CASE STUDY 4:
OVERVIEW OF FRESHWATER AQUACULTURE OF TILAPIA IN THE PHILIPPINES

A. Introduction

1. This case study was undertaken to provide an overview of freshwater aquaculture of tilapia in the context of production, consumption, markets, prices, marketing channels, access to inputs, support services, and relevant lessons.[1]

2. The Philippines is an archipelago of 7,100 islands covering 299,735 square kilometers (km^2), with a total coastline of approximately 17,460 km. The inland waters comprise brackish- and freshwater swamplands (3,384 km^2), fishponds (2,538 km^2), lakes (2,000 km^2), rivers, and reservoirs (500 km^2).[2]

3. Valued at P107 billion in 2001, the fisheries sector accounted for 2.3% of the Philippine gross domestic product (GDP) in that year. The sector employs directly or indirectly, at least one million Filipinos.[3] Net exports of fish and fishery products in 2001 were valued at $443.5 million. In 2002, artisanal capture fisheries,[4] commercial capture fisheries, and aquaculture contributed 29%, 31%, and 40%, respectively, to total fish production of 3.37 million metric tons (t). From 1991 to 2002, total fisheries production grew by 2.4% annually. Artisanal fisheries production declined during this period by 1.3% because of overfishing and environmental degradation, while commercial fisheries production grew by 2.9% from the opening of new fishing areas and new technologies. Over the same period, aquaculture grew by 6.2%, playing an increasing role in food security and livelihoods (Figure 1). Tilapia has gained wide acceptance among consumers, and dominates farmed freshwater fish production in the country, particularly in Region III (Central Luzon) and Region IV (Southern Tagalog).

4. Tilapias are native only to Africa and the Levant. There are no native species with comparable characteristics for aquaculture in the Philippines. The first tilapia introduced to the Philippines was the Mozambique tilapia (*Oreochromis mossambicus),* imported from Thailand in 1950.[5] The Nile tilapia (*O. niloticus*) was first introduced to the Philippines in 1972 and rapidly gained popularity with farmers and consumers. It is now the main species of tilapia farmed in the Philippines and throughout tropical Asia and the Pacific and has been called an "aquatic

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[1] N. Bestari and A. Morales undertook this country case study in collaboration with B. Katon and R. Pullin.

[2] *Philippine Fisheries Profile 2001*. Bureau of Fisheries and Aquatic Resources (BFAR). Philippines: Quezon City.

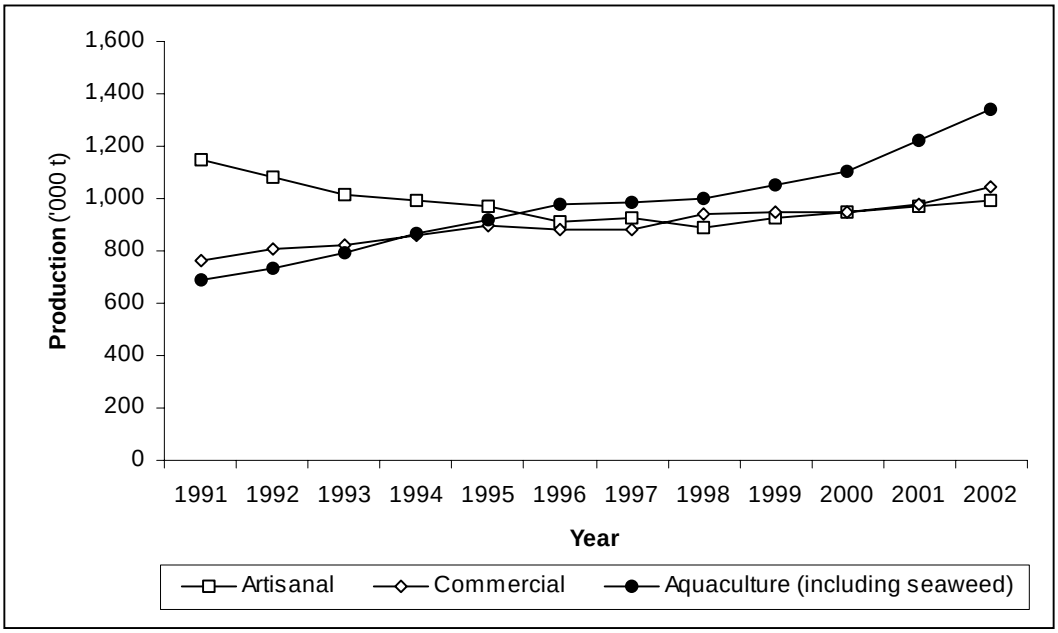
[3] Rivera-Guieb, Rebecca, Alexander Boyd-Hagart, Jocel Pangilinan, and Ronet Santos. 2002. *Aquatic Resources in the Philippines and the Extent of Poverty in the Sector.* Quezon City, Philippines: Voluntary Service Overseas (Philippines). These figures are probably underestimates because of the difficulties of collecting comprehensive data.

[4] Artisanal fisheries in the Philippines are subsistence and small-scale fishing operations including the use of a boat of up to 3 gross tons displacement.

[5] In common with all other stocks of this species that were then being tried for aquaculture in Asia and the Pacific, its origin was a population of only two females and three males, discovered in 1938 in an Indonesian coastal pond, probably introduced from East Africa by traders. All of these Asia-Pacific stocks of *O. mossambicus* subsequently performed poorly in aquaculture, probably in part because of this genetic history.

chicken," suitable for farming in diverse systems, from backyard ponds to large commercial ponds and cages.[6]

Figure 1: Aquaculture, and Commercial and Artisanal Fisheries Production in the Philippines, 1991–2002



Source: Bureau of Agricultural Statistics.

B. History

5. Substantial and continuous programs of freshwater aquaculture research and extension have been undertaken in the Philippines since 1972.[7] Tilapia farming in fishponds and small-scale reservoirs developed mainly on irrigated and rainfed rice lands. Cage farming has been practiced since the 1970s in large and small lakes. Other fishponds (mostly for tilapia) have long been part of small-scale, mixed enterprise farms in the uplands and other remote areas. However, most freshwater aquaculture in the Philippines has developed as a specialized enterprise: with fish as a cash crop and not as a component of the kinds of integrated

[6] (i) The history of tilapia farming and introductions was described by Guerrero, Rafael D. III, and Melchor M. Tayamen. 1988. Philippines. In *Tilapia Genetic Resources for Aquaculture*, edited by Roger S.V. Pullin. *ICLARM Conference Proceedings* 16. p. 42–44. Manila.
(ii) The name "aquatic chicken" has its origin in the paper Maclean, Jay L. 1984. Tilapia: The Aquatic Chicken. *ICLARM Newsletter* 7 (1): 17.
(iii) Tilapia farming in the Philippines was described by: Guerrero, Rafael D. III. 1997. *A Guide to Tilapia Farming*. Bay, Laguna, Philippines: Aquatic Biosystems. 70 p.

[7] This work was undertaken principally by the National Freshwater Fisheries Technology Center (NFTTC) of the Philippine Bureau of Fisheries and Aquatic Resources (BFAR), the Freshwater Aquaculture Center (FAC) of Central Luzon State University (CLSU), and the Southeast Asian Fisheries Development Center (SEAFDEC). Their programs laid the foundations of Philippine freshwater aquaculture and continue to support its expansion.

agriculture-aquaculture farming systems that have typified its history in much of Asia.[8] Similarly, rice-fish integrated farming has not prospered in the Philippines and its future prospects seem limited.[9] Tilapia farming in the Philippines has been and remains a specialized enterprise, regardless of scale, while it retains an artisanal character.[10]

6. The course of Philippine freshwater aquaculture history has followed that of Philippine agriculture. Developing-country agriculture can be classified into two types: green revolution and resource poor.[11] The former is found in fertile "agricultural heartlands," which are usually either irrigated or rainfed lowlands near major urban areas; for example, much of Central Luzon in the Philippines. The latter, usually abbreviated to CDR (complex, diverse, risk prone) agriculture, is found where farming systems are much more fragile; for example, much of the Philippine uplands.[12] Philippine freshwater aquaculture and most tilapia pond farming have developed mainly in green revolution areas, not CDR areas. Freshwater aquaculture has demonstrated its importance in the former mainly for urban and rural fish supply, but has considerable underdeveloped potential for rural livelihoods and fish supply.

7. By the mid-1980s, more than 20 generations of Nile tilapia breeding in the Philippines had gone by with no systematic application of genetics to improve performance. Moreover, some stocks had interbred with the less desirable *O. mossambicus*.[13] The International Center for Living Aquatic Resources Management (ICLARM), Manila, then incorporated the application of genetics in aquaculture as a major thrust of its strategic research with national partners in the Philippines and in other tropical developing countries. From the late 1980s, the Asian Development Bank (ADB) and other donors contributed funds for this research on genetic

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[8] More than 20 years ago, small-scale integrated farming was considered to have potential in the Philippines and on-station research was carried out to determine guidelines and economics. None of the technologies developed was adopted to any significant extent, largely because of the high costs of keeping and feeding poultry and livestock in sufficient quantities to manure the ponds. Small-scale farmers also face difficulties in rearing poultry profitably in small numbers due to their inadequate economy of scale, the specialized nature of the business, constraints in accessing financial resources, and the competitiveness of the market. Some integrated farming of chickens, ducks, and pigs with tilapia is practiced in the Philippines (Guerrero 1997; footnote 6 [iii]), but is rare compared to intensive pond and cage farming with pelleted feeds.

[9] Rice-fish integrated farming systems research and development have been pursued for decades by FAC/CLSU. Rice-fish farming in the narrow sense (i.e., raising fish and rice concurrently in ricefields to marketable or consumable size) has very limited prospects in green revolution areas, where even the nursing of tilapia fry to advanced fingerlings faces problems. A major thrust in current rice research is to reduce the amount and depth of water needed.

[10] Yap, Wilfredo G. 1999. *Rural Aquaculture in the Philippines.* RAP Publication 1999/20. Bangkok: Regional Office for Asia and the Pacific, Food and Agriculture Organization of the United Nations. 102 p.

[11] Chambers, Robert, Arnold Pacey, and Lori Ann Thrupp, Editors. 1989. *Farmer First, Farmer Innovation and Agricultural Research*. London, Intermediate Technology Publications. 218 p.

[12] Integration of aquaculture has potential for small-scale farmers in resource-poor areas in the Philippines. Upland farmers in Quirino Province have derived ecological as well as economic benefits from using on-farm materials, such as rice bran, straw, and hulls; spoiled fruit and vegetables; and chopped leaves and livestock manure in pond culture. See: Prein, Mark, Roberto Oficial, Mary Anne Bimbao, and Teresita Lopez. 2002. Aquaculture for Diversification of Small Farms within Forest Buffer Zone Management: an Example from the Uplands of Quirino Province, Philippines. In *Rural Aquaculture*, edited by Peter Edwards, David C. Little, and Harvey Demaine. Wallingford, UK: CABI Publishing. p. 97–109.

[13] The genetics of tilapias farmed in the Philippines up to the late 1980s were reviewed by Pullin, Roger S.V., and Josephine B. Capili. 1988. Genetic Improvement of Tilapias: Problems and Prospects. In the *Second International Symposium on Tilapia in Aquaculture*, edited by Roger S.V. Pullin, Thirapan Bhukasawan, Kamonporn Tonguthai, and Jay L. Maclean. *ICLARM Conference Proceedings* 15. p. 259–266. Manila. The interbreeding of *O. niloticus* and *O. mossambicus* in the Philippines was reported by Macaranas, Julie M., Nobuhiku Taniguchi, Maria Josepha R. Pante, Josephine B. Capili, and Roger S.V. Pullin. 1986. Electrophoretic Evidence for Extensive Hybrid Gene Introgression into Commercial *Oreochromis niloticus* (L.) Stocks in the Philippines. *Aquaculture and Fisheries Management* 17: 249–258.

improvement of farmed tilapias and dissemination of improved breeds.[14] Many farmers in the Philippines gained rapid access to improved tilapia strains. Farmed tilapia production increased more than five-fold from 1981 to 2001, largely because of improved breeds, increased access to and availability of input supply and commercial feed, sustained technical support and extension, and cooperation among the government, the private sector, and regional and international organizations.[15] The rapid rise in farmed tilapia production has been enabled by an increasing demand for a relatively cheap fish for national food security, partly due to the decline in artisanal capture fisheries production over the last decade.

C. Production and Consumption

8. The Philippines Department of Agriculture has prepared a tilapia master plan; proposed directions for tilapia farming up to 2010; and identified strengths, weaknesses, opportunities, and threats.[16] This master plan addresses strategic targets to meet projected long-term growth, identifying strategic actions to encourage stakeholder participation, and identifying and establishing mechanisms that optimize stakeholder cooperation, coordination, communications, and monitoring. By 2010, the Philippines aims to increase production of farmed tilapia to 250,000 t (from 122,000 t in 2002), reduce production costs, export tilapia, increase consumption of tilapia, and expand employment opportunities. While the Government's program for fisheries and the master plan for tilapia have charted the development of tilapia farming in the Philippines, major challenges lie ahead to fulfilling these targets and increasing the relevance of tilapia farming for small-scale farmers and the poor.

9. **Production.** Based on production data of 1985–2001, the supply of tilapia in the Philippines is all produced domestically, about 79% from aquaculture and the remainder from inland fisheries. Total tilapia production in this period grew on average by 6% per annum while total tilapia aquaculture and total tilapia freshwater aquaculture production grew by 8.5% and 8.8%, respectively (Figure 2), the difference in total amounts being due to a small component of brackishwater tilapia aquaculture. In 2001, freshwater fishponds[17] and cages accounted for 91.2% of the total tilapia aquaculture production of 106,618 t.[18] The total farm gate value of all Philippine tilapia production in 2001 was P5.13 billion ($102 million) and tilapia ranked second

[14] The development of genetically improved farmed tilapias (GIFT) through selective breeding was partly financed by ADB under TA 5279-REG: *Genetic Improvement of Tilapia Species in Asia*, for $475,000, approved on 8 March 1988. ADB also supported dissemination of GIFT through TA 5558-REG: *Dissemination and Evaluation of Genetically Improved Tilapia Species in Asia (DEGITA)*, for $600,000, approved on 14 December 1993. The institutional impacts of the GIFT project included the establishment in 1993 of the ICLARM (now the WorldFish Center)-coordinated International Network on Genetics in Aquaculture (INGA:http://www.worldfishcenter.org/inga), now comprising 13 developing country and 12 advanced research institutional members. In 1997, ICLARM, CLSU and BFAR established the GIFT Foundation International Incorporated, a nonstock, nonprofit corporation that continues breeding research and seed supply with GIFT strains. In 1999, the GIFT Foundation International Incorporated assigned to Genomar ASA (www.genomar.com) the commercial rights and brand name of the GIFT Super Tilapia through a public-private partnership. The DEGITA project distributed GIFT strain tilapias to Bangladesh, People's Republic of China, Philippines, Thailand, and Viet Nam, with on-station and on-farm evaluation of their performance.

[15] Guerrero, Rafael.D. III. 1994., cited in Paclibare, Jose. Development of Commercial Aquaculture in the Philippines: A Policy Perspective. Paper prepared as part of the FAO/NACA/SEAFDEC Regional Study on Commercial Aquaculture Development in Southeast Asia. Quezon City, Philippines. (In press)

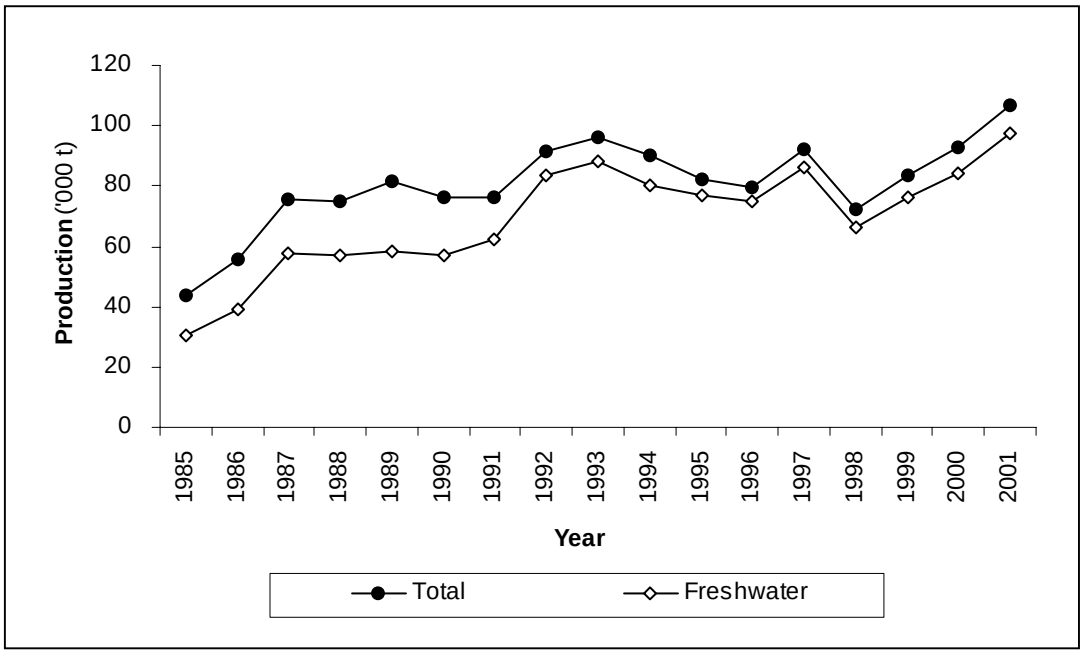
[16] The Tilapia Masterplan was prepared by the Philippines Department of Agriculture. January 2002. This master plan is featured in the objectives of a new trade association, Philippine Tilapia, Inc., founded in 2003.

[17] In 1996, the average landholding of tilapia pond farmers in the country was 3.53 ha. Source: Regaspi, Priscilla 1997, cited by Olalo, Celestino. 2001.Production, Accessibility and Consumption Patterns of Aquaculture Products in the Philippines. In Production, Accessibility and Consumption Patterns of Aquaculture Products in Asia: A Cross-Country Comparison. *FAO Fisheries Circular 973.* 275 p. Rome.

[18] Available: http://www.bas.gov.ph

among the major fish species farmed. Regions III (Central Luzon) and IV (Southern Tagalog)[19] have been consistently the major production areas, contributing 48.4% (51,595 t) and 31.2% (33,297 t) of total farmed tilapia production, respectively, in 2001.

Figure 2: Production of Farmed Tilapia in the Philippines, 1985–2001



Source: Bureau of Agricultural Statistics.

10. Tilapia production is characterized by lean and peak production periods. Production is highest during the second quarter of the year because farmers time their harvests to coincide with local fiestas and religious events (especially Lent and Holy Week). During Lent and Holy Week most Filipinos abstain from eating meat and demand for fish is high. Production is lowest in the third quarter when there is greatest risk of typhoons in areas within the typhoon belt. These include the main tilapia farming areas, regions III and IV.

11. Seasonality of production has an impact on tilapia market price. Generally, prices are higher during lean months and lower during peak months. However, an analysis of the production trends and price variations indicates that tilapia prices in nominal terms have increased in times of increasing total supply, partly because of rising costs of feed, which represents 70–80% of total variable production costs. Tilapia prices also depend on the seasonality of demand for tilapia. For instance, a high demand for tilapia and fish products during the second quarter of the year leads to higher tilapia prices for farmers.[20]

12. **Consumption.** Fish is an important component of the Filipino diet and a valuable source of animal protein and other nutrients. The per capita consumption of fish and fish products

[19] Region III (Central Luzon) comprises the provinces of Aurora, Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, and Zambales. Region IV (Southern Tagalog) comprises the provinces of Batangas, Cavite, Laguna, Marinduque, Mindoro, Palawan, Quezon, Rizal, and Romblon.

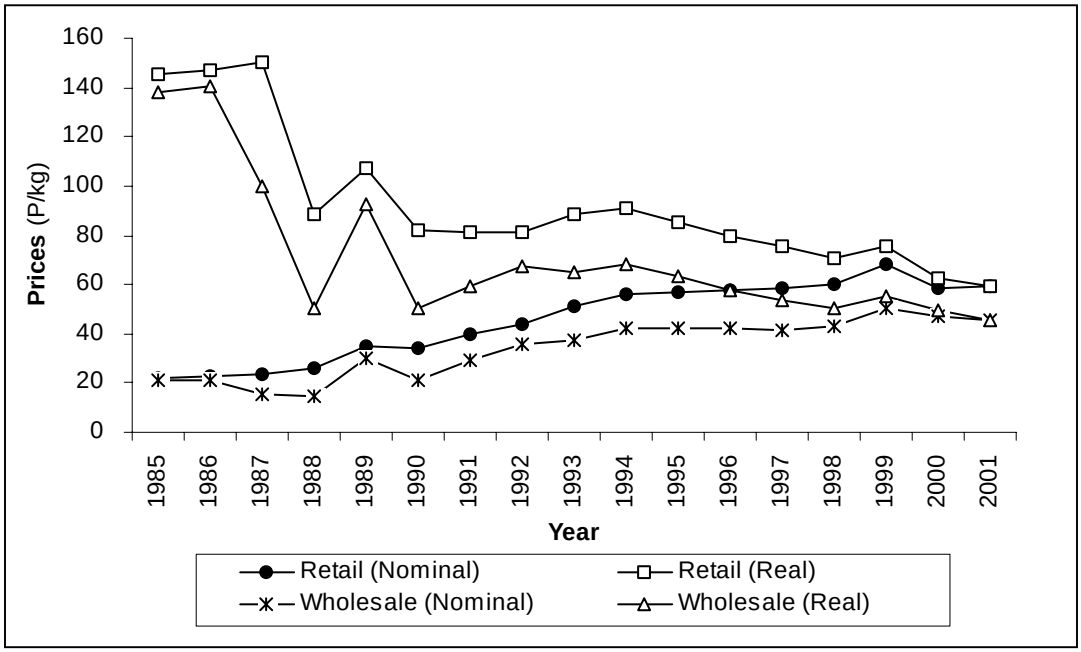
[20] For example, average tilapia prices were highest (P41.74/kg) during the 2nd quarter in 1993–1997, relative to the other 3 quarters. During the same period, average tilapia prices were lowest in the 3rd quarter, despite that quarter having the lowest quarterly production (16.45%). The same relationships are reflected using seasonal indexes of production and prices (see Olalo 2001, footnote 17).

amounted to 36 kg/year in 1993, based on data from the Food and Nutrition Research Institute of the Philippines. Most consumption is of marine fish. Among the freshwater fish, tilapia is dominant and its per capita consumption increased from an average of 0.66 kg/year (1979–1988) to an average of 1.61 kg/year (1989–1997), an increase of 144.5%. During the same period, round scad (*Decapterus* spp.*)* consumption increased by 24.9% and milkfish (*Chanos chanos*) consumption declined by 12.5%.[21] Consumer acceptance of tilapia has increased its share of total fish consumption.

D. Prices, Margins, Elasticity, and Farm Incomes

13. **Prices.** The average nominal wholesale price of tilapia during 1985–2001 was P34.16/kg. Prices grew on average by 8.3%/year and more than doubled (2.5 times) over the period. The average retail price for tilapia during 1985-2001 was P45.47/kg, an average annual growth of 6.9%. While tilapia prices have increased in nominal terms, they have declined in real terms.[22] Wholesale and retail real prices annually declined by 2.8% and 4.3%, respectively, in constant 2001 prices (Figure 3). This means that wholesale and retail prices of tilapia fell 44% and 69%, respectively, over the 17-year period. Tilapia has become more affordable for the poor. In 1997–2001, the average wholesale price/kg of tilapia (P45.4) was lower than that for milkfish (P63.4) but higher than that for round scad (P38.5). Average retail prices for tilapia, milkfish, and round scad were P60.9, P71.5, and P52.0, respectively during the same period.

Figure 3: Wholesale and Retail Prices of Tilapia in the Philippines, 1985–2001
(nominal and real prices)



Source: Bureau of Agricultural Statistics.

[21] The milkfish, locally called *bangus*, has been traditionally the most popular and widely farmed fresh- and brackishwater fish in the Philippines. Round scads (*Decapterus* spp.), locally called *galunggong*, have been traditionally the most popular and affordable marine fish for the poor.

[22] Real or constant prices are determined after the effects of inflation have been eliminated. Nominal prices refer to the current value of a good or commodity during a particular period or year.

14. **Margins.** The average nominal marketing margin between wholesale and retail for tilapia in 1985–2001 was P11.3/kg.[23] In terms of 2001 constant prices, the average marketing margin was P13.7/kg. The high margin for the period is attributed to abundant supply that drove down wholesale prices in some years but did not dampen retail prices as much. The high margins obtained from tilapia trading, especially during the late 1980s, attracted the free entry of additional tilapia traders and producers, making the market more competitive. However, during 1997–2001, marketing margins declined annually by 1% and 7% in nominal and real terms, respectively. Market competitiveness led to the exit of inefficient traders as margins fell. The decline in marketing margins in real terms in 1997–2001 was also attributable to improved access to facilities and competitive marketing practices, which reduced marketing costs. Low-income consumers are expected to benefit more as increased market competition leads to lower market prices for tilapia.

15. **Elasticity.** Demand and supply elasticities of fishery products, including tilapia,[24] indicate the responsiveness of supply or demand to price changes. Tilapia has a supply elasticity of 0.5–0.6, which indicates that a 10% increase in the price of tilapia translates into a 5–6% increase in market supply. For demand elasticities, latest estimates range from 1.24 for the lowest-income group to 0.99 for high-income groups.[25] This implies that lower-income groups tend to respond disproportionately to price changes. For example, a 10% decrease in tilapia prices should increase its consumption by low-income groups by 12.4%. The demand for tilapia also responds to income changes. Income elasticity estimates indicate a shift from elastic for low- to middle-income groups to inelastic for higher-income groups. This implies that increases in incomes of low- to middle-income consumers would trigger higher rates of change in tilapia consumption than would similar increases in income of high-income consumers.

16. Price changes of other products that can either be complements or substitutes also affect tilapia consumption. Two products are considered as complements if the consumption of one product will not lead to a reduction in the consumption of the other product. In contrast, substitute goods exhibit an inverse relationship. Tilapia prices are generally lower if there is an abundant supply of popular low-priced marine fish in the market, particularly of those species considered as its substitutes. Likewise, if the prices of meat and poultry products change, tilapia prices will adjust depending on their price relationships with meat products.[26] Available data indicate that round scad, milkfish, pork, beef, and poultry are tilapia substitutes. The demand for tilapia responds more to price changes of round scad (2.24) than to price changes of beef (1.13)

[23] The marketing margin is the difference between wholesale and retail prices. The scarcity of ex-farm price data precluded computations on grower-wholesaler margins. Nonetheless, interviews with tilapia wholesalers indicated an average margin of P2–5/kg between wholesale and farm gate prices in 2001.

[24] For example: Dey, Madan M. 2000. The impact of genetically improved farmed tilapia. *Aquaculture Economics and Management* 4(1–2): 109–126. See also Estrada, J., and Cynthia Bantilan. 1991. Supply and Demand Elasticities of Major Agricultural Commodities in the Philippines: National and Regional Estimates. ACIAR/ISNAR Project Paper No. 36. 29p., as cited by Olalo 2001 (see footnote 17).

[25] The study "Analysis of Fish Demand in the Philippines" was conducted by Dr. Yolanda T. Garcia, Dr. Madan Dey, and Ms. Sheryl M. Navarez as part of the Philippine Component of ADB TA 5945: *Study on Strategies and Options for Increasing and Sustaining Fisheries and Aquaculture Production to Benefit Poor Households in Asia*, for $1.1 million, approved on 17 October 2000. Using results of the Family Income and Expenditure Survey (2000), the study utilized quintiles to classify income groups. The first 2 quintiles refer to low-income households, the next 2 quintiles refer to middle-income households, and the fifth quintile refers to high-income households.

[26] Based on regression results, a positive coefficient implies that the two products are substitutes. A negative coefficient means that they are complements.

and poultry (1.07), respectively.[27] For example, a 10% increase in beef prices should result in an increase in demand or consumption of tilapia of 11.3%.

17. **Farm Yields and Incomes.** The national average annual yields of tilapia in freshwater ponds and cages in 2002 were 4.5 tons per hectare (t/ha) and 15.8 t/ha, respectively.[28] Surveys conducted for the present study indicated that a 1-ha pond in Central Luzon can generate an average annual net income of P235,000 over 2 crops; a fish cage (measuring 10 meters [m] x 10 m x 6–8 m deep) can generate an average annual net income of P58,000 (based on 2 crop cycles and yields of 3 t/crop). Average operating expenses per crop cycle were P213,000/ha for freshwater ponds and P121,000/cage.

E. Accessing Inputs for Tilapia Farming

18. **Seed Supply.** Tilapia seed, i.e., fry and fingerlings,[29] is raised from captive broodstock in hatcheries and nurseries, respectively, often on the same premises. Seed supply is critical for the continuity of the production cycle, normally 2 or 3 crops each year. Tilapia hatcheries and nurseries can be land- or lake-based.[30] The former use ponds, tanks, and hapas (fine mesh net cages) in ponds, and the latter use hapas and cages in open waters. Seed suppliers can be categorized in various ways depending on the criteria used: size (small/backyard, medium, large) based on monthly seed production, and operator type (public, private, and private-public).[31] Seed accounts for 11% and 18% of total operating costs for pond and cage operations, respectively.[32] Based on latest estimates, there are more than 2,000 hatcheries and nurseries in the country.[33] The Government's program for fisheries for 2002–2004 emphasizes the importance of producing quality tilapia broodstock and fingerlings, including their genetic improvement, for improving and sustaining fish farming productivity.[34]

19. Small-scale hatcheries and nurseries are usually located near the operator's homestead. This enables close monitoring and the use of family labor. Broodstock are usually obtained from government or private hatcheries, although some small and medium-scale operators keep their own broodstock. Broodstock are replaced after 1–2 years. On average, hatcheries achieve 9–12 breeding cycles in a year. More advanced commercial operators achieve continuous and

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[27] Results were obtained from the study of Gomez, C.E. 1986. An Analysis of Household Demand for Selected Seafoods in the Philippines. Unpublished Masters Thesis, University of the Philippines, Los Baños, Laguna, Philippines, as cited by Olalo 2001 (see footnote 17).

[28] Guerrero, Rafael D. III. 2003. The Philippine Tilapia Industry: An Overview. 2nd Philippine Tilapia Congress. 13–14 November 2003. San Fernando, Pampanga, Philippines.

[29] The Philippine Bureau of Fisheries and Aquatic Resources (BFAR) uses a nationwide system of size (and, therefore, price) categories for its tilapia seed. Fry and fingerling sizes range from size 38 (up to 1-week old) to size 12 (about 7-weeks old). The code numbers used are actually based on the mesh sizes of the nets used to grade the fish. For example, "size 24" fry (individual weight 0.045–0.096 g) and "size 22" fry (0.129–0.145 g) cost P0.15–0.25, respectively, in 2000. "Size 17" fingerlings (0.468–1.200 g) and "size 14" fingerlings (1.30–2.96 g) cost P0.35–0.45. The prices apply to all BFAR strains released in 2000.

[30] Guerrero, Rafael D. III. 1985. Tilapia farming in the Philippines: Practices, Problems and Prospects. In Philippine Tilapia Economics, edited by I. Smith, E. Torres, and E. Tan. *ICLARM Conference Proceedings 12*. Manila. p. 3–14.

[31] Sizes are either based on (i) the size of land: small, less than 3 ha; medium, 3–5 ha; and large, greater than 5 ha; or (ii) on monthly seed production: small, less than 1 million; medium, 1–5 million; and large, greater than 5 million.

[32] Based on the results of the survey for this study.

[33] Information gathered from the 2nd Philippine Tilapia Congress. 13–14 November 2003. San Fernando, Pampanga, Philippines.

[34] Ginintuang Masaganang Ani for the Fisheries as cited in University of Asia and the Pacific. *Food and Agribusiness Monitor* 18(6), June 2002.

higher seed production by collecting eggs from female broodstock and rearing them in artificial incubators before the fry start to feed.[35]

20. Tilapia seed production is year-round but has seasonal variations. In the typhoon belt, supply and demand for seed are low when there is high risk from typhoons. The productivity of the different sizes and types of hatchery and nursery operations is very variable and there are few reliable comparative data. Tilapia seed production has increased rapidly and continuously from area expansion and improved technology and management.[36] This increased supply has created keen competition among private hatcheries and also between some private and government hatcheries.

21. Bureau of Fisheries and Aquatic Resources (BFAR) staff estimated total tilapia seed production in 2003 at about 1.02 billion: 900 million from private sources and 120 million from BFAR.[37] Estimated potential demand is 2–3 billion seed, of which BFAR plans to supply about one third through affiliated and accredited private hatcheries. Government hatcheries are expected to remain important sources of seed amid the growing number of private and corporate hatcheries. The Government aims to improve food security through better technologies and increasing the entry of small-scale farmers to tilapia farming. Through BFAR, the Government will likely remain an adjunct supplier and a competitor to private seed producers to some extent. The continued presence of BFAR in the seed market will benefit small farmers by promoting hatchery development in various parts of the country. Although seed supply in remote areas is still problematic, efforts by BFAR have contributed to increased access and choices of seed supply among small-scale farmers. Government seed prices are competitive vis-à-vis other seed suppliers and do not undercut private seed suppliers.

22. Tilapia genetic improvement has become a highly dynamic and competitive field of research and private enterprise in the Philippines. Consequently, farmers now have access to a wide range of tilapia strains. Increasingly, the breeders of a given strain are entering into agreements with other hatcheries and farmers to become accredited seed suppliers and/or growers.[38] In Central Luzon and Lake Taal, agreements are often accompanied by credit and technical advice as sales pitches and to attract customer loyalty. During interviews, BFAR staff indicated that most Nile tilapia farmed in the Philippines now have genes that originated from the genetically improved farmed tilapia (GIFT), either as GIFT strains or as hybrids developed

[35] Nile tilapias are sexually mature when they are 6-months old and are easy to breed in ponds, tanks, and hapas (fine mesh cages). After spawning, the fertilized eggs are immediately taken into the female's mouth and incubated there until they hatch, and thereafter until they become yolksac larvae and then swim-up fry that eventually feed independently, no longer taking refuge in her mouth. All the tilapia species in genus *Oreochromis* exhibit this behavior. Artificial incubators enable mass production of fry of similar age and size.

[36] See, for example: Bimbao, Gaspar, Ferdinand J. Paraguas, Madan M. Dey, and Ambar Eknath 2000. Socioeconomics and Production Efficiency of Tilapia Hatchery Operations in the Philippines. *Aquaculture Economics and Management* 4(1–2): 33–48. These authors considered the average production of fry or fingerlings from land-based operations to be P748,000 per ha per breeding cycle in 1996, yielding a net income of P119,288.

[37] In 2002, the published production for farmed tilapia was 122,316 t. With 40% seed mortality and an average market size of 5–6 fish per kg, the tilapia production required at least 942 million tilapia seeds. This tilapia production does not include fish given away by farmers or used for their home consumption.

[38] Licensing and accreditation arrangements vary. BFAR distributes its GET EXCEL strain seed and broodstock to BFAR multiplier stations and to private hatcheries that are encouraged to breed their own fish and to feedback information and superior breeding material. Genomar Supreme Philippines, however, holds the eight current members of its Preferred Partner Hatchery Network to contracts that preclude the unauthorized breeding of strains other than its Genomar Supreme Tilapia (GST) strain. In practice, restrictions on what recipient farmers or hatcheries do with any strain are almost impossible to enforce because most Nile tilapia strains are not distinguishable except by DNA or other biochemical markers.

with some GIFT material (footnote 14).[39] There is no standard strain nomenclature and no independent strain certification. The result is a confusing mixture of marketing claims. Small-scale farmers, however, are risk averse and hesitate to try new strains based solely on suppliers' claims about performance.

23. Tilapia seed prices vary according to size, strain, and whether they are mixed sex (males and females) or sex-reversed tilapia (SRT) comprising 95–100% males.[40] BFAR applies mandated prices for its accredited hatcheries and private hatcheries have their own set of prices. Higher prices are charged for SRT seed.[41] The case studies of Central Luzon and Lake Taal (Philippines) suggest that the market share of SRT seed is significant: 45% of cage farmers and 62% of pond farmers interviewed have been using SRT. The BFAR GET strain and GST are the most popular strains.[42] Aside from their performance, the popularity of these strains is attributed to the proximity of the suppliers of these strains to farms, the number of accredited suppliers of these strains, and the aggressive marketing and technical assistance provided by their respective accredited hatcheries.

24. Seed prices depend on supply and demand conditions. When seed production is high or demand is low, prices are lower and mortality allowances higher.[43] This occurs mainly in private hatcheries attempting to dispose of their produce quickly because of space constraints and maintenance costs. Seed prices from government hatcheries have remained relatively stable. The Philippines Commission on Audit reviews proposed price increases, ensuring that any price change is based on cost recovery.[44] Prices of mixed-sex seed from BFAR-accredited and other private hatcheries are usually P0.05–P0.10 higher than government prices. Prices of SRT seed are higher due to added costs arising from the sex-reversal treatment.[45] Some private hatcheries impose additional mark-up to cover the costs of delivery or transport, particularly for distant clients. Market competition and the increasing choice of strains are beneficial for small-scale operators in the long run because they receive competitive prices and technical services.

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[39] The Genomar Supreme Tilapia (GST) was developed from the GIFT Foundation's strain G9. The BFAR strain (GET 2002 EXCEL) was developed by crossbreeding other farm stocks with BFAR GET 2000 (i.e., GIFT renamed by BFAR). FAC sells its own strain known variously as FAC-selected, FAST, and IDRC strain (acknowledging support from the International Development Research Centre of Canada).

[40] Tilapias breed prolifically and males grow faster than females. These factors encourage use of monosex, all-male tilapia seed. Feeding sexually undifferentiated fry with feed containing methyltestosterone is the main method to produce "sex reversed" tilapia (SRT) seed. This is safe because there are no detectable hormone residues in the fish long before they reach harvestable size. An alternative approach, pioneered at the University of Wales Swansea, United Kingdom, with FAC/CLSU collaboration in 1991–1994, is called the "YY technology," yielding "genetically male tilapia" (GMT) from broodstock that have YY sex chromosomes. Hormonal sex reversal is needed to develop the YY broodstock, but no hormone treatment is involved in the seed production phase. GMT have given mixed results on-farm, sometimes containing unacceptable numbers of females. GMT research and development are continuing. SRT and GMT describe seed production methods and are not strain names.

[41] Based on interviews with government and private hatchery operators in the Central Luzon study area, sex reversal increases cost by at least P0.10–0.15 per fingerling. A size 22 fingerling that sells for P0.25 sells at P0.35–0.45 if it is sex reversed.

[42] Based on the case studies of Central Luzon and Lake Taal (Philippines), BFAR GET (64%) and GST (28%) are the most popular strains used in Central Luzon. GST (42%) and "Nilotica" (a term for a local breed of unknown provenance) (19%) are the most popular in Lake Taal, Batangas.

[43] Mortality allowances refer to the 10–15% additional fingerlings provided by seed suppliers to their buyers on top of the total volume purchased. The allowance is to cover seed mortality losses resulting from various factors, especially transport and handling.

[44] The latest increase in government tilapia seed prices was in 2000, mandating a P0.05 increase across all sizes. In the 1980s, a size 22 fingerling cost P0.10. Its current price is P0.25.

[45] The price of methyltestosterone, the hormone used for SRT, is P2,100–2,700 per 10 g, and 1 g treats about 66,000 fry. Sex reversal also incurs additional labor costs.

However, small-scale farmers put a premium on the growth characteristics of strains, and seasonal price influences are secondary in the choice of tilapia strain.

25. Marketing of fry and fingerlings is lucrative because there is high demand for seed. The major sources of seed are the hatcheries and nurseries in Nueva Ecija, Bulacan, Pampanga, and Laguna. These areas are also the final market destinations of seed, in addition to Batangas, Isabela, Bataan, and Camarines Sur. However, the archipelagic nature of the country poses a challenge for the seed market to expand nationwide, unless more hatcheries are established in remote islands and coastal provinces. The availability of and preference for marine fish over farmed fish among the population in coastal communities are also major factors constraining the expansion of freshwater tilapia farming.

26. The market channels for tilapia seed, although unorganized, are relatively short and simple, due to the high risks involved in selling the product. Normally, a hatchery operator sells directly to growout farmers, either through delivery or pick-up. Product delivery facilitates and strengthens seed supplier-farmer relationships.[46] Seed quality is judged by growth rate, survival, uniformity of size at harvest and, for SRT and GMT seed, whether there is any breeding in the production stock from unwanted females. These factors largely determine seed suppliers' reputations and business positions. The main problems affecting the tilapia seed business are high seed and broodstock mortality, seasonality of markets, low seed prices, unfavorable weather conditions, collection of arrears, and nonpayment among seed buyers.

27. A few hatchery and nursery operators use agents to increase sales, especially in remote areas.[47] Others sell directly and employ agents at the same time. This practice is quite common among nursery operators in Batangas, who resort to intermediaries to buy fry from Laguna, which they nurse to fingerlings for sale to cage growout farmers in Lake Taal. Generally, agents obtain their incomes by a mark-up of P0.01–P0.02 per fingerling or through pre-agreed commissions. Promotion of seed sales is usually by word of mouth and small business signs, particularly for small- and medium-scale operators. Among large-scale seed suppliers, printed materials, such as brochures and leaflets, signboards, and the maintenance of Internet web sites are utilized for market promotion.

28. **Feeds for Tilapia Farms.** The case studies of Central Luzon and Lake Taal indicated that feeds accounted for 72% and 79% of total operating costs for pond and cage operations, respectively. The increasing share of feeds to total operating costs is attributed to feed price changes resulting from the escalating costs of feed ingredients. Feed prices are highly dependent on the costs of imported ingredients (especially fishmeal) and the availability of local ingredients (e.g., rice bran, copra).[48] Reducing feed costs through better feed conversion ratios (FCR) is the key to increasing returns and staying competitive in tilapia farming. Better FCRs may be achieved by increasing reliance on pond fertilization to generate natural feed for fish. As

[46] Delivery is sometimes priced higher than pick-up, but in Central Luzon prices for delivery and pick-up sales are similar because suppliers usually pay for delivery costs. Most seed suppliers monitor their performance by ensuring that their clients' farms and husbandry are suitable. This lessens the risk of claims for mortality replacements. Moreover, after-sales support is a good marketing strategy to enhance or maintain hatchery-farmer relationships and hatchery reputations. This is a common practice among medium- to large-scale hatcheries in Central Luzon.

[47] For example, Central Luzon hatcheries use agents for seed sales to more distant areas in Luzon (e.g., Isabela and Zambales) that have good potential for tilapia farming because of increasing demand and suitability of the areas for tilapia production.

[48] During 1997–2001, the share of fishmeal imports to total fish imports was 35% both by volume and value and the average cost of fishmeal was P17,362/t. Source of basic data: BAS 2002. *Fisheries Statistics of the Philippines, 1997–2001.* Quezon City, Philippines. 74 p.

the amount of nutrition derived from natural food organisms in the pond increases, there is a corresponding reduction in the amount of artificial feed required.[49]

29. Recognizing the high costs of feed inputs, farmers look for alternative ways of reducing feed costs. An alternative is the use of home-made feeds.[50] Homemade feeds are rarely a feature of Philippine tilapia farming, except in resource-poor areas. On-farm feed manufacturing has not developed significantly because of the high cost and erratic supplies of raw materials, high capital requirements, and lack of equipment specifically designed for small-scale farmers. Moreover, feed mills receive 20–30% discounts for bulk purchase of ingredients. Because they pay cash, they get preferential treatment from traders when raw materials are in short supply.[51]

30. The average costs of producing tilapia feed in 2003 were P13,000–17,000/t, of which 70–90% of costs were for imported feed ingredients, such as fishmeal, wheat, soya, vitamins, and minerals.[52] Theoretically, the large share of imported components is the primary reason why feed prices fluctuate—the depreciating value of the Philippine peso against foreign currencies[53] has increased the domestic costs of imported ingredients of feeds. The distance and isolation of many small-scale farms also contributes to higher feed prices. Access to inputs is one of the major problems confronting small-scale farms.

31. Major feed mills produce feeds for livestock, poultry, fish, and shrimp. The growth of Philippine aquaculture has contributed to the expansion of the feed industry. By 1995, tilapia feeds comprised 47.3% (70,000 t) of the total national production of aquaculture feeds for aquaculture (148,000 t).[54] These tilapia feeds were used mainly in Luzon (87%), with Mindanao and Visayas accounting for 10% and 3%, respectively.

32. Tilapia feeds are usually sold in standard 25-kg polypropylene bags and have various forms and composition appropriate to the production cycle: starter mash and crumble for fry, and pellets (starter, grower, and finisher) for growout. Tilapia feed prices in 2003 were P15–23/kg.[55] Feed prices depend on the type of feed and the manufacturer. Distributors and dealers generally impose a price margin of 4–6% for fish feeds. In general, because of differences in protein content, the prices of feeds used during the early stages of tilapia rearing (30–48% crude protein) are higher than those for subsequent stages of the crop cycle (25–44%). These

[49] For pond and cage farming systems where tilapia growth is almost totally dependent on pelleted feeds, a typical FCR for current feeds, strains, and husbandry methods is about 1.5 (weight of feed given to unit weight of fish harvested). For well-fertilized ponds and for less intensive systems that use home-made feeds, FCRs vary and are about 1.2 or less.

[50] See for example, Guerrero, Rafael D. III. 1994. Evaluation of Homemade Feeds Used for Commercial Tilapia Production in the Philippines. Paper presented at the 7th International Conference of International Institute of Fisheries Economics and Trade, 18–21 July 1994. Taipei,China.

[51] Cruz, Philip S. 1997. Aquaculture Feed and Fertilizer Resource Atlas of the Philippines. *FAO Fisheries Technical Paper* 366.Rome. 259 p.

[52] Information provided by 5 major feed companies engaged in aquaculture feed production in the Philippines.

[53] Two major feed companies reported a 25–29% increase in feed prices during 2001–2003 because of increasing costs of imported feed ingredients.

[54] As of 2002, there were 55 feed mills producing feeds for aquaculture with a rated capacity of 8,114 t over an 8-hour operation. Aquaculture feedmills are concentrated in Region III (22), Region IV (7) and the National Capital Region (7). Collectively, these mills have a rated capacity of 7,140 t over an 8-hour operation.

[55] Based on interviews with selected feed manufacturers and surveys in Batangas, Nueva Ecija, and Pampanga for the case studies on Central Luzon and Lake Taal. See also, Merican, Zuridah, and Chakrit Ridmontri. 2003. Pressure for Lower Costs and Better Quality Feeds. *Asian Aquaculture Magazine* May/June: 12–15.

crude protein levels may be higher than necessary and lowering them may lead to reduced feed prices.[56]

33. Tilapia feeds are distributed and sold together with feeds for livestock and poultry by agricultural supply stores. Some large feed manufacturers have agreements with farmers and with those who finance tilapia farming for exclusive use of feeds, with favorable purchase and credit terms. Some feed companies are also involved in seed supply and growout in vertically integrated arrangements.

34. The marketing chain of aquaculture feeds is well organized. It starts with the feed manufacturer who distributes products either to a wholesaler or to an authorized area distributor. Wholesalers pass the products to dealers who have their own set of retailers for final distribution to end-users. Authorized dealers deal directly with farmers. Some major feed companies have their own distribution warehouses in key areas. In such cases, the company deals directly with large customers. Feed manufacturers provide sales incentives to wholesalers or dealers depending on the volume of their total sales. Promotional activities to boost feed sales are usually undertaken by the technical and sales agents of feed manufacturers, through sponsorship of community and industry activities, feed trials, and the distribution of promotional items like shirts, bags, pens, caps, and calendars.

35. **Fertilizers for Fishponds.** Organic and inorganic fertilizers are used as inputs for freshwater fishponds and play a critical role in enhancing production of natural food. The case study of Central Luzon indicated that fertilizers were frequently used only as a basal fertilizer during pond preparation, and were not routinely used during growout to continue production of natural food. This practice has not fully captured the potential of reducing feed costs through routine pond fertilization; fertilizers accounted for only about 4% of total variable costs. The most widely used organic fertilizer for ponds was chicken manure at P30–40 for a 50-kg bag. Livestock manure, mudpress (agricultural waste from sugar mills), and rice bran are also used but to a much lesser extent. Collection of manure from poultry and livestock on small-scale farms is seldom feasible because the animals scavenge to feed or they are not held in sufficient numbers to provide adequate manure. However, chicken manure is collected by large-scale, feedlot broiler and layer farms and is sold as a commercial product. The demand for chicken manure as an organic fertilizer for tilapia fishponds is relatively high in Central Luzon because of the proximity of ponds to large poultry farms. There are only a few firms that process organic fertilizers and most farmers in Central Luzon prefer low-cost unprocessed organic fertilizers.[57]

36. The supply of inorganic fertilizers, including those used for tilapia farming, is usually adequate, and government support for the fertilizer industry is historically strong.[58] Data from 2000–2001 reveal that at least half (51%) of the total annual inorganic fertilizer supply (2.32 million t) then used in the Philippines was imported. The most widely used inorganic fertilizers in tilapia production are urea (45–0–0), ammonium phosphate (16–20–0), and to some extent ammonium sulfate (21–0–0) and complete fertilizer/NPK (nitrogen-phosphorus-

[56] Jauncey, K. 2000. Nutritional Requirements. In *Tilapias: Biology and Exploitation*, edited by M.C.M. Beveridge and B.J. McAndrew. Dordrecht: Kluwer Academic Publishers. p. 327–375. According to Jauncey, recommended optimum dietary protein contents for tilapia are 30–35% for fish weighing 0.5–10.0 g and 25–30% for fish of 30.0 g to market size.

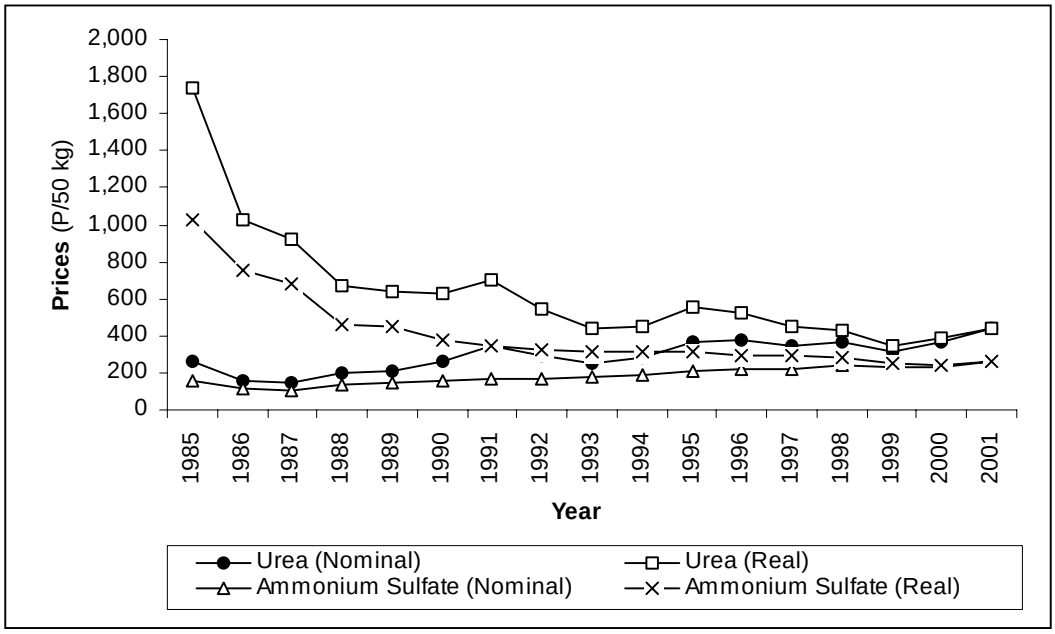
[57] Processed organic fertilizers are products of composting mixtures of animal manures, agricultural wastes, and limestone and other nutrients. The selling price is usually 2–3 times that of chicken manure.

[58] Government support was manifested through price controls and other cash and noncash incentives. This also explains why nominal price increases were limited.

potassium; 14–14–14). In 1997–2001, the average shares[59] of imported chemicals for the supply[60] of fertilizers were 100% of urea, 7% of ammonium phosphate, 57% of ammonium sulfate, and 0.9% of NPK.

37. Inorganic fertilizer retail prices increased annually by 4.0–5.5% in 1985–2001. However, in real terms at 2001 constant prices, their retail prices declined by 6.7– 7.6%, indicating that these fertilizers have become more affordable and accessible to small-scale and poor farmers (Figure 4). Progressive farmers have used a combination of organic and inorganic fertilizer in tilapia pond farming to reduce feed costs. Pond fertilization with reduced use of commercial pelleted feed could reduce feed costs, but lengthen the time taken for the fish to reach marketable size. Domestic prices of inorganic fertilizers are influenced by world prices and currency exchange rates; prices of organic fertilizers are more stable because they are locally produced. In 2003, prices for a 50-kg bag of inorganic fertilizer used for aquaculture were as follows: P551 for urea, P316 for ammonium sulfate, P466 for ammonium phosphate, and P477 for NPK. The deregulation of the fertilizer industry in 1986 encouraged the entry of more traders, allowing increased competition that reduced marketing margins and dampened retail prices.

Figure 4: Nominal and Real Prices of Urea and Ammonium Sulfate in the Philippines, 1985–2001



Source: Fertilizer and Pesticide Authority.

38. While organic fertilizers are usually sold in the area where they are produced, the market channel for inorganic fertilizers originates with producers or importers who distribute them to their area distributors (wholesalers) through their regional or provincial sales offices. The distributors transfer the products to local dealers and retailers who sell directly to farmers. Hence, the presence of local dealers is important, particularly in isolated areas, to increase the access of farmers to fertilizer inputs. Akin to the feed industry, fertilizer companies advertise their products through sponsorship of related activities and the distribution of promotional items.

[59] Percentage shares were derived from production and import data from http://www.fadinap.org/philippines/

[60] The average annual quantities of fertilizer supplies in 1997–2001 were 610,073 t (urea), 405,941 t (21–0–0), 96,089 t (16–20–0), and 337,168 t (NPK).

However, there are intricacies in fertilizer marketing. A few importers are also distributors, giving them an added advantage in terms of direct access to retailers. At the wholesale level, some distributors are authorized dealers themselves and sell directly to plantations and/or farmers in areas where local dealers are absent, few, or relatively weak. In some cases, traders access cooperatives to distribute fertilizers to their farmer-members. However, the geographical isolation of most Philippine islands adds to marketing and distribution costs, although transportation through the use of inter-island vessels is widely available.

39. **Access to Land and Water.** Access to land is a prerequisite for hatcheries and pond farming. Small-scale fish farms have gained access to land either through private ownership or lease arrangements. Private lands are acquired either through direct purchase or inheritance. However, issues related to land-use rights and landownership are very complex and access to land is frequently made possible through lease arrangements or other schemes involving transfers of land-use rights under various terms and conditions. Under lease arrangements, farmers may either pay an annual rent or share net profits with landowners. In some cases, land-use rights are acquired in exchange for an interest-free loan for a specific or indefinite period. In Central Luzon, annual land rental rates are P10,000–25,000/ha. The period of leased rights may be several years, depending on the agreement between the two parties. Land rentals are influenced by prevailing land prices and the opportunity costs of land. Access to land by small-scale landless farmers may severely decline as land prices and rental rates continue to rise. Rising land prices can also affect tilapia production if landowners sell their farms when faced with more lucrative options, instead of making their land available for rent.

40. In terms of water access, fishpond operators rely on deep wells, irrigation, rain, rivers and streams, and small water impoundments. For tilapia cage farming in lakes and reservoirs, the only requirements for access to land are the lakeshore and marginal lands from which services for the fish farms can be provided. There is also limited use of land for nursery ponds. In the Philippines, lake waters are state property, and cage operators gain access to these waters by leasing or obtaining a permit. However, certain conditions and restrictions may apply in accessing public or open water bodies, including preferences for people residing in certain locations in the vicinity of the designated water bodies. Such restrictions can exclude people who do not reside in the immediate vicinity of the water bodies, unless partnership arrangements are made between outsiders and local inhabitants.

41. **Labor and Employment.** Freshwater tilapia farming, including hatchery and nursery operations, provides opportunities for self-employment for operators and cage caretakers and their families. Backyard/small-scale pond and cage farms rely mainly on family labor. Larger farms employ regular full-time workers and seasonal or casual workers for pond preparation, stocking, and harvesting. Exchange labor from members of the local community is also used. Neighbors and other members of the community provide labor exchange (e.g., for pond preparation or harvesting) without financial payment. The pond or cage owner is expected to reciprocate the initiative by helping fellow farmers when needed. If the activity is harvesting, fish are normally given to reward those who participate. In rural areas, with limited employment opportunities and high unemployment, labor supply is abundant. Men, women, and even children assist in hatchery/nursery, pond, and cage operations. However, heavy physical tasks, such as pond construction, preparation, and harvesting remain male-dominated.

42. The total number of Filipinos directly or indirectly involved in freshwater aquaculture and specifically in tilapia farming is debatable because there are no disaggregated statistics. Field observations indicate that much of the hired labor requirements are seasonal. The abundance of labor supply in rural areas means that workers often receive less than the legislated minimum

wages. Work opportunities in aquaculture include full- and part-time employment in pond excavation, cage and net making, boat operation, services for cage farms, fish sorting and grading, marketing, transport, and miscellaneous activities. The employment impact is clearly seen in the local economies where tilapia is farmed. At least 280,000 people, including their families, directly and indirectly benefit from employment generated by the freshwater tilapia industry alone. This does not include additional full-time, part-time, and seasonal labor required by associated industries, such as tilapia feed processing and fertilizer and other supplies and their respective processing and distribution.

Constructing a fishpond

Feeding tilapia in a fishpond

F. Accessing Support Services

43. **Credit, Financial Services, and Incentives.** Small-scale operators usually rely on their limited household savings to finance tilapia operations. However, the long growing period before harvest and sales can strain household finance. Access to financial capital is generally a major constraint. Farmers usually avoid formal credit from commercial banks and private lending institutions because of high interest rates, paper work, and requirements for collateral. In addition, the risks of tilapia farming have often deterred small-scale farmers from attempting to obtain formal credit, fearing loss of property or collateral in the event of harvest failure. Many farmers resort to informal credit, which incurs high interest but is usually collateral free, readily available, and has flexible repayment terms. Informal loans may carry interest rates of 2.5–20.0% per month.

44. The dominance of informal credit over formal credit in tilapia farming is further emphasized by the emergence of informal credit schemes and other financial arrangements to overcome financial barriers facing tilapia production. These include financier-caretaker arrangements, trader-operator agreements (usually forward sales), contract farming, and various suppliers' credit schemes. Financier-caretaker arrangements are prevalent in cage culture in Batangas, where the financier pays all operating expenses of the fish farms regardless of whether the financier owns or rents the cage. Under these arrangements, net profits are shared between both parties on agreed terms; caretakers absorb some of the operating risks because they receive no wages. In contrast, trader-operator arrangements are usually based on forward sales, characterized by loans extended by the trader to the operator on condition that the final produce will be sold to the trader exclusively. In the case of contract farming, farmers receive all inputs in advance except land and the final produce is sold to the contractor. Under suppliers' credit schemes, input suppliers (usually feed suppliers) provide credit lines to farmers who pay for the inputs at harvest. Depending on pre-agreed conditions,

input prices are usually higher than prevailing prices of the specific inputs to cover the cost of capital and the risks involved. Overall, these nonbank financial arrangements have benefited and enabled small-scale farmers to take advantage of the economic opportunities of tilapia farming.

45. The Philippine Government operates low-interest credit and financing programs for the fisheries sector, particularly aquaculture, to meet national food requirements and to improve farmers' welfare.[61] These credit programs have been channeled through commercial private and government-controlled financial institutions as well as nongovernment organizations. However, credit delivery along these channels mostly fails to reach the intended beneficiaries. Municipal agricultural officers[62] and agricultural technicians find that many farmers are hesitant to apply for these credit schemes because of the paperwork required. The difficulties of forming groups to seek group credit and unawareness of available credit schemes, particularly among small-scale farmers, have also contributed to their low use of government credit schemes. Where farmers have enjoyed free or heavily subsidized farm-inputs through government programs, they tend to develop dependency and expect to continue to receive government aid.

46. The Quedan Rural Credit and Guarantee Corporation (QUEDANCOR) is currently the executing agency for a government credit program for aquaculture that provides loans to farmers' groups at an annual interest of 12%, including a 3% service fee. The system involves the creation of self-reliant teams, whose members are collectively responsible for loan repayment. Government fishery loan programs implemented by QUEDANCOR have helped tilapia farming teams by providing loans in the form of farm inputs in kind. Reportedly, the repayment rate is higher than 98%.[63] QUEDANCOR has also formulated special loan arrangements for tilapia contract growers targeting future exports. The Philippines' investment policy embodied in Executive Order 226, the Omnibus Investment Code of 1996, provides incentives for investments in the form of tax holidays, tax and duty exemptions on imported inputs and equipment, and tax credits for domestic inputs. The Code applies to tilapia production in the form of tax exemption, an incentive that has already been granted to a potential tilapia exporter in Region III.

47. **Extension Services.** Advisory services are critical to the success of tilapia operations, particularly for small-scale tilapia farmers who lack the necessary training and education. Fortunately, extension services for tilapia operations are virtually free. Most input suppliers, particularly seed and feed suppliers, provide such services as part of their marketing schemes. Furthermore, strong social networks facilitate technical information exchange and dissemination of knowledge among farmers. Government agencies also remain important sources of technical advice to small-scale farmers. BFAR, fishery-related agencies, and the agricultural officers and technicians of local government units provide free extension and advisory technical services to tilapia farmers—including small-scale farmers—complementing the advisory services provided by input suppliers. However, government budgetary constraints have limited the number of agricultural extension workers in rural areas.

[61] Past credit programs for fisheries and aquaculture were comprehensively discussed by Yap 1999. See footnote 10.
[62] Under the Local Government Code of 1991, the responsibilities of facilitating national and local government programs were devolved to local/municipal agriculture staff, which include local agricultural officers and technicians.
[63] Based on the presentation of QUEDANCOR officers during the 2nd Philippine Tilapia Congress, 13–14 November 2003. San Fernando, Pampanga, Philippines.

48. **Fish Health Services.** BFAR provides fish health services and maintains a fish health division that addresses drug use in aquaculture and related concerns under existing national legislation.[64] An ongoing but under-resourced national program on the use of drugs in aquaculture comprises the following: (i) monitoring the efficacy of drugs in treatment and prevention of diseases of farmed fish; (ii) testing fish feeds and produce for the presence and concentrations of prohibited[65] and regulated drugs in the fish and human food chains; and (iii) monitoring the impacts of drugs on the environment. Irresponsible use of drugs in fish farming can lead to environmental contamination and the evolution of drug-resistant strains, not only of fish pathogens but also of human pathogens, because the same drugs are used in medicine and drug resistance may be transferred. Technically, the presence of prohibited drug residues in farmed fish disqualifies the fish from being exported.

G. Marketing Tilapia

49. **Market Structure and Conduct.** Farmed tilapia is sold live, fresh, and, to a lesser extent, chilled or frozen.[66] In practice, the nature of the product has shielded the domestic market from imports because of transportation and other transaction cost barriers. Tilapia harvesting is normally timed according to the preferred mode of sale and its marketing channel. For example, in Batangas, harvesting of tilapia from cages in Lake Taal for the Manila markets is done late in the morning or early afternoon, for fish delivery to coincide with the opening of urban wholesale markets in the early evening. Elsewhere, for fish intended for the markets of neighboring towns, pond and cage harvests start as early as midnight to reach final market destinations before dawn. Harvest time is crucial to pricing for two reasons. First, early arrival in the market provides better opportunities of ready sales and better prices, given a large number of customers and intermediaries who want to be assured of an early supply of fish. Second, the entry of more suppliers in the course of the day will tend to saturate supply, leading to lower prices. Some traders, particularly wholesalers, finance small-scale farmers in order to be assured of a steady supply of fish. Under this arrangement, the farmer is mandated to sell exclusively to the trader at a pre-agreed price. Major marketing issues for tilapia include fluctuating prices, irregular supply, nonpayment of debts by traders, informal levies (particularly when transporting the product), and seasonal off-flavors that render the fish less marketable.

50. Buyer and seller concentration is high, particularly in Luzon. With the increasing popularity of tilapia, the number of tilapia traders has increased substantially. This is beneficial for small-scale farmers because it provides more market outlets for their produce. Entry and exit of traders to the tilapia market have been relatively easy, especially at the retail level. However, traders' knowledge of the market is often poor. Some new entrants leave quickly after incurring losses, indicative of an unorganized but highly competitive market. For example, traders may trigger tilapia harvesting from many farms at the same time, causing seasonal excess supply and driving market prices down.

51. Figure 5 illustrates different marketing channels for tilapia in the Philippines. The most direct channel (1)—producer to consumer—is prevalent among small-scale or backyard farms where buyers, usually neighbors and community members, consume most farm produce at

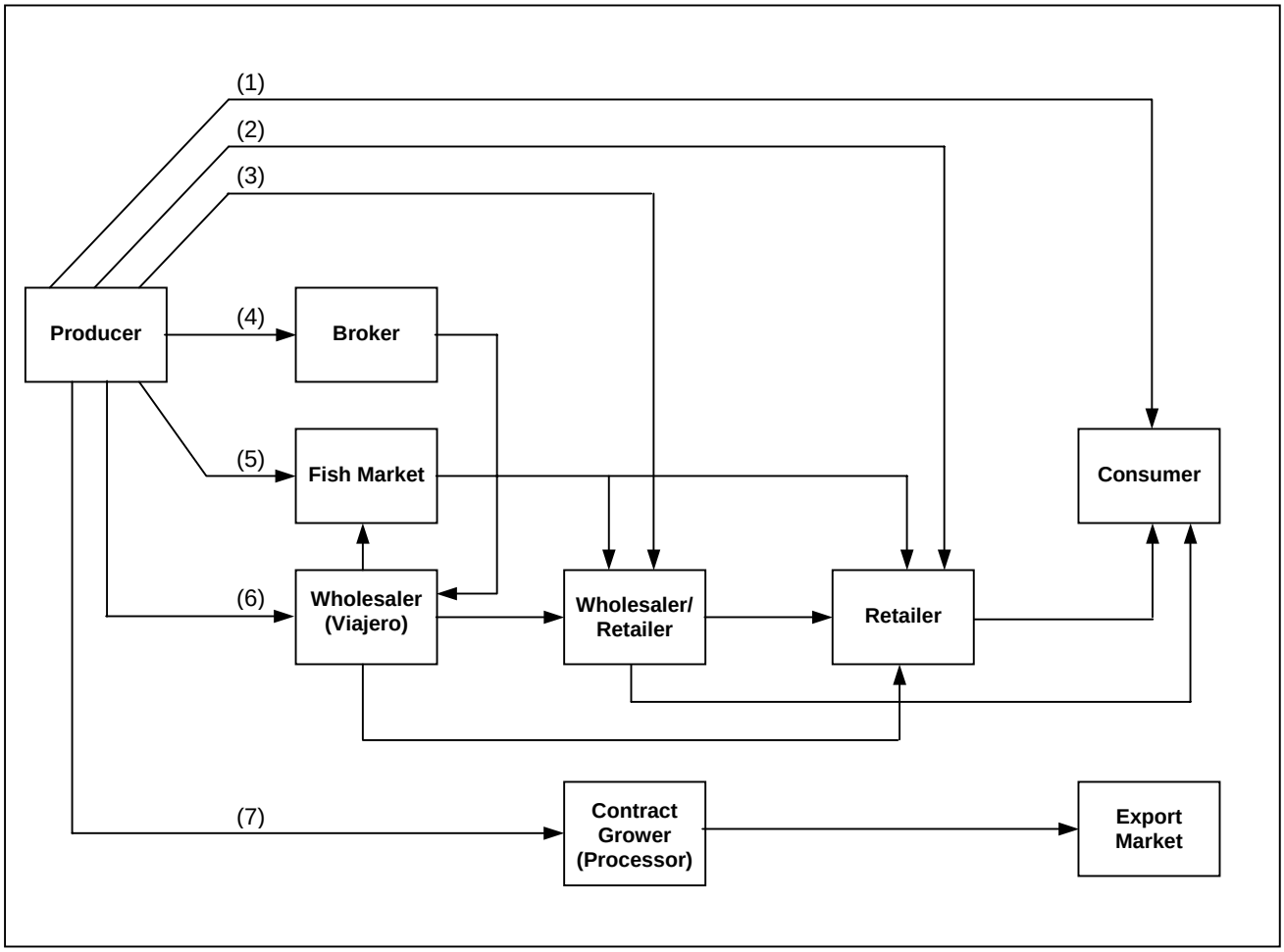
[64] Republic Act 8550 (The Fisheries Code of 1998) is the main legal framework. More recent instruments include fisheries administrative orders 213 and 214, Series of 2001: Operation of the Fish Health laboratories and the Code of Practice for Aquaculture, respectively.

[65] Examples are nitrofuran and chloramphenicol prohibited by the Department of Health and Department of Agriculture Joint Administrative Orders Nos. 2 and 60, respectively, series of 2001.

[66] Tilapia is also sold in value-added forms, such as filleted and smoked. Tilapia fillets have potential for export, with one large commercial farm targeting an initial shipment of 5,000 t in 2003.

home. Here, marketing cost is almost nil when the buyer collects the fish at the farm, and minimal if the farmer is the ambulant vendor. Sales are for cash or on credit. Channels 2 and 3 are typical for small pond farms and for some small cage farms, selling by delivery to or pick-up by ambulant vendors, who sell fish around the locality or deliver to various market sites within the community or in neighboring towns and municipalities. In Central Luzon, ambulant vendors (wholesaler-retailers or retailers) with tricycles or jeeps buy tilapia from ponds. They usually pick up tilapia from early morning harvests and transport them as live fish to prolong product freshness, selling around town from aerated plastic or metal barrels and tanks that hold 30–150 kg of fish. Iced tilapia are delivered to wet markets in the community or in neighboring municipalities of Lake Taal from some of the cages there. Channel 4 involves brokers who initiate sales between the producers and clients. Brokers do not own the products that they handle. With many active traders and abundant tilapia supply, brokers make P0.5–1.0 per kg of fish sold, representing "viajeros," i.e., wholesalers who transport tilapia in bulk to major market destinations. Brokering is typical in Central Luzon, particularly with traders who want an assured daily supply of fish.

Figure 5: Marketing Channels for Philippine Tilapia



52. Large fish markets (channel 5) facilitate trade among various entrepreneurs by offering physical facilities for product handling and negotiations. For tilapia, the large fish market serves as the venue where wholesaler-retailers and retailers procure their fish for resale. Large markets usually operate on a consignment basis because they earn a fixed commission of 5% of gross sales in exchange for the use of their facilities. Wholesalers or producers who use these market facilities are directly paid in cash. Small-scale farmers usually receive cash payments from wholesalers. Channel 6 is the most popular among tilapia farmers in the main production areas of Central Luzon and Batangas. Selling to wholesalers reduces farmers' transaction costs and minimizes the risks of selling a perishable commodity. Wholesalers buy in bulk and usually pay in cash. A wholesaler's choice of its own marketing channel greatly depends on marketing costs, distance, prevailing supply, and prices.[67] Generally, for channels 4, 5 and 6, the wholesalers pay for harvesting costs, with pick-up at the farm gate as the preferred mode of sale.

53. An emerging channel (7) centers on the imminent entry of Philippine tilapia in the world market in fillet form. The channel is relatively simple: farm production goes directly to the exporter/processor who maintains contract schemes with a number of small-scale farmers to ensure a sufficient volume of tilapia for processing and export. The addition of this marketing channel can benefit small-scale farmers in two respects. First, they can group themselves and make contract agreements with a processor who is able to provide financing arrangements, including from government sources.[68] Second, the prospect of entry to the export markets for tilapia can improve marketing opportunities for small-scale farmers.

Harvesting tilapia from a fish cage at Lake Taal

Loading fresh tilapia onto a boat

54. **Pricing Strategies.** In tilapia marketing, the point of first sale is the farm gate where the producer and buyer agree on a certain price. The usual practice for tilapia marketing at the farm gate is to provide a price discount to bulk buyers.[69] Wholesalers in Central Luzon and Batangas

[67] Usually, a wholesaler has an established contact person at a specific market destination. Wholesalers prefer to deal with just a few individuals. For large wholesalers, the wholesaler-retailers are usually the next channels in bigger markets. Small wholesalers deal directly with retailers, especially if the destination market is small.

[68] The QUEDANCOR program has agreed to provide a higher loan limit (P170,000/ha/crop cycle) for farmers who are engaged in contract programs with the fillet exporter.

[69] This practice, prevalent in Batangas and Central Luzon, involves the reduction of total purchase price by 5–10%, depending on market conditions.

usually impose margins of P2–5/kg before the fish reach the next intermediary.[70] Product differentiation and pricing are based on fish size. For example, in Batangas, there is an 8-level pricing scheme. The highest price (1st tier) is for tilapia of 0.5–1.0 kg each, and the lowest (8th tier) is for fish of about 100 grams each. After harvest, Batangas tilapia are sorted and graded into 40-kg containers. In Central Luzon, there are 4–5 pricing levels at retail markets. However, farm gate sales in Central Luzon usually have a uniform price for a single harvest given the difficulty of sorting fish into aerated tanks. Further price differentiation occurs when the fish reach retail outlets. At retail markets, retailers resort to price reduction before the end of the day if tilapia remain unsold. In Central Luzon, a price premium of about P5/kg is applied to live tilapia over iced or chilled fish. Retailers generally apply a mark-up of P10–P15/kg. A recent shift in consumer preference for live tilapia has led to the development of sales from aerated containers in markets and at the roadside.

Roving retailer of live tilapia on his motor tricycle

Roadside tilapia retailer

55. **Marketing Investments.** Based on interviews with wholesalers and retailers in the provinces of Batangas, Pampanga, and Nueva Ecija, investments among wholesalers total P650,000 to P1.5 million. Tilapia traders' investments include vehicles (tricycles, jeeps, or trucks) and equipment (containers, weighing scales, and sorting trays). Wholesalers' operating expenses are mainly labor for harvests and delivery, fuel, ice, toll and parking fees, commissions, maintenance and repairs, and vehicle rental. Daily operating expenses, specifically for marketing tilapia intended for large fish markets in Metro Manila, are usually P4,000–5,000 per trip. Retailers invest in vehicles and equipment and their operating costs include fuel, stall fees, packaging materials (plastics), and ice. Daily operating expenses of ambulant fish vendors may be P80–250, depending on the area covered.

H. Lessons Learned

56. **Rising Costs of Feeds.** Concerted efforts are needed to reduce the dependence of tilapia farmers on commercially formulated feeds by finding viable alternatives. A shift from intensive to semi-intensive fish culture can reduce feed costs by increasing reliance on natural food produced in fishponds through fertilization, with supplementation of rather than total

[70] Wholesalers are sometimes forced to sell tilapia at low prices because of excess supply and/or competitively priced marine fish. The main destination markets of tilapia from Central Luzon and Batangas include Metropolitan Manila, Laguna, Rizal, Cavite, Pangasinan, and other provinces in Central Luzon. On average, wholesalers in Batangas alone handle 3– 6 t of tilapia daily during peak seasons, and 1–2 t daily during low seasons.

reliance on commercial feed. The Philippines is a net importer of fishmeal for making fish feeds. Developing and testing technologies to reduce the fishmeal component of commercial feeds is a key challenge. There is also scope for reducing the protein content of commercial feed as a way of reducing feed costs. Without viable alternatives, small-scale farmers will be vulnerable to rising production costs and narrowing profit margins. Feed costs account for more than 70% of total operating costs for producing tilapia in ponds and in cages. Domestic fishmeal prices have increased largely because of the continuing depreciation of the peso. The reduction of tariffs on imported fishmeal from 50% in 1997 to 20% by 2004 is expected to dampen this trend.[71]

57. **The Importance of Seed Supply.** In Philippine tilapia seed production and distribution, there are strategic linkages between breeders and private hatcheries/nurseries, enabling farmers in major production areas to gain access to a range of tilapia strains. Farmed tilapia production in the country increased more than five-fold in 1981–2001, largely because of improved seed quality through selective breeding, increased access to and availability of input supply, sustained advisory services, declining catches of marine fish, expanding consumer markets, and development of marketing channels in response to the market-driven demand for tilapia. Also, tilapia genetic improvement has become a highly dynamic and competitive field of research and development. Access to a reliable seed supply has become the backbone of tilapia farming, which is characterized by vibrant competition and promotional initiatives. This highlights the importance of continued efforts to ensure a reliable seed supply to support an expanding industry that has benefited small, medium, and large fish farm operators, and consequently generated rural employment and incomes for a large number of people.

58. **Accessing Credit.** One of the enabling conditions for small-scale farmers to enter tilapia farming is the provision of appropriate credit schemes. Small-scale farmers are often ineligible or reluctant to apply for bank loans because of stringent requirements for loan application. Some bank loans require insurance and invariably require collateral. Aquaculture insurance has almost no history or current market in the Philippines. The emergence and increasing dominance of informal credit schemes from nonbank sources has benefited small-scale tilapia farmers directly and indirectly, although some of these schemes carry higher costs than bank commercial loans. These nonbank financing arrangements include financier-caretaker arrangements, trader-operator agreements (usually forward sales), contract farming, and suppliers' credit schemes.

59. **Accessing Technology and Related Services.** Small-scale tilapia farmers need access to technology and support services from a network of providers, both public and private. Public institutions and agencies in the Philippines provide substantial support to freshwater aquaculture, particularly tilapia farming, through collaborative research, technology development, and extension. The private sector continues to invest in aquaculture education, extension, facilities, and equipment.[72] Nongovernment organizations and cooperatives also contribute as conduits of support services. The result is a broad network, including public-private partnerships that have benefited the tilapia industry to date. However, numerous local government agricultural officers have noted that one immediate impact of the devolution of responsibilities to local government units has been the deterioration of extension services in

[71] Tariff reform programs began in the Philippines in 1981 in order to reduce and simplify tariff rates on imports over a given period of time. See Morales, Alvin C. 2001. *An Analysis of the Philippine Decision-Making Process on Trade and Tariff-Related Matters*. Proceedings of the Scoping Workshop on the Sustainability Assessments of Trade in the Philippines. Manila: World Wide Fund for Nature. April.

[72] Paclibare, Jose. Development of Commercial Aquaculture in the Philippines: A Policy Perspective. Paper prepared as part of the FAO/NACA Regional Study on Commercial Aquaculture Development in Southeast Asia. Quezon City, Philippines. (In press)

terms of quality and frequency, particularly during the transition period. Local governments are confronted with financial constraints and inadequate technical skills on aquaculture among their agricultural extension workers. Favorable market conditions have expanded opportunities for accessing farm inputs and services, and small-scale tilapia producers have benefited from demand-led and market-based extension services provided by farm input suppliers, particularly seed and feed suppliers. Social networks among small-scale farmers have helped information exchange and farmer-to-farmer dissemination of knowledge.

60. **Legal Framework.** Various laws that affect freshwater aquaculture and can benefit small-scale farmers, have been enacted in the Philippines. If properly implemented, appropriate legal provisions may enable these farmers to overcome binding constraints confronting them. However, inadequate funding and institutional capacities have restricted their effective implementation. The Local Government Code of 1991 (Republic Act 7160) devolved many of the functions of central government offices to local government units, including extension services, regulation and licensing, and law enforcement in municipal waters. Increased capacity-building efforts at the local level are required if local governments are to fulfill their new mandates. The Agriculture and Fisheries Modernization Act of 1997 (Republic Act 8435) provides a blueprint for modernizing the agriculture sector in the context of global competitiveness and is concerned with the allocation of appropriate budgetary and technical resources, but actual funding has generally fallen short of planned levels.

61. The Fisheries Code of 1998 (Republic Act 8550)[73] aims to ensure sustainable resource management, food security, and development, including the reconstitution of BFAR for improved service delivery. It also recognizes the active participation of local fishers and coastal communities in policy formulation, planning, and program implementation. However, the overall management of fisheries and aquatic resources has been partly dependent on the priority accorded by local government units to this sector and on the presence of strong fisheries and aquatic resource management councils (FARMCs). Not all FARMCs are functional. Thus, improving resource management capacity and consensus building are required for addressing the needs of stakeholders, together with monitoring impacts on poor and small-scale farmers. In some areas, fishers have organized themselves to create FARMCs and have been able to influence policymaking and benefit from aquaculture operations.

[73] The Fisheries Code of 1998 has many provisions for small-scale fish farmers, leading to the formulation of various fisheries administrative orders (FAOs) pursuant to the Fisheries Code. FAOs of significance to tilapia production include the recognition and empowerment of small fishers in resource management (FAO 196), provision of incentives for aquaculture workers (FAO 197), stabilization of input prices, particularly seed (FAO 205), proper conduct of aquaculture operations (FAO 214), insurance for aquaculture stocks (FAO 215), ensuring the absence of obstructions to navigation (FAO 217), and defined fish migration paths (FAO 218). Although there are no recorded reports regarding the implementation of FAO 215, its purpose is to increase the participation of formal financing institutions to lend and allocate funds for small tilapia farmers. Lending risks are minimized through insurance guarantees for loans.