	224	623

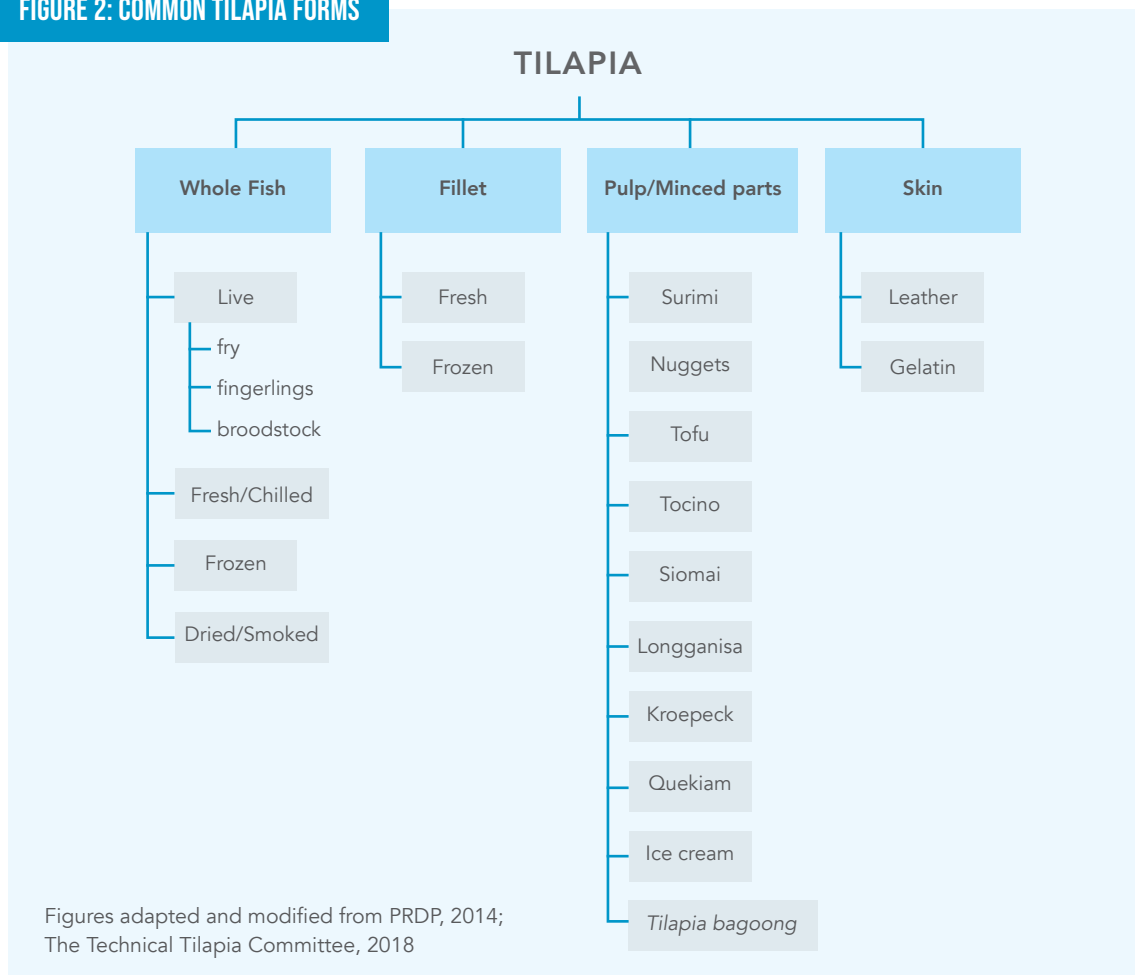
Note: *=<10 hatcheries; --= no data available; /a=PSA, 2012; /b=BFAR-RO stakeholder directory, 2021

Product Forms

Tilapia products in the Philippines comes in varied forms. It can be categorized into four major forms: (1) whole fish, (2) fillet, (3) pulp/minced parts, and (4) skin. Presented in Figure 2 are the tilapia forms are commonly traded in the Philippines (Philippine Rural Development Project, 2014; The Tilapia Technical Committee, 2018).

Several forms can be made out of the whole tilapia. Such examples are live, fresh, frozen (whole gutted), dried, and smoked. Meanwhile, fillet form, fresh and frozen fillet are the common products that are sold in the markets. In terms of pulp and minced parts, value-added products such as surimi, nuggets, tofu, tocino, siomai, longganisa, kroepeck, quekiam, ice cream and tilapia bagoong can be processed out of pulp and minced flesh of tilapia. Furthermore, leather and gelatin can be produced out of tilapia skin.

FIGURE 2: COMMON TILAPIA FORMS



The common export forms of tilapia are frozen whole gutted and fillet. Meanwhile, institutional buyers (e.g. supermarket, restaurants and specialty food shop) prefer the frozen whole gutted, fillet, belly and skin.

In local and wet market, tilapia is commonly sold in fresh and live form. Households generally prefer live whole tilapia (200-250 g/fish). However, consumers in Northern Luzon typically prefer darker-skinned tilapia due to its “tastier meat and has more belly fats” according to locals. The most common food recipes for tilapia are charcoal grilled, fried, *sinigang*, and *paksiw*. Meanwhile, the live form of tilapia is the fry, fingerlings and broodstock.

The most commonly known processed form of tilapia are *tilanggit* and *buro*. Other processed forms include smoked (bone and deboned), surimi, and tilapia pulps. In some parts of the Philippines, there is a production of tilapia bagoong or tilapia fish paste. However, production and distribution of these processed tilapia products are very limited and usually undertaken by microenterprises and government supported community groups.

Aside from traditional and value-added products, novel forms have been produced through the project funded by the Department of Science and Technology (DOST). These tilapia cookies and ice cream which have been developed and promoted by Central Luzon State University (CLSU) was awarded with the Innovation Gold Award 2016 during the Salon International de L'Agroalimentaire (SIAL) ASEAN Manila in 2016.

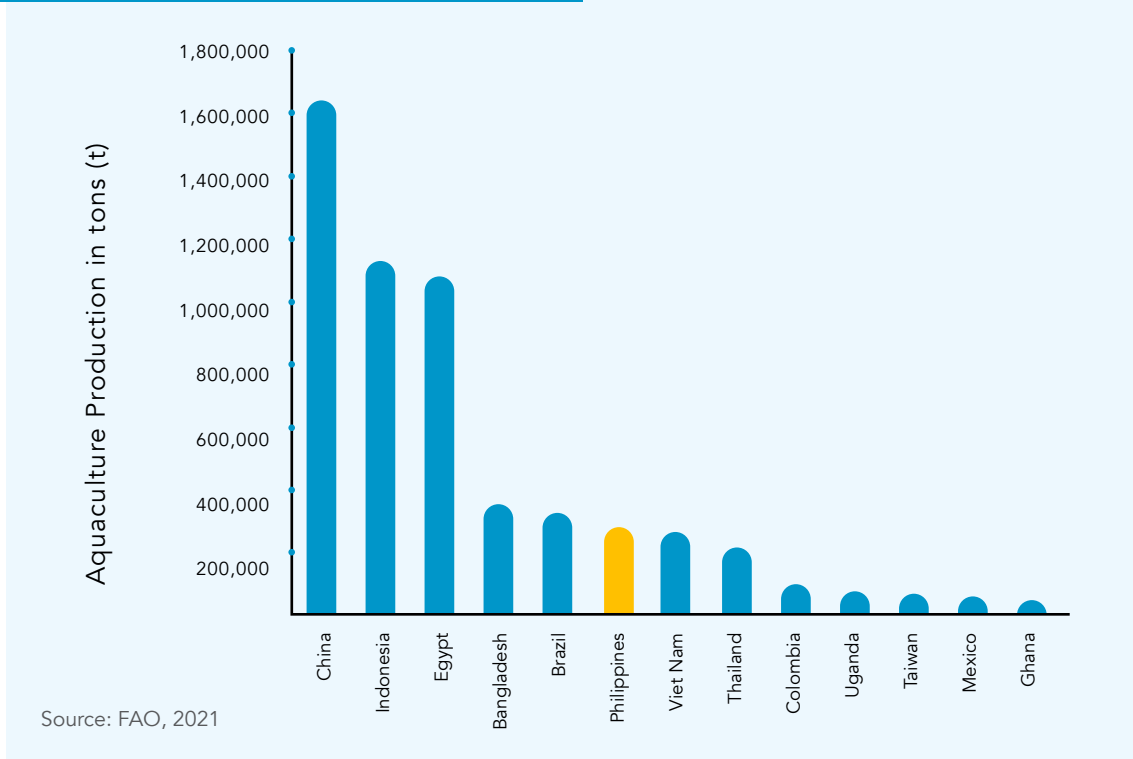
Industry Performance and Outlook

Production

World Farmed Tilapia Production

Tilapia is the most popular cultured aquatic species in the world, in which 145 countries are into tilapia production. Furthermore, China remained as the top producer of farmed tilapia with 1,641,662 tons in 2019, representing the 26.5% of the total global production of 6,192,963 tons (FAO, 2021). In 2015, China's Evergreen Company, in cooperation with Egypt, established a 1,680 ha fish farm project capable of producing 2,000 tons of shrimp, 3,000 tons of saltwater fishes, and 1,600 tons of freshwater fishes per cycle (Ahram, 2017). Meanwhile, Philippines maintained its position as the 6th world producer of farmed tilapia in 2019. It produced a total of 279,385.9 MT of farmed tilapia that accounted for the 4.5% of total global production of tilapia as shown in Figure 3 (PSA, 2021).

FIGURE 3: WORLD PRODUCER OF FARMED TILAPIA IN 2018



Domestic Tilapia Production

The Philippine tilapia industry has made a notable growth in tilapia production from 2002 to 2020 (Figure 3). Ninety-nine percent increase in production was observed since 2002. In terms of aquaculture and inland municipal production, the industry increased its production by 115.58 and 32.39% during the similar period, respectively. The highest recorded total production was observed during 2019 with a total production of 321,187.79 MT (PSA, 2021).

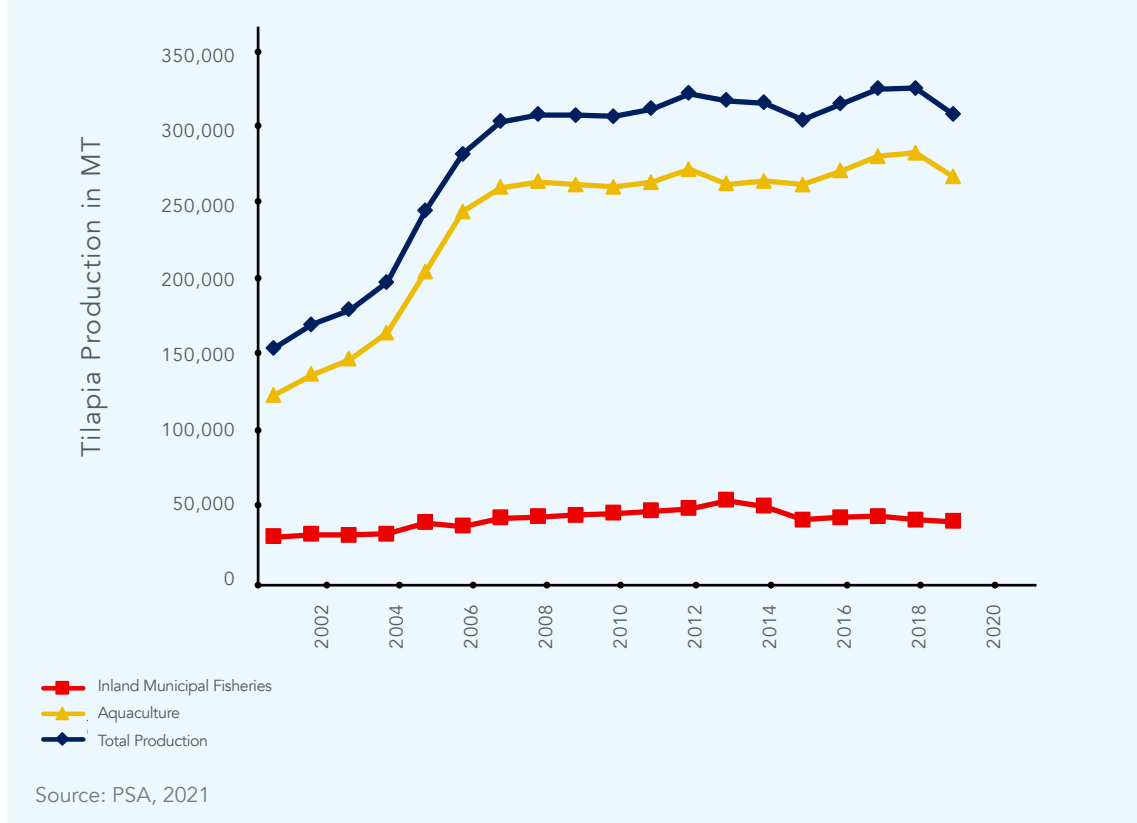
In terms of aquaculture production, the industry increased its production by 115.58%. Figure 4 shows that tilapia production in 2002 to 2020 doubled and this may be attributed to the several interventions done by the government. One is the introduction of Genetically Improved Farmed Tilapia (GIFT) and other improved tilapia strains (e.g. GET-EXCEL, FaST, and GST) to the aquaculture industry. In addition, the Department of Agriculture (DA) initiated the creation of the flagship project “Nationwide Dissemination of GET EXCEL Tilapia”. This project is mandated to replace the old breed of tilapia in the country with the latest and improved breed of tilapia, the GET-EXCEL tilapia. The said projects may have contributed to the significant increase in production of tilapia in the country.

For inland municipal catch of tilapia, decline in production (-23.08%) was recorded during 2014-2016 and rises again by 5.74% in 2016-2018. The inland municipal catch of tilapia remained stable in the following years.

In 2017, the DA-BFAR initiated a program, Balik Sigla sa Ilog at Lawa (BASIL). This program is mandated to restore the life and productivity of inland waters — lakes, rivers and reservoir. BFAR also distributed motor bancas, fishing gears, life vests and other materials necessary for fishing. Regular stocking of tilapia fry and other endemic fishes has been conducted since the establishment of the program. However, during the implementation of BASIL program, several issues arose including that of tilapia being invasive species when introduced into bodies of water such as lakes, rivers and reservoirs. Hence, BFAR issued supplementary guidelines through Fisheries Office Order (FOO) No. 338, series of 2019 or “Guidelines on the Dispersal/Distribution of Fish Fingerlings and Broodstock”. This emphasizes provisions and the stock enhancement composed

of diverse species excluding tilapia in communal bodies of water such as lakes, rivers, reservoirs, small water impoundments and the likes. Since its approval in 2019, inland municipal catch of tilapia has also declined (-3.22%) from 41,801.92 MT in 2019 to 40,445.3 MT in 2020 (PSA, 2021).

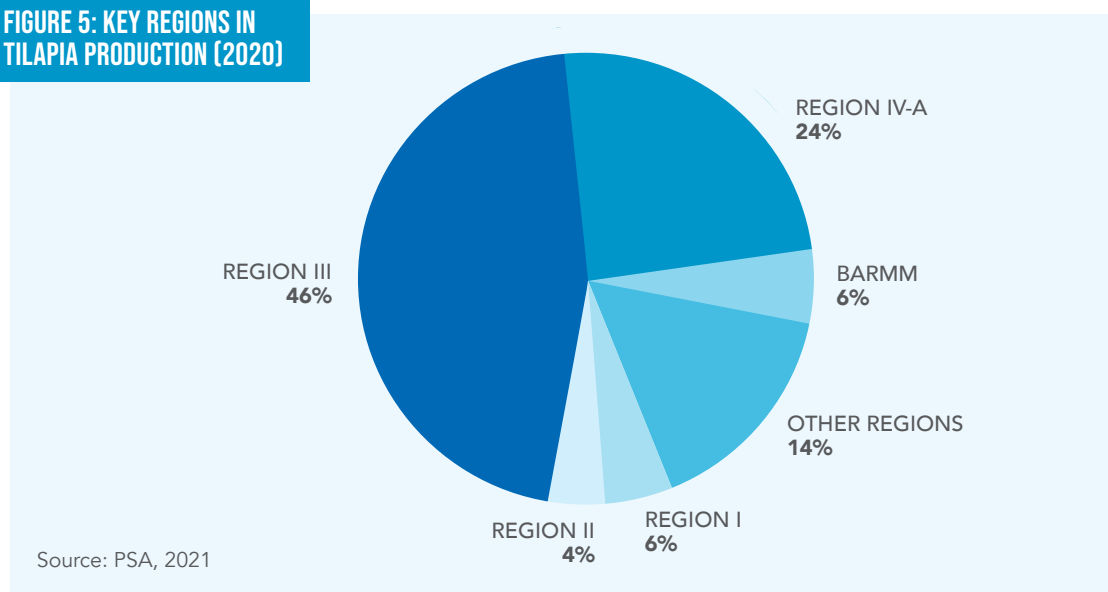
FIGURE 4: COUNTRY'S TILAPIA PRODUCTION (2002-2020)



Key Regional Producers

In 2020, 85.96% or 261,608.38 MT of 304,326.59 MT of tilapia were accounted from five (5) key regions. These are Region III (45.71%), Region IV-A (23.84%), Bangsamoro Autonomous Region of Muslim Mindanao (BARMM) (6.37%), Region I (5.84%) and Region II (4.17%) while the 14.06% were produced from remaining regions (See Figure 5).

FIGURE 5: KEY REGIONS IN TILAPIA PRODUCTION (2020)



Positive growth was registered in Region II (1.28%), III (3.25%) and BARMM (2.8%) from 2019 to 2020 (See Table 2). Meanwhile, the production in Region IV-A have decreased by -23.14 and -1.11% in Region I (PSA, 2021). The decrease in production may have been due to natural calamities such as Taal eruption and typhoons that occurred during the said period. According to a report by FAO, around 6,000 cages in Taal lake were destroyed due to volcanic eruption which incurred a loss of 31.4M USD.

TABLE 2: KEY REGIONS IN TILAPIA PRODUCTION (2020)

REGION	PRODUCTION (MT)	SHARE	GROWTH (%)
III	139,153.84	45.71	3.25
IV-A	72,586.20	23.84	-23.14
BARMM	19,399.03	6.37	2.80
I	17,782.03	5.84	-1.11
II	12,687.28	4.17	1.28
Others	42,812.25	14.06	0.51

Source: PSA, 2021

Aquafarm-type Production

Tilapia aquaculture is mainly being done in freshwater fishponds, cages, pens, and brackish water fishponds, including brackish water pens and cages, marine pens and cages, rice-fish, and small farm reservoirs.

From 2000 to 2020, an upward production trend has been observed in freshwater fishpond from 43,173.78 MT to 164,072.52 MT (280.03%), in freshwater cages from 37,622.0 MT to 64,111.18 MT (70.41%), freshwater pens from 3,688.0 MT to 17,020.74 MT (361.52%) and brackish water fishponds from 8,033 MT to 18,406.36 MT (129.13%) (See Figure 6) (PSA, 2021). During the similar period, brackish water cages production has increased from 9 MT to 122.16 MT (1,257.33%). However, a decline in production was observed in brackish water ponds, marine pens and cages by -0.51%, -81.0% and -17.42%, respectively. Since the introduction of rice-fish in 2007 and small farm reservoir in 2005, the production from these systems has increased from 1.19 MT to 3.69 MT (210.08%) for the former and from 25.92 MT to 83.13 MT (220.72%) for the latter (See Figure 7) (PSA, 2021).

FIGURE 6: PRODUCTION TREND PER AQUAFARM (2000-2020)

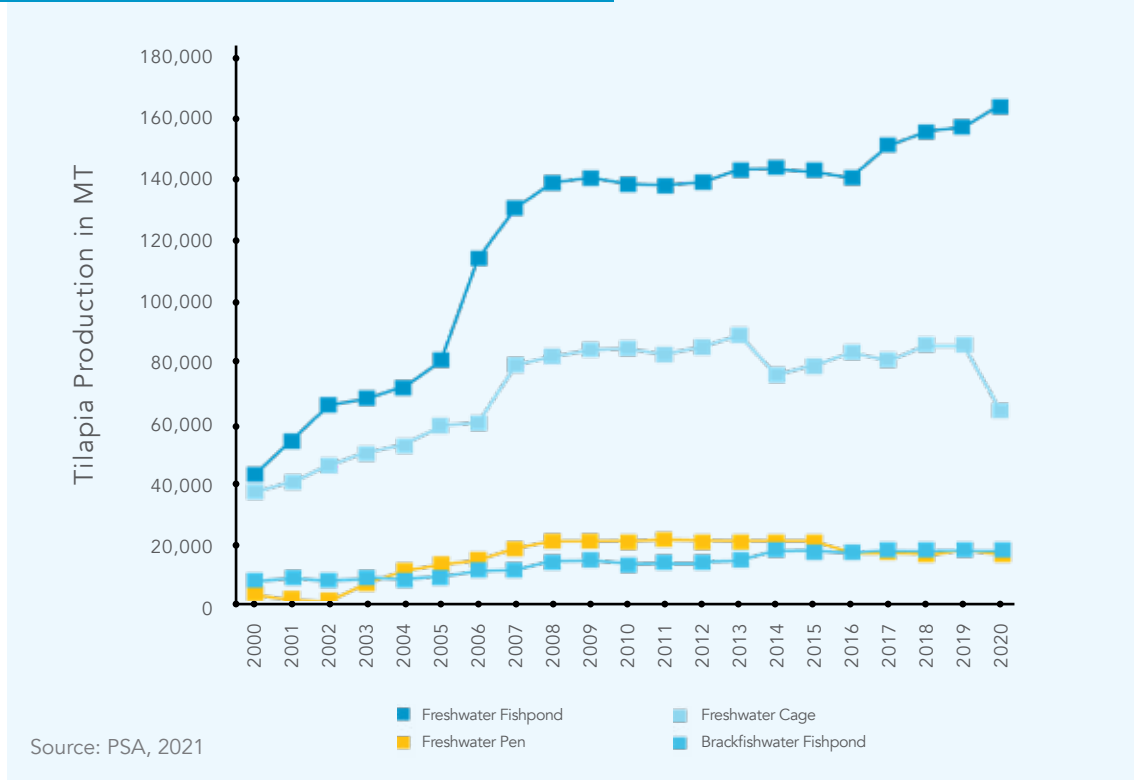
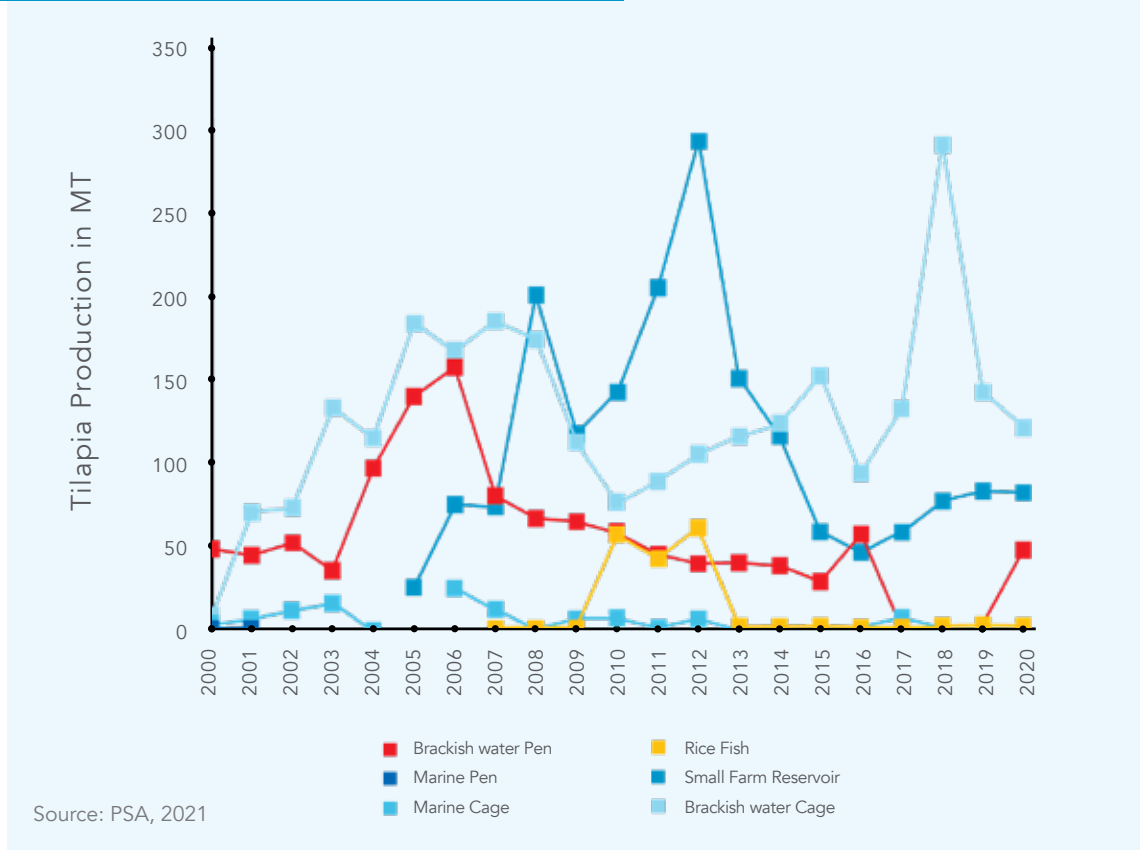


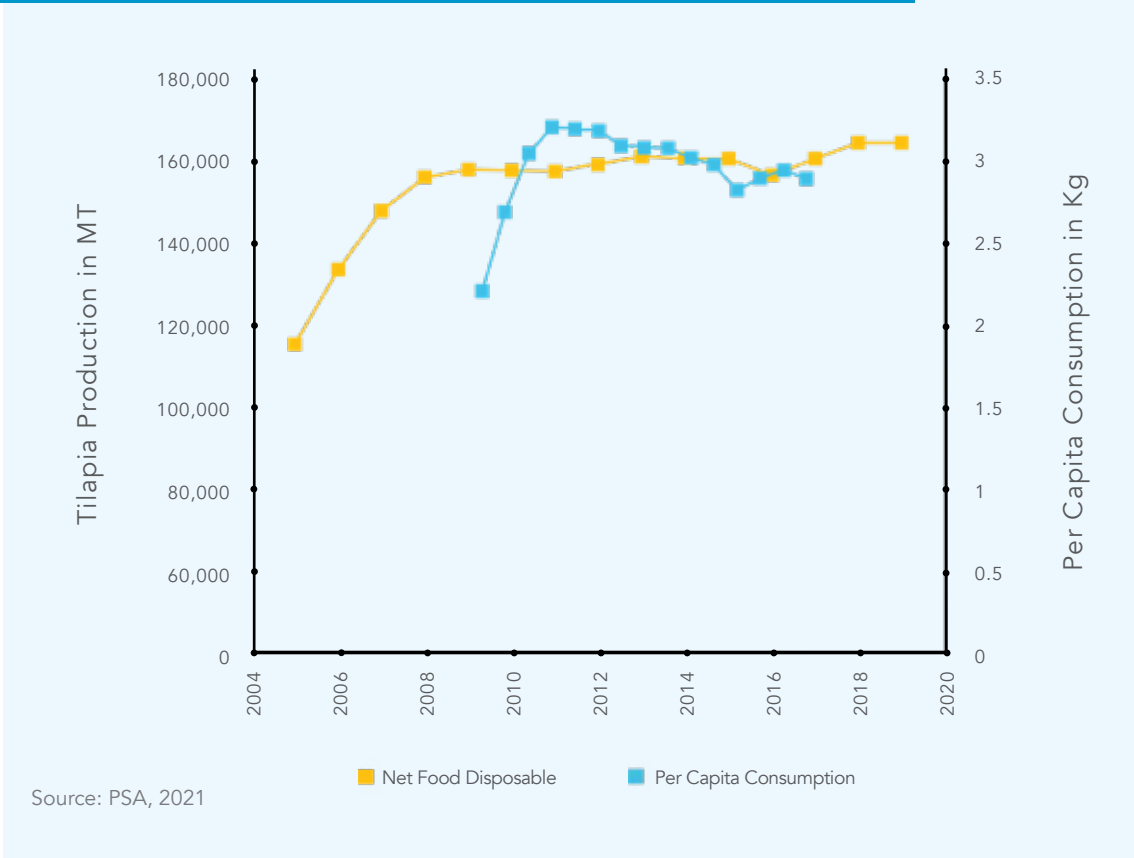
FIGURE 7: PRODUCTION TREND PER AQUAFARM (2000-2020)



Consumption

Tilapia is one of the most sought-after sources of cheap protein. Among the freshwater fishes, tilapia is the most consumed fish for animal protein due to the market acceptance of Filipinos and its year-round availability. From 2005-2019, the average annual per capita consumption of tilapia was 2.96Kg. The annual per capita consumption of Filipinos in 2019 was 2.9Kg (See Figure 8) (PSA, 2021).

FIGURE 8: NET FOOD DISPOSABLE AND PER CAPITA CONSUMPTION OF TILAPIA (2005-2019)



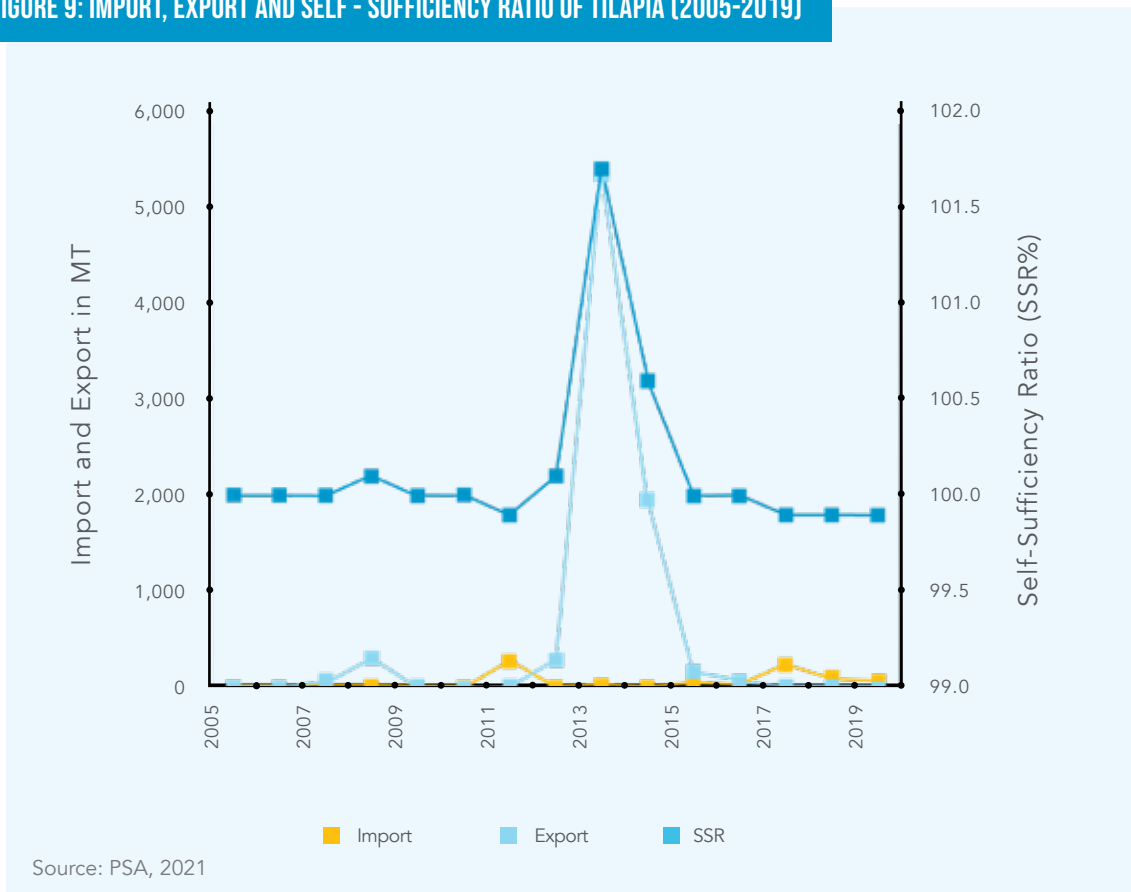
Trade

Import and Export Scenario

The industry has been able to export tilapia with a total volume of 8,165 MT from 2005-2019. The highest volume of tilapia exported was in 2013 (5,319 MT). However, in 2005-2006, 2010-2011, and 2019, Philippines was not able to export tilapia. Tilapia importation was relatively low. The total volume of tilapia imported in the country from 2005-2019 was 813 MT. In 2019, a total of 62 MT of tilapia was imported into the country (PSA, 2021). Furthermore, no importation has occurred from 2005-2006, in 2010, 2012, and 2014. The highest tilapia importation was recorded in 2011 (277 MT).

Self-Sufficiency Ratio (SSR) measures the extent to which a country relies on its own production to meet the domestic requirements of the populace. A ratio of less than 100% indicates inadequacy of food production to cope with the demand of the population; equal to 100% indicates that the food production capacity of the sector is enough to support the food needs of the population; ratio of greater than 100% indicates that domestic production is more than enough to support the domestic requirements. The higher the ratio, the greater the self-sufficiency. Concurrent to the data in SSR, the country has been able to maintain 100% SSR from 2006-2010, and 2012-2016, therefore insignificant amount of tilapia has been imported to the country (PSA, 2021). Meanwhile, tilapia exportation has occurred during the same period wherein SSR of the country is 100% and above (See Figure 9).

FIGURE 9: IMPORT, EXPORT AND SELF - SUFFICIENCY RATIO OF TILAPIA (2005-2019)

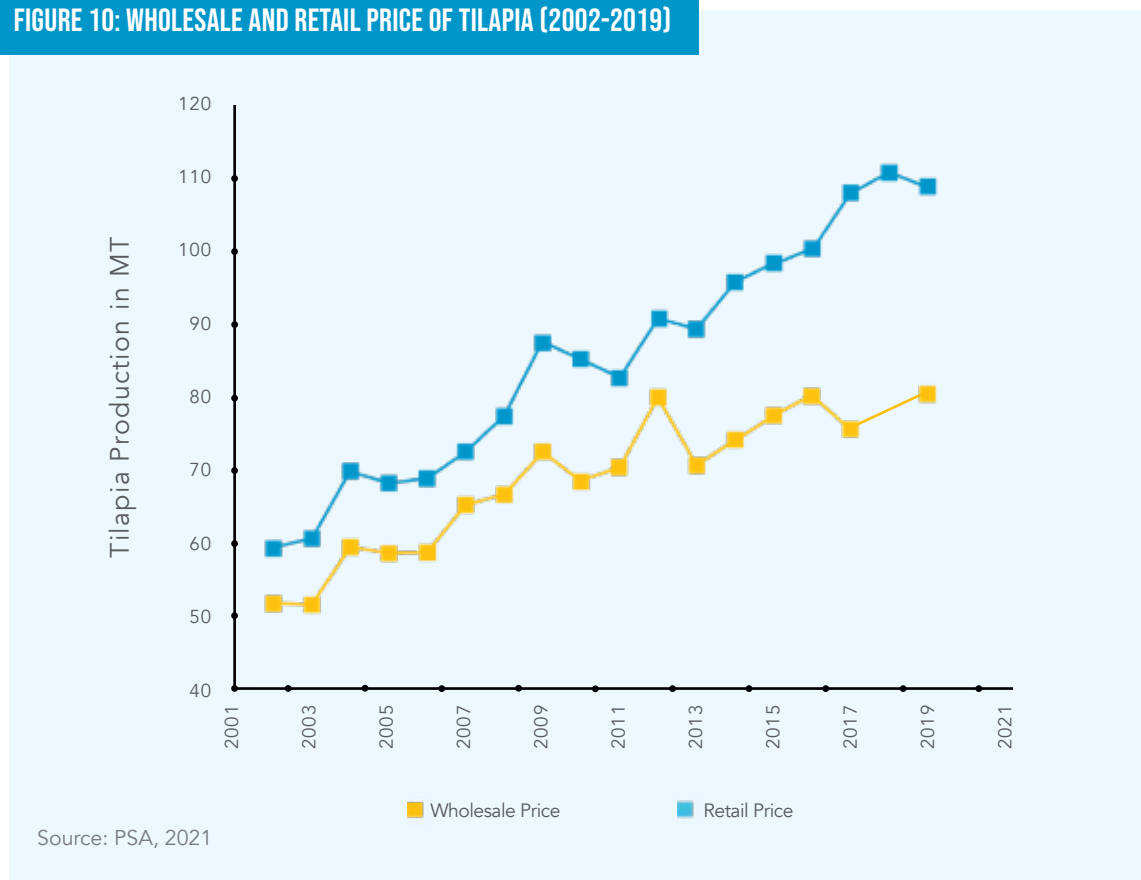


Prices

Domestic Prices

The cost of tilapia has been increasing from 2002-2019 (See Figure 10). The wholesale price of tilapia from 2002 to 2019 increased by 55.2% while retail price was up by 83%. In 2019, the prevailing wholesale price of tilapia was PhP 80.60 while PhP 109.00 for the retail price (PSA, 2021). Seasonality of production has an impact on tilapia price market. Generally, prices are higher during lean months and lower during peak months.

FIGURE 10: WHOLESALE AND RETAIL PRICE OF TILAPIA (2002-2019)



ANALYSIS OF THE TILAPIA INDUSTRY

Value Chain Map (Structural Analysis)

Supply Chain Segments and Players

Hatcheries

The responsibilities of hatchery and nursery operators cover the general operation of farm facilities. Duties are not limited to maintenance and conditioning of breeders, egg and fry collection, nursing of fry, and the general operations of the facilities and provision of technical guidance to grow-out operators. Hatchery and nursery operators are closely linked and coordinated with each other. In some provinces particularly in Laguna and Batangas, hatchery operators, offer delivery of fry to the nursery operators, then the latter will rear the fry until it reaches the sizes preferred by some grow-out operators, size 14 and 12 (Jamandre et al., 2011).

Other Input Suppliers

Input Suppliers include feed companies, fertilizer suppliers, cage manufacturers, and equipment and other tools dealers/suppliers. Some of the known tilapia feed manufacturers are B-meg or San Miguel Foods, Inc., Charoen Pokphand Foods, FeedMix, Feedworld, Hoc Po, President Feeds, Purina or Cargill, Sahara, and Santeh feeds (PRDP, 2014). Based on the data gathered on BFAR-Fish Health Management and Quality Assurance Laboratory, currently, there are 48 registered aqua feed millers in the country and majority (35 registered aqua feed mills) are situated in Luzon.

Farm Production

Cage and pond operators have different practices in the preparation of ponds. Tilapia growers utilizing earthen ponds are preparing them by soil tilling, drying, liming, and applying inorganic and organic fertilizer such as animal manure in order to improve the productivity of the pond. After stocking of fingerlings, regular activities in the farm involve water management (water flushing and monitoring of water parameters like dissolved oxygen, pH, and turbidity), stock sampling, and feeding. For cage operation, activities prior to actual operation include cage preparation and installation. The rest is similar to that of the pond culture. After four months of culture, stocks will be harvested and either sold to the traders or directly to the consumers.

Marketing/Trading

Traders/wholesalers, *viajeros/retailers*, and agents (*consignacion*) are the key players in this segment. The consolidators are the biggest traders who regularly supply supermarkets and bulk buyers in major fish terminal markets (or transshipment points). Then, the agents facilitate the transactions between the traders (*viajeros*) and bulk buyers (provincial traders) for a commission fee. They also act as gatekeepers key players in the price discovery process thus also perform price monitoring and occasional small-scale trading. Wholesalers and/or *viajeros* buy tilapia from the terminal market in bulk and ship them to other bulk buyers serving other geographical markets. Strategically, some wholesalers resort to backward integration by producing their own tilapia and contracting other farmers to meet market commitment and reduce supply risks. The retailers are the smallest players in the segment and market chain that finally cater the end-user/costumer (Jamandre et al., 2011).

Processing

The small-scale processors process tilapia into smoked and *tilanggit* (similar to *danggit*) products. Medium scale processors who are into the export business process fresh fish into fillet. Whole-gutted-frozen tilapias are also exported to other countries. Some processors regularly supply specific product forms such as fillet, cubes, whole frozen and choice portions or trimmings for institutional buyers (supermarket, specialty food shop,

food chain, bar, restaurants and canteens) (Jamandre et al., 2011). Based on the data gathered from BFAR-ROs, there are 15 tilapia processing facilities in the country. Seven (7) are situated in Region 3, four (4) in Region 10, two (2) in Region 9, one (1) in Region 1, and the last one (1) in CAR.

Markets

Local markets of tilapia are the wet markets (*palengke*), supermarkets, processing plants, and supermarkets. Tilapia fillet is sold locally in the supermarkets and restaurants and exported to the other countries at the same time. Meanwhile, whole gutted-frozen tilapia is mostly exported.

Logistics

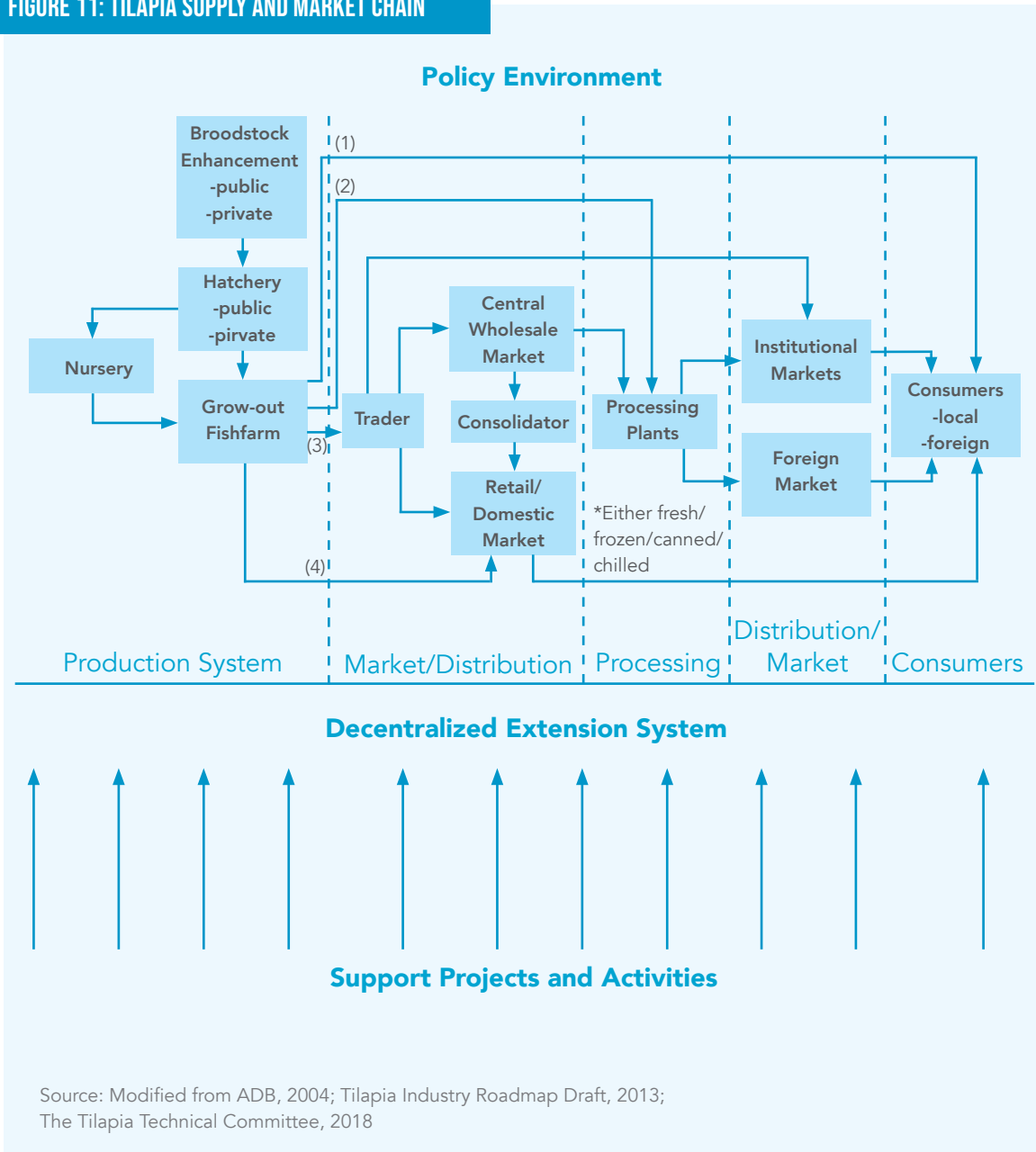
The logistic providers offer services for transport (local and international) and storage of processed tilapia.

Tilapia Supply and Market Chain

The market channel for tilapia as food fish is relatively short due to the perishable nature of fresh fish and the high preference or demand of local consumers for live tilapia (The Tilapia Technical Committee, 2018). Generally, there are four market channels of tilapia in the country (See Figure 11). Channel 1 is the shortest and most direct among the four types of market channels. This channel is common in backyard tilapia growers. Tilapia producers typically sell the tilapia to consumers. Meanwhile, channel 2 is an emerging market channel that caters to the potential of tilapia as processed and exportable products. Some processors employ contract growing schemes among producers to ensure the sufficient production of desired juvenile-sized tilapia (in the case of tilanggit processors) and large-sized tilapia (≥ 600 g). Processed products such as fillet are sold in institutional market (e.g. supermarket, hotel and restaurants, and specialty shops). On the other hand, smoked and dried tilapia (*tilanggit*) are usually sold locally and in supermarkets. Channel 3 is considered the longest market chain with the addition of

traders on top of wholesalers, consolidators and retailers. This type of market chains is found in large tilapia markets. Finally, channel 4 is the most common market chain of tilapia in the Philippines, found among the small to medium scale tilapia grow-out producers whose harvest are transported o retail or domestic market with or without the aid of traders down to consumers.

FIGURE 11: TILAPIA SUPPLY AND MARKET CHAIN



SWOT Analysis (Chain Segment)

Strengths

The Bureau has succeeded in producing high quality tilapia broodstock. The broodstock available for our tilapia producers are fast growing, disease resistant, and resilient to climate change. The Bureau is also supported by different Fish Health Laboratories for fish disease diagnosis and prophylaxis. Moreover, nutritional requirements of tilapia are not to be compromised because raw materials for feed formulation are locally available. As such, tilapia feed-manufacturers are knowledgeable in proper feed formulation for faster growth and healthy production. Technical assistance and developed technologies are available and can be provided thru trainings and seminars when possible.

At present, the government has established a strong arm in aquaculture research through a strong linkage with National Fisheries Research Development Institute (NFRDI). Researches open opportunities to deal with other areas such as nutritional value of tilapia which support food and health security. Importantly, logistics of small tilapia producers is supported by “Kadiwa ni Ani at Kita Market” program to assist small producers in marketing their products. Table 3 shows the strengths, weaknesses, opportunities, and threats of the tilapia chain segment.

Weaknesses

Commercial feeds a great comprise 60-70% of total production cost. At present, there is no government facility or program that subsidizes tilapia feed production cost. Unavailability or limited supply of raw materials for feed formulation and production such as nets, ropes, and chemicals used in pond preparation commands higher price in some areas.

Fingerling supply also significantly affects the production program of fish farmers. Some municipalities have limited area and rely on rain waters which are the primary requirement in tilapia production. Supply of fingerlings is also greatly affected by cold weather which influences diseases. The lack or even absence of market-supply for oversized fingerlings also poses serious problems to fish farmers. Local Government Units hatcheries and

nurseries are not available for the provision of accessible sources of fingerlings. The availability of tilapia fingerlings in some Local Government Unit's hatcheries and nurseries are lacking due to technical and financial capacity of the LGU's facilities.

Opportunities

An important area in aquaculture research is the use of alternative local agriculture-by-products as potential raw materials for feeds and supplemental feeding. The country, being tropical, has vast agricultural resources that can be tapped as cheap sources of raw materials. Feed formulation may vary depending on the availability of raw materials but without compromising its nutritional value.

Upgrading tilapia hatcheries is another major concern to increase fish production and mitigate problems in fingerling supply. Fingerlings shall be disseminated to areas/ regions with low tilapia production. To support this, improvements in loan windows (e.g. Agricultural Competitive Enhancement Fund and Agricultural Credit Policy Council) through Landbank Development are available at low interest rates. The production of post-fingerlings/ larger juveniles is another technology that may shorten the culture period and payback time. Tilapia utilization in shrimp farms adopting green water technology is also a good opportunity for tilapia hatcheries. Shrimp farms are now stocking tilapias which consume planktons and bacteria (present in water column) that may be harmful to shrimps.

Based on report, reduction of imported tilapia processed products from China increases demand and job opportunities. Tilapia is a promising commodity especially when exported in fillet form because of its white meat and high protein content. With such export demand where competition is high, facilities in postharvest production must be upgraded to meet the demand. Identification of potential areas for aqua park offers opportunities for job generation and provision of alternative livelihood.

Threats

Fluctuating temperatures cause fish stress that often causes fish mortalities. Proper handling and provision of flowing water must be well taken care of to address such conditions. Philippines gets affected by at least 30 typhoons per year. During such natural calamities, fish farms may experience either strong winds, heavy rains or floods/flooding.

Another concern of fish farmers is the emergence of new fish diseases. The global COVID19 pandemic has likewise brought about constraints in the delivery and movement of inputs and produce due to border restrictions.

Different loan programs by the government with usually minimal interest are available, however, some are not feasible given the voluminous documentary requirements. Lack of fish growers mean insufficient supply and leads to importation of low quality tilapia products.

TABLE 3: SWOT ANALYSIS OF TILAPIA CHAIN SEGMENT

CHAIN SEGMENT	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Input Supply	<ul style="list-style-type: none"> • Availability of quality broodstock from BFAR Breeding Nucleus and Central Hatcheries • Availability of quality (improved strains, disease free) fingerlings from B, FAR registered hatcheries • Availability of raw materials for feed formulation and development • Availability of commercial feeds for different production stages of tilapia • Availability of laboratory services for screening TiLV in farm stocks by BFAR Regional Fisheries Laboratory and NFRDI-Fisheries Biotechnology Center • Established BFAR protocol for hatchery registration • Established government standard and low-price quality tilapia fingerlings and broodstock (FOO 338) • Tilapia technology trainings and information provided by BFAR 	<ul style="list-style-type: none"> • High cost of raw materials and equipment (e.g. extruders) for tilapia feed production • High price and limited supply of production materials such as nets, ropes, tea seed etc. • No supply chain for bigger size fingerlings • Unstandardized sizes and prices of fingerlings in government and private tilapia hatcheries • Lack of financial capacity to pay outright production inputs • High cost of commercial feeds • No government feed mill facility to produce subsidized feeds for the stocks • Limited fingerling supplies during cold months • Pandemic restrictions on travel and mobilization 	<ul style="list-style-type: none"> • Availability of alternative local agri-by-product as supplemental feeds • Utilization of invasive species as raw materials for feed formulation • Upgrading of tilapia hatcheries in key tilapia producing areas • Supply of production inputs from the local market (farm inputs, fingerlings and marketable size tilapia) • Available loan windows (ACEF and ACPC) through Landbank • Development of cost-effective diet (R4D output) • Job generation and provision of alternative livelihood from private and government institutions 	<ul style="list-style-type: none"> • Unstable climatic and weather conditions and natural calamities • Current COVID19 pandemic hampering the delivery and movement of inputs and produce • Local border restrictions that affect logistics • Quality of feeds
Production	<ul style="list-style-type: none"> • Availability and easy access to latest technologies • Wider areas available for farming • Full government support • Highly trained manpower at the national level on tilapia technologies • Lots of researchable areas like production of tilapia with omega 3 (good for the heart) and breed that can tolerate climate change 	<ul style="list-style-type: none"> • High production cost (especially feeds) • Disease problems and mortalities • High dependence on ground water • Lack of hatcheries and nurseries (LGU level) • Lack of capacity to grow tilapia at the size and weight required by the processors, institutional and export market. • Absence of BFAR guidelines for the registration of grow-out farms • Unavailability of tilapia seed during cold season-decrease • Limited production areas in some localities 	<ul style="list-style-type: none"> • Adoption of green water technology (utilizing tilapia in shrimp farms) • Production of post-fingerling producers • Strong linkage with fingerlings producers • Crafting of BFAR guidelines for the registration of grow-out farms • Presence of potential areas for aqua park • Intensify post-fingerlings production to shorten culture period • Job generation and provision of alternative livelihood 	<ul style="list-style-type: none"> • Abrupt changes in temperature from May to August • Emergence of new disease • Climate change and occurrence of typhoon and other natural calamities

CHAIN SEGMENT	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Post-Harvest/ Processing	<ul style="list-style-type: none"> Available technology from BFAR given thru trainings, seminars, and IECs (brochures, etc.) 	<ul style="list-style-type: none"> Geographical and environmental condition disadvantages Slow adaption of stakeholders to the technology Increase of capital in the implementation of new technology Weak domestic and international marketing assistance of the government Lack of raw materials for fillet (>500g/pc) Weak traceability of products Limited supply of raw materials Limited facilities High cost of production which results to weaker competition with international produced fillets 	<ul style="list-style-type: none"> Increased production Increased income Availability of insurance (Philippine Crop Insurance Corporation) and loan widows such as LBP, AEF Increased export demand (specifically Europe and U.S.) on tilapia fillet because of its white meat and increasing awareness and concern of people on their health Reduction of tilapia processed products from China Job generation and provision of alternative livelihood Increased income Mechanization/automation of postharvest in tilapia 	<ul style="list-style-type: none"> Volatile farm gate price Unstable climatic and weather conditions
Marketing/ Distribution	<ul style="list-style-type: none"> Existing reefer van of BFAR to assist small producers for the movement and transportation of their produce (e.g. KADIWA Agri fairs) Established market linkage mechanisms 	<ul style="list-style-type: none"> Too many market layers Lack of awareness on processed products 	<ul style="list-style-type: none"> Online marketing services Export quality and market Provision of fish supply to less producing areas/regions 	<ul style="list-style-type: none"> Importation of cheap and lower quality tilapia products Local border restrictions that affect logistics Reduced fisherfolk income
Cross-cutting Capital	<ul style="list-style-type: none"> Funding mechanisms Provision of government subsidies 	<ul style="list-style-type: none"> Infrastructure is not in place (farm-to-market roads) Weak credit access Security Lack of efficient/trained manpower to effectively transfer technology at the municipal level to fish farmers Unsustainable repayment of stakeholders Lack of required documents submitted by potential stakeholders 	<ul style="list-style-type: none"> More stakeholders venturing into tilapia production Higher production Higher income Sustainable fish supply Increase in the number of qualified fisheries professionals 	<ul style="list-style-type: none"> Prioritization of government funds Voluminous documentary Requirements of lending institutions

Farm Income/Costs and Return Analysis

The average production costs and return of a one-hectare tilapia grow-out farm in 2019 is presented in Table 4. The average total operational costs is PhP 302,000.00 wherein 85% or PhP 256,959.00 is accounted to the total cash costs. Furthermore, feed cost of PhP 172,033.00 accounts for 56.9% followed by fingerling cost of PhP 43,572.00 accounting for 14.4% and labor cost of PhP 17,591.00 accounting for 5.8% of the total production. Meanwhile, imputed cost account for 14.1% (PhP 42,740.00) followed by non-cash costs of PhP 2,700.00 which accounts for the 0.01% of the total production cost (PSA, 2021).

Generally, the average gross return of 1-ha tilapia farm in 2019 is PhP 486,890.00 with a yield of 6,048 kilograms/hectare. These values correspond to the net return of PhP 184,490/cycle.

TABLE 4: AVERAGE PRODUCTION COSTS AND RETURNS OF 1-HECTARE TILAPIA GROW-OUT FISHPOND FARM (2019)

PARAMETER	AMOUNT (PHP)
CASH COSTS	256,959.00
Stocking materials paid in cash	43,572.00
Feeds paid in cash	172,033.00
Fertilizer paid in cash	1,869.00
Pesticides and other materials inputs	2,284.00
Hired labor	9,623.00
Land tax	185.00
Rentals	4,583.00
Salaries of permanent employees	1,363.00
Wage of stay-in labourer paid in cash	7,968.00
Fuel and oil	6,647.00
Transportation cost of inputs	874.00
License/permits	7.00
Electricity	140.00
Interest payment on loans	728.00
Food expense for laborers	1,725.00
Repairs	3,315.00
Other expenses	43.00

PARAMETER	AMOUNT (PHP)
NON-CASH COSTS	256,959.00
Stocking materials paid in kind	381.00
Feeds paid in kind	104.00
Fertilizer paid in kind	16.00
Hired labor paid in kind	319.00
Harvester's share	650.00
Caretaker's share	44.00
Wage of stay-in laborer paid in kind	572.00
Other laborer's share	510.00
Lease fishpond rentals	78.00
Rice allowance overseer	27.00
IMPUTED COSTS	42,740.00
Stocking materials	403.00
Feeds	165.00
Fertilizer	1.00
Operator labor	3,443.00
Family labor	1,253.00
Exchange labor	3.00
Depreciation	7,801.00
Interest on operating capital	16,918.00
Rental value of owned fishpond	12,753.00
ALL COSTS	302,400.00
Gross returns	486,890.00
Returns above cash costs	229,931.00
Return above cash and non-cash costs	227,230.00
Net returns	184,490.00
Net profit-cost ratio	1
Cost per kilogram (PhP/Kg)	50.00
Yield per hectare (Kg)	6,048.00
Farmgate price (PhP/Kg)	81.00

Source: PSA, 2021

The cost and return margins along the tilapia supply chain were estimated based on the information given by the tilapia grow-out operators in Central Luzon, Pampanga, and Mindanao.

In a typical 1-ha farm in Central Luzon, the farmgate cost per kilogram of fresh or live tilapia reaches PhP 64.09. The total production cost per kilogram is broken down to feeds at PhP 45.5, fingerlings at PhP 5.25, diesel at PhP 4.04, land lease at PhP 1.65, and labor and maintenance at PhP 6.00. The farmer's margin is PhP15.91 at farmgate price of PhP80.00. In the distribution and market chain, logistics, distribution, and trading add an additional cost of PhP10.70 that covers the handling, transport and informal fees and PhP2.00 for ice. Meanwhile, the *consignor* or *bakulera* adds a margin price of PhP4.80. Another distribution cost of PhP7.90 by the traders adds to the price of tilapia along the chain. Generally, fresh tilapia reaches a retail price of PhP109.00 in the wet market in the wet market (See Table 5).

TABLE 5: FRESH TILAPIA SUPPLY VALUE CHAIN: COST STRUCTURE AND MARGIN, ONE HECTARE FISHPOND CULTURE, TYPICAL FARM, CENTRAL LUZON, PHILIPPINES (2020)

CHAIN SEGMENT	AMOUNT (PHP/KG)
INPUT SUPPLY	
Feeds	45.5
Fingerlings	5.25
Total cost of input	50.75
FARM PRODUCTION	
Cost of inputs	50.75
Labor, maintenance & others	6.00
Diesel	4.04
Land lease	1.65
Miscellaneous	1.65
Farmgate cost	64.09
Farmgate price	80.00
Margin (20-25% mark-up)	15.91
LOGISTICS/DISTRIBUTION	
Handling	2.00
Ice	2.70
Transport and informal fees	6.00
Sub-total	10.70
TRADING	
Farmers' tilapia selling price	80.00
Distribution cost	10.70
Total wholesale cost	90.70
Wholesale price of fresh/chilled tilapia	95.50
Margin(5.3% mark-up) (Consignacion/Bakulera)	4.80

CHAIN SEGMENT	AMOUNT (PHP/KG)
LOGISTICS/DISTRIBUTION	
Handling	1.35
Ice	2.70
Transport and informal fees	3.85
Sub-total	7.90
MARKET	
Wholesale price of tilapia	95.50
Distribution cost	7.90
Total retail cost	103.40
Retail price of fresh/chilled tilapia	109.00
Margin(5.5% mark-up) (Retailer)	5.60

In a semi-intensive, 4-hectare farm, the production cost of tilapia per kilogram is PhP 54.79 with a farm gate price of PhP76.70 at 35-40% mark-up price. A more comprehensive utilization of cost is presented in Table 6. Meanwhile, 5.3 % and 7.6% margin have been added by *consignor* or *bakulera* and retailer, respectively. Another distribution cost of PhP18.6 is being charged by traders, reaching the total retail cost of PhP 100.00 per kilogram of tilapia in the wet market.

TABLE 6: FRESH TILAPIA SUPPLY VALUE CHAIN: COST STRUCTURE AND MARGIN, FOUR HECTARES FISHPOND CULTURE, TYPICAL SEMI-INTENSIVE, PAMPANGA, PHILIPPINES, 2020

CHAIN SEGMENT	AMOUNT (PHP/KG)
INPUT SUPPLY	
Feeds	30.16
Fingerlings	5.25
Fertilizer	2.28
Total cost of input	37.69
FARM PRODUCTION	
Cost of inputs	37.69
Labor, maintenance & others	9.62
Diesel	3.57
Land lease	2.91
Miscellaneous	1.00
Farmgate cost	54.79
Farmgate price	76.70
Margin (35-40% mark-up)	21.91

cont'd ►

CHAIN SEGMENT	AMOUNT (PHP/KG)
LOGISTICS/DISTRIBUTION	
Handling	2.00
Ice	2.70
Transport and informal fees	6.00
Sub-total	10.70
TRADING	
Farmers' tilapia selling price	76.70
Distribution cost	10.70
Total wholesale cost	87.40
Wholesale price of fresh/chilled tilapia	92.00
Margin (5.3% mark-up) (<i>Consignacion/Bakulera</i>)	4.60
LOGISTICS/DISTRIBUTION	
Handling	1.35
Ice	2.70
Transport and informal fees	3.85
Sub-total	7.90
MARKET	
Wholesale price of tilapia	92.00
Distribution cost	7.90
Total retail cost	100.00
Retail price of fresh/chilled tilapia	107.10
Margin (7.6% mark-up)(retailer)	7.10

For a big-scale operation, an 81-hectare farm utilizes PhP75.18 for the total cost of inputs and production to produce 1 kilogram of tilapia. The total cost consists of feeds, fingerlings, fertilizer, probiotic, labor and maintenance, electricity, and land lease. At farmgate price of PhP95.00, the farmer's margin is PhP19.82 or 25-30% mark-up. The detailed costing in every chain is presented in Table 7. For logistics, traders, and distributor, a total of PhP18.6 is added to the initial price of tilapia. Another charge is added by retailer with a mark-up of 5% completing the total retail price of tilapia PhP118.90 in a wet market in Southern Mindanao.

TABLE 7: FRESH TILAPIA SUPPLY VALUE CHAIN: COST STRUCTURE AND MARGIN, 81-HECTARE FISHPOND CULTURE, BIG-SCALE FARM, SOUTHERN MINDANAO, PHILIPPINES (2020)

CHAIN SEGMENT	AMOUNT (PHP/KG)
INPUT SUPPLY	
Feeds	48.00
Fingerlings	10.88
Fertilizer	0.06
Probiotic	0.80
Total cost of input	59.74
FARM PRODUCTION	
Cost of inputs	59.74
Labor and maintenance	13.17
Electricity	0.05
Land lease	2.22
Farmgate cost	75.18
Farmgate price	95.00
Margin (25-30% mark-up)	19.82
LOGISTICS/DISTRIBUTION	
Handling	2.00
Ice	2.70
Transport and informal fees	6.00
Sub-total	10.70
TRADING	
Farmers' tilapia selling price	95.00
Distribution cost	10.70
Total wholesale cost	105.70
Wholesale price of fresh/chilled tilapia	111.00
Margin(5%mark-up) (Consignacion/Bakulera)	5.30
LOGISTICS/DISTRIBUTION	
Handling	1.35
Ice	2.70
Transport and informal fees	3.85
Sub-total	7.90
MARKET	
Wholesale price of tilapia	111.00
Distribution cost	7.90
Total retail cost	118.90
Retail price of fresh/chilled tilapia	125.00
Margin (5.1% mark-up)(Retailer)	6.10

Benchmarking Analysis

Local

Tilapia Hatchery Benchmarking

Qualitative Parameters

Production System

A typical hatchery farm operation is limited to fry collection and fingerling production as a production method. This is done especially in earthen ponds where tilapia breeders are stocked and left to spawn naturally. On the other hand, a modern farm utilizes ponds, hapas, and tanks in the production of fry and fingerlings together with an artificial incubation system for the hatching of collected eggs.

Farm Practices

In terms of pond preparation, both typical and modern farms follow the standard procedure: draining-levelling-drying-treatment (liming)-basal application of fertilizer - water filling. However, some typical farms seldom practice pond preparation before every culture cycle.

The water source of a typical farm comes from irrigation and groundwater while a modern farm prefers ground and spring water which is safer from agricultural and anthropological contaminants. The average water depth is maintained at 0.75 to 1 meter in both farm types.

Typical and modern farms utilize quality and superior strains such as iEXCEL, Genomar Supreme Tilapia, and FaST strain which are being outsourced from reputable and registered hatcheries (BFAR-NFFTC, FAC, SEAFDEC-AQD). A low stocking density (1 to 3 pieces/m²) is maintained by typical farm following the male to female ratio of 1:3. However, higher stocking densities (3 to 6 pieces/m²) for breeding is maintained in a modern farm that follows male to female ratio of 1:3 to 1:5.

Breeders are manually fed twice a day with commercial feeds. Likewise, frequent feeding (2 to 4x/day) is practiced in modern farms with commercial feeds and sometimes supplemented with commercial and home-made probiotics. In addition, operators of modern farms are following basic biosecurity practices such as removal of dead tilapia.

Regular harvesting is usually being done every 15 to 21 and 7 to 10 days in typical and modern farms after pairing of broodstock. However, the production cycle is shorter in modern farm that usually complete their production cycle in just 10 to 30 days while typical farms usually do in 21 to 45 days. The shorter production in modern farms is due to the utilization of artificial incubation systems for fry production which usually takes from 3 to 5 days. Both types of farms practice sex-inversion of tilapia during the early stage. Some farms still produce mixed-sex fingerlings in order to lower the cost of production.

Labor Capacity

A typical farm usually employs 2 to 6 laborers/ha. Meanwhile, a modern farm employs 1 to 6 laborers/ha. If need be, some farms employ additional laborers during pond preparation, stocking and harvesting.

Technological and Machinery Capacity

In terms of technology and machinery capacities, typical farms are equipped with water pumps and aeration systems. Modern farms are likewise equipped with the abovementioned machineries and equipment. However, further technological and machine advancements in modern farms make them far better or superior compared to typical farms, that is with the addition of water filtration, solar power, and the artificial incubation systems.

Quantitative Parameters

Productivity

The average survival of eggs of becoming fry during incubation in modern farm is 70-90%. Higher survival of fry is significantly attributed to the artificial incubation system. Meanwhile, a comparable survival performance of fry to fingerlings stage is observed in

modern (70-95%) and typical farm (70-90%). Both farms produced fingerlings of sizes 24, 22, 17 and 14. The availability of larger fingerlings in modern farm is due to the practice of rearing tilapia fry in fine mesh hapa.

Despite of fingerlings availability in tilapia private hatcheries, majority of tilapia hatchery operators obtain their broodstock from government institutions (e.g. BFAR National Centers and BFAR-TOS Central Hatcheries). Table 8 shows the comparison of typical and modern hatchery farm in Pampanga in terms of qualitative and quantitative parameters.

TABLE 8: VIS-À-VIS COMPARISON OF TYPICAL AND MODERN HATCHERY FARM IN PAMPANGA

PERFORMANCE MEASURE	TYPICAL FARM	MODERN FARM
QUALITATIVE PARAMETERS		
Production system (facilities)	<ul style="list-style-type: none"> Pond-based 	<ul style="list-style-type: none"> Pond-based Hapa-based Tank-based
Production method	<ul style="list-style-type: none"> Fingerling production Fry collection 	<ul style="list-style-type: none"> Egg/yolk sac fry collection Fry collection
Source of breeders	Superior strains from a reputable and registered hatchery	Superior strains from a reputable and registered hatchery
Number of breeders/m ²	1 to 3 breeders	3 to 6 breeders
Sex ratio (male: female)	1:3	1:3 to 1:5
Basal harvesting	15 to 21 days	7 to 10 days
Number of days/production	25 to 45 days	10 to 30 days
Types of fingerlings produced	<ul style="list-style-type: none"> Mixed sex Sex-reversed 	<ul style="list-style-type: none"> Mixed sex Sex-reversed
Feeding practices and management	<ul style="list-style-type: none"> Daily feeding (2x/day) Manual feeding 	<ul style="list-style-type: none"> Basic biosecurity practices Daily feeding (2 to 4x/day) Manual feeding
Labor capacity	2 to 6 laborers/ha	1 to 6 laborers/ha
Technological and machinery capacity	<ul style="list-style-type: none"> Aeration system Water pump system 	<ul style="list-style-type: none"> Aeration system Artificial incubation system Power spray Solar power system Water filtration system Water pump system
QUANTITATIVE PARAMETERS		
Average production of fry/fingerlings per cycle	250 pcs fingerlings per female	700 pcs fry per female
Average survival rate (%) (eggs to fry)	N/A	70 to 90%
Average survival rate (%) (fry to fingerlings)	70 to 90%	70 to 95%
Size of fingerlings produced	# 24 to #22	#22 to #14

Tilapia Grow-Out Benchmarking

Qualitative Parameters

Production System

Grow-out culture of tilapia is commonly done in different culture systems (e.g. ponds, tanks, cages, and pens). In Pampanga, fish pond culture system is more commonly done.

Tilapia production is done using three culture management-extensive, semi-intensive, and intensive. In some farms, polyculture of tilapia is done with giant freshwater prawn (*Macrobrachium rosenbergii*), white shrimp (*Litopeneus vannamei*), tiger shrimp (*Penaeus monodon*), and milkfish (*Chanos chanos*). However, majority of typical and modern farms are employing monoculture from semi-intensive to intensive culture.

Farm Practices

In terms of pond preparation, typical and modern farms prepare ponds every culture cycle following the standard pond preparation procedure; draining-levelling-drying-treatment (lime and/or tea seed)-basal application of fertilizer and water filling. However, some tilapia grow-out operators are not strictly following the pond preparation procedure commonly in typical farm.

On water management in typical farms, occasional to regular flushing is done. Some farms apply organic and inorganic fertilizer to promote growth of natural foods. Meanwhile, modern farms practice regular flushing and exchange of water using water from ground source, irrigation, and river. Likewise, application of basal and periodic fertilizers is being done in modern farm to promote the growth of natural food.

Water quality parameters are monitored regularly in modern farms using commercial water testing kit. In contrast, typical farms rely on physical manifestation of pond water as a method of water quality monitoring. Both farms utilize groundwater, irrigation, and river. Water level in typical farms is maintained at 1 to 3 meters (m) and 1 to 4 m in modern farms. Furthermore, some tilapia operators apply commercially available probiotics to further enhance the general well-being of the fish. Some apply molasses three weeks prior to harvest to avoid off-flavors "*lasang gilik*".

Both typical and modern farms normally use superior-quality-sex-reversed tilapia. Tilapia fingerlings are sourced from a reputable and registered hatchery. iEXCEL, GST©, FaST and SEAFDEC selected strain are some of the strains commonly used by tilapia grow-out operators.

In terms of feeding management, typical farms commonly feed tilapia stocks with commercial feeds without referring to a feeding guide. This practice could result to poor feeding management and, consequently, poor Food Conversion Ratio (FCR). Feeding is manually done twice a day by broadcasting. On the other hand, modern farm strictly follows feeding guide as a reference for the correct amount of feeds to be given. Moreover, feeding was done 2 to 3 times per day by broadcasting method.

Labor Capacity

Labor capacity of typical and modern farms is somehow comparable. Farms usually have 1 to 2 laborers in order to maintain a hectare of tilapia grow-out farms. Additional labor is required depending on the activities (partial and total harvesting).

Technological and Machineries Capacity

Typical farms usually have water pump system. On the other hand, modern farms are equipped with several machineries and technology such as water pump, solar power, and aeration system (e.g. paddle wheel and propeller powered by motor banca).

Quantitative Parameters

Productivity

Majority of the typical farms produce an average of 3 to 8 MT/ha/cycle with a survival rate of 30 to 80% and FCR of 1 to 1.5. Such type of farm usually attains marketable size tilapia (3 to 6 pieces/Kg) in a period of 5 to 6 months. However, shorter culture period (4 to 6 months) is required in modern farm with tilapia weighing 250 to 300 grams with higher survival rate of 50 to 80%. The average production in modern farm is 7 to 15 MT/ha/cycle. Furthermore, contract-growing scheme is practiced in some regions. The scheme is offered by vertically integrated processors (feed companies) to facilitate access of farmers to feeds. In return, farmers are obliged to sell all produce to their partnered processors. Table 9 shows the comparison of typical and modern tilapia grow-out farm in Pampanga in terms of qualitative and quantitative parameters.

TABLE 9: VIS-À-VIS COMPARISON OF TYPICAL AND MODERN TILAPIA GROW-OUT FARM IN PAMPANGA

PERFORMANCE MEASURE	TYPICAL FARM	MODERN FARM
QUALITATIVE PARAMETERS		
Culture management	<ul style="list-style-type: none"> • Semi-intensive culture system 	<ul style="list-style-type: none"> • Semi-intensive culture system • Intensive culture system
Feeding practices	<ul style="list-style-type: none"> • Doesn't necessarily follows feeding guide • Feed stocks with commercial and supplemental feeds • Daily feeding (1 to 3x/day) 	<ul style="list-style-type: none"> • Strictly follows feeding guide • Feed stocks with commercial feeds • Daily feeding (2 to 3x/day)
Pond preparation practices	<ul style="list-style-type: none"> • Not necessarily follow pond preparation procedure 	<ul style="list-style-type: none"> • Strictly follow pond preparation procedure
Water management	<ul style="list-style-type: none"> • Occasional to regular flushing or exchange of to water • Water maintained at 1 to 3m • Water source is groundwater, irrigation and river 	<ul style="list-style-type: none"> • Regular flushing or exchange of water. • Water maintain at 1 to 4m • Water source is groundwater, irrigation and river • Applied molasses before harvest (to avoid off- flavor)
Labor capacity	1 to 2 laborers/ha	1 to 2 laborers/ha
Technological and machinery capacity	<ul style="list-style-type: none"> • Water pump system 	<ul style="list-style-type: none"> • Water pump system • Aeration system • Solar power system
QUANTITATIVE PARAMETERS		
Productivity	<ul style="list-style-type: none"> • 3 to 8MT /ha/cycle • 1 to 1.5 FCR • 30 to 80% survival 	<ul style="list-style-type: none"> • 7 to 15 MT/ha/cycle • 1 to 1.5 FCR • 50 to 80% survival
Culture period and average body weight of produced tilapia	<ul style="list-style-type: none"> • 3 to 6 pieces/Kg • 4 to 8 months 	<ul style="list-style-type: none"> • 3 to 5 pieces/Kg • 4 to 6 months

International/Global Benchmarking

Production System

China was chosen as benchmark partner as it is perceived to be the best performer in terms of tilapia production. The purpose of benchmarking is to identify and adopt best known practices that can lead to superior performance.

In China, most of the tilapia operator employs monoculture system while some provinces practices polyculture system with carp and shrimp. Tilapia is being cultured at ponds, rice paddies, cages, rivers, and reservoirs. The tilapia farming system has gradually shifted from extensive to intensive culture, including pond monoculture, polyculture, integrated

culture, cage culture and reservoir running water culture. In some provinces, tilapia is being cultured using wastewater from power plants. Meanwhile, tilapia culture in the Philippines is being done in freshwater, brackish water and marine water. The common culture units in these water systems are fishponds, pens and cages. This is usually done in a semi-intensive to intensive culture system. Furthermore, insignificant volume of tilapia is being produced in rice-fish culture system and small-farm reservoir. On the other hand, monoculture and polyculture of tilapia (saline-tolerant strain) with tiger shrimp, milkfish and other marine fishes is being practice in some regions of the Philippines (Table 10).

TABLE 10: COMPARATIVE ANALYSIS OF PHILIPPINE TILAPIA INDUSTRY VIS-À-VIS CHINA (GROW-OUT PRODUCTION)

PERFORMANCE MEASURES	PHILIPPINES	CHINA
Production system	<ul style="list-style-type: none"> • Monoculture using semi-intensive system (freshwater and brackish water) • Polyculture with milkfish and shrimp • Fishpond culture in freshwater and brackish water • Pen culture in fresh, brackish and marinewater • Cage culture in fresh, brackish and marine waters • Rice-fish culture and small farm reservoir culture 	<ul style="list-style-type: none"> • Intensive culture in freshwater ponds/tanks • Semi-intensive polyculture w/ carp or shrimp • Integrated fish/duck culture/rice culture • Intensive culture in brackish water ponds • Cage culture • Flow-through culture
Tilapia strain	<ul style="list-style-type: none"> • GIFT and GIFT-derived strains • Climate resilient tilapia (e.g. Cold tolerant tilapia strain) • Site-specific strain (e.g. iBEST and Molobicus) • Red tilapia 	<ul style="list-style-type: none"> • GIFT and GIFT-derived strains (60%) • Auni tilapia (30%) • Blue and Red tilapia (10%)
Culture period	<ul style="list-style-type: none"> • 3 to 4 months for local market (250g/pc) • 6-7 months for fillet 	<ul style="list-style-type: none"> • 5 to 6 months (for fillet)
Productivity	3 to >10MT/ha	15.97 to 16.51MT/ha
% contribution of feeds in the production costs (1-ha pond culture per cycle)	64.6%	68%
Certification	<ul style="list-style-type: none"> • Several government and third-party issued certification but not fully implemented 	<ul style="list-style-type: none"> • Government issues aquaculture licenses
Tilapia product form	<ul style="list-style-type: none"> • Live and fresh tilapia • Fresh frozen tilapia fillet • Frozen, cleaned and gutted tilapia • Skin (tilapia chicharon) • Smoked • Tilanggit 	<ul style="list-style-type: none"> • Live and fresh tilapia • Wide variety of tilapia processed products. • Whole frozen • Gutted and scaled • Gilled, gutted and scaled • Frozen fillet which includes regular-skinned fillets, deep-skinned fillets and skin-on fillets • Other processed forms are breaded fillet and stick, belly, fish jaw, skin-made products

Tilapia production system in both countries differ insignificantly. However, China shifted into intensive culture system while Philippines remain into semi-intensive with some are into intensive culture system.

Culture Period

Generally, the culture period in China is 150 to 180 days (5-6 months) with year-round production of fillet-size tilapia. On the other hand, the culture period of tilapia in the Philippines usually takes 4 to 6 months depending on weather conditions. In this period, tilapia is about 3 to 5 pieces/Kg.

China's production is mostly used for fillet whether consumed domestically or being exported. Some fresh products are consumed locally. In the Philippines, tilapia is consumed fresh and rarely farmers grow tilapia up to more than four months due to additional cost on inputs.

Productivity

The average tilapia production in China reaches 15.97 MT/ha in ≤ 1 ha tilapia pond and 16.51 MT/ha in > 1 ha tilapia pond with FCR of 1.5. Meanwhile, the average production of tilapia in the Philippines is 3 to > 10 MT/ha and the FCR is around 1.6. Generally, China's productivity is much higher than in Philippines.

Production Cost

The major component of tilapia operation in China is feed comprising of 68% of the total production cost followed by cost of rent and seed which accounted for the 7.6% and 7.1% of the total production cost, respectively. Meanwhile, majority of the variable cost of tilapia farming in the Philippines is from feeds comprising of 64.6% followed by wages of hired labor (14.7%) and fingerling cost (8.8%). These variables comprise of 88.1% of total variable cost.

Feed is the major component of the total production cost in both countries. However, fingerling cost is slightly higher in the Philippines.

Certification

Farming is only allowed under aquaculture licenses. Meanwhile, Philippines has several certification bodies from government and private institutions issued quality control and assurance protocols in the production and processing of tilapia (e.g. GAqP, GMP, HACCP). However, these standard protocols were not strictly being followed and implemented particularly in production system. On top of that, majority of tilapia growers does not want to undergo accreditation due to laborious certification processes.

China is strict on this aspect while in the Philippines it is much less stringent. Majority of farms in the Philippines are not registered and certified in the mentioned standard certification.

Processing

China's processed products include whole frozen tilapia, gutted and scaled tilapia, gilled, and frozen fillet which include regular-skinned fillets, deep-skinned fillets and skin-on fillets. Other processed forms are breaded fillet and stick, belly, fish jaw, skin-made products and so on. On the other hand, processed products produced in the Philippines are quite limited. Most of the tilapia fillets are exported although there are some (in small volume) which are being supplied to supermarkets and restaurants. The frozen, cleaned and gutted are also exported to the United States, Canada and in Europe. Other processed forms include chicharon made from tilapia skin, smoked, and tilanggit.

Competitive Analysis

Local

Hatchery

Supply Reliability and Marketing Strategies

The prevailing price of tilapia fingerlings in typical farm is Php 0.28 to 0.35 and modern farms is from Php 0.35 to 0.45 since most of their production are sex reversed tilapia (SRT). In terms of supply reliability, both type of farm is capable to cater large and bulk orders even to walk-in customer however the typical farm caters order in staggered basis. Likewise, both farms have the similar marketing strategies such as giving discounts to those customers that procure large quantities of tilapia fingerlings, provision of after sales services (e.g. technical assistance and/or mortality allowance), free delivery services in order to gain a regular customer or suki. Generally, fingerlings dispersal is done by schedule basis and in some instances “first come, first serve” basis (Table 11).

TABLE 11: VIS-À-VIS COMPARISON OF TYPICAL AND MODERN TILAPIA HATCHERY FARM IN PAMPANGA

PARAMETERS MEASURES	TYPICAL FARM	MODERN FARM
Fingerling price (#24–17)	Php 0.28 to 0.35	Php 0.35 to 0.45
Supply reliability	<ul style="list-style-type: none"> • Fingerling is always available even to walk-in customer • Cater large quantity/bulk orders (in staggered basis) • Not at all times meet the customer’s need and orders 	<ul style="list-style-type: none"> • Fingerling is always available even to walk-in customer • Cater large quantity/bulk orders • Always meet the customer’s need and orders
Marketing strategies	<ul style="list-style-type: none"> • Discount on price • After sales services (e.g. technical assistance or mortality replacement) • Free delivery services • Use of advertisement (word-of-mouth) • Dispersal is by schedule and appointment basis • First come, first serve basis 	<ul style="list-style-type: none"> • Discount on price • After sales services (e.g. technical assistance or mortality replacement) • Free delivery services • Use of advertisement (word-of-mouth and social media) • Dispersal is by schedule and appointment basis • First come, first serve basis

Grow-out

Supply Reliability and Marketing Strategies

Generally, the prevailing price of tilapia in typical farm ranges from PhP 80 to 87.00/Kg. Meanwhile, the farm gate price of marketable tilapia in modern farm is PhP 80 to 85.00/ Kg. Both farms are capable of catering large or bulk orders and the quantity of harvest goes to the local market and major cities (e.g. Metro Manila, Baguio and Dagupan City). However, supplies of tilapia in modern farm is more accessible even to walk-in clients.

In Luzon, the prevailing farm gate price of tilapia is ranging from PhP 60 to 90.00/Kg. Meanwhile, in Visayas, the prevailing farm gate price is ranging from PhP 80 to 120.00/ Kg. Likewise, the farm gate price of tilapia in Mindanao is similar with those in Visayas region.

In terms of marketing strategies, typical and modern farm are employing the same marketing strategies such as discount on price for those buyers that acquire large and bulk quantities of tilapia. Another strategy to gain a regular customer is through *reseko* or giving an additional tilapia in every purchase of large quantity of tilapia. On the hand, modern farm is tapping middlemen or Bakulera since modern farm produced large quantity of marketable tilapia (Table 12).

TABLE 12: VIS-À-VIS COMPARISON OF TYPICAL AND MODERN TILAPIA GROW-OUT FARM IN PAMPANGA

PARAMETERS MEASURES	TYPICAL FARM	MODERN FARM
Farmgate price	PhP 80-87.00/Kg	PhP80-85.00/Kg
Supply reliability	<ul style="list-style-type: none">• Cater large or bulk orders• Quantity of harvest goes to major Cities (e.g. Dagupan, Baguio and Metro Manila) and local market	<ul style="list-style-type: none">• Always available even to walk-in customers• Cater large or bulk orders• Quantity of harvest goes to major Cities (e.g. Dagupan, Baguio and Metro Manila) and to local market
Marketing strategies	<ul style="list-style-type: none">• Discount on price (bulk order)• Reseko	<ul style="list-style-type: none">• Discount on price (bulk order)• Reseko• Calls middlemen(agent)

Majority of tilapias produced in fish cages were from Taal Lake (Region IV-A). According to the Taal Lake Aquaculture Alliance Inc. (TLAAI), tilapia fry is initially reared in ponds following the stocking density of 500 pieces per m². After it reaches fingerling size (size 17), fingerlings are being transferred to grow-out cages with a stocking density of 50,000 pieces per cage with 10% allowance for mortality. It will then take 5 to 6 months to reach the marketable size of 250-300 grams per piece or 3-4 pieces per kilogram. At higher stocking densities of 200,000 to 250,000 pieces per cage, modular method is applied by some cage operators. Table 13 shows the tilapia cage culture practices of TLAAI in Taal, Batangas.

TABLE 13: TILAPIA CAGE CULTURE PRACTICES BY TAAL LAKE AQUACULTURE ALLIANCE INC. IN TAAL LAKE, BATANGAS

CULTURE STAGE	CULTURE UNITS	LIFE STAGE	STOCKING DENSITY	SIZE RANGE	DEPTH	AREA
Nursery to Grow out stage	Pond	Fry	500 pcs/m ²	Fry to # 17 fingerlings	1-2 ft	300-500m ²
	SG14	Fingerlings	50,000 pcs/cage	5-20 g	6-8 m	10x10m
	SG12	Juvenile		21-66 g	8-10 m	
	SG10	Adult		>71 g		
Nursery to grow-out Stage (modular method)	Net Cages -A-net, -B-net, -K6/24/22 -net #17	Fry/ fingerlings to Adult	200,000 to 250,000 pcs/cage	Fry to marketable size	3-10 m	10x10m

Source: TLAAI spokesperson, pers. comm., 2020

International/Global

In 2017, China was able to export tilapia worth of 426.44 million USD. Furthermore, the Chinese market share of tilapia exports to the USA decreased from 69% to 63.2% during 2014-2017. Prices for 300-500g live tilapia in China dropped to 0.79 USD per kilogram at the end of 2019, marking an almost 20% decline from a recent year (FAO, 2020). On the other hand, Philippines were able to export 5.31MT of tilapia which is equivalent to 520,886 USD. Despite the lower exportation of tilapia, Philippines managed to increase the exportation of tilapia during 2017 to 2018 by 20.3% or 6.39 MT.

Although there is a current China-USA trade conflict, Chinese tilapia industry remain as the top producer and exporter of tilapia worldwide due to high productivity and lower price in international market of tilapia from China.

MARKET TRENDS AND PROSPECTS

Key Demand Drivers

Tilapia production is directly affected by the supply-demand balance. This can be easily picture by supply-demand principle, where selling price of agricultural product tends to increase when there is limited supply in the market. Price is primarily regulated by the supply. This factor affects the buying preference of consumers when there is abundant supply of tilapia in the market which equate to low selling price. Low selling price will greatly increase the demand of tilapia in the market. Another key demand driver is affected by the growing human population and the income growth of the population. The growth in population will certainly increase the fish eating population, therefore will increase the demand for tilapia. Based on reports, income growth will essentially increase the demand curves of tilapia over time.

Market Prospects

Local

Disruption of domestic demands in the Philippines was observed due to COVID-19 pandemic that caused nationwide lockdown and border-to-border restrictions therefore causing hindrance to the movement of all stakeholders from production system to consumer. Consequently, national lockdown together with the occurrence of natural weather phenomena (e.g. volcanic eruptions and typhoons) has resulted to the declined (-5.2%) in production during 2019-2020.

According to research, tilapia is one of the food source that promotes food security in the country during the hard times for its adaptability, fast growing characteristics and low selling price. Consumers can have an access to cheap protein sources such as tilapia. Furthermore, issues on African Swine Fever (ASF) affecting the Philippine swine industry dictates high prices and insufficient supply in some regions. Therefore, households are looking for an alternative protein sources. This would further increase the consumption of tilapia.

International/Global

According to the report of FAO of United Nations, tilapia industry is expected to resume rapid growth after the temporary slowdown during pandemic. Global tilapia production is expected to increase by around 3 to 4% in 2019. This increase is primarily due to China's increase in production (50,000 MT). However, regulatory changes and rising challenges in China's most important market, the United States of America will give an opportunity to other countries to fill a supply gap in the US market. In 2019, the prevailing import prices of frozen tilapia is USD 1.62 per kilogram. Tilapia has been one of the most heavily affected casualties of the United States of America-China trade conflict. The 25% increase in tariffs have decline the demand from China causing a 4.6% decline in import compared to the same volume from 2018. Given the situation, other countries such as Indonesia, Brazil, Philippines and other tilapia producing countries will have a better opportunity to fill the supply gap in the US market (Globefish, 2021).

PRIORITY CONCERNS & OPPORTUNITIES/ CONSTRAINTS & OPPORTUNITIES

SWOT Analysis (Industry Level)

Strengths

The industry shows confidence in the support of the government and private sectors from provision of seedstocks to adoption of technologies. Stakeholder's associations greatly influence strong public-private relationship and may attributed to visibility of year round government programs that updates them also to recent techniques as well as on future researches. Table 14 shows the strength, weaknesses, opportunities, and threats of the Philippine Tilapia Industry.

Weaknesses

Production is highly dependent on feeds and water, and investing on these two factors will guarantee high production. However, the industry may experience seasonal seed insufficiency especially in summer months where egg fertilization is affected by hot water temperature. Therefore, temperature regulators on summer months are necessary to avoid problem. Despite technologies in tilapia production is well recognized, assistance in domestic and international marketing which are important to stakeholders is not available. Implementation of Good Aquaculture Practices (GAqP) that may certify quality and elevate global market competitiveness is under way.

Equipment and materials needed to produce tilapia fillet (>500g/pc) are not yet available. Programs for technology dissemination of tilapia processing is still not established. Primary steps in logistics and identification of post-harvest facilities are not recognized or not present at all in many areas.

Opportunities

Exploring usefulness of available agricultural by-products as raw materials for feed formulation may significantly decrease cost of production. This technology will maximize natural resources and provide high impact in production of fish farmers. Moreover, presence of outreach stations and well trained manpower is available for technology transfer in hatchery and nursery. Demand in tilapia fillet is increasing and create job opportunities.

Threats

In every industry costs of raw materials and input supplies are the primary consideration in defining income. At present, some supplies are limited, reason why they are highly priced. There are different apprehensions need to be addressed in formulating technologies to maintain confidence of stakeholders and investors. Investments in aquaculture is always threatened by natural calamities such as typhoon. The country is being visited by many typhoons each year. Strong typhoon may cause flood, which result in over flowing of waters in fishponds and wreckage of cages and pens.

Predators when not properly eliminated will consume the stocks and will cause great loss in tilapia production. More so, concern in infections caused by pests and diseases may not only affect its production but much more with the market price. Maintaining healthy stocks is a routine need to be practiced.

TABLE 14: SUMMARY OF STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS OF THE PHILIPPINE TILAPIA INDUSTRY

STRENGTH	WEAKNESSES	OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • Full government support • Availability and accessibility of quality seedstocks • Highly trained manpower at the national level on tilapia technologies • Presence of tilapia stakeholder associations • Strong public-private relationship • Wider areas available for farming • Availability and easy access to latest and innovative technologies • Lots of researchable areas • Availability of government facilities (National Centers, TOS, LGUs, HEIs) 	<ul style="list-style-type: none"> • High production cost • High dependence on groundwater • Lack of efficient/trained manpower (LGU) • Too many marketing layers • Seasonal/limited supply and access to quality fingerlings and broodstocks • Weak domestic and international marketing assistance • Lack of raw materials for fillet processing (>500g/pc) • Weak extension services • Weak credit access and limited credit window • Inadequate post-harvest facilities (local and export) • Traceability of products • Biosecurity • Inadequate logistics (e.g. trucks and post-harvest facilities) • Industry is not ready for full implementation of GAqP • Low technology dissemination • Low awareness on processed product 	<ul style="list-style-type: none"> • Full government support • Availability of highly trained manpower • Technology transfer on hatchery, nursery and grow-out operations • Presence of technology outreach station in every region • Wider areas available for farming • Lots of researchable areas • Increasing demand of tilapia fillet • Utilization of local agri-by-products • Upgrading of engineering infrastructure and mechanizations services towards increase in production • Fast tracking of the development of engineering services 	<ul style="list-style-type: none"> • High cost of raw materials and equipment • Climate change • High cost of input supply • Disease problems • Pests (predators) • Limited supply of raw materials • Surplus production • Deception of online marketing • Existence of invasive tilapia species • Importation • Natural disasters • Competitive price of tilapia imported from China

THE TILAPIA INDUSTRY ROADMAP

WAY FORWARD



TARGET SETTING

Vision

A globally competitive and sustainable tilapia industry that is private sector led and market oriented, with strong government support that will improve the quality of life of Filipinos.

Mission

Development of a globally competitive, eco-sensitive and climate resilient Tilapia Industry that is private sector-led, client driven, supply-reliable following an innovative value chain that is based on sustainable standards.

Goals

1. Increase tilapia production from 304,326.59 MT (2020) to 352,797.9 MT (2025),
2. Ensure quality and traceability of inputs and outputs
3. Promote use of environment friendly tilapia feeds and reduce cost of feed production by utilizing locally sourced raw materials
4. Reduce fishery postharvest losses from 25% to 10% in five years
5. Improve and/or develop a more efficient marketing system for the tilapia industry

Goals, Objectives and Targets (Matrix Form)

Short-Term (2022-2025)

TABLE 15: SHORT-TERM PLAN FOR THE PHILIPPINE TILAPIA INDUSTRY

Goal 1. Increase tilapia production from 304,326.59 MT (2020) to 352,797.9 MT (2025)

Objective:

- To improve and increase tilapia production of the country by 3% annually
- To rehabilitate BFAR Tilapia Central and Satellite Hatcheries and capacitate technical staff
- To increase percentage recovery from less than 50 to 70% or above
- To shorten culture period from 5-6 months to 3-4 months
- To produce more than 500 grams tilapia for fillet purposes
- To increase in tilapia production in brackish water areas, mariculture parks and SWIPs from 18,660 MT in 2020 to 21,633 MT in 2025

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS										RESPONSIBLE ENTITY		
		PHYSICAL					FINANCIAL (PHP '000)							
		2021	2022	2023	2024	2025	TOTAL	2021	2022	2023	2024		2025	TOTAL
Broodstock improvement for resilient tilapia strain	Continue selective breeding and broodstock enhancement programs	1	1	1	1	1	5	5,000	5,000	5,000	5,000	5,000	20,000	BFAR (NFFTC, NIFTDC), NFRDI-FBC, HEIs, RDIs, DA, DOST-PCAARRD, & Private Sector
	Continue Genotyping towards Marker Assisted Selection in breeding	1	1	1	1	1	1	1,500	1,500	1,500	1,500	6,000	BFAR (NFFTC & NIFTDC), NFRDI-FBC, HEIs, & RDIs	
	Importation of other strains or species of tilapia (Oreochromis sp) as needed for selective breeding	1	1	1	1	1	2	1,500	1,000	1,000	1,500	2,500	BFAR (IFAD & NFFTC) & NFRDI	

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS											RESPONSIBLE ENTITY	
		PHYSICAL						FINANCIAL (PHP '000)						
		2021	2022	2023	2024	2025	TOTAL	2021	2022	2023	2024	2025		TOTAL
Broodstock development and maintenance	Maintenance of broodstocks (in'000)		257	279	279	279	1,094		23,451	25,459	28,005	30,805	107,720	BFAR (ROs, NCs w/ tilapia, Central & Multiplier Hatcheries), HEIs, & RDIs
	Production and distribution of high quality broodstock (in '000)		6,827	7,855	8,907	10,914	34,501		10,240	12,961	16,121	21,828	61,150	
Fingerling distribution & production	Production and distribution of quality fingerlings for grow-out purposes		185	222	228	235	870		27,750	33,300	34,200	35,250	130,500	BFAR (NFFTC, NIFTDC, all Regions, Central & Multiplier Hatcheries) & HEIs
	a. freshwater (in M)		31	38	38	45	180		5,224	6,340	6,342	7,552	30,000	BFAR (ROs, NCs w/ tilapia) LGUs, & DENR
Modernization of BFAR Tilapia Central, Satellite Hatcheries, National Centers and private sectors	b. brackish water and high-saline (in M)		4	10	10	10	34		20,000	50,000	50,000	50,000	170,000	BFAR (ROs, CHs, TOS, & NCs)
	<ul style="list-style-type: none"> Re-assess status and capacity of existing BFAR Tilapia Central, Satellite Hatcheries and National Centers Rehabilitation of BFAR Tilapia Central, Satellite Hatcheries, and National Centers 		25	25	25	25	75		12,500	13,750	15,125	41,375	BFAR (ROs & NCs w/ tilapia) & private sector	
Technology dissemination	Provision of small-scale set-up of artificial incubation system		21	21	21	21	84		1,050	3,150	3,465	3,811	11,476	BFAR (ROs, CHs, TOS, & NCs w/ tilapia)
	Conduct of capacity building and training to the manpower of BFAR Tilapia Central, Satellite Hatcheries, National Centers													

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS											RESPONSIBLE ENTITY	
		PHYSICAL						FINANCIAL (PHP '000)						
		2021	2022	2023	2024	2025	TOTAL	2021	2022	2023	2024	2025		TOTAL
	Technology training (hatchery, shading innovations, nursery, grow-out (>500 g), brackish water, high saline culture technologies) for adoption, entrepreneurship and farm business management	31	31	31	31	31	124		1,550	4,650	5,115	5,626	16,941	BFAR (ROs, CHs, TOS & NCs w/ tilapia), NFRDI, HEIs, DOST-PCAARRD, & Private Sector
	Establishment of technology demonstration projects [hatchery, shading innovations, nursery, grow-out (>500 g)]	36	48	48	48	12	100		7,200	10,560	11,616	3,195	32,571	BFAR (RO & NCs w/ tilapia), LGUs, & Private Sector
	Conduct of Tilapia Congress	1				1	2		500			1,500	2,000	BFAR, RDIs, HEIs, & tilapia stakeholders
Province-led Agriculture and Fisheries Extension System (PAFES)	Conduct of capacity building for LGU extension officers and academe on extension methodologies and fisheries technologies	21	21	21	21	21	84		1,050	3,150	3,465	3,811	11,476	BFAR (IFAD, ROs & NCs w/ tilapia), ATI, & LGUs
Diversification	Practice of polyculture technology	50	50	50	50	50	200		12,500	12,500	12,500	12,500	50,000	Private Sector & BFAR-ROs
Research for Development for increase production	Development of eco-friendly and climate smart hatchery technologies	4	4	4	4	4	16		20,000	20,000	20,000	20,000	80,000	BFAR (NFFTC & NIFTDC), NFRDI, HEIs, RDIs, DOST, & DA
	Development of culture technology in the production of fillet-size tilapia (500 g)	21	23	23	24	26	94		3,150	3,450	3,600	3,900	14,100	BFAR (ROs & NCs w/ tilapia), NFRDI, RDIs, HEIs, DOST-PCAARRD, & Private Sector

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS											RESPONSIBLE ENTITY	
		PHYSICAL					FINANCIAL (PHP '000)					TOTAL		
		2021	2022	2023	2024	2025	TOTAL	2021	2022	2023	2024			2025
Agri-Industrial Business Corridors (ABCs)	Promotion and establishment of potential business: a. Tilapia nursery		24	30	35	40	129		9,600	12,000	14,000	16,000	51,600	BFAR-ROs, DA, & Private Sector
	b. Mariculture parks		5	5	5	5	20		50,000	50,000	50,000	50,000	200,000	
Expansion culture areas	Evaluation of existing SWIPs, mariculture parks and man-made reservoirs		85	90	90	80	345		765	810	810	720	3,105	BFAR (ROs & IFAD), LGUs, & DENR
	Identification and utilization of tilapia production areas (SWIPs, mariculture parks and man-made reservoirs)		58	65	68	60	303		522	585	612	540	2,259	BFAR (ROs & NCs w/ tilapia), POs, LGUs, DENR & RDIs
Fisheries Career System	Provision of scholarship and internship leading to fisheries profession		340	340	340	340	1,360		20,400	20,400	20,400	20,400	81,600	BFAR (ROs, Special Concern unit & HR), Fisheries Student, & Private Sector
	Establishment of farm school		2	2	2	2	8		10,000	10,000	10,000	10,000	40,000	TESDA, ATI, & Private Sector
	Accreditation of BFAR facility and farm schools as Training provider		1	2	1	2	6		50	100	50	100	300	BFAR-NFFTC, HR, PRC, TESDA, & Private Sector

Goal 2. Ensure quality and traceability of inputs and outputs

Objective: Implement Good Aquaculture Practices for food safety, animal health and welfare, environmental integrity and socio-economic for the industry to prosper

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS										RESPONSIBLE ENTITY	
		PHYSICAL					FINANCIAL (PHP '000)						
		2021	2022	2023	2024	2025	TOTAL	2021	2022	2023	2024		2025
	Promotion of Good Aquaculture Practices (GAQP) by conduct of trainings	21	21	21	21	21	84	1,050	3,150	3,465	3,811	11,476	BFAR (FRLs, CO & all Regions, NCs w/ tilapia) & LGUs
	Application of biosecurity measures in:												
	a. Government fishery facilities	4	10	10	10	10	34	400	1,000	1,000	1,000	3,400	BFAR (FRLs, CO & all Regions, NCs w/ Tilapia) & LGUs
	b. Private aquafarms												
Food Safety and Regulation	• grow-out	300	300	300	300	300	1,200	15,000	15,000	15,000	15,000	60,000	BFAR (FRLs, CO & all Regions), LGUs, & Private Sectors
	• hatchery	50	50	50	50	50	200	2,500	2,500	2,500	2,500	10,000	
	Aquafarm registration (AquaR) of all hatcheries, nurseries and grow-out tilapia farm	10,000	20,000	20,000	20,000	10,000	60,000	200	400	400	200	1,200	BFAR (all Regions, NFFTC, IFAD), LGUs, & Private Sectors
	Accreditation of tilapia hatcheries	60	90	90	90	60	300	540	810	810	540	2,700	BFAR (all Regions & NFFTC), LGUs, & Tilapia Hatchery Operators
R4Ds on emerging diseases	Development of farmer-friendly, cost-effective kits and optimal laboratory-based protocols for detection and diagnosis of tilapia disease	4	3	3	4	3	17	10,000	7,500	10,000	7,500	35,000	NFRDI-FBC, HEIs, BFAR (NFLD, RFL & NFFTC), DOST-PCAARRD, RDIs, & HEIs
Monitoring, control and surveillance of tilapia diseases	Surveillance and monitoring of hatcheries and aquafarms re: survey of emerging disease (e.g. TILV etc.)	188	193	193	253	253	1,060	1,383	1,420	1,862	1,862	7,800	NFRDI-FBC, HEIs, & RDIs

Goal 3. Promote use of environment friendly tilapia feeds and reduce cost of feed production by utilizing locally sourced raw materials

Objective: Conduct production-related studies , training and provide technical assistance on cost effective feeds.

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS										RESPONSIBLE ENTITY		
		PHYSICAL					FINANCIAL (PHP '000)							
		2021	2022	2023	2024	2025	TOTAL	2021	2022	2023	2024		2025	TOTAL
R4Ds and transfer of technologies on the feeding management and strategies and development of cost-effective feeds	Conduct researches on cost-effective feed management and strategies and development of environment friendly cost-effective feeds	9	9	9	10	10	38	5,571	5,573	6,190	6,190	6,190	23,524	NFRDI-FBC, HEIs, DOST-PCAARRD, LGUs, BFAR, RDIs, & Tilapia Stakeholders
	Conduct of technology transfer through technical assistance, trainings and seminars on cost-effective feed management and strategies	21	21	21	21	21	84	1,050	3,150	3,465	3,811	11,476	BFAR (all Regions, NCs w/ tilapia), RDIs, ATI, POs, LGUs, & Private Sectors	
R4Ds on nutrigenomics	Conduct researches on nutrigenomics	5	5	5	4	2	16	12,500	12,500	10,000	5,000	40,000	DA-Biotech, NFRDI-FBC, BFAR-NFFTC, HEIs, Tilapia Stakeholders, & RDIs	
Collective Action/ Cooperative Development	Establishment of small-scale feed mill enterprise	2	3	3	5	2	12	6,000	9,000	15,000	6,000	36,000	BFAR (all Regions, NCs w/ tilapia), POs, LGUs, CDA, & Private Sectors	

Goal 4. Reduce fishery postharvest losses from 25% to 10% in five years

Objective: To improve postharvest practices through introduction of proper fish handling techniques and appropriate postharvest technologies.

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS										RESPONSIBLE ENTITY		
		PHYSICAL					FINANCIAL (PHP '000)							
		2021	2022	2023	2024	2025	TOTAL	2021	2022	2023	2024		2025	TOTAL
	Operation-alization of CFLCs	200	100	50	50	50	400	100,000	50,000	25,000	25,000	25,000	200,000	BFAR (PHTD & ROs), LGUs, & Private Sectors
	Profiling of tilapia processors	17	5	5	5	5	32	3.40	1	1	1	1	6.40	BFAR (FHL, FIQD, PHTD & all Regions) Private Sectors
Improvement of the quality of the fishery products and food safety	Establishment of public-private partnership for tilapia processing plant and provision of post-harvest facilities (cold chain facilities and transport vehicle)	2	2	4	4	4	12	10,000	10,000	20,000	20,000	20,000	60,000	BFAR (FHL, FIQD, PHTD & ROs), Private Sectors, HEIs, DTI & DOST
	Improvement of tilapia processed products including the packaging and labels	10	5	5	5	5	25	1,500	750	750	750	750	3,750	
Improve the traceability of tilapia export products	Creation of fish processors and traders group	17	5	5	5	5	32							BFAR-ROs, LGU, & Private Sectors
	Capacity building on post-harvest technologies and quality control	15	15	15	15	15	60	1,500	1,500	1,500	1,500	1,500	6,000	BFAR (ROs & PHTD), LGU, & Private Sectors
	Establishment of fish product testing laboratory	2	3	2	2	2	10	6,000	9,000	6,000	6,000	6,000	27,000	BFAR (NFIL, FIQD, FHL, & PHTD)
	Monitoring and inspection of farms, processing plants, ice plants and tilapia products	71	76	81	86	86	86	1,065	1,140	1,215	1,290	1,290	4,710	BFAR (NFIL, FIQD & ROs) (monitoring and inspection is under FIQD)

Goal 5. Improve and/or develop a more efficient marketing system for the tilapia industry

Objective: Establish market information system, facilitate tilapia marketing, strengthen market networking and registration of traders.

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS										RESPONSIBLE ENTITY
		PHYSICAL					FINANCIAL (PHP '000)					
		2021	2022	2023	2024	2025	TOTAL	2021	2022	2023	2024	
	Consolidation of MSMEs	25	31	36	42	134	450	558	648	756	2,412	BFAR-FIDSSD & Regional Counterpart
Equitable access and strengthen local market network	Facilitation of tilapia marketing and linkages between producer and market (e.g. kadiwa & e-kadiwa)	25	25	25	25	100	500	500	500	500	2,000	BFAR- FIDSSD & Regional Counterpart, & Private Sectors
	Establishment of market information system	10	10	10	10	49	1,000	1,000	1,000	1,000	4,900	BFAR-FIDSSD, FIMC Regional Counterpart, & Private Sectors
	Forge partnership with financing institutions	15	15	15	15	75	750	750	750	750	3,750	BFAR (FIDSD & ROs), COA, & Financing Institutions
Accessible credit and loan programs by financing institutions	Strengthening of local marketing network	16	19	20	20	87	800	950	1,000	1,000	4,350	
	Establishment of new and strengthening of existing fisheries cooperative/ organization/ association	35	39	44	50	195	1,750	1,950	2,200	2,500	9,750	BFAR (CO, FIDSSD, ROs, COA, & Private Sectors
Regulation of tilapia market price	Registration of baculeras/viajeros or middlemen	315	315	315	315	1,274	1,575	1,575	1,575	1,575	6,370	BFAR (CO, FIDSD), Regional Counterpart, & Private Sectors
	Total										1,717,447	

Note: The activities for the short-term plan were derived from the results of tilapia industry stakeholders survey conducted on February 2021. These activities were presented and validated during the consultative meeting with BFAR-Regional Fisheries Production and Support Services Division (FPSSD) heads, Technology Outreach Station (TOS) heads and Regional Tilapia Focal Persons Nationwide. Finally, the output was circulated to all BFAR -Regional Focal Persons for confirmation and target-setting.

Medium-Term (2026-2030)

TABLE 16: MEDIUM-TERM PLAN ON PHILIPPINE TILAPIA INDUSTRY

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS										RESPONSIBLE ENTITY
		PHYSICAL					FINANCIAL (PHP '000)					
		2026	2027	2028	2029	2030	TOTAL	2026	2027	2028	2029	
1. Development of climate resilient tilapia												BFAR (IFAD, NFFTC & NIFTC), NFRD, HEIs, RDIs, DOST, DA, & Private Sectors
2. Full implementation of Good Aquaculture Practices												BFAR (IFAD, NCs, NFLD & ROs) & Private Sectors
3. Mechanization of tilapia farming												BFAR (ROs IFAD & NCs) PHILMECH, & Private Sectors
4. Application of biotechnology on diagnosis treatment												BFAR (NFLD & NFFTC) NFRD-I-FBC
5. Improve cold chain technology												BFAR (PHTD, FIQD, & ROs) & Private Sectors
6. Availability of value added products in local and international market												BFAR (PHTD, FIQD, & ROs) & Private Sectors
7. Availability of cost effective feeds locally												DOST-PCAARRD, LGUs, BFAR, RDIs, & Tilapia Stakeholders
8. Electronic marketing adoption												BFAR (FIMC & FIDSSD), Regional Counterparts, & Private Sectors
Total												

Note: The activities for the medium-term plan were derived from the results of tilapia industry stakeholders survey conducted on February 2021. These activities were presented and validated during the consultative meeting with BFAR-Regional Fisheries Production and Support Services Division (FPSSD) heads, Technology Outreach Station (TOS) heads and Regional Tilapia Focal Persons Nationwide. Finally, the output was circulated to all BFAR -Regional Focal Persons for confirmation.

Long-Term (2031-2040)

TABLE 17: LONG-TERM PLAN ON PHILIPPINE TILAPIA INDUSTRY

Goal: Sustain resilient breed of Tilapia, modernized marketing system and globally competitive Tilapia products for a food secured Filipinos.

Objective:

- To enhance of fish immunity
- To conduct isolation and cryopreservation of somatic cells
- To formulate ready-to-eat tilapia products
- To improve electronic marketing system
- To export fish fillet and value added products
- To apply genomics and Marker Assisted Selection (MAS) in fish breeding and production

STRATEGY	PROGRAM/ ACTIVITY/ PROJECT	TARGETS								RESPONSIBLE ENTITY				
		PHYSICAL				FINANCIAL (PHP '000)								
		2022- 2025	2026- 2030	2031- 2035	2036- 2040	TOTAL	2022- 2025	2026- 2030	2031- 2035		2036- 2040	TOTAL		
1.Enhancement of fish immunity														BFAR (NFLD & ROs), NFRDI, HEIs, & RDIs
2.Isolation and cryoconservation of somatic cells														BFAR & NFRDI-FBC
3.Formulation of ready-to-eat tilapia products														BFAR (PHTD & ROs), NFRDI & Private Sectors
4. Improvement of electronic marketing system														BFAR (FIMC & FIDSSD), Regional Counterparts, & Private Sectors
5.Exportation of fillet and value added products														BFAR (FIOD, ROs, & PHTD), & Private Sectors
6. Application of genomics and Marker Assisted Selection (MAS) in tilapia breeding and production														BFAR (NFLD & ROs) & NFRDI-FBC
Total														

Note: The activities for the long-term plan were derived from the results of tilapia industry stakeholders survey conducted on February 2021. These activities were presented and validated during the consultative meeting with BFAR-Regional Fisheries Production and Support Services Division (FPSSD) heads, Technology Outreach Station (TOS) heads and Regional Tilapia Focal Persons Nationwide. Finally, the output was circulated to all BFAR -Regional Focal Persons for confirmation.

RECOMMENDATIONS FOR POLICIES, PROGRAMS AND STRATEGIES

TABLE 18: RECOMMENDATIONS FOR POLICIES, STRATEGIES AND PROGRAMS ON PHILIPPINE TILAPIA INDUSTRY

ISSUES	POLICY	OBJECTIVE	PROGRAM/STRATEGIES	KRAs / KPIs	TIMELINE	RESPONSIBLE AGENCY LEAD, SUPPORT
A. BROODSTOCK IMPROVEMENT						
1. Inconsistent production performance of tilapia under different farming environments and geographic areas	FOO 338	To increase in tilapia production by 3% annually	Continue Selective breeding and broodstock enhancement programs	Broodstock improved <ul style="list-style-type: none"> Number of new strains improved 	2022-2025	BFAR (NIFFTC & NIFTDC), NFRDI-FBC, HEIs, RDIs, DA, DOST & Private Sectors
			Continue genotyping towards Marker Assisted Selection (MAS) in breeding	Broodstock development conducted <ul style="list-style-type: none"> Number of breeding program conducted 	2022-2025	BFAR (NIFFTC & NIFTDC), NFRDI-FBC, & HEIs
			Importation of other strains or species of tilapia (<i>Oreochromis</i> sp.) as needed for selective breeding	Better strains of <i>Oreochromis</i> sp. re-introduced <ul style="list-style-type: none"> Number of new blood of tilapia species introduced 	2022-2023	BFAR (Legal Division, IFAD, NIFFTC & FIQD) & NFRDI
B. BROODSTOCK & FINGERLING PRODUCTION						
1. Short supply and variety of genetically improved Nilile tilapia	FOO 338 ¹	To increase production of good quality broodstock	Broodstocks development and maintenance	Broodstock developed and maintained <ul style="list-style-type: none"> Number of broodstock maintained 	2022-2025	BFAR (ROs, NCs w/ tilapia, Central & Multiplier Hatcheries), HEIs & RDIs
			Production and distribution of quality broodstock	Broodstocks-quality fingerlings produced & distributed <ul style="list-style-type: none"> Number of broodstocks produced Number of broodstocks distributed 	2022-2025	
			Production and distribution of quality fingerlings for grow-out (freshwater, brackish water and high-saline breed)	Grow-out quality fingerlings produced and distributed <ul style="list-style-type: none"> Number of fingerlings produced Number of fingerlings distributed 	2022-2025	

1 FOO 338: Fisheries Office Order No. 338, Series of 2019 also known as "Guidelines on the Dispersal/Distribution of Fish Fingerlings and Broodstock"

ISSUES	POLICY	OBJECTIVE	PROGRAM/STRATEGIES	KRAs / KPIs	TIMELINE	RESPONSIBLE AGENCY LEAD, SUPPORT
B. BROODSTOCK & FINGERLING PRODUCTION						
Rehabilitation of Central and Satellite Tilapia Hatcheries and National Centers is imperative towards intensified tilapia production	NFEP	To modernize BFAR Tilapia Central, Satellite Hatcheries and National Centers and private sector hatcheries	Assessment/evaluation of BFAR Tilapia Central, Satellite Hatcheries and National Centers	Assessed/evaluated/surveyed BFAR Tilapia Central, Satellite Hatcheries and National Centers <ul style="list-style-type: none"> Number of BFAR Tilapia Central and Satellite Hatcheries and National Centers assessed/evaluate/surveyed 	2022-2025	BFAR (ROs, CHs, TOS, & NCs)
			Rehabilitation of BFAR Tilapia Central and Satellite Hatcheries and National Centers	<ul style="list-style-type: none"> Number of Central Hatcheries rehabilitated Number of Satellite Hatcheries rehabilitated Number of National Centers rehabilitated 	2022-2025	
			Provision of small-scale set-up of artificial incubation system	<ul style="list-style-type: none"> Provided small-scale set-up of artificial incubation system Number of small-scale set-up of artificial incubation system provided 	2023-2025	BFAR (ROs & NCs w/ tilapia) & Private Sectors
BFAR technical staff needs for retooling		To update knowledge and technical know-hows and skills of BFAR technical staff	Capacity building and training to the manpower of BFAR Tilapia Central and Satellite Hatcheries, National Centers	Capacitated and trained manpower of BFAR Tilapia Central and Satellite Hatcheries, National Centers <ul style="list-style-type: none"> Number of capacity buildings and trainings conducted 	2022-2025	BFAR (ROs, CHs, TOS, & NCs)
LGU extension workers and private sector needs for retooling		To update knowledge and technical know-hows and skills of LGU extension workers and tilapia and tilapia stakeholders	Technology training on hatchery, shading innovations, nursery, grow-out (>500g) brackish water and high-saline culture technologies) for adoption, entrepreneurship and farm business management	Trainings on aquaculture technologies, entrepreneurship and farm management <ul style="list-style-type: none"> Number of trainings conducted 	2022-2025	BFAR (ROs, CHs, TOS & NCs), NFRDI, HEIs & DOST-PCAARRD & Private Sectors

ISSUES	POLICY	OBJECTIVE	PROGRAM/STRATEGIES	KRAs / KPIs	TIMELINE	RESPONSIBLE AGENCY LEAD, SUPPORT
			Establishment of technology demonstration projects (hatchery, shading innovations, nursery, grow-out (>500g))	Established technology demonstration projects (hatchery, shading innovation, nursery and grow-out (>500g)) <ul style="list-style-type: none"> Number of technology demonstration projects established 	2022-2025	BFAR (RO & NCs w/ tilapia), LGUs, & Private Sectors
			Conduct of tilapia congress	Tilapia congress conducted <ul style="list-style-type: none"> Number of tilapia congress conducted 	2022 & 2025	BFAR, RDIs, HEIs, & Tilapia Stakeholders
			Conduct of capacity building for LGU extension officers and academe on extension methodologies and fisheries technologies	Capacitated LGU and academe extension officers <ul style="list-style-type: none"> Number of capacity building conducted 	2022 & 2025	BFAR (FAD, ROs & NCs w/ tilapia), ATI & LGUs
Low adoption of culture technologies by farmers		To promote adoption of polyculture technology	Practice of polyculture technology	Promoted tilapia polyculture technology <ul style="list-style-type: none"> Number of polyculture technology adopters 	2022-2025	Private Sector and assistance from BFAR
Production of affected by climate change		To develop eco-friendly and climate smart hatchery technologies	Development of eco-friendly and climate smart hatchery technologies	Developed technology on eco-friendly and climate smart hatchery technologies <ul style="list-style-type: none"> Number of technologies developed 	2022-2023	NFRDI, BFAR (NCs) HEIs, RDIs, DOST, & DA
Few farmers produced > 500g tilapia ideal for fillet and value added products		To encourage investors to produce > 500g tilapia-sized products	Development of culture technology on the production of fillet-size tilapia (>500g)	Technology developed of the culture technology on the production of >500g tilapia <ul style="list-style-type: none"> Number of technologies developed 	2022-2025	BFAR (ROs & NCs w/ tilapia), NFRDI, RDIs, HEIs, DOST-PCAARRD, & Private Sectors
No supply chain of bigger sized seeds (fingerling and juvenile stage) for nursery, mariculture parks and tilanggit producers	DA, AO No. 17, s. 2021 ²	To promote and establish potential business	Promotion and establishment of potential business (tilapia nursery and mariculture parks and for tilanggit producers of Women's group)	Established tilapia nursery and mariculture parks <ul style="list-style-type: none"> Number of tilapia nursery and mariculture parks established 	2022-2025	Private Sector assisted by BFAR
				Ensured continuous supply of raw material for tilanggit production <ul style="list-style-type: none"> Number of tilanggit producer supplied 		

2 D.A. Administrative Order No. 17, series of 2021 stated the "Strengthening the inclusive agribusiness development program (IADP) through agro-industrial business corridors (ABCs) including the fisheries management areas in the country

ISSUES	POLICY	OBJECTIVE	PROGRAM/STRATEGIES	KRAs / KPIs	TIMELINE	RESPONSIBLE AGENCY LEAD, SUPPORT
Productivity in SWIPs, brackish water pond and mariculture parks are low		To optimize utilization of existing SWIPs, mariculture parks and man-made reservoir	Evaluation of existing SWIPs, mariculture parks and man-made reservoirs	<ul style="list-style-type: none"> Evaluated existing SWIPs, mariculture parks and man-made reservoir Number of SWIPs, mariculture parks and man-made reservoirs evaluated 	2022-2025	BFAR (ROs & IFAD), LGUs, & DENR
Challenge to produce the next generation of fisheries professionals and fish farmers through scholarship grants and establishment of farm schools		To produce the next generation of fisheries professionals and fish farmers through scholarship grants and establishment of farm schools	<p>Identification and utilization of tilapia production areas (SWIPs, mariculture parks and man-made reservoirs)</p> <p>Provision of scholarship and internship leading to fisheries profession</p>	<ul style="list-style-type: none"> Production areas identified and utilized Number of productive areas identified and utilized Number of trainings, technical assistance and fingerlings provided Provided scholarship and internship grant Number of scholarship and internship granted 	2022-2025	BFAR (ROs, ROs & NFFTC), LGUs, DENR, & RDIs
			Establishment of farm school	<ul style="list-style-type: none"> Established farm school Number of farm school established 	2022-2025	TESDA , ATI, & Private Sectors
			Accreditation of BFAR facilities and farm school as training provider	<ul style="list-style-type: none"> Accredited BFAR facilities and farm school Number of BFAR facilities and farm school accredited 	2022- 2025	BFAR-NFFTC, PRC, TESDA, & Private Sectors
D. PRODUCT QUALITY ASSURANCE						
Industry is not ready for full implementation of GAqP		To promote compliance to GAqP to boost competitiveness of tilapia industry	<p>Promotion of Good Aquaculture Practices (GAqP) by conduct of trainings</p> <p>Application of biosecurity measures Government fishery facilities and private aquafarms (hatchery and grow-out)</p>	<ul style="list-style-type: none"> Provided training on GAqP Number of GAqP trainings provided Promoted the application of biosecurity measures in government facilities and private aquafarms Number of trainings and basic biosecurity paraphernalia provided 	2022-2025	BFAR (FRLs, CO, ROs & NCs w/ tilapia), LGUs & Private Sectors
Too many unregistered hatcheries resulted to proliferation of poor quality fingerlings		To ensure quality of fingerlings to be produced by private hatcheries	<p>Aquafarm registration (AquaR) of all hatcheries, nurseries and grow-out tilapia farm</p> <p>Accreditation of tilapia hatcheries</p>	<ul style="list-style-type: none"> Registered tilapia hatcheries, nurseries and grow-out farm Number of tilapia hatcheries, nurseries and grow-out farms registered Accredited tilapia hatcheries Number of tilapia hatcheries accredited 	2022-2025	BFAR (FRLs, CO & all Regions), LGUs, & Private Sectors
				<ul style="list-style-type: none"> Accredited tilapia hatcheries Number of tilapia hatcheries accredited 	2022-2025	BFAR (all Regions & NFFTC), LGUs, & Private Sectors

ISSUES	POLICY	OBJECTIVE	PROGRAM/STRATEGIES	KRAs / KPIs	TIMELINE	RESPONSIBLE AGENCY LEAD, SUPPORT
Emerging tilapia diseases		To develop farmer-friendly, cost-effective kits and optimal laboratory-based protocols for detection and diagnosis of tilapia disease	Development of farmer-friendly, cost-effective kits and optimal laboratory-based protocols for detection and diagnosis of tilapia disease	Conducted R4Ds on emerging diseases <ul style="list-style-type: none"> Number of researches conducted 	2022-2025	NFRDI-FBC, HEIs, BFAR (NFLD, RFL & NFFTC), DOST-PCAARRD, RDIs, & HEIs
		To lessen the cost of production and increase the utilization of locally sourced raw materials in the formulation of tilapia feeds	Surveillance and monitoring of hatcheries and aquafarms re. survey of emerging disease (e.g. TilV etc.)	Monitored and surveyed farms on emerging diseases <ul style="list-style-type: none"> Number of monitoring and survey conducted 	2022-2025	BFAR (NFLD, ROs, FRLs, NFFTC & NIFTDC), NFRDI-FBC, HEIs, & RDIs
Feed cost comprised 60-70% of total cost production		To lessen the cost of production and increase the utilization of locally sourced raw materials in the formulation of tilapia feeds	Conduct researches on cost-effective feed management and strategies and development of environment friendly cost-effective feeds	Conducted researches on cost-effective feed management and strategies and developed environment friendly cost-effective feeds <ul style="list-style-type: none"> Number of researches conducted Number of cost-effective feeds developed 	2022-2025	NFRDI, NFRDI-FBC, HEIs, DOST-PCAARRD, LGUs, BFAR, RDIs, & Tilapia Stakeholders
High cost of feeds, availability and sustainability of feed source			Conduct of technology transfer through technical assistance, trainings and seminars on cost-effective feed management and strategies	Provided technical assistance, trainings and seminars on cost-effective feed management and strategies <ul style="list-style-type: none"> Number of technical assistance, trainings and seminars provided 	2022-2025	BFAR (ROs, NCs w/ tilapia), RDIs, ATI, POs, & LGUs
		To apply nutritional genomics studies focusing on the development of cost-effective feeds using alternative feed ingredients and functional additives	Conduct researches on nutrigenomics	Conducted researches on nutrigenomics <ul style="list-style-type: none"> Number of researches conducted 	2022-2025	DA-Biotech, NFRDI-FBC, NFFTC, HEIs, Tilapia Stakeholders, & RDIs
		To build capacity of farmers to produce cost-effective nutrient rich feeds utilizing locally available feed ingredients	Establishment of small-scale feed mill enterprise	Established small-scale feed mill enterprise <ul style="list-style-type: none"> Number of small-scale feed mill enterprise established 	2022-2025	BFAR (all Regions, NCs w/ tilapia), POs, LGUs, CDA, & Private Sectors

ISSUES	POLICY	OBJECTIVE	PROGRAM/STRATEGIES	KRAs / KPIs	TIMELINE	RESPONSIBLE AGENCY LEAD, SUPPORT
E. POST-HARVEST						
Inadequacy of post-harvest facilities such as processing plants and delivery trucks to deliver products to target destination	F.A.O. No.212, Series of 2001 ³	To make quality fishery products at the place, at the time and the form required	Operationalization of CFLCs	Operationalization of CFLCs <ul style="list-style-type: none"> Number of CFLCs operationalized 	2022-2022	BFAR (PHTD & ROs), LGUs, & Private Sectors
		To ensure availability of quality fish and fishery products	Profiling of tilapia processors	Profiled tilapia processors <ul style="list-style-type: none"> Number of tilapia processors profiled 	2022-2025	BFAR (FHL, FIQD PHTD, & ROs) & Private Sectors
			Establishment of public-private partnership for tilapia processing plant and provision of post-harvest facilities (cold chain facilities and transport vehicles)	Established public-private partnerships for tilapia processing plants and provided post-harvest facilities <ul style="list-style-type: none"> Number of pilot tilapia processing plant established Number of transport vehicles provided Number of village level facility identified 	2022-2025	BFAR (FHL, FIQD, PHTD & ROs), Private Sectors, HEIs, DTI, & DOST
Invest in innovative post-harvest technologies especially on packaging and labelling		To improve tilapia processed products giving priority to product development and packaging	Improvement of tilapia processed products including the packaging and labels	Improved tilapia products including the packaging and labelling <ul style="list-style-type: none"> Number of tilapia product developed Number of tilapia product packaged improved Number of tilapia product labels improved 	2022-2025	

3 Fisheries Administrative Order No. 212, Series of 2001 also known as "Guideline on the Implementation of HACCP System"

ISSUES	POLICY	OBJECTIVE	PROGRAM/STRATEGIES	KRAs / KPIs	TIMELINE	RESPONSIBLE AGENCY LEAD, SUPPORT
Proper post-harvest handling and sound technologies are needed towards global competitiveness	D.A. A.O No.10, section 24, rules 24.3, series of 2015 ⁴	To ensure product quality assurance through improved handling techniques	Creation of fish processors and traders group Capacity building on post-harvest technologies and quality control	Created fish processors and trader groups <ul style="list-style-type: none"> Number of fish processors and trader groups created Conducted capacity building on post-harvest technologies and quality control <ul style="list-style-type: none"> Number of training conducted Number of processing technologies improved 	2022-2025 2022-2025	BFAR-ROs, LGU, & Private Sectors BFAR(ROs & PHTD), LGU, & Private Sectors
Products upon reaching the port of destination are being rejected due to traceability issues	BFAR AC No. 251, series of 2014 ⁵	To ensure the tilapia products can be tracked throughout the supply chain and accurately to consumers	Establishment of fish product testing laboratory and institutionalize GAqP to ensure safety Monitoring and inspection of farms, processing plants, ice plants and tilapia products	Established fish product laboratory <ul style="list-style-type: none"> Number of fish product laboratory established Conducted capacity building on traceability <ul style="list-style-type: none"> Number of capacity building conducted on GAqP (traceability of products) Monitored and inspected farms, processing plants, ice plants and tilapia products <ul style="list-style-type: none"> Number of farms monitored and inspected Number of processing plants monitored and inspected Number of ice plants monitored and inspected Number of tilapia products monitored and inspected 	2022-2024 2022-2025 2022-2025	BFAR (NFLD, FIQD, FHL, & PHTD) BFAR (NFLD, FIQD & ROs) (monitoring and inspection is under FIQD) & private sector

4 Department of Agriculture Administrative Order No. 10, Series of 2015 also known as “The Implementing Rules and Regulations of Republic Act No. 8550 as Amended by Republic Act No. 10654”

5 BFAR Administrative Circular No.251, Series of 2014 also known as “Traceability System for Fish and Fishery Products”

ISSUES	POLICY	OBJECTIVE	PROGRAM/STRATEGIES	KRAs / KPIs	TIMELINE	RESPONSIBLE AGENCY LEAD, SUPPORT
F. MARKETING						
Intercession of market layering		To have equitable access to local market	Consolidation of MSMEs	Consolidated MSMEs <ul style="list-style-type: none"> Number of MSMEs assisted 	2022-2025	BFAR-FIDSSD & Regional counterpart
		To strengthen local marketing network	Facilitation of tilapia marketing and linkages between producer and market (kadiwa and e-kadiwa)	Facilitated tilapia marketing and linkages between producer and market <ul style="list-style-type: none"> Number of e-commerce assistance (business to business platforms) Number of Agri-fisheries business incubators facilitated 	2022-2025	BFAR-FIDSSD Regional counterpart and Private Sectors
Export of tilapia products is the least priority of marketing due to lack of supply at present		To recognize increase in demand for tilapia products in the global market	Establishment of market information system	Established market information system <ul style="list-style-type: none"> Number of market information system established Number of international events/trade fairs participated Number of export promotion conducted 	2022-2025	BFAR (FIDSSD & FIMC), Regional Counterpart, & Private Sectors
Credit is not accessible due to strict requirement and high interest rates of lending institutions		To have access to soft loans and long term funds	Forge partnership with financing institutions	Forged partnership with financing institutions <ul style="list-style-type: none"> Number of credit matchings conducted Number of borrowers 	2022- 2025	BFAR (FIDSSD & ROs), COA, & financing institutions
			Strengthen local marketing network	Strengthened local marketing network <ul style="list-style-type: none"> Number of local market network strengthen 	2022- 2025	
Farmers needs government facilitative assistance in credit access to help them in gaining credit access with financing institutions		To come up with a more organized fish cooperation/ organizations that will serve as service conduits for credit access	Establishment of new and strengthening of existing fisheries cooperatives, organizations and associations	Established a new and strengthened existing fisheries cooperatives, organizations and associations <ul style="list-style-type: none"> Number of new fisheries cooperatives, organization, associations established Number of existing fisheries cooperatives, organization, associations strengthened 	2022- 2025	BFAR (CO, FIDSSD & ROs), COA, & Private Sectors
Market price of tilapia is manipulated by middlemen thus giving less profit to producers and unequitable domestic trade.		To regulate middlemen or baculeras/viajeros	Registration of baculeras/viajeros or middlemen	Registered baculeras/viajeros or middlemen <ul style="list-style-type: none"> Number of registered middlemen 	2022- 2025	BFAR (CO, FIDSSD & ROs) & Private Sectors

INDUSTRY CLUSTER GOVERNANCE NETWORK

TABLE 19: INDUSTRY CLUSTER GOVERNANCE NETWORK OF THE TILAPIA INDUSTRY ROADMAP

ACTORS	ROLE	RESPONSIBILITY
Philippine Council for Agriculture and Fisheries (PCAF), Philippine Tilapia Roadmap-Steering Committee (PTR-SC), and representatives from tilapia fisherfolk, industry associations/cooperatives processor groups, association of feed companies, DA, DA-BFAR, DA-BAR, DA-NFRDI, DOST-PCAARRD, DENR, DTI, LGUs, SEAFDEC/AQD, HEIs, PFDA, PhilMech and NIA	Oversight and advisories	<ul style="list-style-type: none"> • Advocate, promote, and coordinate with the national agencies on nationwide supportive policies and programs for the tilapia industry • Validate and consolidate plans and proposal of the provinces/regions on tilapia development • Act as top advisory body of the Philippine Tilapia Industry Roadmap implementation • Monitor and Update the Philippine Tilapia Industry Roadmap • Liaison with the national policy makers on the tilapia development programs needed legislative support • Represent the tilapia industry in International Conferences • Conduct national and regional tilapia congresses and conferences • Solicit funding support for the implementation of the Philippine Tilapia Industry Roadmap • Assist in the formation of the provincial/regional implementing teams
National Technical Working Group- representatives from DA-BFAR Tilapia Program Focal Team, Planning, Monitoring and Evaluation Division and Inland Fisheries and Aquaculture Division	National Secretariat and Coordinator	<ul style="list-style-type: none"> • Act as the secretariat to consolidate specific policies and directives from PTR-SC
Regional Tilapia Focal Persons (Region 1-13, NCR, CAR, and BARMM)	Regional Coordinators	<ul style="list-style-type: none"> • Shall act upon the policies and directives from PTR-SC in regional level • Monitor the strict implementation of activities and programs indicated in the Philippine Tilapia Industry Roadmap • Shall act as report officer that consolidate accomplished activities within the region • Shall ensure the implementation of programs in the regional level

ACTORS	ROLE	RESPONSIBILITY
Representatives from DA-BFAR (Fisheries Planning and Economic Division, Fisheries Post-harvest Technology Division, Fisheries Industry Development Support and Services Division, National Fisheries Laboratory Division and Regional Training and Fisherfolk Coordination Division	Regional Technical Working Group	<ul style="list-style-type: none"> Assist the Regional Coordinators in monitoring and strict implementation of activities and programs indicated in the Philippine Tilapia Industry Roadmap
PLGU Provincial Agriculturist and DA-BFAR Provincial Fisheries Officers	Provincial Coordinators	<ul style="list-style-type: none"> Assist project implementation team Shall ensure the implementation of programs and activities in provincial level
Tilapia industry associations/cooperatives, BFAR-National Centers and Regional Offices and LGUs	Project Implementing Team-Input Supply and Farm Production Activities	<ul style="list-style-type: none"> Take lead in the implementation of all production-related programs and activities stated in the Philippine Tilapia Industry Roadmap
BFAR-Regional Offices, HEIs, LGUs, TESDA, ATI, DOLE and CDA	Project Implementing Team-Training and Extension Activities	<ul style="list-style-type: none"> Provide seminars and trainings stated in the Philippine Tilapia Industry Roadmap
Philippine Fisheries and Development Authority (PFDA), Philippine Center for Postharvest Development and Mechanization (PhilMech) and National Irrigation Administration (NIA)	Project Implementing Team-Infrastructure Activities	<ul style="list-style-type: none"> PFDA shall handle all government infrastructure programs PhilMech will work on post-harvest equipment NIA will be responsible for irrigations needs of tilapia farmers
BFAR-Fisheries Industry Development Support and Services Division (BFAR-FIDSSD) and Department of Agriculture-Agribusiness and Marketing Assistance (DA-AMAS), Landbank of the Philippines (LBP), Agricultural Credit Policy Council (ACPC), LGUs, rural banks, fisheries cooperatives and Philippine Crop Insurance Corporation (PCIC)	Project Implementation Team- Marketing and Credit Activities	<ul style="list-style-type: none"> Shall work on the marketing and credit activities identified under the Philippine Tilapia Industry Roadmap
BFAR-Fisheries Post Harvest Technology Division and Regional Offices	Project Implementation Team-Product Development Activities	<ul style="list-style-type: none"> Shall pursue production development activities on tilapia stated under the Philippine Tilapia Industry Roadmap

ACTORS	ROLE	RESPONSIBILITY
BFAR-Fisheries Regulatory Division, BFAR-Fisheries Inspection and Quarantine Division and Bureau of Customs	Project Implementation Team-Regulatory System Requirements	<ul style="list-style-type: none"> Enforce regulatory activities on tilapia
BFAR-National Freshwater Fisheries Technology Center (BFAR-NFFTC), HEIs, SEAFDEC/AQD, DA-NFRDI, DA-BAR, DOST and industry associations/cooperatives	Project Implementation Team-Research and Development	<ul style="list-style-type: none"> Formulate R&D plans and conduct research and development aligned with the identified program in the Philippine Tilapia Industry Roadmap

(Five-Year) Implementation Plan (2022-2026)

Vision, Mission, Goals, Objectives, and Targets

Vision. A globally competitive and sustainable tilapia industry that is private sector led and market oriented, with strong government support that will improve the quality of life of Filipinos.

Mission. Development of a globally competitive, eco-sensitive and climate resilient Tilapia Industry that is private sector-led, client driven, supply-reliable following an innovative value chain that is based on sustainable standards.

Goals

1. Increase tilapia production from 304,326.59 MT (2020) to 352,797.9 MT (2025)
2. Ensure quality and traceability of inputs and outputs
3. Promote use of environment friendly tilapia feeds and reduce cost of feed production by utilizing locally sourced raw materials
4. Reduce fishery postharvest losses from 25% to 10% in five years
5. Improve and/or develop a more efficient marketing system for the tilapia industry

Institutional Arrangement

The implementation of the National Tilapia Industry Roadmap shall be directly supervised by the Philippine Council for Agriculture and Fisheries. This committee shall be created to ensure that all programs are implemented and targets are accomplished accordingly. It shall be composed of the following:

- Tilapia fisherfolk
- Tilapia industry associations/cooperatives
- Tilapia Processors group
- Association of feed companies
- Philippine Council for Agriculture and Fisheries (PCAF)
- Department of Agriculture (DA)
- DA-Bureau of Fisheries and Aquatic Resources (DA-BFAR)
- DA- Bureau of Agricultural Research (DA-BAR)
- DA-National Fisheries Research and Development Institute (DA-NFRDI)
- Department of Science and Technology-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD)
- Department of Environment and Natural Resources (DENR)
- Department of Trade and Industry (DTI)
- Local Government Unit (LGU)
- Southeast Asian Fisheries Development Center/Aquaculture Department (SEAFDEC/AQD)
- Higher Education Institutions (HEIs) with fishery curriculum
- Philippine Fisheries Development Authority (PFDA)
- Philippine Center for Postharvest Development and Mechanization (PHilMech)
- National Irrigation Administration (NIA)
- Technical Education and Skills Development Authority (TESDA)

Seven Technical Working Groups (TWG) shall be created and these are – (1) Production; (2) Training and Extension; (3) Infrastructure; (4) Product Development; (5) Regulatory; (6) Marketing, Credit and Insurance Program; and (7) Research and Development. Each group shall be in-charge in the implementation of their respective programs. Composition of each group shall come from the tilapia industry associations, feed companies, fish processors, BFAR, DTI, DA, HEIs, DOST-PCAARRD and LGUs.

Production-related Programs

The private sector thru the tilapia industry associations shall take lead in the implementation of all production-related programs in partnership with BFAR and LGUs.

Training and Extension Program

The BFAR Regional Offices, HEIs offering fisheries courses, TESDA, ATI, DOLE, CDA and LGUs can be tapped for training programs of this roadmap.

Infrastructure Program

The Philippine Fisheries Development Authority (PFDA) and Philippine Center for Postharvest Development and Mechanization (PHilMech) in coordination with BFAR shall handle all government infrastructure programs such as the construction/improvement of processing plants. PHilMech will specifically work on all post-harvest equipment such as cold storage, reefer vans, among others. The private sector on their part can invest in post-harvest facilities to support tilapia export. Moreover, National Irrigation Administration (NIA) will be tapped for the irrigation needs of tilapia farmers. Existing Irrigators' Association shall also be included in the structure.

Marketing, Credit and Insurance Program

In case of marketing and credit needs, BFAR-Fisheries Industry Development Support and Services Division (BFAR-FIDSSD) and Department of Agriculture-Agribusiness and Marketing Assistance (DA-AMAS) shall work together on the various activities identified under this component. In coordination also with the agriculture attaches posted abroad,

they will provide information on the volume of exports needed by a specific importing country. They will also handle all trade exhibitions and food expositions local and abroad.

For credit support, agencies involved including Landbank of the Philippines, Agricultural Credit Policy Council (ACPC), LGUs, rural banks and fisheries cooperatives. They will work on the specific guidelines to make credit accessible and available to all. The Philippine Crop Insurance Corporation (PCIC) on the other hand shall handle the insurance program.

Product Development

The BFAR-Post Harvest Technology Division shall handle the technology promotion through technology demonstration, capability building and distribution of Information, Education and Communication (IEC) materials. However, improvement of product packaging and labeling shall be carried out with the assistance of National Government Agencies (NGAs) like Department of Trade and Industry (DTI), Department of Science and Technology (DOST) among others.

Regulatory System Requirements

The BFAR- Fisheries Regulatory and Licensing Division and Fisheries Inspection and Quarantine Division of all BFAR Central and Regional Offices in coordination with the Bureau of Customs and respective airport management shall ensure quick and transparent regulatory activities to all tilapia exporters.

Research and Development

NFRDI in partnership and coordination with private sector, HEIs, and RDIs shall be tapped in the Research and Development component such as the continuous improvement of tilapia strains. On the other hand, the NFRDI Fisheries Post-Harvest Research and Development Division shall pursue the product development activities for tilapia.

Monitoring and Evaluation

The monitoring and evaluation on the progress of project implementation shall be done by a team at the Regional and Provincial level. The team shall be composed of the Regional/Provincial Agricultural and Fishery Coordinators, representatives from the industry associations, NGAs such as BFAR Regional/Provincial Fisheries Offices (R/PFOs) and Higher Education Institutions (HEIs).

Moreover, the Sub-Committee on Fisheries of the Philippine Council for Agriculture and Fishery (PCAF) together with the National Fisheries and Aquatic Resources Management Council (NFARMC) and National Agriculture and Fisheries Council (NAFC) shall monitor the accomplishment and milestone of the National Tilapia Roadmap. The frequency of monitoring shall be mutually decided by the Steering Committee, PCAF, NFARMC and NAFC. For the impact monitoring and evaluation, a third party evaluator can be hired to conduct the activity so that it can help provide an independent perspective on the project performance.

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APPENDICES

APPENDIX TABLE 1. LIST OF TILAPIA INDUSTRY SURVEY RESPONDENTS ON JULY 14, 2020

Number	Name	Involvement in the Tilapia Industry
1	Joriel Aclan	Hatchery Operator/Government Worker
2	Maria Rowena Romana-Eguia	Researcher
3	Dante Mendoza	Academe
4	Reinafil C. Bernal	Government Worker
5	Melchor B. Deramas	Government Worker
6	Jon Juico	Hatchery Operator/Tilapia Grower
7	Melba E. Francisco	Government Worker
8	Westly Rosario	Government Worker
9	Ralphrandt Atabay	Government Worker
10	Paterno H. Bag-Ao	Hatchery Operator
11	Irma A. Villanueva	Hatchery Operator/Tilapia Grower
12	Judy B. Mendiola	Government Worker
13	Gerardo D. Gran	Tilapia Grower
14	Robert Vilbar	Technician
15	Marivic M. Panahon	Feed Miller
16	Ravelina R. Velasco	Academe
17	Jenny Ann Santos-Ercilla	Government Worker
18	Efren Capistrano	Hatchery Operator
19	Marx Perfecto C. Garcia	Researcher/Government Worker
20	Dario J. Doctolero	Hatchery Operator/Tilapia Grower, Technician/Government Worker
21	Danilo Trongco	Tilapia Grower
22	Rodmar Salaan	Tilapia Grower
23	Josephine T. Dela Vega	Government Worker
24	Marlon B. Dagandan	Government Worker
25	Gloria D. Santos	Technician/Government Worker
26	Gaymelo Y. Lopez	Hatchery Operator/Government Worker
27	Joel P. Ceperez	Tilapia Grower
28	Rogelyn B. Apit	Technician/Government Worker
29	Tereso A. Abella	Tilapia Grower/Researcher/ Academe
30	Victorino M. Zafra	Hatchery Operator
31	Norida P. Samson	Hatchery Operator/ Tilapia Grower / Government Worker
32	Bensar S. Ola	Technician/Government Worker
33	Rito E. Bombeo	Tilapia Grower
34	John Ferdinand L. Babao	Technician
35	Jan Emerson Manuzon	Technician
36	Michael Kevin Kier M. Santos	Technician
37	John Castro Señora	Technician
38	Paul Filip Depra	Technician/Government Worker

APPENDIX TABLE 2. LIST OF TILAPIA INDUSTRY SURVEY RESPONDENTS ON FEBRUARY 18, 2021

Number	Name	Involvement in the Tilapia Industry
1	Jenny Ann Ercilla	Government Worker
2	Marx Perfecto C. Garcia	Government Worker
3	Ralphrandt T. Atabay	Government Worker
4	Norida P. Samson	Hatchery Operator
5	Jon Juico	Tilapia Grower
6	Reynely M. Cardel	Government Worker
7	Jake E. Martinez	Government Worker
8	Paul Filip A. Depra	Government Worker
9	Oliva O. Ledda	Government Worker
10	Melba E. Francisco	Government Worker
11	Myrna E. Sevilla	Hatchery Operator
12	Norberto C. Paguia	Hatchery Operator
13	Riza Chua	Government Worker
14	Aldrin N. Taoatao	Researcher
15	Galicana A. Toston	Government Worker
16	Remigio Pangan	Hatchery Operator
17	Antonio G. Taduan	Hatchery Operator
18	Maricel P. Antiga	Government Worker
19	Victorino Zafra	Hatchery Operator
20	Emmanuel Vera Cruz	Researcher
21	Ruel V. Eguia	Industry Stakeholder/Input Supplier
22	Maria Rowena R. Romana-Eguia	Researcher
23	Norberto Duran	Tilapia Grower
24	Bensar S. Ola	Government Worker
25	Patricio Timog	Hatchery Operator
26	Charlie Josue Dasalla	Academe
27	Levi Brian P. Somido	Hatchery Operator
28	Romeo J. Cajandig	Tilapia Grower
29	Jun Pamay	Hatchery Operator
30	Mar Macasiray	Hatchery Operator
31	Reinafil C. Bernal	Government Worker
32	Basilio Pastor	Tilapia Grower
33	Rufino Senoja	Hatchery Operator
34	Gaymelo Y. Lopez	Hatchery Operator
35	Lauro F. Aspillaga	Hatchery Operator
36	Andre Von James S. Villanueva	Government Worker
37	Ricardo Songco	Hatchery Operator
38	Vivian Taniza	Hatchery Operator

Number	Name	Involvement in the Tilapia Industry
39	Fred A. Bisquera	Hatchery Operator
40	Beth P. Bunday	Tilapia Grower
41	Benito P. Travilla	Hatchery Operator
42	Arnel Santiago	Hatchery Operator
43	Jefrey Escobido Niave	Hatchery Operator
44	Mercilyn V. Hj.Rebuan	Government Worker
45	Joel Ceperez	Tilapia Grower
46	Erwin Domingo Enriquez	Feed Mix Technician
47	Lake Danao Freswater Fish Farm (LDFE)	Hatchery Operator
48	Antonio B. Berona	Tilapia Grower
49	Jessie Malong	Tilapia Grower
50	Laila M. Holoyohoy	Government Worker
51	Marlon Dagandan	Government Worker
52	Bienvinado Hesita	Tilapia Grower
53	Jose Infante	Tilapia Grower
54	Melchor B. Demaranas	Government Worker
55	Carl Janssen O. Jarabe	Government Worker
56	Charina Gascon Borre	Technician, Bmeg Feeds, San Miguel Food, Inc.
57	Nelson Ramat	Tilapia Grower
58	Julian Dipasupil	Tilapia Grower
59	Danilo Trongco	Tilapia Grower
60	Leticia M. Pita	Tilapia Grower
61	Vicente Luarez	Hatchery Operator, Tilapia Grower
62	Elmer B. Payno	Hatchery Operator
63	Noe D. Ligares	Hatchery Operator, Tilapia Grower
64	Ronald Escobido	Government Worker
65	Mark Alponse Buniel	Government Worker

APPENDIX TABLE 3. LIST OF PARTICIPANTS DURING THE “CONSULTATION MEETING WITH BFAR REGIONAL FISHERIES PRODUCTION AND SUPPORT SERVICES DIVISION (FPSSD) HEADS, TECHNOLOGY OUTREACH STATION (TOS) HEADS, AND REGIONAL TILAPIA FOCAL PERSONS NATIONWIDE” ON FEBRUARY 23, 2021 VIA ZOOM PLATFORM

Number	Name	Designation
1	Florencio A. Aparri	OIC-FPSSD
2	Paul Filip A. Depra	Aquaculturist I/Technical Staff
3	Rhemar C. Bayato	OIC-Aquaculture Section
4	Galicana A. Toston	OIC-Aquaculture Section
5	Dr. Antonio P. Morales	Focal Person-National Centers
6	Severina S. Bueno	Chief, FPSSD
7	Riza J. Chua	FPSSD Staff
8	Benife C. Lutao	FPSSD Staff
9	Lois June B. Fermin	Chief, FPSSD
10	Remely Lachica	Chief, FPSSD
11	Ralphrand T. Atabay	FPSSD, TOSBW
12	Sancho Bilog	Production Unit
13	Mercilyn V. Hj.Rebuan	OIC-BFRS
14	Jake E. Martinez	RFFTC Staff
15	Marx Perfecto C. Garcia	Senior Aquaculturist
16	Oliva O. Ledda	Aquaculturist II
17	Antonio G. Tadian	Senior Aquaculturist
18	Aldrin N. Taoatao	Aquaculturist I
19	Rowena E. Langga	Senior Aquaculturist
20	Mark Alphonse A. Buniel	OIC, Aquaculture Section
21	Jenny Ann S. Ercilla	Aquaculturist I
22	Felecitas M. Paraggua	Senior Aquaculturist
23	Melba C. Francisco	Senior Aquaculturist
24	Rhodamel C. Soriano	Aquaculturist II
25	Madelyne Rubio	Aquaculturist I
26	Claribeth Dupaya	Aquaculture Technician
27	Henry Q. Canlas, Jr.	Senior Aquaculturist
28	Ness D. Ababa	Technical Staff
29	Reinafil C. Bernal	Head, RFAPC

APPENDIX TABLE 4. LIST OF PARTICIPANTS DURING “VIRTUAL TILAPIA CONSULTATION STAKEHOLDERS MEETING” ON AUGUST 10, 2021 VIA ZOOM PLATFORM

Number	Name	Involvement in the Tilapia Industry
1	Emiliana C. Casbadillo	OIC, PFO-Laguna, BFAR-RO4A
2	Caren D. Punzalan	Technical Staff, BFAR 4-A-FDFF Station
3	Edward A. Viñan	Agricultural Technologist, LGU Argao, Cebu
4	Myla I. Ladines	Agricultural Technologist, LGU Sampaloc, Quezon
5	Rodrigo C.Gocon	Fish Cage Owner, SAFA Association
6	Carmelo F. Gagan	Fish Cage / Fish Pond Owner, SAFA Association
7	Adrienne Nera	TAAI BOD
8	Monica Euzel U. Peñamante	Fish Pond Owner, Region 4-A
9	Mario Balazon	TAAI BOD
10	Rodrigo Cacao	TAAI BOD
11	Lavern Luke L. Burce	Fish Pond Owner, SAFA Association
12	Michelle E. Patoc	Aquaculturist II, BFAR-NFFTC
13	Marx Perfecto C. Garcia	Senior Aquaculturist, BFAR- CAR
14	Hector De Guzman	Aquaculturist II, BFAR- CAR
15	Privy Jane C. Cadlum	OIC,SRAPC, BFAR-RO8
16	Peter T. Astrera	Fish Cage/Fish Pond Owner, Region 4-A
17	Roger B. Tuba	Technical Staff, BFAR-RO8
18	Michelle Ferrer	Aquacultural Technician I, BFAR-CAR
19	Marilou V. Palado	Aquaculture Technician I, BFAR-CAR
20	Danilo Trongco	Hatchery & Grow-Out Operator, CAR
21	Rodel I. Taganna	Technical Staff, BFAR-RO8
22	Emilio G. Perucho	Fish Pond Owner, Region 1
23	Reynaldo Galano Malaubang	Operator, LGU Ozamiz City
24	Lym G. Pait	Hatchery Operator, CAR
25	Diosdado Bernal	Fish Cage Operator, CAR
26	Florendo G Juico Jr	Hatchery & Grow-out Operator, Region 3
27	Nathan S. Gelig	Hatchery Caretaker, BFAR-RO8
28	Sergio Dalayon	Grow- Out Operator, CAR
29	Luis De Leon	Tilapia Hatchery Operator, LGU Tanza
30	Michelle Peralta	Aquaculturist II, BFAR-CAR
31	Narciso C. Ponce Jr.	GM-Casuga Farm, Region 11
32	Nelson B. Lacubtan	Chairperson, Pickism Tilapia Growers Association
33	Virginia P. Valde	Senior Aquaculturist, PFO Misamis Occidental
34	Asmailyn Macalimbang	Aquaculturist II, MAFAR, BARMM
35	Mirasol M. Calma	Aquaculturist I, BFAR-RO3
36	Vicente Lugagay	Tilapia Hatchery Operator, Region 2

Number	Name	Involvement in the Tilapia Industry
37	Sulaiman T. Alid	Program Assistant For Fisheries, MAFAR, BARMM
38	Aimee A. Campanilla	AT-Designate, Region 13
39	Bensar S. Ola	AT/Alternate- TOS, Region 12
40	Arnel N. Cabanig	Association President, Buayan Tilapia Farmers Association
41	Melba E. Francisco	Senior Aquaculturist, BFAR-RO2
42	Elisa A. Benafin	Secretary, Tadian Farmers Fisherfolk and Irrigators Association
43	Vivia N. Taniza	Hatchery Operator, Region 2
44	Elmer B. Payno	Fishpond Operator, Region 5
45	Reynaldo S. Del Amor	Adviser, Tadian Farmers Fisherfolk and Irrigators Association
46	Irma A Villanueva	Hatchery and Grow-Out Farm Operator, Region 7
47	Robinson G. Pel-Ingen	President, Tadian Farmers Fisherfolk and Irrigators Association
48	Mark Joseph B. Piloton	Aquaculturist 1, BFAR-RO7
49	Rogelio Taghoy Mazo	Guess-Observer, Chamber of Commerce French in Vietnam
50	Badal T. Awal	Fishpond Operator, Pulotan Farmers and Fisherfolk Cooperative
51	Cirila O. Libay	Aquacultural Technician, BFAR-RO7
52	Joel B. Clapano	Aquaculturist II, BFAR-RO7
53	Mario Ruinata	Senior Aquaculturist, BFAR-RO7
54	Drusila Esther Bayate	Assistant Director, DA BFAR
55	Maricel L. Pino	Aquacultural Technician
56	Lydia M. Morales	Supervising Aquaculturist, BFAR-IFAD
57	Clarice C. Massagan	Aquaculture Technician II, BFAR-CAR
58	Atty. Jerick Christian p. Dagdagan	Attorney II-BFAR RO1
59	Trysonel R. Minay	PFO Staff, BFAR-RO4B
60	Amparo L. Fang	Senior Aquaculturist, BFAR-RO4A
61	Maricel C. Kinit	Aquacultural Technician I, BFAR-CAR
62	Reynely M. Cardel	Aquacultural Technologist, BFAR-RO4A
63	Aurelio A. Carandang	Farm Worker, BFAR-RO4A
64	Badal T. Awal Norsalyn I. Abdulfatah	Chairman, Pulotan Farmers and Fisherfolk Marketing Cooperative
65	Victor Doblas	Private sector

Number	Name	Involvement in the Tilapia Industry
66	Joel Luching	Agriculturist II, LGU Magro
67	Adin B. Siaboc	Agriculturist II, LGU Magro
68	Jonas Estorba	Private sector
69	Severina Bueno	BFAR Region 2
70	Adam Galimba	Private sector
71	Mark Estrada	BFAR Region 3
72	Leonardo Primne	Private sector
73	Arnel Santiago	Hatchery operator
74	Maricel Antiga	BFAR-RO11
75	Rodel Villena	Private sector
76	Victorino Zafra	Hatchery operator, CHLRTHOA-MPC
77	Mirasol M. Calma	Aquaculturist I, BFAR-RO3
78	Angelito Haligao	Private sector
79	Mergie Laurden	Private Sector
80	Genevie S. Domingo	Private sector
81	John K. Sornito	Fishery Technician, MAO Palawan
82	Jeffrey Naive	Private sector
83	Carmelita Balaba	Private sector
84	Narciso D. Minguito Jr.	BFAR-RO10
85	Normina G. Camsa	Private sector, Mangungaya Fisherfolk Association
86	Victor Delusen	Private sector
87	Glenn Taneza	Private sector, Miramar Tilapia Growers Association
88	Janel M. Villamor	Private sector
89	Janet S. Daguio	Private sector
90	Cristy Lae A. Tolentino	BFAR-CAR
91	Maria Jessa Esabel Anlap	BFAR-RO4B
92	Casiano Choresca	NFRDI - FBC
93	Ma. Therasa Oclos	NFRDI - PMED
94	Azalea Combatir	NFRDI- FBC
95	Ma. Jodecel C. Danting	BFAR NFFTC
96	Evelyn H. Zafra	BFAR NFFTC
97	Milagros M. Apaga	BFAR- NFFTC
98	John Wilbert A. Orilla	NFRDI-FBC

APPENDIX TABLE 5. LIST OF REGISTERED AQUAFEED MANUFACTURER IN THE PHILIPPINES AS OF MAY 2021

Number	Region	Feed Manufacturer	Plant Address
1	I	Cargill Philippines, Incorporated	Bo. Bacag, Villasis, Pangasinan
2		San Miguel Foods, Incorporated	Brgy. Bued, Binalonan, Pangasinan
3	II	New Hope Isabela Agriculture, Incorporated	National Highway, Mambabanga, Luna, Isabela
4		San Miguel Foods, Incorporated	Bo. Soyung, Echague, Isabela
5	III	Aces Agri-Manufacturing Corporation	Km 102 Maharlika Hi-way, San Leonardo, Nueva Ecija
6		Cargill Philippines, Incorporated	Bo Dampol 1st, Pulilan, Bulacan
7		Charoen Pokphand Foods Philippines Corporation	Km 111 Roman Super Highway, Brgy. Gugo, Samal, Bataan; Brgy. Caturay, Gerona, Tarlac; 233 C. Mercado St., Brgy. Panginay, Guiguinto, Bulacan
8		Feedmix Specialist, Incorporated II	#053 National Road, Dampol 2nd-A, Pulilan, Bulacan
9		Feedworld, Incorporated	Edsan Farm Maninaug Paralaya, Porac, Pampanga
10		Gold Label Feedmill	Dela Paz Norte Rd, Sindalan, San Fernando, Pampanga
11		Texicon Agri Ventures Corporation	C. Mercado St., Brgy. Panginay, m Guiguinto, Bulacan
12		Grobest Feeds Philippines, Incorporated	Barangay Singat, Gerona, Tarlac
13		Hoc Po Feeds Corporation	Cagayan Valley Rd., Tabang, Sta Cruz, Guiguinto, Bulacan
14		Mersan Agri Development, Incorporated	Panguinay, Guiguinto Bulacan
15		Sunjin Philippines Corporation	#102 Brgy Partida, Pob Norzagaray, Bulacan
16		Santeh Feeds Corporation	Silangan Hiway, Sto Niño Calumpit Bulacan
17	New Hope Bulacan Agriculture, Incorporated	0645 Brgy. Tibag, Pulilan, Bulacan	
18	New Hope Central Luzon Agri, Incorporated	Sto. Niño San Simon, Pampanga	
19	New Hope Tarlac Agriculture, Incorporated	Brgy. Parsolingan, Gerona, Tarlac	
20	Southeast Feed Specialist Corporation	Brgy. Matungao, Bulacan, Bulacan	

Number	Region	Feed Manufacturer	Plant Address
21	IV-A	Armor Milling Corporation	San Felipe, Padre Garcia, Batangas
22		Jetbest Animal Nutrition And Health Care, Incorporated	National Road, Maraouy, Lipa City, Batangas
23		Lipa Agricultural Development Corporation (Ladeco)	Lamar Village, Sabang, Lipa City
24		Limcoma Multi-Purpose Cooperative	Gen. Luna St., Sabang, Lipa City, Batangas
25		Primera Agro-Development Corporation	Antipolo del Norte, Lipa, Batangas
26		Soro-Soro Ibaba Development Cooperative	Sorosoro Ibaba, Batangas City
27		Solid One Mill Philippines, Incorporated	Km. 68 J. P. Laurel Hi-Way, Brgy Darasa, Tanauan, Batangas
28		Welgro Philippines, Incorporated	PTCC, Carmona, Cavite
29		Tower Feeds Corporation	Pinagkawitan, Lipa City
30		Philippine Foremost Milling Corporation	Quarantine Road, Brgy. ,Progreso, Lapaz, Iloilo City
31	VI	Vitarich Corporation	Progreso, Lapaz, Iloilo City, Maliao, Pavia, Iloilo
32	VII	Integrated Aquaculture Specialist, Incorporated	P. Remedio St., Banilad, Mandaue City
33	X	Marcela Farms, Incorporated	Lomangog, Ubay, Bohol
34		Oversea Feeds Corporation	Balud, San Fernando, Cebu
35		Popular Feedmill Corporation	80-B Aranas St., Taboan, Cebu City
36	XI	San Miguel Foods, Incorporated	Brgy. Kalansangay, Malaybalay, Bukidnon
37		Tateh Premium Feeds Corporation	Zone 8, Upper Puerto, Cagayan de Oro, Misamis Oriental
38		Julu Enterprises Incorporated	Dumoy, Toril, Davao City
39	XII	Vitarich Corporation	Km 14, Panacan, Davao City
40		Arowana Agriventures Corporation	Richmond Global City, Silway 7, Polomolok, South Cotabato
41		San Miguel Foods Incorporated	San Roque, Lagao, Genera Santos City
42		Tateh Premium Feeds Corporation	Purok Riverside, Matin-ao, Silway 8, Polomolok, South Cotabato
43	NCR	General Milling Corporation	Rodriguez Avenue, Bo. Ugong, Pasig, MM
44		Universal Robina Corporation	16 Santiago St., Bagong Ilog, Pasig City
45		Sahara Feeds Corporation	53 Planters Ave., Rincon St., Valenzuela City
46		First El Presidente Manufacturing, Incorporated	50 R. Magsaysay Avenue, San Bartolome District, Novaliches, Quezon City

APPENDIX TABLE 6 LIST OF BFAR-REGISTERED TILAPIA AQUACULTURE FARMS AS OF MAY 1, 2021

No.	Region	Control Number	Farm Code	Name of Farm
1	CAR	003630	CAR-KAL-01	Almora Fish Farm
2		003632	CAR-APA-02	Teotimo Guzon Farm
3		003633	CAR-APA-03	Rio's Farm
4		003634	CAR-IFU-08	Addon Fish Farm
5		003700	CAR-ABR-01	Danny Joan Farm
6		003701	CAR-ABR-02	Bessat Fish Farm
7		003805	CAR-ABR-02	Bessat Fish Farm
8		003806	CAR-APA-04	RJ Domingo Fish Farm
9		003811	CAR-APA-06	Bag-o Shintako Fish Farm
10		003808	CAR-IFU-08	Mexico Farm's
11	I	003524	R1-ILS-222	Mario's Farm
12		003526	R1-ILS-224	Antonia Rafanan Farm
13		003527	R1-ILS-225	Ronnie Arca Jr. Aqua Farm
14		003528	R1-ILS-226	Ireneo Farm
15		003529	R1-ILS-227	Rommel Arca Farm
16		003531	R1-ILS-229	RR Farm
17		003532	R1-ILS-230	Rabe Aqua Farm
18		003534	R1-ILS-232	Goze Farm
19		003620	R1-PAN-240	JM Perez Aquafarm, Inc.
20		003621	R1-PAN-052	Ramon Perdon Farm
21		003688	R1-PAN-248	MR2AS Aqua Farm
22		003721	R1-PAN-170	Erickson Bangus Enterprise
23		002495	R2-ISA-088	Madduma Fish Farm
24		002496	R2-QUI-083	Luttwad Farmer's Association Fish Farm
25		002497	R2-QUI-084	Pastor Fish Farm
26		002498	R2-NV-085	Lucero Fish Farm
27	002499	R2-NV-086	Tupaz Fish Farm	
28	002500	R2-NV-087	Meligrito Fish Farm	
29	II	003503	R2-NV-089	De leon Fish Farm
30		003608	R2-CAG-063	Garcia's Farm
31		003609	R2-ISA-090	Sanchez Fish Farm
32		003610	R2-ISA-091	Carlos' Fish Farm
33		003611	R2-ISA-092	Acupido's Fish Farm
34		003612	R2-ISA-093	Sevilla's Fish Farm
35		003613	R2-CAG-094	Lando's Fish Farm
36		003614	R2-CAG-095	Jose Fish Farm

No.	Region	Control Number	Farm Code	Name of Farm
37		003615	R2-ISA-096	Bernardino Fish Farm
38		003616	R2-CAG-097	Arciaga's Fish Farm
39		003617	R2-CAG-098	Andam Fish Farm
40		003618	R2-CAG-099	SGB Fish Farm
41		003520	R3-NUE-160	Genomar Supreme Phils., Inc.
42	III	003690	R3-PAM-104	Squatter Farm
43		003691	R3-PAM-105	Parara Farm
44		002478	R4A-BAT-024	Anson Farm
45		002479	R4A-BAT-026	De Castro Fish Farm
46		003595	R4A-BAT-016	King Benjie Fish Farm
47	IV-A	003596	R4A-BAT-054	MGB Aqua Farm
48		003600	R4A-BAT-048	Bilibinwang Fish Farm
49		003601	R4A-BAT-028	Othoc Aqua Farm & Marine Resources
50		003602	R4A-BAT-035	Natalio Carandang
51	IV-B	003591	R4B-MOC-203	Fulgencio Farm 5
52		003815	R4B-MOR-211	Angela's Agri-Aqua Resources-Prawn Culture
53		003637	R5-ALB-010	Tiwi Fry Bank and Grow-out Farm
54		003640	R5-CAS-226	LGU-Bato Fish Cage
55		003750	R5-CAS-086	Yolly and Edcel Crab and Praw Farm
56		003751	R5-SOR-114	Leticia M. Homo
57		003753	R5-CAS-192	Intia Farm
58		003754	R5-CAS-205	J&J Fishpond
59		003756	R5-CAS-207	Romeo Cedo Farm
60		003774	R5-CAS-244	Violeta De Jesus Farm
61		003778	R5-CAS-248	Gazpar Calleja
62	V	003779	R5-CAS-249	Israel Buena Farm
63		003780	R5-CAS-250	Zorilla Fish Cages
64		003781	R5-CAS-251	Pili Farm
65		003783	R5-CAS-253	Cangayo Farm
66		003784	RS-CAS-254	Domingo Tanay Farm
67		003785	RS-CAS-255	Presado Farm
68		003786	R5-CAS-256	Buena Farm
69		003787	R5-CAS-257	Pili Farm
70		003788	R5-CSA-258	Rodel Pili Farm
71		003789	R5-CAS-259	Mota Farm
72		003790	R5-CAS-260	Peñaflorida Farm

No.	Region	Control Number	Farm Code	Name of Farm
73		003791	R5-CAS-261	Rosendo Matucad Farm
74		003792	R5-CAS-262	Kobo'Jo
75		003793	R5-CAS-263	Dela Rama Farm
76		003794	R5-CAS-264	Ramos Farm
77	VI	002440	R5-ILO-006	Parcon Fish Farm
78		003661	R6-ILO-043	Franton Aqua Farm
79		003542	R7-BOH-126	Marcela Farms, Inc.
80		003547	R7-BOH-238	Marcela Farms, Inc.
81	VII	003711	R7-BOH-189	Ubay Brackish water Fish Farm
82		003712	R7-BOH-225	BFAR 7- Central Visayas Multi-Species Nursery Demonstration and Training Center
83	VIII	002412	R8-NSA-012	Unno Aquafarm
84		002453	R9-NTE-153	Genereza S. Recamara Farm
85		002454	R9-NTE-162	Genereza S. Recamara Farm
86	IX	003514	R9-ZAM-154	Cesar H. Sulla Farm
87		003515	R9-ZAM-155	Erlie H. Zulla Farm
88		003516	R9-ZAM-157	Fernando H. Sulla Farm
89		003517	R9-ZAM-158	Labordo Heirs Farm
90		003518	R9-ZAM-163	Troy Farm
91	X	002433	R10-MOC-003	DN Farm
92		002434	R10-MOC-004	Arado Farm
93		003572	R10-LDN-028	DMA Aquafarm
94		003574	R10-LDN-025	Christorey E. Ramones Farm
95		003575	R11-DVOro-063	Aposacas Hatchery
96		003664	R11-DVS-040	Aquasur Resources Corporation
97	XI	003665	R11-DVOro-063	LAA Hatchery
98		003702	R11-DVN-042	3DC Aquaculture
99		003816	R11-DVOro-084	Aloy Farm & Tilapia Hatchery
100	XII	003659	R12-SAR-06	Alsons Aquaculture Corporation
101	XIII	003565	R13-SDN-89	AB Aqua Ventures

APPENDIX TABLE 7 SUMMARY OF TILAPIA STAKEHOLDERS DIRECTORY AS OF MAY 30, 2021

Region	Private Hatcheries		Government Hatcheries			Grow-out Farms
	Registered Hatcheries	Non-registered Hatcheries	BFAR TOS	Provincial and Municipal Hatcheries	HEI Hatcheries	
CAR	5	20	5	15	2	7,953
I	2	15	1	4	3	3,343
II	3	3	7	4	1	21,308
III	29	28	3	6	3	12,874
IV-A	3	108	2	2	0	760
IV-B	3	0	5	0	0	553
V	18	0	8	0	0	211
VI	0	6	3	11	1	3
VII	0	0	2	0	0	98
VIII	3	3	5	3	2	130
IX	6	0	1	0	2	957
X	1	0	2	7	1	1,096
XI	16	0	1	5	1	6,542
XII	0	201	1	0	0	3,586
XIII	13	12	1	5	0	642
Total	102	396	47	62	16	60,056

APPENDIX FIGURE 1 SAMPLE SURVEY QUESTIONNAIRE USED FOR THE LOCAL BENCHMARKING ANALYSIS FOR HATCHERY OPERATION, PAGE 1 OF 5

TILAPIA INDUSTRY ROADMAP
LOCAL BENCHMARKING

Name of Respondent: _____
Address: _____
Contact No.: _____ Email Address: _____

Hatchery Operation

Qualitative Parameters

1. Production system
 - o Pond (Average size of production pond (m²): _____)
 - o Hapa (Average size of breeding hapa (LxWxH): _____)
 - o Tank (Average size of production tank (m²): _____)
 - o Others (pls. specify) _____
2. Total area of the hatchery: _____
3. Production method
 - o Fingerling production
 - o Fry collection
 - o Egg/yolk sac fry collection
4. Pond preparation practices
 - o Prepare pond regularly (check as many as applicable)
 - () draining
 - () levelling
 - () drying
 - () treatment
 - () basal application of fertilizer
 - () water filling
 - () others _____
 - o Seldom perform pond preparation
 - o No pond preparation at all
 - o Others (pls. specify) _____
5. Source of water (check as many as applicable)
 - o Irrigation
 - o Groundwater
 - o Spring
 - o River
 - o Recycled water
 - o Others (pls. specify) _____
6. Average water depth of production pond/tank
 - o 0.5 meter
 - o 0.75 meter

APPENDIX FIGURE 2 SAMPLE SURVEY QUESTIONNAIRE USED FOR THE LOCAL BENCHMARKING ANALYSIS FOR HATCHERY OPERATION, PAGE 2 OF 5

- 1.0 meter
 - 1.2 meters
7. Source of breeders
- Well-known strains (e.g. iExCEL, FaST, SEAFDEC Strain, GST) from certified hatchery
 - Unknown strains
 - Others(pls. specify)_____
8. Number of breeder per square meter (m²)
- 1 breeder/2 m²
 - 1 breeder/m²
 - 2 breeders/m²
 - 3 breeders/m²
 - Others(pls. specify)_____
9. Sex ratio of breeders
- 1 male : 2 females
 - 1 male : 3 females
 - 1 male : 4 females
 - Others (pls. specify)_____
10. Basal harvest of eggs/fry/fingerlings (No. of days after stocking of breeders/pairing of male and female)
- 10-12 days
 - 13-14 days
 - 21 days
 - Others (pls. specify)_____
11. No. of days per production cycle
- 25-30 days
 - 13-14 days
 - Others (pls. specify)_____
12. Duration of incubation period from eggs to fry stage (for hatchery using Incubation System):
- 7-8 days
 - 9-12 days
 - Others (pls. specify)_____
13. Type of fingerlings produced
- Normal/ mixed sex
 - Sex-reversed
 - All-male (hybrid)

APPENDIX FIGURE 3 SAMPLE SURVEY QUESTIONNAIRE USED FOR THE LOCAL BENCHMARKING ANALYSIS FOR HATCHERY OPERATION, PAGE 3 OF 5

- 14. Use of probiotics (application in feeds and/or in pond water)
 - None
 - Home-made probiotics
 - Commercially available probiotics

- 15. Water management
 - Regular flushing/exchange of filtered water
 - Flushing of water is not necessarily done
 - Others (pls. specify) _____

 - Application of inorganic/organic fertilizer (dressing)
 - No fertilization throughout the production period

- 16. Feeding practices and management (check as many as applicable)
 - Manual feeding
 - Automatic feeder
 - Demand feeder (improvised)

 - Daily feeding
 - Alternate feeding

 - Feed once a day
 - Feed 2x a day
 - Feed 3x a day
 - Feed ≥4x a day

- 17. Labor capacity of the farm:
 - 1 laborer/ha
 - 2-3 laborers/ha
 - 4-6 laborers/ha
 - Others(pls. specify) _____

- 18. Technological capacity and machinery of the farm (check as many as applicable)
 - Aeration system
 - Water pump system
 - Water filtration system
 - Automatic feeder system
 - Solar power system
 - Power spray/washer
 - Others (pls. specify) _____

APPENDIX FIGURE 4 SAMPLE SURVEY QUESTIONNAIRE USED FOR THE LOCAL BENCHMARKING ANALYSIS FOR HATCHERY OPERATION, PAGE 4 OF 5

Quantitative Parameters

- 19. Estimated average production of fry/fingerlings per cycle: _____
- 20. Average percent survival of eggs to fry: _____
- 21. Average percent survival of fry to fingerlings: _____
- 22. Sizes of fry/fingerlings for dispersal
 - Fry
 - #32
 - #24
 - #20
 - #22
 - #17
 - #14

Competitiveness

- 23. Estimated average production cost per cycle: _____
- 24. Cost of fry/fingerlings for sale
 - Fry _____
 - #32 _____
 - #24 _____
 - #20 _____
 - #22 _____
 - #17 _____
 - #14 _____
- 25. Supply reliability (check as many as applicable)
 - Fingerlings is always available even to walk-in clients
 - Caters large quantity/bulk orders
 - Quantity of harvest is for local/within the vicinity only
 - Can the supply/production meet the customer's orders/needs?
 - Always
 - Sometimes
 - Never
- 26. Innovations in sales and marketing (check as many as applicable)
 - Discounts on price
 - After sales service to customers
 - Technical assistance
 - Mortality replacement
 - Offers free delivery service
 - Offers door to door delivery service

APPENDIX FIGURE 5 SAMPLE SURVEY QUESTIONNAIRE USED FOR THE LOCAL BENCHMARKING ANALYSIS FOR HATCHERY OPERATION, PAGE 5 OF 5

- Use of advertisement
 - () Print advertising (brochure, newspaper)
 - () Broadcast advertising (T.V., radio)
 - () Outdoor advertising (banners, posters, etc.)
 - () Digital advertising (internet & digital devices)
 - () Product/Brand Integration (TV show, YouTube video, etc)
 - () Social media advertising (facebook, instagram, twitter, pinterest, etc.)
 - () Word-of-mouth advertising
- Dispersal is by schedule/appointment
- Dispersal is first come first serve basis
- Frequent or loyal customers are prioritized in dispersal

--END--

APPENDIX FIGURE 6 SAMPLE OF SURVEY QUESTIONNAIRE USED FOR THE LOCAL BENCHMARKING IN GROW-OUT OPERATION IN POND, PAGE 1 OF 4

**TILAPIA INDUSTRY ROADMAP
LOCAL BENCHMARKING**

Name of Respondent: _____
Address: _____
Contact No.: _____ Email Address: _____

Grow-Out Operation in Pond

Qualitative Parameters

1. Total area of the farm: _____
2. Average size/area of grow-out pond (m²): _____
3. Pond preparation practices
 - o Prepare pond regularly (check as many as applicable)
 - () draining
 - () levelling
 - () drying
 - () treatment
 - () basal application of fertilizer
 - () water filling
 - () others _____
 - o Seldom perform pond preparation
 - o No pond preparation at all
 - o Others (pls. specify) _____
4. Average water depth throughout the culture period (meters): _____
5. Source of water (check as many as applicable)
 - o Irrigation
 - o Groundwater
 - o Spring
 - o Recycled water
 - o River
 - o Others (pls. specify) _____
6. Water Management (check as many as applicable):
 - o Regular flushing/water exchange from
 - () Irrigation
 - () Groundwater
 - () Spring
 - () Recycled water
 - () River
 - () Others (pls. specify) _____

APPENDIX FIGURE 7 SAMPLE OF SURVEY QUESTIONNAIRE USED FOR THE LOCAL BENCHMARKING IN GROW-OUT OPERATION IN POND, PAGE 2 OF 4

- Occasional flushing/water exchange from
 - Irrigation
 - Groundwater
 - Spring
 - Recycled water
 - River
 - Others (pls. specify) _____
- Regular monitoring of water quality parameters
- Occasional monitoring of water quality parameters
- Application of inorganic/organic fertilizer (dressing)
- No fertilization throughout the production period
- 7. Source of Fingerlings
 - Well-known strains (e.g. ExCEL, FaST, GST) from certified hatchery
 - Unknown strains
 - Others(pls. specify) _____
- 8. Type of fingerlings used
 - Normal/ mixed sex
 - Sex-reversed
 - All-male (hybrid)
- 9. Feeding practices and management (check as many as applicable)
 - Follows feeding guide (based from percent body weight)
 - No feeding guide followed

 - Use formulated feeds throughout the culture period
 - Use commercial feeds throughout the culture period
 - Combination of formulated feeds and commercial feeds
 - Employ supplemental feeding (e.g. rice bran, Kitchen waste and etc.)

 - Manual feeding
 - Automatic feeder
 - Demand feeder (improvised)

 - Daily feeding
 - Alternate feeding (ex. Feeding every other day)
 - Delayed feeding (ex. no feeding during first two weeks or one month)

 - Feed once a day
 - Feed 2x a day
 - Feed 3x a day
 - Others(pls. specify) _____

APPENDIX FIGURE 8 SAMPLE SURVEY QUESTIONNAIRE USED FOR THE LOCAL BENCHMARKING IN GROW-OUT OPERATION IN POND, PAGE 3 OF 4

- 10. Use of probiotics (application in feeds and/or in pond water)
 - None
 - Home-made probiotics
 - Commercially available probiotics
- 11. Technological capacity and machinery of the farm (check as many as applicable)
 - Aeration system
 - Water pump system
 - Water filtration system
 - Automatic feeder system
 - Solar power system
 - Others (pls. specify) _____
- 10. Labor capacity of the farm:
 - 1 laborer/ha
 - 2 laborers/ha
 - 3 laborers/ha
 - Others (pls. specify) _____

Quantitative Parameters

- 11. Productivity
 - 1-2 MT/ha/cycle
 - 3-5 MT/ha/cycle
 - 6-8 MT/ha/cycle
 - Others (pls. specify) _____

 - 1-1.5 FCR
 - 1.6-2 FCR
 - 2.1-3 FCR
 - Others (pls. specify) _____

 - 40-50% survival
 - 51-60% survival
 - 61-80% survival
 - 81-90% survival
 - Others (pls. specify) _____
- 12. Culture period and average body weight of tilapia produced
 - 3-4 months
 - 4-5 months
 - 5-6 months
 - Others(pls. specify) _____

 - 4-5 pcs/Kg
 - 3-4 pcs/Kg
 - Others (pls. specify) _____

APPENDIX FIGURE 9 SAMPLE SURVEY QUESTIONNAIRE USED FOR THE LOCAL BENCHMARKING IN GROW-OUT OPERATION IN POND, PAGE 4 OF 4

Competitiveness

13. Production cost per kilo: _____

14. Farm gate price: _____

15. Supply reliability (check as many as applicable)

- Always available even to walk-in clients
- Caters large quantity/bulk orders
- Quantity of harvest is for local/within the vicinity only
- Can the supply/harvest meet the customer's orders/needs?
 - Always
 - Sometimes
 - Never

16. Innovations in sales and marketing

- Discounts on price
- "Reseko" (ex. 10 kilos purchased = 1 kilo free)
- Offers free delivery service
- Offers door to door delivery service
- Use of advertisement
 - Print advertising (brochure, newspaper)
 - Broadcast advertising (T.V., radio)
 - Outdoor advertising (banners, posters, etc.)
 - Digital advertising (internet & digital devices)
 - Product/Brand Integration (TV show, YouTube video, etc)
 - Social media advertising (facebook, instagram, twitter, pinterest, etc.)
 - Word-of-mouth advertising

--END--

APPENDIX FIGURE 10 SAMPLE SURVEY QUESTIONNAIRE USED ON TILAPIA INDUSTRY SURVEY,
PAGE 1 OF 7

Tilapia Industry Survey

Name of Respondent: _____
Address: _____
Contact No.: _____
Email Address: _____

1. What is your involvement in the tilapia industry?
 - a. Hatchery Operator
 - b. Tilapia Grower
 - c. Academe
 - d. Government Worker
 - e. Others, please specify
2. How can you classify the operation of tilapia industry in your region?
 - a. Mechanized
 - b. Automated
 - c. Manual
 - d. Others, please specify
3. On a scale of 1-10 (10 being the highest) rate the availability and accessibility of raw materials needed in tilapia production in your region.
Answer: _____
4. Sources of raw materials for feed formulation in your region.
 - a. Locally available in the area
 - b. Sourced outside the region
 - c. Imported from other countries
 - d. Others, pls. specify
5. Are the raw materials and supplies undergo examination in terms of characteristics and compliance with technical specifications?
 - a. Yes
 - b. No
 - c. Not Applicable
6. In your region, what is the average income of tilapia farmers?
 - a. Poor (Less than Php 11,690.00 per month)
 - b. Low Income but not poor (Between Php 11,690.00 to Php 23,381.00 per month)
 - c. Lower Middle Income (Between Php 23,381.00 to Php 46,761.00 per month)
 - d. Middle Middle Class (Between Php 46,761.00 to Php 81,832.00 per month)
 - e. Upper Middle Income (Between Php 81,832.00 to Php 140,284.00 per month)
 - f. Upper Income but not rich (Between Php 140,284.00 to Php 233,806.00 per month)
 - g. Rich (At least Php 233,807.00 per month)
 - h. Others, please specify
7. Source/s of broodstocks in hatchery operation in your region.
 - a. Government Institution (e.g. BFAR)
 - b. Private Institution
 - c. Others, pls specify

APPENDIX FIGURE 11 SAMPLE SURVEY QUESTIONNAIRE USED ON TILAPIA INDUSTRY SURVEY,
PAGE 2 OF 7

8. Are there any tilapia hatchery and grow-out organizations/associations/cooperatives present in your area?

- a. Yes
- b. No

9. Are tilapia fingerlings supply readily available in your region?

- a. Yes
- b. No

10. Source/s of fingerlings for grow-out operation in your region.

- a. Government Hatcheries within the region
- b. Government Hatcheries outside the region
- c. Private Hatcheries within the region
- d. Private Hatcheries outside the region
- e. Others (Please specify)

11. Is contract growing exists in grow-out operation in your area?

- a. Yes
- b. No

12. Are tilapia available in the market daily?

- a. Yes
- b. No

13. What is the prevailing farm gate price of tilapia in your region?

- a. Php 60-70
- b. Php 71-80
- c. Php 81-90
- d. Others

14. What is the prevailing market/retail price of tilapia in your region?

- a. Php 81-90
- b. Php 91-100
- c. Others

15. What are the common market forms of tilapia in your region?

- a. Live
- b. Chilled
- c. Frozen
- d. Value-added product (dried, smoked, fermented, dsing)
- e. Other

16. What are the available processed tilapia in your region?

- a. Fillet
- b. Smoked
- c. Dried (e.g. "bilanggit")
- d. Other

17. What is the average percentage mark-up price from farm to every marketing layers?

- a. 5%
- b. 10%
- c. 15%
- d. 20%
- e. Other

APPENDIX FIGURE 12 SAMPLE SURVEY QUESTIONNAIRE USED ON TILAPIA INDUSTRY SURVEY,
PAGE 3 OF 7

18. What are the average production volumes per hectare in your region?

- a. 3 MT and below
- b. 3.1 MT -5 MT
- c. 5.1 MT – 10 MT
- d. 10.1 MT and above

19. Please select the marketing channels present in your region.

- a. Direct (Producers → Consumers)
- b. Retail (Producers → Retailer → Consumers)
- c. Wholesale (Producers → Wholesaler or Distributor → Retailer → Consumers)
- d. Agent (Producers → Agent/Broker → Wholesaler or Distributor → Retailer → Consumers)
- e. Other

20. Are the tilapia produced in your area meet the needs of customers in terms of quantity?

- a. Yes
- b. No

21. Are the tilapia produced in your area meet the needs of customers in terms of efficiency (delivery time)?

- a. Yes
- b. No

22. Do you think tilapia growers have the capability to adopt and invest in new technologies at present?

- a. Yes
- b. No

23. Please rank the following factors according to its importance in uplifting the status of Tilapia industry (1 being the most important)

- ___ Presence of machineries and equipment
- ___ Compliance to industry standards
- ___ Government support facilities
- ___ Market distribution
- ___ Skilled manpower
- ___ Knowledge on the production
- ___ Capital
- ___ Availability of locally produced raw materials
- ___ Product quality

24. Please rank the following strengths of the Tilapia industry (1 being the most important).

- ___ Availability and easy access to latest and innovative technologies
- ___ Availability and accessibility of quality seedstock
- ___ Wider areas available for farming
- ___ Full government support
- ___ Highly trained manpower at the national level on tilapia technologies
- ___ Lots of researchable areas
- ___ Strong public-private partnership
- ___ Presence of Tilapia stakeholders association
- ___ Availability of government facilities (National Centers, TOS, LGUs, SCUs)

25. Are there additional strength you want to be included other than the previously stated?
Answer: _____

APPENDIX FIGURE 13 SAMPLE SURVEY QUESTIONNAIRE USED ON TILAPIA INDUSTRY SURVEY,
PAGE 4 OF 7

26. Please rank the following weaknesses of the Tilapia industry (1 being the most important).

- Seasonal /limited supply and access to quality fingerlings and broodstocks
- High production cost
- High dependence on ground water
- Weak domestic and international marketing assistance
- Lack of raw materials for fillet (>300g/pc)
- Traceability of products
- Too many marketing layers
- Inadequate logistics (e.g. Trucks and Post-harvest facilities)
- Low awareness on processed products
- Weak credit access and limited credit window
- Weak extension services
- Biosecurity
- Lack of efficient/trained manpower (LGU)
- Industry is not ready for full implementation of GAqP
- Inadequate post harvest facilities (local and export)
- Low technology dissemination

27. Are there additional weakness you want to be included other than the previously stated?
Answer: _____

28. Please rank the following opportunities of the tilapia industry (1 being the most important).

- Utilization of local agri-by-products as supplemented feeds (e.g. rice bran, copra meal)
- Technology transfer on hatchery, nursery and grow-out operations
- Full government support
- Availability of highly trained manpower
- Wider areas available for farming
- Lots of researchable areas
- Increasing demand of tilapia fillet in the US and in Europe
- Presence of Technology Outreach Station in every region

29. Are there additional opportunities you want to be included other than the previously stated?
Answer: _____

30. Please rank the following threats of the tilapia industry (1 being the most important).

- High cost of raw materials and equipment
- Importation
- Natural disaster
- Climate change
- High cost Input supply
- Limited supply of raw materials
- Surplus production
- Disease problem
- Deception online marketing
- Pest (Predator)
- Existence of invasive tilapia species

31. Are there additional threats you want to be included other than the previously stated?
Answer: _____

APPENDIX FIGURE 14 SAMPLE SURVEY QUESTIONNAIRE USED ON TILAPIA INDUSTRY SURVEY,
PAGE 5 OF 7

32. Do you think the tilapia industry is capable of exportation within?

- a. 1-3 years
- b. 4-6 years
- c. more than 6 years

33. Do you think the consolidation of small and medium sized farms would help promote partnership and community enterprise in the tilapia industry?

- a. Yes
- b. No

34. Please rank what aspect in the tilapia industry modernization program should be given priority (1 being the most important).

- Latest technology
- Digitization/automation of production facilities
- Mechanization of production and post-harvest facilities

35. Rank the following areas of research you think is important in the tilapia industry (1 being the most important)

- Improvement of tilapia breeds
- Value addition
- Low-cost feed formulation
- Immunostimulation
- Effective and efficient farming technologies

36. What are the quality control and assurance protocols being implemented in your area? Encircle all that are applicable.

- a. BFAR Fisheries Office Order
- b. Good Aquaculture Practices (GAQP)
- c. Good Manufacturing Practices (GMP)
- d. Hazard Analysis Critical Control Point (HACCP)
- e. Best Management Practices (BMP)
- f. Others

37. On a scale of 1-10 (10 being the highest), rate if the tilapia industry in the country is comparable with the international practices.

Answer: _____

38. Please rank what kind of empowerment do tilapia stakeholders needs (1 being the most important).

- Capacity building on technology updates
- Financial assistance
- Formation of association/cooperative
- Facilitation of marketing system
- Establishment of networking

39. Are farm employees in your area undergo technical capability trainings?

- a. Yes
- b. No

40. Are farm employees in your area undergo sanitary, health and safety trainings?

- a. Yes
- b. No

APPENDIX FIGURE 15 SAMPLE SURVEY QUESTIONNAIRE USED ON TILAPIA INDUSTRY SURVEY,
PAGE 6 OF 7

41. Are farms in your region employ/hire the following as worker. Please tick all that are applicable

- a. Men
- b. Women
- c. Person with disability
- d. Senior citizen
- e. Indigenous People (IP's)
- f. LGBT group or community

42. How many percent of men farm workers are employed in your area?

- a. 1-20%
- b. 21-40%
- c. 41-60%
- d. 61-80%
- e. 81-100%
- f. Other

43. How many percent of women farm workers are employed in your area?

- a. 1-5%
- b. 6-10%
- c. 11-15%
- d. 16-20%
- e. 21-25%
- f. 26-30%
- g. 31-35%
- h. Other

44. How many percent of People with Senior Citizen are employed in your area?

- a. 1-5%
- b. 6-10%
- c. 11-15%
- d. 16-20%
- e. 21-25%
- f. 26-30%
- g. 31-35%
- h. Other

45. How many percent of People with Disability (PWD) are employed in your area?

- a. 1-5%
- b. 6-10%
- c. Other

46. How many percent of People with Indigenous People (IP's) farm workers are employed in your area?

- a. 1-5%
- b. 6-10%
- c. Other

47. How many percent of People LGBT group or community farm workers are employed in your area?

- a. 1-5%
- b. 6-10%
- c. Other

APPENDIX FIGURE 16 SAMPLE SURVEY QUESTIONNAIRE USED ON TILAPIA INDUSTRY SURVEY,
PAGE 4 OF 7

48. Please rank the following interventions to be attained by 2025 (1 being the most important)

- Registration of Hatchery, Nursery and Grow-out Operators
- Accreditation of Private Hatcheries
- Rehabilitation of Central and Satellite Hatcheries
- Implementation of Good Aquaculture Practices
- Adoption of Fry Rearing to Advanced Fingerling Stage Technology (Nursery).
- Conduct of Health and Quality Certification
- Formation of Fish Processors and Traders group
- Forge partnership with government financing
- Strengthen local market network
- Conduct of market research for export promotion
- Equitable access to domestic trade
- Feed formulation using locally available raw materials

49. Please rank the following intervention to be attained by 2030 (1 being the most important)

- Development of Climate Resilient Tilapia
- Full implementation of Good Aquaculture Practices
- Mechanization and Modernization of Tilapia Farming
- Application of Biotechnology on diagnosis and treatment
- Improved Cold Chain Technology
- Establishment of Fish Product Testing Laboratory
- Establishment/ Strengthening of Producer Cooperative
- Availability of value added products in local and international market
- Availability of cost effective feeds locally

50. Please rank the following interventions to be attained by 2040 (1 being the most important)

- SNPs-gene identification Microsatellite marker development
- Cloning - isolation of somatic cells
- Formulation of ready to eat tilapia products
- Electronic marketing adaptation
- Export of fillet and value added products
- Enhancement of fish immunity (vaccination and formulation of immunostimulants for the diet of fish and etc.)

THANK YOU VERY MUCH!

