



Food and Agriculture
Organization of the
United Nations

HANDBOOK ON ENHANCING THE ENTREPRENEURIAL CAPABILITY OF FARMERS IN THE CONTEXT OF TILAPIA VALUE CHAIN DEVELOPMENT IN THAILAND





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PREFACE

It is from the farmers' perspective, particularly the small and medium aquaculture producers, that this handbook was designed and developed. Placing the production node along the value chain of the product broadens the farmer's outlook towards farming: that it is a business. A widely shared opinion is that farmers, apart from bearing almost all of the production and much of the marketing risks, have a weak capability to transact with suppliers and buyers. It would thus benefit farmers to develop the attitude and acquire the skills of an entrepreneur. It would enable them to obtain a higher share of the final market value of their product. More than this, the entrepreneurial ethos provides the guidance for responsible transactions with the other actors along the value chain.

The training workshop that was conducted in 2016 for a case farmers' association aimed to upgrade the members' entrepreneurial knowledge and skills as well as to imbue them with the entrepreneurial attitude. The task was facilitated and made systematic by learning materials having been organized according to the value chain framework. Before the training workshop, a case study was conducted of a group of tilapia farmers in Pho Phra Village, Phetchaburi Province. Their farming and value adding practices and strategies were studied. The training workshop was joined by members of the Pho Phra group as well as a leader of another aquaculture farmers' group and a manager of a corporate farm.

It must be emphasized that the content of the handbook had been validated and its structure molded into its present form by this process: (1) specialists from various institutions prepared the training materials that they themselves presented in the training workshop, (2) the case study of the farmer group that was the recipient of the training was used to inform the training workshop, (3) the feedback from the farmers and the other participants, that were obtained during the training workshop, informed the revision of the learning materials by the resource persons and (4) additional technical reviews, by other specialists, on the handbook, after it has been compiled and organized, were facilitated by the service provider. The various specialists who served as resource persons and prepared the learning materials and the technical reviewers are cited in the Acknowledgements.

This handbook is designed as a ready reference and comprehensive supplement to other related learning resources for trainers, advisers of farmer groups, leaders of farmer groups, farm managers, and teachers and students of, especially, agribusiness management courses.

ACKNOWLEDGEMENTS

A multi-step process that involved several experts and farmer representatives refined and validated the content and structure of this handbook (see Preface). The prototype handbook, which comprised the learning materials prepared and presented by technical experts was administered and therefore tested with the Pho Phra tilapia farmers' group in Phetchaburi Province in a training workshop organized in 2016. The case study of the group, carried out by a team, was part of the learning materials.

The resource persons for the training workshop who were subsequently engaged in the compilation and drafting of the handbook are professional staff members of their respective institutions: Juthatip Patrawart of the Cooperative Agricultural Institute (CAI), Saroj Aungsumalin of the Faculty of Economics and Praphansak Srisaphum of the Faculty of Fisheries of Kasetsart University, and Kulapa Boonchuwong of the Thai Department of Fisheries.

The development of this handbook owes much to Juthatip Patrawart, Director of CAI and her team for preparing the draft materials; Emmanuel Vera-Cruz, Director of the Freshwater Aquaculture Center of the Central Luzon State University in the Philippines, the professional, academic and technical personnel of the Overseas Filipinos Society for the Promotion of Economic Security (OFSPES), and Tipparat Pongthanapanich of FAO Regional Office for Asia and the Pacific for technical review and editing. Language editor was Robin Leslie. Layout and cover design were done by Trina Clemente. Nianjun Shen of Fisheries Division at FAO Rome provided support to the development and implementation of the projects, of which this handbook is one of the outputs.

ACRONYMS AND ABBREVIATIONS

DOF	Department of Fisheries
FTDD	Fishery Technological Development Division
GAP	good aquaculture practice
KPI	key performance indicator
MOAC	Ministry of Agriculture and Cooperatives
NBACFS	National Bureau of Agricultural Commodity and Food Standards
OTOP	one tambon, one product
SWOT	strengths, weaknesses, opportunities and threats
TAS	Thai agricultural standard

Units of measurement

6.25 rai = 1 hectare

INTRODUCTION

Value chain development aims to increase the performance of the major stakeholders in the value chain based on the basic market law that the consumer needs products of a certain standard of quality at an appropriate price, time and place. It accords with the United Nations' Sustainable Development Goals and should promote environmental conservation, food quality and safety standards, food security and, broadly, social welfare. Value chain development should lead to five aspects of improvement: (1) efficient and competitive business operation, (2) quality product development, (3) differentiation of products to increase their value, (4) environmental and social responsibility and (5) provision of a system to support the development of the chain.

This handbook aims to enhance the entrepreneurial capacity of small producers in the tilapia value chain. It describes the principles involved and explains the practical skills in analysing situations and designing an efficient business arrangement that would increase opportunities for business partners to participate in and effectively access the target market.

This handbook aims to increase knowledge and understanding of value chain development, with farmed tilapia as an example. It is designed as a learning resource for training farmers and other stakeholders along the aquaculture value chain who are involved in value addition and marketing. It may be used by trainers, government officers, private entrepreneurs, community leaders, extension officers, researchers and students.



The handbook has five chapters:

Chapter I: Understanding the concepts of value chain development.

This chapter describes the principles and strategies of value chain development and the importance of the applications. It is particularly applicable to small-scale farmers who need to mitigate constraints to improving their farm business and improve their market access and market power. The key steps in developing the value chain are described. The highlights of the case study of the tilapia farmers' group in Pho Phra Village are presented.

Chapter II: Good farm management in tilapia pond culture.

The main aspects of good aquaculture practices for tilapia farming in earthen ponds and guidance are introduced. They comprise site selection, farm model and pond preparation, selection of quality seed and handling, stocking and grow-out pond management, as well as good harvesting and product handling practices.

Chapter III: Financial planning for tilapia farming.

This chapter guides farmers' investment decisions on farm operation, farm expansion, acquiring or upgrading farm assets and on how the investment can be financed. It describes four key components of farm enterprise management: (1) production, (2) marketing, (3) human resources and (4) finance. The section on financial management explains financial record keeping, financial statements and the evaluation of farm performance.

Chapter IV: Development of tilapia products to meet quality standards.

This chapter describes the processes and standards based on the Thai Department of Fisheries' guidelines to ensure the safety and quality of fish products from on-farm culture to processing and transportation. Examples of tilapia product development and distribution channels are provided.

Chapter V: Business plan to achieve mutual goals with partners along the value chain.

This chapter describes the concept and principles of developing a business plan. Detailed guidance on preparing a business plan is provided. The business plan of the Pho Phra farmers' group serves as an example.

CHAPTER I

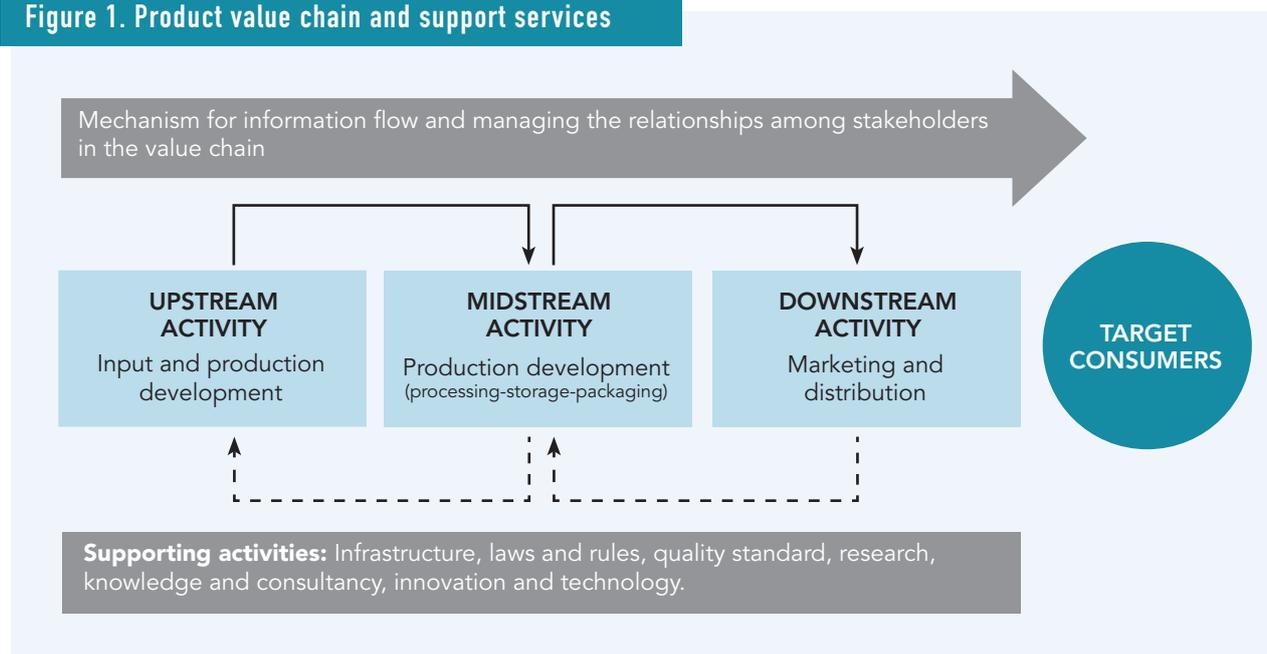
UNDERSTANDING THE CONCEPTS OF VALUE CHAIN DEVELOPMENT

1. The concept of value chain development

A value chain consists of integrated activities along the upstream–midstream–downstream path and on to the final consumer. The upstream activities include input production, procurement and production; midstream activities are product processing, storage and packaging; and downstream activities are marketing and distribution of products to consumers.

Value chain development entails managing the relationships among the business partners. It involves mechanisms for information flow among stakeholders to drive business operations so that the principal players along the chain achieve their mutual goals. It also includes facilitative support from government agencies, financial institutions and the provision of basic infrastructure, laws, regulations and legal standards for product quality, research, training and innovative ideas and improved technologies (Figure 1).

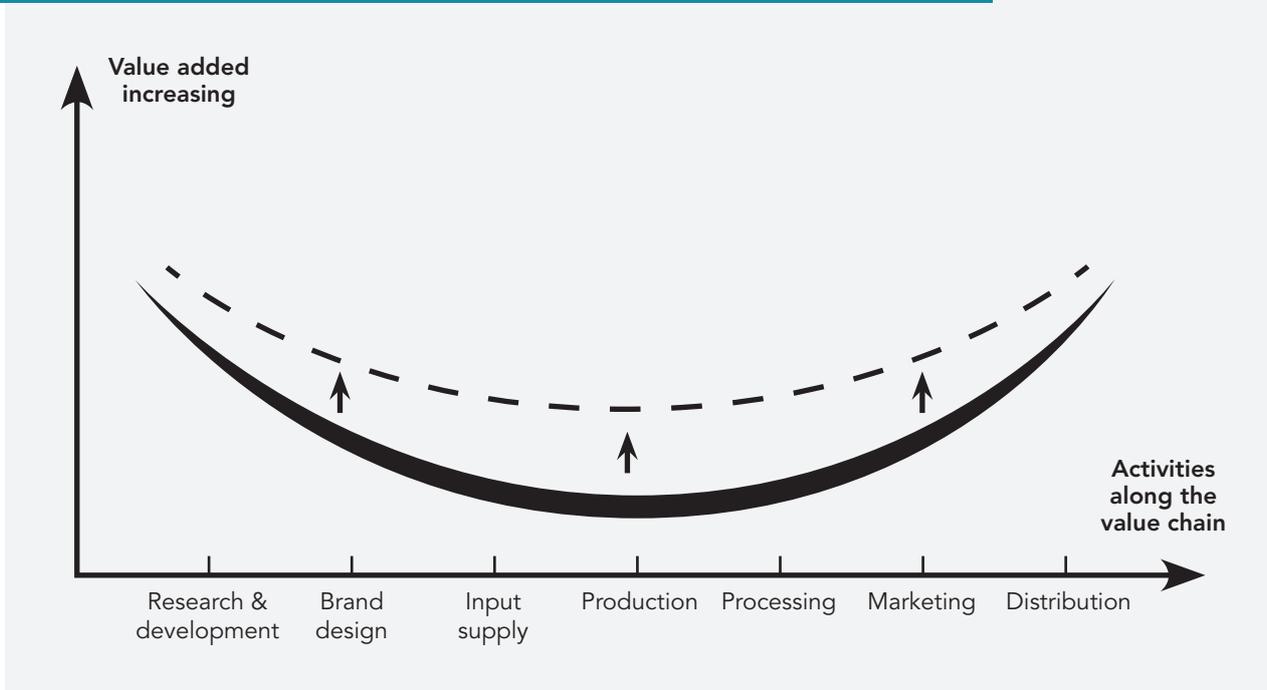
Figure 1. Product value chain and support services



Value chain development supports small farmers – preferably organized into groups – in creating a business system that manages or rearranges the relationships among business partners to improve the performance of all parties so they can achieve their common and respective goals. This enhances the capacity and opportunities of business partners in the contexts of achieving more efficient production, better product quality, lower costs, stronger bargaining power, improved product development and entry into target markets.

This framework is derived from the concept of value chain development to increase value added, depicted in Stan Shih's smiling curve (Figure 2).

Figure 2. Stan Shih's smiling curve as a concept for value chain development



Stan Shih's smiling curve depicts activities in the value chain starting with research and development, followed by business concept and design, brand creation, input procurement, production, processing and concluding with marketing, distribution and selling. The players who gain the most benefits are those located at both ends of the smiling curve – the brand owners, marketers and distributors who have high bargaining power and a strong influence on the roles and functions of the other stakeholders in the chain. This framework suggests four main strategies to raise the competitiveness of all stakeholders:

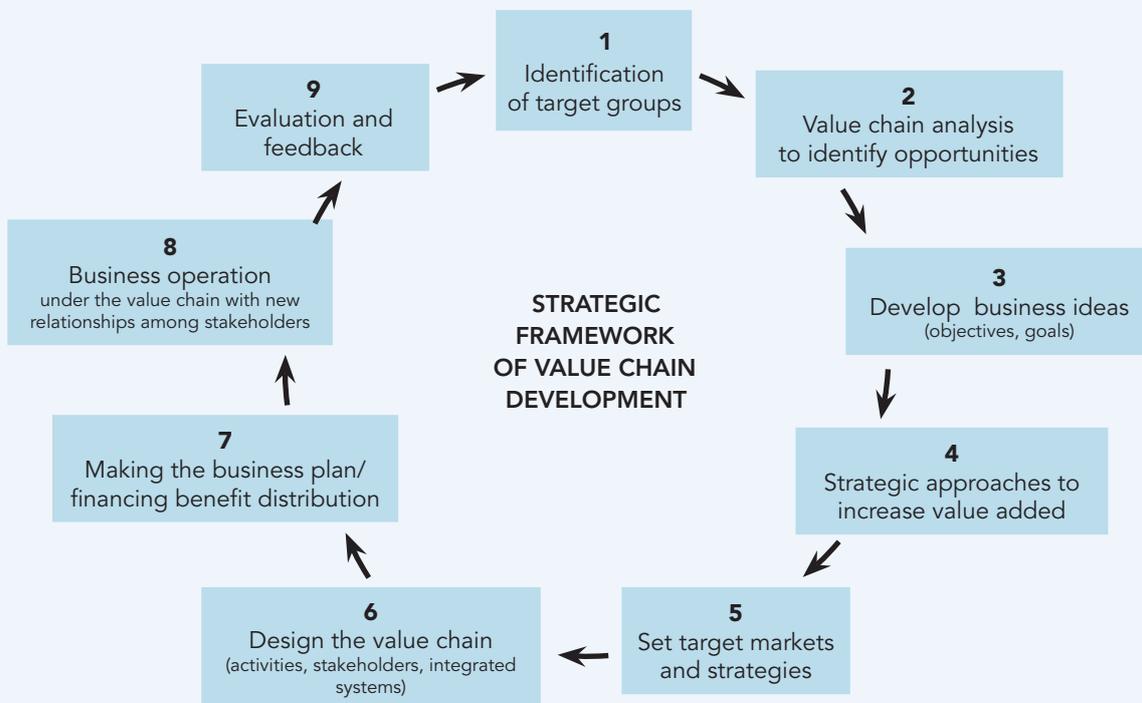
- **product upgrading** by increasing quality standard to meet consumer demand;
- **process upgrading** by increasing production efficiency with innovation usually featuring new technology, better process and more efficient management;
- **functional upgrading** by enhancing key functions of the business that can add value to the product; and
- **chain upgrading** by expanding into other businesses and branching into other value chains to increase market opportunities.

Enhancing the capacities and value added of stakeholders along the chain can be done through research and development, creation or adoption of innovations, product development, product branding and devising a business concept to design a marketing strategy that efficiently delivers products to customers.

2. The strategic framework of value chain development

The strategic framework for value chain development can be defined in nine steps (Figure 3):

Figure 3. The concept framework of value chain development



- Step 1: Determination of target farmers or farmers' groups. They can organize by themselves or with the initiation and assistance of government extension offices.
- Step 2: Value chain analysis to identify business opportunities.
- Step 3: Determination of the business strategy and goals.
- Step 4: Development of strategic approaches to increase value added, which comprise product upgrading, process upgrading, functional upgrading and chain upgrading.
- Step 5: Determination of target market(s) and designing marketing strategies. This involves the identification, selection and understanding of end target markets and consumers. The objective is to deliver products to customers and satisfy their needs as well as to achieve market targets.
- Step 6: Value chain design on what activities to conduct in the chain, the structure of business partners and stakeholders, and a coordination system among partners and stakeholders that specifies their functions, all with the aim of their being able to achieve mutual goals.
- Step 7: Formulating a business plan that comprises business ideas, analysis of the situation, a marketing plan, a product and service production plan, a risk management plan and a financial plan.
- Step 8: Business operations under the value chain to achieve the mutual goals. This involves rearranging relationships – with trust as the common thread – among business partners and stakeholders. The aim is to increase value added of products and services and achieve mutual goals. Trust is key to achieving mutual goals.
- Step 9: Monitoring, evaluation and adjustments. Actual results are compared with the expectations in the plan. The evaluation report recommends ways to improve business operations.

3. Case study of the Pho Phra farmers' group

This section discusses the process and method of value chain development learned and applied by the Pho Phra farmers' group. Selecting the group and farmers for the case study was guided by four criteria: (1) farmers voluntarily participate in the study, (2) farmers want to use the group as the mechanism to add value to tilapia products, (3) the location of the group is suitable for carrying out the study and (4) the group's leader is an effective manager. The focus group discussion and interviews of key informants in Pho Phra Village were conducted in 2016.

3.1 Basic information on the case group

The Pho Phra aquaculture farmers' group was established in 2003 under a project that aimed at increasing income of small farmers. Farmer groups were organized by the Ministry of Agriculture and Cooperatives (MOAC). The group began operating in 2006. The provincial cooperative extension office in Phetchaburi was the principal supporter.

There were initially 48 members, all tilapia farmers. The focus group discussion in 2016 (at the time of conducting this case study) indicated that 30 members remained. The functions of the group were to provide credit, sell inputs, assemble products and market the products. Initially, the group received THB 300 000 from the government for its working capital, i.e. for re-lending to its members; each member received approximately THB 10 000 to 20 000 at an annual interest rate of 3 percent. The members were required to attend the annual meeting to learn about the progress and results of the group's operation and relevant government policies.

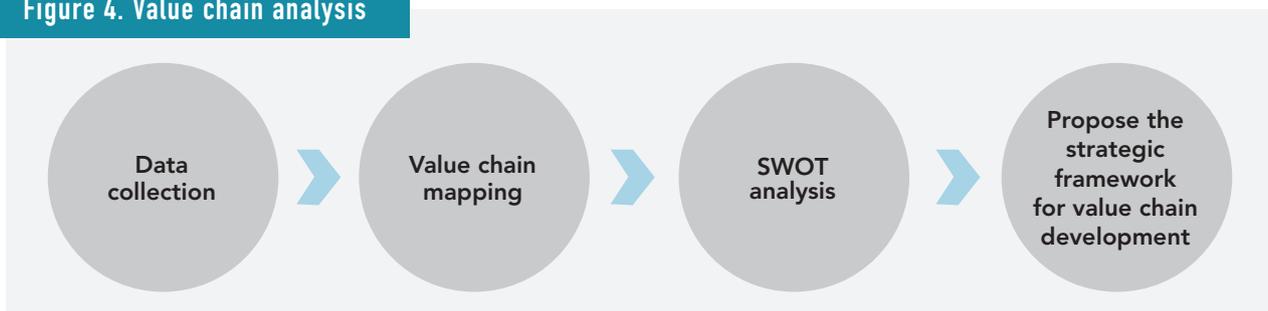
During the focus group discussion, the following constraints to tilapia farming were cited: (1) landownership – most of the members did not own the land on which their ponds were built, (2) lack of information on appropriate production technologies and marketing and (3) recurrent drought.

The group, however, had a good leader who understood and was familiar with good practices in tilapia farming and processing. He had worked hard at coordinating the activities of members and other persons in the value chain to increase value added of tilapia products.

3.2 Value chain analysis

Value chain analysis describes the present situation and the relationships among the stakeholders in the chain, the distribution of benefits, information flows and innovations that increase value added of tilapia products. The analysis comprises has four steps: (1) collecting data, (2) value chain mapping, (3) strengths, weaknesses, opportunities and threats (SWOT) analysis and (4) drafting the strategic framework for value chain development (Figure 4).

Figure 4. Value chain analysis



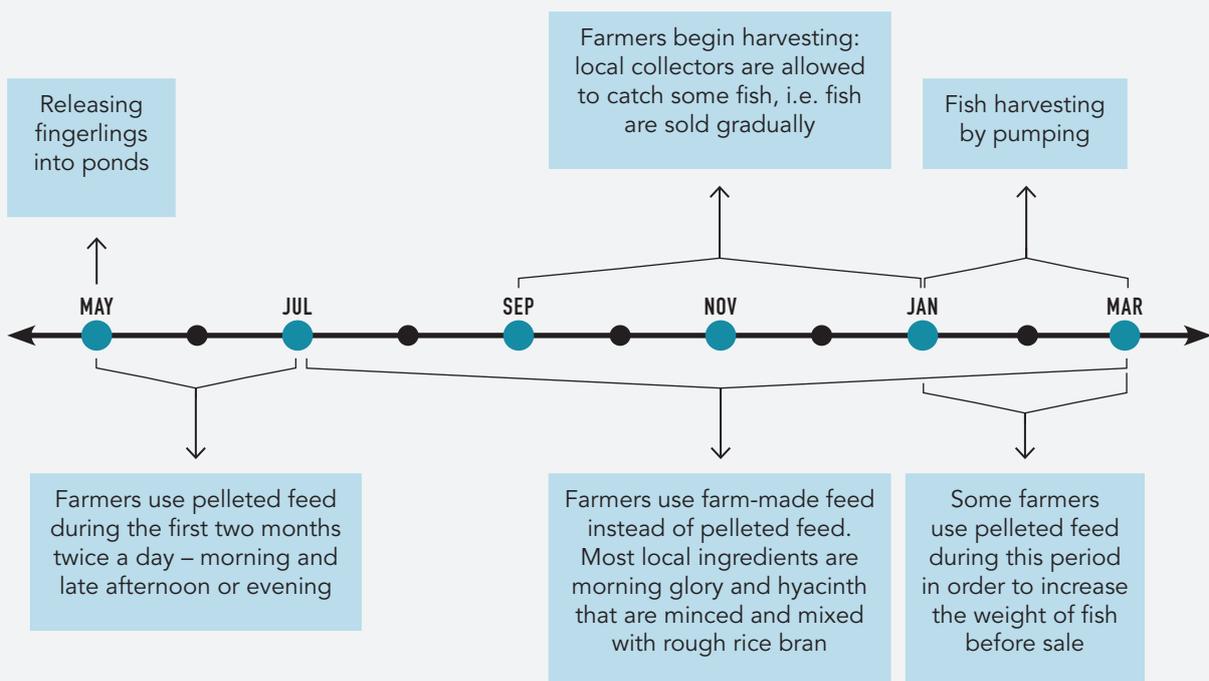
3.2.1 Data collection

Market. The major markets were the local markets in the district and nearby provinces. Although many exporters were interested in the farmers' aquaculture products, the terms of purchase and prices were usually unattractive to the farmers who sold them to collectors or at the local markets; prevailing prices were checked before transporting fish to the market. Sometimes, local collectors visited the farms to negotiate prices and, if these were agreed, they helped to harvest the fish.

Production cycle. A popular tilapia strain is Chitralada 3. Most farmers bought fingerlings from private companies such as Saineung Phan Pla, Jintana Farm and Mani Farm. Only one government office, the Phetchaburi Inland Fishery Development and Research Center, sells fingerlings in Phetchaburi. It has a very limited supply. Most farmers tried to save money by buying male and female fish, releasing them in the same ponds to breed naturally.

The farmers followed the pattern illustrated in Figure 5. The cropping season begins in May when farmers buy fingerlings and stock their ponds. Most farmers use pelleted feed during the first two months. They feed twice a day, in the morning and evening. After two months, they switch from pellets to farm-made feed that they prepare. They mostly use the ubiquitous morning glory (water spinach) and water hyacinth that are minced and mixed with rough rice bran. When their stock is six months old, some farmers begin to contact local collectors (the collectors harvest the fish). The stock is sold periodically until the end of January, after which the remaining fish are harvested and sold in February and March. Some farmers switch back to pelleted feed during the later stage of the culture period to accelerate fish growth before harvest.

Figure 5. Tilapia production cycle of the Pho Phra farmers' group



Farm profit. Four sample farms of the Pho Phra farmers' group were interviewed in 2016. They revealed that the average output per *rai* (0.16 ha) was 600 kg. The average annual revenue was THB 24 400/*rai* (at a farm-gate price of THB 40/kg) and the average annual cost was THB 16 211/*rai* (THB 27/kg). The average annual net income was THB 8 189/year (THB 13/kg). The major production expenses were for feed (37 percent) and fingerlings (25 percent), followed by management and labour cost (17 percent).

3.2.2 Value chain mapping

The stakeholders or actors in the tilapia value chain were identified through value chain mapping of those involved in a variety of activities in the upstream, midstream and downstream sections of the chain (Figure 6). These activities were facilitation and extension, input supply, production, assembly, processing, wholesaling and retailing.

Figure 6. Value chain mapping by actor

INPUT SUPPLY / FACILITY	PRODUCTION	COLLECTION / PROCESSING	WHOLESALE / EXPORT	RETAIL
Broodstock producers (breeders)	Subsistence	Contractors for harvesting	Fish markets	Retailers
Hatchery business	Commercial	Local collectors	Wholesalers	Restaurants
Fingerling business		Community enterprise	Exporters	
Financial institutions				
Government sector				

Facilitators and extension agents. The initial cooperation project involved multi-agency participation. The MOAC, Cooperative Promotion Department, Department of Fisheries and the Bank for Agriculture and Agricultural Cooperatives provided the relevant services under their mandates. They encouraged farmers to form a group or association (of tilapia farmers) in 2004. Low-interest loans were provided to farmers who joined the project. One of the purposes of setting up a farmers' group was for the group to be a cost-effective mechanism to promote extension and information messages to farmers. Data from the focus group discussion and interviews with farmers pointed out some operational limitations.

Fry and fingerling traders. One government agency produced and sold seed in the area but it did not have enough fingerlings to meet demand. However, three private companies sold fingerlings and some of them were highly trusted by the farmers owing to their good breeding techniques. They also guaranteed the survival rate of fingerlings. This information indicated that easy access to high quality fingerlings was an advantage for farmers. The price of fingerlings depended on size, starting from THB 0.10 for a 2 cm to 3 cm fingerling up to THB 0.40 for larger sizes.

Feed and chemical supply. Several companies sold pelleted feed and competition was high. Although there were many brands, their prices were comparable to the feed produced by farmers themselves using local ingredients, i.e. farm-made feed. But farmers sometimes experienced insufficient supply of local ingredients. The easy availability of pellet feed enabled them to overcome this shortcoming and they saved on feed cost by mixing pellet feed with whatever local ingredients were available.

Financial sources. The farmers' main source of funds for investment was their savings. However, they were eligible to borrow up to THB 10 000 from the government project at a 3 percent interest rate per year. Other sources of capital were the Bank for Agriculture and Agricultural Cooperatives, the agricultural cooperatives and credit unions in the area.

Local collectors. The farmers were familiar with three local collectors. Some collectors visited the farms to negotiate prices and purchased directly at the pond site. Others conducted negotiations in their offices. The local collectors played an important role because they had long experience in the business, production information in the area as well as nearby areas and information on product prices at each market level. Furthermore, they had business relations with entrepreneurs who ran fishing pier businesses and with other traders. The fish prices were quoted by size. Local collectors had their own tanks to keep the live fish for grading and fattening and to maintain an inventory to balance supply and demand.

Harvesting contractors. There were five professional fish harvesting contractors in the area. The service charge was THB 1.00/kg of fish caught. The contractors brought their own workers, water pumps, fish nets, trucks and other equipment for the job. The harvesting skills of these contractors were very important for the farmers. Improper harvesting practices would result in a high percentage of dead or damaged fish and, invariably, lower prices.

Processing. Processors in the areas included the local collectors, village enterprises and some farmers themselves. A common practice was to dry fish so that it lasted longer and, more importantly, increased the value. Fresh fish sold at THB 30/kg and dried fish at THB 60/kg.

Wholesalers. Most wholesalers operated fishing pier businesses and were intermediaries. Their function was to collect the products from farms and sell them to retailers, exporters and restaurants. The farmers faced a high price risk owing to wildly fluctuating buying prices depending on demand and supply conditions on a particular day. There were occasions when the actual demand was much lower than the expected demand so the wholesalers would process the excess supply of fresh fish into dried fish.

Retailers. The retailers were merchants in flea markets and weekend markets at village, district and provincial levels. Some of the retailers were tilapia farmers or local collectors.

3.2.3 SWOT analysis

The SWOT analysis from the focus group discussion with the Pho Phra farmers' group is presented in Table 1.

Table 1.
SWOT analysis of the Pho Phra farmers' group

STRENGTHS
<ul style="list-style-type: none"> • The farmer leaders have good knowledge of improved aquaculture technology and commercial farming. • Farmers are keen to raise their tilapia value added through value chain development. • Farmers have close relationships.
WEAKNESSES
<ul style="list-style-type: none"> • Some farmers do not own the land, which affects long-term investments. • Farmers lack knowledge on tilapia production quality standards. • Farmers lack access to relevant information. • Farm productivity is low. • Farmers have no idea about value chain development.
OPPORTUNITIES
<ul style="list-style-type: none"> • The farms and group locations are suitable with easy access to feed suppliers, hatcheries and extension services, as well as nearby local markets, fishing piers and fish markets. • There are government policies to promote the creation of value-added tilapia products. • Input suppliers and local collectors are interested in upgrading their businesses and providing supporting information to farmers. • Domestic consumption trends of tilapia are increasing. • The group can be a platform or a mechanism for training, extension and other services. • The group can be developed further as a learning centre for dissemination of knowledge and best practices to enhance value addition of tilapia products to other groups.
THREATS
<ul style="list-style-type: none"> • Lack of mechanisms to access appropriate production technology and to obtain good aquaculture practice standards. • Weak bargaining power. • Recurring and often prolonged drought episodes have adverse effects on aquaculture; this exacerbates water pollution. • Lack of mechanisms to access information on physical and market risks and risk management approaches.

3.2.4 Strategic approaches to increase value added

Improving value addition along the chain can be done through four approaches. The first is the improvement of production processes to reduce costs, improve quality and raise productivity – process upgrading. The second is the development of higher value products – product upgrading. The third aims to have the farmers’ group manage its business in the value chain – functional upgrading. The fourth is to have the business fully integrated into the value chain – chain upgrading.

Process upgrading. This approach is used to design a system and mechanism to manage the farmers’ groups that have applied the value chain concept. Key activities in this strategy are:

- Set the strategic direction of the group and decide on its long-term operational goals.
- Develop the plan to adjust the group’s organizational structure and management system to conform to the value chain concept.
- Develop the business plan to conform to the strategic direction and goals.

Product upgrading. This approach is used to raise the levels of production and processing quality standards. The key activities are:

- Conduct market research on high value-added tilapia products.
- Develop a production plan for the products.
- Devise a marketing plan with business partners for selling these products under a mutual agreement.
- Devise a mechanism to develop processed products that comply with food safety standards.

Functional upgrading. This approach is used to enhance functions of the business that increase value added. There are three activities:

- Develop an extension programme to raise tilapia production of farmers to international standards. Devise a mechanism to monitor the progress. Internalize good practices into the group’s mission.
- Develop a tilapia production and market information system and increase the farmers’ access to the information. Build better understanding among members of the marketing issues so they can make collective decisions effectively.
- Create a learning and development system for members to acquire capacity to implement the strategies to enhance value addition and achieve mutual goals.

Chain upgrading. This approach is used to develop a management scheme that integrates the farmers' group with business partners and consumers. Given this setting, the proposed value chain should be a fair trade system for all stakeholders. Key activities are:

- Build business connections with business partners and government agencies for the supply of inputs and information as well as ways to reduce production costs, increase production efficiency and improve production process standards and product quality to meet required standards.
- Build business connections with local collectors and entrepreneurs for the marketing of fresh fish.
- Build business connections with business partners for the marketing of processed products under the group's quality product brand.

CHAPTER II

GOOD FARM MANAGEMENT IN TILAPIA POND CULTURE

1. Farm location

The farm location should facilitate various activities, delivery of inputs and transport of products. It should not be vulnerable to pollutants and floods. Areas for tilapia farming are linked to other factors that farmers must consider carefully. A particular area affects other key factors such as costs, production capacity, farm management and productivity. The following factors should be considered when choosing a farm location:

- **Water source.** The farm should be near a water source of good quality and sufficiency. Most farms are near water sources, such as rivers and canals, which can support farming activities throughout the year.
- **Transportation.** Access to roads and transport is the second priority. The ease and cost of stocking, feeding, water quality management, monitoring of stock, harvesting and marketing depend on the farm's access to road and transportation.
- **Location relative to human habitation.** Ponds should not be in close proximity to villages because they could be obstacles to people's access to livelihood resources or exposed to agricultural and domestic waste. Effluent from agriculture and domestic sources degrades water quality and affects fish health. The discharge from ponds should not pollute common water resources or affect farmlands. Also, poaching of stock might occur, creating conflict. Farmers should provide suitable security.
- **Suitable soils.** Farms should be located remotely from areas with known or suspected soils contaminated with toxic compounds. If farms are located on acidic soil areas such as peat soils or former mangrove sites, water in earthen ponds will turn acidic, affecting productivity. Acidic substrate and water affect fish health directly or indirectly. For example, fish need to adapt continuously, or there will be a shortage of natural food resulting in retarded growth. Amelioration of acid soils is carried out via lime application, which adds to cost. Likewise, farms located in hazardous areas may experience high fish mortality, especially if the concentration of toxic substances is high. This is difficult to manage. Fish quality is affected, farm costs increase and the health of farmers and workers is jeopardized. Moreover, if consumers learn that the farm is located in a contaminated area, they will likely avoid buying the product. The farm should be built in areas with soil containing a sufficient amount (at least 30 percent) of clay to minimize seepage because earthen ponds must retain water for long period.

2. Farm models

Farm models influence a farmer's decision because they determine the amount of key inputs and investment and the intensity of farm management. Thailand has the following types of tilapia farm models:

- **Earthen ponds with area ranging from 10 *rai* to 50 *rai*.** With this model, farmers may use monoculture or polyculture in a semi-intensive system. Fish must be sex reversed. Stocking density is approximately 3 500 fingerlings/*rai* to 5 000 fingerlings/*rai* using small fingerling size of approximately one inch. Natural ingredients such as manure (to grow plankton), rice bran and maize meal combined with composting straws and other inputs are used as feed. It takes eight to ten months until harvesting occurs (the harvest size of tilapia in Thai farms is from 700 g to 1 kg).
- **Earthen ponds with area ranging from 3 *rai* to 5 *rai*.** This model employs intensive farming. Farmers stock large fish of 50 g or larger (100 g to 200 g) with stocking rates of 1 500 fish to 3 500 fish/*rai*. It takes four to six months using commercially pelleted feed until they are harvested. Farmers must provide aeration. Some farms install automatic feeders.
- **Cages in earthen ponds.** Farmers use cage nets with sizes of 3 m x 2 m x 2 m up to 10 m x 15 m x 2 m. Most farmers hang the cages in earthen ponds that are 10 *rai* to 20 *rai* in area, and stock fish that are 30 g to 50 g (60 fingerlings to 120 fingerlings/m²). Most farmers use an aeration system and pelleted feed. It takes four to six months until harvest.

3. Farm structure and farm environment

Farm structure and environmental management of tilapia farming in earthen ponds follows when the farmers decide on the farm model. The considerations for each model are:

- **Grow-out ponds.** Ponds should be rectangular with sizes ranging from 3 *rai* to 50 *rai* depending on the farm model. Depth should be about 1 m to 2 m. The pond should be oriented to the usual prevailing wind direction and near a farm road. In addition, pond inclination should be 1:2. The pond bottom should have a slope to facilitate draining. It should be located close to a water source such as a well or storage pond or reservoir.
- **Farm roads.** Roads should be strong enough to support a vehicle moving through any part of the farm. Roads should be maintained regularly.
- **Office and storage areas.** For a large farm, the office should be separated from the storage buildings. The structure of storage facilities should be durable and able to withstand extreme natural events as well as infestation by rodents and other pests. A good ventilation system is important.
- **Water reservoir.** This component is crucial to tilapia farming. The reservoirs should have capacity to supply water to grow-out ponds at 20 percent to 30 percent of total water usage. They should be built near water sources. It is necessary to reserve water for emergency situations such as poor water quality during culture periods or low water levels in grow-out ponds.

- **Water supply and drainage systems.** The system should be designed for efficient flow of water in and out of the grow-out ponds and farm. It can be a pipe system or a channel system.
- **Electricity and aeration systems.** Tilapia farming in earthen ponds needs a reliable electricity system for equipment such as water pumps and aerators. It should be designed during the establishment of the farm so that it can efficiently provide the level of energy required. The aeration system is necessary. It has a positive impact on feeding and thus growth of fish and helps to reduce risks from sudden changes in water quality such as low oxygen and high water temperature. There are various types of aeration systems such as air jets, paddle wheels and aquarium models (plastic or rubber tubes with air stones at the end).
- **Residential areas for farm workers.** This area should have a waste disposal system. Wastewater from kitchens or toilets must be drained into a storage area to prevent the contamination of water for fish culture. Solid waste must be managed in a hygienic way so it does not harbour infected animals and insects that could be carriers of pathogens.

4. Pond preparation

Poor preparation of the grow-out pond and improper practices can affect the performance of subsequent crops. For example discharge of water effluent into natural waterbodies, too much use of lime and piling pond sludge on the dyke. Micro-organisms in pond bottom soil can help to decompose waste. Some tips on pond preparation that does not eradicate these useful micro-organisms are:

Step 1: After harvesting the entire crop, drain the water from the ponds. If the sludge accumulation is thick, remove some until only 5 cm to 10 cm remain.

Step 2: Apply calcium carbonate (CaCO_3) or dolomite ($\text{CaMg}(\text{CO}_3)_2$) to the pond bottom at 100 kg to 160 kg/rai and leave it for seven days (Figure 7). During this time, do not let the pond bottom dry up. If the previous crop encountered fish disease, it is advisable to initially apply burnt lime (CaO) at 200 kg/rai to 300 kg/rai.

Figure 7. Preparation of a grow-out pond bottom for the next crop



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Step 3: After seven days, farmers must turn over the soil by ploughing or raking (Figure 8).

Figure 8. Ploughing or raking to turn over pond soil during the pond preparation step



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Step 4: Repeat Step 2 and Step 3 two to three times until the soil turns brown (Figure 9).

Figure 9. The soil substrate turns brown after drying and ploughing or raking



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Step 5: Pump water into the reservoir and leave it standing for one week to let the silt settle at the bottom; then apply lime (CaCO_3) or $\text{Ca}(\text{OH})_2$ at the rate of about 100 kg/rai to 160 kg/rai. Dissolve the lime in the water for about 30 minutes and allow it to spread around the reservoir.

Step 6: Pump treated and desilted water from the reservoir to the ponds; wait one week before releasing the fingerlings.

The time of pond preparation depends on the farm model and the season. The most appropriate time for pond preparation is after the 'winter' crop (in Thailand, this is the cooler season from November to February) when farmers can spend two to four weeks for preparation. In the rainy season, farmers usually spend less time (one to two weeks).

5. Selection of fingerlings and handling

Fry and fingerling selection and handling are crucial to the growth and health of the stock. Farmers are recommended to observe the following guidelines:

- Farmers should buy fingerlings from reliable suppliers.

- Stock with more than 95 percent of sex-reversed male fingerlings: If the proportion is less than 95 percent, there is risk of breeding in the pond, resulting in many new fingerlings and diverse stocking sizes. This is usually uneconomical.
- The size of fingerlings must be uniform.
- Fingerlings should not have wounds or parasites adhering to their bodies.
- Fingerlings must have complete organs.
- Fingerlings should swim vigorously with no display of weakness during transport. Inspect the containers for dead fish during or after transport.
- Fingerlings should not be fed for three to five days before shipment. The appropriate transport period is six to eight hours with a temperature of about 25°C to 26°C. Farmers should avoid releasing fingerlings when air temperature is high or under intense sunlight. Suitable time for releasing is early morning or evening. Do not release them from the container immediately. They should be acclimatized in the new environment for 30 minutes to 1 hour by immersing the fish bag in the pond (Figure 10) or mixing some water from the pond with the water in the transport container.

Figure 10. Acclimatizing fish fingerlings in a grow-out pond



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- Farmers should hang some salt bags near fingerling release areas, 120 kg/*rai* to 160 kg/*rai*, and turn on the air pump to add some dissolved oxygen. Farmers must avoid too much water movement so as not to stress the newly stocked fish.
- Farmers may initially stock the fingerlings in a cage hung over the pond so they can adjust to the new environment. Also, this makes it easier to monitor their health status and survival rate.

6. Releasing fingerlings and nursing

After the pond is prepared and filled with water, the farmer should make a production plan. This starts with the optimum stocking density that is compatible with management capacity and the farm model. Normally, the output is from 800 kg to 1 000 kg/*rai*. For this volume of output, stocking

density with good soil substrate should be 1 000 fingerlings/*rai* to 1 500 fingerlings/*rai* supported by good management. The density can be higher if management capacity is optimal. The following nursing techniques are recommended:

- To disinfect the fry, use a formalin solution with a concentration of 100 ppm. Immerse the fry in the solution for 5 to 10 seconds for disinfection against bacteria, protozoa or parasites. Aerate the solution to avoid oxygen depletion and reduce the toxicity of the formalin.
- When releasing fry, use an aeration system that does not disturb the water too much and force the new fry to spend too much energy. A suitable technique is pumping air through a rubber tube. Conversely, if farmers release bigger fingerlings (30 g to 50 g), they can use an air jet or paddle wheel. The level of dissolved oxygen should be maintained at not less than 4 mg/l.
- Farmers should suspend bags of salt in the pond at 120 kg/*rai* to 160 kg/*rai* to supply minerals that fry may have lost during transportation. This has a positive impact on fish health. The technique is shown in Figure 11.

Figure 11. Suspending salt bags in a fish pond



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- Sometimes, farmers release as many as 3 500 to 5 000 fingerlings/*rai* in the belief that mortality will reduce density to the optimum level. However, after two to three months, farmers should observe the survival rate. If survival is high, some of the fish should be transferred to other ponds at the appropriate density of about 1 000 to 1 500 fish/*rai*. A very high density such as 3 500 to 5 000 fish/*rai* with sizes ranging from 200 g to 300 g will have an adverse effect on the health of the stock because of excessive excreta or other waste in the pond. Furthermore, if there are risks such as heavy rainfall or high temperature that deplete pond oxygen, the mortality rate will be high.
- Feeding is not necessary a few days after releasing the fry. This allows the fish to adapt better to the new environment. Broadcast feed in certain parts of the pond when the fish are observed to have already adapted. Always place the feed in these areas and at specific times so the fish remember the feeding areas and feeding times. If the pond has been well prepared, natural food such as phytoplankton and zooplankton will be growing already. Such natural food contains essential nutrients that improve the health and growth of the fish. They also reduce the need for artificial feed.

- The initial feeding rate is 5 percent to 10 percent of fish body weight twice a day (morning and evening). Observe the feeding behaviour of the fish closely to adjust the feeding rate. Too little and the fish lack adequate nutrition. Too much and feed is wasted.

7. Water quality

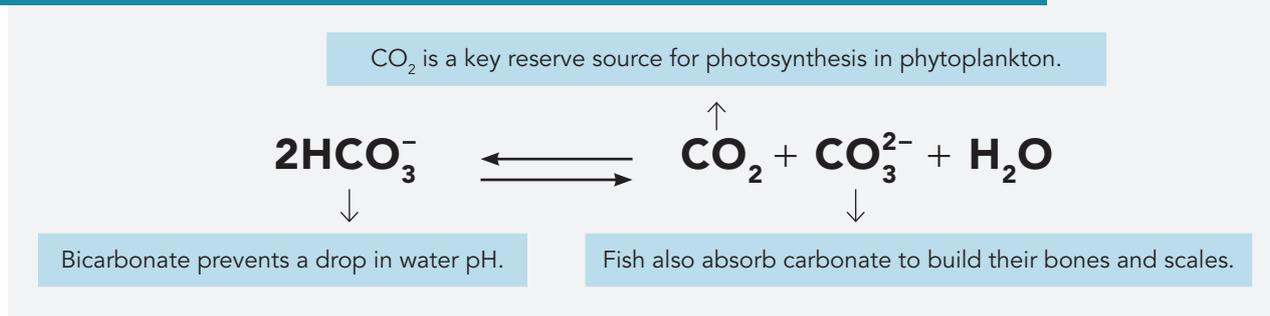
The three essential properties of water quality are the chemical, physical and biological components. The chemical factor consists of dissolved oxygen and pH, which indicates acidity or alkalinity. The physical factors are temperature, transparency and colour. The biological factors are the micro-organisms, phytoplankton and zooplankton in the water. Water quality management concentrates on these key factors. It is not necessary to manage all of them.

Dissolved oxygen management. Use an aeration system to maintain the optimum level of oxygen in the water for fish survival and growth. Aerate the pond before fish are released and when they attain 100 g. Farmers should supply dissolved oxygen at night, between 10 p.m. and 7 a.m. During rainy or overcast days, farmers should aerate all day and maintain the oxygen level at over 3 mg/l between 6 a.m. and 7 a.m. It is not necessary to aerate the entire pond, but only specific spots, especially feeding points. Fish instinctively swim to the area that has adequate oxygen. Aeration promotes good feeding and reduces the risk of some diseases. A sudden drop in dissolved oxygen to a critical level can result in mass mortality.

Control of pH level. The crucial role of pH levels in pond management is described below:

- A steady pH level, which should be 7 to 8, means the fish do not have to spend energy adapting to this water parameter. An appropriate pH level helps to control toxic compounds such as ammonia and nitrite in water.
- An optimum level of alkalinity prevents the death of plankton, especially when it rains. Rainfall reduces the amount of carbon dioxide (CO₂) needed by the phytoplankton for photosynthesis. Photosynthesis produces oxygen. Lack of carbon dioxide causes the death of phytoplankton, which then uses up the dissolved oxygen in the water. A sign of oxygen depletion and overall deterioration of pond water is the water colour changing from green to light green to brown. This can cause mass mortality. In contrast, if the level of alkalinity is optimum – the concentration of bicarbonate (HCO₃⁻) is 80 mg/l to 150 mg/l – the level of carbon dioxide can be maintained during rainy days. Bicarbonate comes from calcium carbonate (CaCO₃) or lime. Bicarbonate gradually releases CO₂ during cloudy days, which is useful for the photosynthesis process by phytoplankton during such a critical period (Figure 12). Also, fish absorb carbonate (CO₃²⁻) to build up bones and scales.

Figure 12. Alkalinity equation for bicarbonate in association with water quality control



- Add some minerals that build bones and scales, especially carbonate through the proper application of lime. It maintains optimum pH level (some alkalinity or a pH of more than 7) for fish health and growth. To maintain the proper level of alkalinity apply lime the day after fish are stocked. Use calcium carbonate or dolomite [$\text{CaMg}(\text{CO}_3)_2$] at the rate of about 30 kg/rai to 50 kg/rai (or 50 kg/rai to 100 kg/rai for ponds with lightly acidic soil) every week depending on the monthly monitoring of the pond water's alkalinity level. Dissolve the lime in water, leave it for 30 minutes to 1 hour and then spread the solution around the pond. Do this in the evening at 8 p.m. This should maintain the pond water's optimum alkalinity level in the form of bicarbonate.
- When water turns light green or brown, use dolomite. Not only does it help to keep a suitable alkalinity level, its component (Mg^{+2}) is also an effective fertilizer for phytoplankton. The result is shown by the water turning from light to dark green. This leads to an increase in natural food in ponds. However, if the water is already dark green, use calcium carbonate instead of dolomite. The magnesium from the dolomite can cause overgrowth in phytoplankton. Overgrowth leads to plankton decline which then results in a high organic load in the water and the depletion of dissolved oxygen.

8. Feed and feeding

Feed quality and feed management are key to a profitable crop because feed cost can occupy 50 percent to 80 percent of the total operating cost. Quality feed contains the correct levels of essential nutrients for fish health and growth. Correct feeding enables the fish to fully benefit from the feed. It also reduces wastage from uneaten feed, which is a waste of money and source of water pollution. The accumulation of uneaten feed, fish excreta and other organic matter that decay on the pond bottom fosters the occurrence and spread of pathogens and reduces the productivity of the fishpond. Some important considerations in feed management are:

- Farmers should feed according to the life stage of the fish. The amount of feed for small fish is 5 percent to 10 percent of body weight and 1 percent to 3 percent of body weight for juvenile or adult fish. If insufficient feed is provided, fish become undernourished. If too much is supplied or given at the wrong time, feed is wasted.
- If disease is noticed in fish, feeding should be reduced to 20 percent to 50 percent for two to three days (or stopped) until the fish recover.
- Farmers should control feeding if there are environmental changes or disturbance in the pond, such as:
 - During water exchange, fish usually suffer from stress. Reduce feed by at least 50 percent or even 100 percent for one to two days.
 - If air temperature is high (above 38°C) and the water temperature is 32°C to 33°C, fish eat a lot because the high temperature increases the rate of metabolism. This leads to an increase in feed consumption and excreta. Too much excreta contributes to deterioration in water quality; oxygen is depleted and toxic compounds such as ammonia and nitrite

are released from the decomposing organic matter. Too much nitrite also gives rise to excessive bloom in phytoplankton, which then decomposes and depletes dissolved oxygen.

- During rainy days, especially in the monsoon season, fish can get stressed from the changes in water quality especially from lack of oxygen and death of phytoplankton. Thus, much of the feed is uneaten and becomes organic waste.
- During the colder months, if water temperature is lower than 2°C, fish will stop eating. As the fish is a cold-blooded animal, its metabolic processes will slow down. Farmers should change the time and rate of feeding, i.e. once a day. Give the feed between 12 p.m. and 3 p.m. when the water temperature is higher.
- Farmers should avoid using manure or food waste as feed supplement because this leads to the growth of blue-green algae. The algae produce compounds such as geosmin and 2-methylisoborneol. When absorbed and accumulated in fish tissues, they impart a muddy smell or unpalatable flavour in fish flesh, resulting in lower farm-gate price received from intermediaries.

9. Fish health management

It is essential for a farmer to know what to do when the health of the stock is at risk from various hazards such as (1) sudden changes in water condition, (2) prolonged periods of high temperature, (3) rainy or overcast days, (4) sudden changes in weather conditions and (5) seasonal changes. Important measures to minimize the risks include:

- **Salt (sodium chloride) application.** Salt is an important source of minerals for maintaining the normal functions of freshwater fish. Sodium chloride ions reduce stress and protect fish from toxic substances such as ammonia and nitrite. The recommended measure is to use salt at 120 kg/rai to 150 kg/rai. Hang bags of large crystal salt with 10 cm to 15 cm of the bags immersed in the water, and place them at fixed points, especially feeding spots. Each point should have around 30 kg to 40 kg of salt (Figure 11). Fish in stressed condition usually swim in these areas. Fish absorb the salt through their gills. Hanging salt regularly promotes fish health.
- **Supplementation of vitamin C in feed.** Vitamin C is a key nutritional requirement for animals. It is necessary for bone and scale formation. It boosts the immune system by activating white blood cells to fight pathogens and other antigens. It reduces stress by reducing the stress hormone, cortisol. Although there is some vitamin C in pond water from the formulated feed and the natural food (phytoplankton), the level of vitamin from these sources may not be sufficient for high density culture. It is recommended to apply vitamin C at 3 g to 5 g/1 kg of feed for five to seven consecutive days before anticipated risk periods.

Mass mortality caused by disease is one of the main problems in tilapia farming. At present, the three major bacterial pathogens in tilapia farming in Thailand are *Aeromonas hydrophila*, *Flavobacterium columnare* and *Streptococcus agalactiae*. These pathogens cause the following diseases:

- *Aeromonas hydrophila*. Clinical signs are bleeding wounds on skin and fins as well as abdominal edema (Figure 13). Internal organs, especially the liver, are pallid and hemorrhagic. The severity of the disease depends on water quality and weather conditions. The disease can occur at any time during the culture period, especially at the start of the rainy season and during seasonal transition from the rainy season to the cold season.

Figure 13. Abdominal edema disease and bleeding wounds caused by *Aeromonas hydrophila*



- *Flavobacterium columnare*. This causes speckled body disease or the so-called ‘columnaris disease’. It usually occurs after transportation (especially in small fish, fry and fingerlings) and after water exchange (in larger fish in earthen ponds). Infected fish swim slowly at the water surface. Their scales flake off and fins are broken resulting in white speckled marks (Figure 14). Their gills are yellow or brown because of the dying or dead tissues. Internal organs, especially the liver, are noticeably pallid.

Figure 14. Columnaris disease caused by *Flavobacterium columnare*



- *Streptococcus agalactiae*. This causes streptococcosis or pop-eye disease. It usually occurs when water temperature is 32°C or warmer, especially in summer months (March to July). It commonly infects large fish (300 g to 800 g) in earthen pond and cage culture systems. Diseased fish display exophthalmia (bulging eyes) and swelling of the fin base. They swim in an erratically corkscrew motion. Their liver, spleen and kidney are pale and enlarged, and intestines are filled with a yellow fluid (Figure 15). They may show severe inflammation in the heart and brain. Infected fish sink to the bottom of the pond. The mortality rate can be 20 percent to 60 percent.

Figure 15. Streptococcosis caused by *Streptococcus agalactiae*



Although some infected fish can still feed regularly, most lose their appetite. Farm management and environmental conditions are linked to diseases. Water quality and feeding management are part of fish health management. An effective and inexpensive preventive measure is to immerse fry or fingerlings in water with formalin at a concentration of 100 ppm before stocking.

Early detection of the onset of disease infection is crucial; it is easier and less expensive to treat the stock before the disease has become widespread and serious. The following early signs of infection should be closely observed:

- noticeable change in the feeding rate of fish;
- some behavioural changes in swimming such as corkscrew motion, slow and lethargic swimming at the water surface;
- physical changes such as colour, abnormal skin, gills, scales, eyes and fins; and
- dead fish floating in the water with an initial mortality rate of 1 percent to 3 percent.

Follow these measures if you notice these signs of infection:

- Reduce feed or stop feeding for about two to three days. This helps to reduce waste in ponds because diseased fish do not usually eat. If farmers do not reduce or stop feeding, waste will accumulate and degrade water quality. Moreover, some pathogens feed on such waste and further multiply, leading to more severe infection. If feeding is reduced or stopped, fish may eat natural feed or some waste at the pond bottom. Additionally, this action will make the fish hungry and resume active feeding.
- Prudent use of antibiotics regarding the types of bacterial infection, timing and dosages. The recommended dose is 3 g to 5 g/1 kg of feed. Dissolve in 200 ml of water. Then, mix the solution with the feed and air-dry the feed for about 30 to 60 minutes. The antibiotic-laced feed can be given to the fish for five to seven consecutive days. After that, stop antibiotic use. Do not use banned antibiotics. Use only the prescribed types for respective diseases.
- Use of chemicals. Normally, farmers use disinfectants such as formalin and benzalkonium chloride or BKC, which they sprinkle on the pond water to control pathogens. However, this action has minimal effect because the concentration is usually weak and inadequate for treatment. Moreover, these chemicals have side-effects such as death of phytoplankton.
- Observe a withdrawal period in the use of drugs and chemicals. Stop using them 7 to 14 days before the scheduled harvest. This period allows the fish to release chemical or antibiotic residues in their tissues making them safe for human consumption.
- After the application of antibiotics or chemicals and the fish have recovered, maintain good water quality and follow proper feeding. Guard against the introduction of pathogens into the farm. These three measures – water quality management, feed management and health management – are mutually reinforcing. The outcomes of practising them are a good harvest of quality fish, lower production cost and greater profit.

10. Harvesting and product handling

Decide on the suitable size of fish for harvest. In Thailand, tilapia grown in ponds are usually harvested when they reach 700 g to 1 000 g. Good harvest practice aims to maintain the quality of the product. Good practices are:

- Stop the use of antibiotics or chemicals 7 to 14 days before harvest.
- About a week or ten days before harvest, provide a vitamin C supplement. Apply 3 g to 5 g of vitamin C/1 kg of feed. Give this fortified feed daily for five to seven days. It will improve fish health and product quality, such as smooth scales and quality of the meat texture.
- Stop feeding three to five days before harvest. This reduces waste.
- In an earthen pond system, try to harvest all the fish at one time and quickly. Drain the water until the water level in the pond is reduced to 80 cm to 100 cm, then use a trawl net with a large surface area to catch as many fish as possible in one pass.

- In harvesting fish with the trawl, the fish usually gather in specific spots in the pond. Keep aerating those spots to reduce stress (Figure 16).

Figure 16. Using the trawl net and aerating the pond during harvest



- For live fish harvest, fill containers for fish transport with clean freshwater. Dissolve salt in the water at 1 kg/m³ of water. Provide oxygen to the water and maintain temperature at approximately 25°C to 26°C. Use some ice together with oil of cloves to keep the temperature level down and to anaesthetize the fish. A suitable total weight of fish in the container is 500 kg/m³ of water. Transport time should not be more than three to six hours (Figure 17). If the farm is remote and roads are not good, protect the container from direct sunlight and warm air by covering it with opaque plastic.

Figure 17. Transporting and grading the fish harvest



- Some fish might die during the harvest. Wash them with freshwater and put them in a container with crushed ice. Cover the container properly. Maintain a sufficient amount of ice until the fish reach the market.
- When only a few fish are left in the pond, drain the water completely and collect the rest of the fish quickly to avoid any muddy smell. If there are still many fish, clean them thoroughly with freshwater to wash away the sludge.

CHAPTER III

FINANCIAL PLANNING FOR TILAPIA FARMING

1. The concept of business management

The main factors of production are land, capital and labour; management is part of labour and technology enhances labour. These are combined to increase yield, reduce cost, increase profitability and assure the long-term financial viability of the business. Occasional risks are part and parcel of the production process. Farmers must face and accept business risks and seek ways to manage them.

Enterprise management has four key functions:

- **Production management.** Producers combine the production factors to deliver goods and services demanded by customers in target markets. They have to know the production process, production capacity, tools and equipment needed as well as capital requirement. An aquaculture farmer needs to understand the nature of the various physical, biological and chemical influences, and their impacts on the growth and health of the crop. Production management, essentially, is keeping the fish alive, healthy and growing well. This requires proper feeding, disease prevention, control or treatment, and maintaining good water quality throughout the day and under any weather or climatic condition.
- **Marketing management.** The core of marketing management is meeting customer demand, which means providing the product at the time it is needed, in a form and quality that is desired and at a price that the customer is willing to pay. It involves anticipating and identifying customer needs, developing products and services to meet those needs, devising a promotional programme, setting a pricing policy and designing a distribution system to deliver products to customers. Farmers have to anticipate what their customers want and have the right products available when the customers are ready to buy them.
- **Human resource management.** Human resource management covers two areas: managing the organization and the finer points of motivating workers to offer and contribute their maximum potential. Decisions include how to organize the farm, where to find workers, how to hire, compensate and motivate them, and how to evaluate their performance. The structure and nature of the organization can be a single proprietary, a partnership, a farmers' association, a cooperative or a corporation. As individual owners, farmers can choose to be independent or under a farming contract awarded by a major agribusiness firm.
- **Financial management.** Farming is usually a commercial, profit-driven activity. A farm business aims to generate the highest possible returns from the farmer's investment. Profit generation needs good financial decisions and careful management of financial resources. Financial management includes providing the data needed to make good decisions, using financial tools to make effective decisions and managing assets, liabilities and the owner's investment in the farm business.

2. Financial record keeping

Financial management requires the interpretation of financial information from a farm record to meet two needs: decision-making and financial reporting. The latter can be reporting the financial performance for the benefit of the owner as well as for lenders, suppliers, government agencies, members of the cooperative or farmers' association, and others who have a legitimate interest in the farm.

Record keeping starts with keeping and recording all the transactions of a business. Transactions are represented in documents including sales slips, receiving tickets, checks, invoices, employee time-cards and bills.

Normally, a farm incurs expenses and earns revenue every day (Table 2). These day-to-day transactions are recorded in a book or computer file called a 'journal'. The journal is the book of original entry. In it, all transactions of the business are recorded in chronological order. The journal thus provides a running account of the day-to-day transactions or activities of the business. In a small business, there may be only one book, or computer file or general journal in which all the transactions are recorded. As the business grows larger, it is necessary to have several specialized journals or computer files for particular areas of the business to record separate categories such as sales, purchases and available cash.

While the journal records the transactions or activities of the business in chronological order, it does not show them in any meaningful form that the manager can interpret. There is still the need for records of details maintained in such a way that the farmer/manager can meaningfully measure the success of the business. These records organize the information into ledger accounts. Maintaining financial information in separate ledger accounts not only makes these data more usable, it also provides information that is easily understood by the manager.

Table 2.
Example of day-to-day transactions recorded in a journal

Date	Item	Detail				Type	
		Quantity		Unit cost	Amount (THB)	Revenue	Expenses
1 May 2019	Buy fingerlings	1 000	fingerlings	3	3 000		X
2 May 2019	Buy manure	10	sacks	35	350		X
:							
5 Nov 2019	First harvest	800	kg	60	48 000	X	
25 Dec 2019	Second harvest	100	kg	50	5 000	X	

3. Financial statements

Financial statements are a summarized statement of the financial status of a business, usually prepared as a summary of accounts from the ledgers. The common financial statements introduced here are: (1) the balance sheet, (2) the income statement, (3) the cash flow statement and (4) the owner's equity statement.¹

3.1 Balance sheet

A balance sheet has three main components: assets, liabilities and owner's equity. Table 3 is an example of balance sheet of a tilapia farmers' group farm, operating with support from the government. Assets as resources or inputs used to generate revenue are listed on the left. The amounts that the business owes to creditors, so-called 'liabilities', are on the right. Legally, the creditors would have the first claim against any of the assets. The value of the assets over and above the farm's liabilities is the owner's claim against the assets, or owner's equity. This is also referred to as 'net worth'. The owner's equity section usually appears just below the liability section on the balance sheet.

Table 3.
Example of a balance sheet

BANTAWAN FARMERS' GROUP BALANCE SHEET			
30 June 2019			
All figures in THB			
Asset		Liability and owner's equity	
Current asset		Liability	
Cash on hand	5 000	Short-term loans	10 000
Cash in banks	45 000	Medium-term loans	200 000
Account receivables	10 000	Total liability	210 000
Inventories		Government support	300 000
Feed	10 000		
Diesel and oil	3 000		
Others	2 000		
Total current asset	75 000		
Fixed asset		Owner's equity	
Land, building, equipment, machine	600 000	Share capital	500 000
Pickup truck	400 000	Retained earnings	175 000
Motorcycle	50 000	Total	675 000
Office equipment	50 000		
Others	10 000		
Total fixed asset	1 110 000		
Total asset	1 185 000	Total liability and equity	1 185 000

¹ The four statements shown in the following tables and the calculation are not based on data from actual farms; the figures serve only to illustrate how the statements are derived.

The balance sheet shows the financial condition of a farm at a specific point in time. It shows that, to produce goods and services, the farm needs this amount of money to invest in various kinds of assets. It also shows the source of financing for the investment. Normally, the first source of capital is the owner's own savings (owner's equity). If it is not sufficient, the business has to find money from other sources such as partners, family members, relatives and friends, merchants, input suppliers or financial institutions (liabilities). Therefore, a balance sheet shows claims over the asset. It is called a 'balance sheet' because the value of the assets is always equal to the claims over the assets, or how the assets are financed.

Assets of a farm are items such as cash on hand, savings accounts, accounts receivable, inventories of raw materials, work in progress and finished products as well as investment in capital goods. The latter includes land, buildings, equipment, tools, trucks, the office and other physical assets.

Assets can be classified according to how quickly they can be converted into cash. Those that can be converted in a short period of time, normally one year or shorter, are called 'current assets'. Those that take a longer time to be converted, i.e. longer than one year, are called 'fixed assets'. Examples of current assets are cash on hand, savings accounts, accounts receivable, and various types of inventories. Fixed assets usually include land, ponds, the storage building, the pickup truck, water and oxygen pumps, and the power generator.

Those who have an interest in the farm business might want to know more about liabilities. For example, the liability burden of the farm and the borrowing terms and conditions. Liabilities are the commitments the farm must honour. The farm has to repay a loan's principal and interest as specified in the contract. If not, a creditor can have a legal claim over the farm's assets, especially those that are used as collateral. The operation may have to stop if key assets used as collateral are foreclosed.

Loans, according to their sources, are formal or informal. Formal sources include financial institutions such as banks and special financial institutions set up by the government. Examples are the Bank of Agriculture and Agricultural Cooperatives and the Government Savings Bank. Formal institutions also include finance companies, agricultural cooperatives and credit unions. Informal sources include family members, relatives, friends, merchants, money lenders and input (usually feed) suppliers.

Liabilities can be classified by repayment periods. Current liabilities are those that the farm has to repay, or is due to repay, within one year. Long-term liabilities are those that have to be repaid in more than one year. Long-term liabilities are typically used to finance the acquisition of fixed assets that have a long life and can be used to generate income over a period of several years.

The difference between total asset and total liability is called 'owner's equity'. It is the amount of money the owner invests in the farm. It is his/her own money therefore the farm is not legally obliged to pay it back. But the owner would get back the invested money when the farm is dissolved or stops operating (or sold in share/stock). However, the owner would get some returns in the form of dividends or increase in the price of share/stock when the farm operates at a profit.

How much capital is needed. There are two components of capital, i.e. investment capital and working capital. Investment capital is used to acquire fixed assets. In the case of a tilapia farm operation, it is the capital used to finance the acquisition of, for example, land, the construction and preparation of fish ponds, buildings, trucks and so forth. The annual expenses of these assets are treated in the form of annual depreciation.

Working capital is the money the farm uses in day-to-day operations. It is spent on various current assets and can be classified into two groups, i.e. fixed expenses and variable expenses. Examples of fixed expenses are wages/salaries of workers and land rent (if any). They do not change with level of production. Variable expenses are, for example, fingerlings, feed and chemicals. They vary with the level of production.

As shown in Table 3, on 30 June 2019 the farm made a total investment of THB 1 185 000. More than 90 percent of the amount (THB 1 110 000) financed the acquisition of fixed assets. THB 600 000 was spent on land, fish pond construction and preparation, the storage building, tools and equipment. The rest of the investment was spent on a pickup truck, motorcycle, office supplies and other hard assets. The farm needed THB 75 000 (7 percent of total investment) to spend on current assets. In other words, the amount of working capital needed as of that date was only THB 75 000. The amount of working capital changes throughout the period of fish production. In some periods, the farmer needs to pay for more inputs including water bills, gasoline and workers' wages so that the working capital will increase during that time.

Sources of capital. The first should be personal capital (savings) or share capital in the case of the Pho Phra farmers' group members. The first source of capital was the owner as it was not possible to use capital from other sources to finance the operation of the business. If the operation was running at a loss, other people would be harmed and not the owner of the business. Moreover, the motivation to run the business profitably can be expected to be strong if the owner uses her/his own money. The equity capital could be the farmer's own savings.

In the example, THB 500 000 of equity capital came from the share capital of the association members (500 shares at THB 1 000/share). The second part of the equity capital was retained earnings. This is the earnings retained by the business, not distributed as dividend to members. The retained earnings was THB 175 000. Adding these two items, the total owner's equity was THB 675 000, which was 57 percent of the total capital.

In addition, the government provided a grant of THB 300 000 to the farm. The business did not have to repay this grant. Altogether the amount of capital raised was still less than the amount needed. The business decided to borrow both medium-term and short-term capital to the amount of THB 210 000 of which only THB 10 000 was a short-term loan. The remainder was a medium-term loan that the farm needed to finance the acquisition of fixed assets.

Interest and principal repayment. There are many schemes to repay outstanding debts. Two common schemes are:

- **Equal amount of principal each year.** Table 4 shows a five-year repayment scheme for the outstanding debt of THB 200 000. The annual interest rate charge was 10 percent. In total, the total interest was THB 60 000. However, the total repayment of principal and interest each year was not equal: a fixed amount of THB 40 000 for the principal and a decreasing amount of interest each year. Interest is treated as an expense and can be deducted before paying the net income tax (if any). The principal repayment, however, cannot be treated as an expense.

Table 4.
Example of a repayment plan of equal amount of principal each year

Year	Principal	10% interest	Total repayment	Outstanding balance
1	40 000	$200\,000 \times 0.1 = 20\,000$	60 000	$200\,000 - 40\,000 = 160\,000$
2	40 000	$160\,000 \times 0.1 = 16\,000$	56 000	$200\,000 - 80\,000 = 120\,000$
3	40 000	$120\,000 \times 0.1 = 12\,000$	52 000	$200\,000 - 120\,000 = 80\,000$
4	40 000	$80\,000 \times 0.1 = 8\,000$	48 000	$200\,000 - 160\,000 = 40\,000$
5	40 000	$40\,000 \times 0.1 = 4\,000$	44 000	
Total	200 000	60 000	260 000	

- **Equal repayment in each period.** Lenders prefer to have borrowers pay equal amounts of total repayment in each period to simplify their own financial plan. This equal total payment could be calculated using a certain formula (not shown in this handbook). Table 5 shows the equal total repayment for the same borrowing terms. In this repayment scheme, the amortization is the same in each period, i.e. THB 52 770. However, the principal and interest repayments in each period are not equal. In other words, the lender is not paid the same amount of principal in each period. The calculation of interest was based on the outstanding balance of principal at the beginning of each period.

Table 5.
Example of a repayment plan of equal payment each year

Year	Principal balance	10% interest	Principal payment	Total repayment
1	200 000	$200\,000 \times 0.1 = 20\,000$	$52\,770 - 20\,000 = 32\,770$	52 770
2	$200\,000 - 32\,770$	$167\,230 \times 0.1 = 16\,723$	$52\,770 - 16\,723 = 36\,047$	52 770
3	$200\,000 - 68\,817$	$131\,183 \times 0.1 = 13\,183$	$52\,770 - 13\,183 = 39\,652$	52 770
4	$200\,000 - 108\,469$	$91\,531 \times 0.1 = 9\,153$	$52\,770 - 9\,153 = 43\,617$	52 770
5	$200\,000 - 152\,014$	$47\,986 \times 0.1 = 4\,799$	$52\,770 - 4\,799 = 4\,791$	52 770

3.2 Income statement

The income statement provides a primary measure of business profitability. It summarizes revenue and expenses during a specific period of time and reports the loss or profit. Table 6 shows an example of the income statement of a tilapia farm.

In the case of investment on fixed assets, the entire expenditure on buying assets is not treated as expense in that accounting period. This is because fixed assets have long useful lives, i.e. more than one year, therefore the expenditure should be allocated (pro-rated) over their useful years not in the year of purchase. Depreciation is used to approximate the reduction in value every year as a result of using an asset. For example, the farm spends THB 1 000 000 to buy a pickup truck and it can last ten years. At the end of the tenth year, if its salvage value is assumed to be zero, the depreciation is then THB 100 000 a year. In the preparation of an income statement, this depreciation is treated as an expense in one accounting period. In other words, the depreciation is the expense of using the truck in a year. Thus, the earnings before interest and taxes would be reduced by the amount of depreciation. This also reduces the net value of the fixed asset by the same amount.

There may be instances when the farm is unable to use all the raw materials that have been purchased at the end of the accounting period (such as the end of the year). Only the portion that is used in the accounting period is counted as expense. The remaining portion is counted as an inventory item in the balance sheet.

3.3 Cash flow statement

A cash flow statement shows cash coming in (inflows) and cash going out (outflows) of the business during a certain period. It is usually prepared at the end of that period and summarized to let the manager and those with interest in the business know the cash balance of the farm during that particular period. However, it is more helpful to prepare expected cash flow in the initial period. This is normally called a 'cash budget'. The farm prepares the projected or expected cash inflows and outflows for any certain period such as next week, next month, next quarter and so forth. The farmer uses the information from the cash budget to manage the cash flows appropriately and support the growth of the business.

One important feature of the cash flow statement is that, in any given period, total cash inflows must equal total cash outflows – it should always be balanced. Cash flows of the business can be categorized as cash flows from operations, cash flows from investment activities and cash flows from financing activities (Table 7).

Table 6.
Example of an income statement

**BANTAWAN FARMERS' GROUP
INCOME STATEMENT**

30 June 2019
All figures in THB

Income		
Income from sale of tilapia products		576 000
Other income		0
Total (1)		576 000
Variable cost		
Pond preparation	5 000	
Water (buy and pump)	2 000	
Water preparation	2 000	
Fingerlings	80 000	
Feed	150 000	
Medicines	10 000	
Wage	3 000	
Electricity	1 200	
Fuel	40 000	
Lubricant	5 000	
Machine repair and maintenance	3 000	
Harvesting expenses	10 000	
Processing	0	
Expenditure on sales operation	3 000	
Office expenses	60 000	
Interest (short-term)	1 200	
Total (2)		375 400
Fixed cost		
Salary	12 000	
Depreciation of equipment	40 000	
Land rent	5 000	
Depreciation of ponds	1 500	
Farm land and property taxes	150	
Interest (medium-term)	600	
Interest (long-term)	10 000	
Total (3)		69 250
Total cost (4) = (2) + (3)		444 650
Net profit before tax (5) = (1) – (4)		131 350
Income tax (6)		0
Net profit after tax (7) = (6) – (5)		131 350

Table 7.
Example of a cash flow statement

CHAIYA FARM	
CASH FLOW STATEMENT	
For the year ended 31 December 2019	
All figures in THB	
Cash flow from operational activities	
Net profit	983 250
Depreciation	1 450 000
Increase in account receivables	(100 000)
Decrease in account payable	(75 000)
Decrease in advance expenditure	(75 000)
Net cash flow from operational activities	2 183 250
Cash flow from investment activities	
Cash from sale of old equipment	50 000
Expenditure on new equipment	(1 683 250)
Net cash flow from investment activities	(1 633 250)
Cash flow from financial activities	
New short-term loans	225 000
Payment of long-term debt	(375 000)
Net cash flow from financial activities	(150 000)
Net cash flow	400 000
Cash on hand in the beginning of period	475 000
Cash on hand in the end of period	875 000

3.4 Owner's equity statement

The statement of owner's equity is the shortest and least complicated of the financial statements. It details the changes that affect the owner's equity accounts. The primary change is the change in retained earnings, resulting from a net income or loss. Other changes could occur due to contributions made to or withdrawn from the owner's invested capital such as the contribution to various community activities, the contribution to a learning centre and other similar items. Table 8 gives an example of an owners' equity statement.

Each of the financial statements discussed provides a way to report historical accounting information. Historical information provides information needed to analyse past financial performance, but it does not provide the information needed to assess future plans that involve many uncertainties. To provide such information, financial statements can be prepared for a future period under different scenarios of technology, political, economic, market competition and farm conditions. Such statements are called 'pro-forma statements'. The preparation of these statements is complicated and the procedures are not provided in this handbook.

Table 8.
Example of owner's equity statement

BANNA FARMERS' GROUP		
OWNER'S EQUITY STATEMENT		
For the year ended 31 December 2019		
All figures in THB		
Owner's equity (31 December 2018)		17 825 000
Cumulative profit (31 December 2018)	8 400 000	
Net profit of account year 2019	983 250	
Dividend	(480 000)	
Expenditure on community activities	(120 000)	
Increase (decrease) in cumulative profit	383 250	
Cumulative profit (31 December 2019)		8 783 250
Capital stock (31 December 2018)	9 425 000	
Increase in capital	0	
Decrease in capital	(0)	
Increase (decrease) in capital stock	0	
Capital stock (31 December 2019)		9 425 000
Owner's equity (31 December 2019)		18 208 250

4. The use of financial statements in evaluating performance

Ratio analysis is the principal tool used to analyse past performance. Ratio analysis permits relative comparisons of important financial data. Making a conclusion as to whether the past performance is good or not can be arrived at by comparing the farm's performance with others. They can be the farm's competitors or the best farm in the area. Or based on historical trends, of the farm itself. Or with the expectations of the owner and shareholders. The principle is to compare the farm's performance against some reference points. However, the interpretation of the comparison is subjective. Different people can interpret the result differently.

Agribusiness managers can use ratios to monitor financial positions and performances. Five areas are normally explored when financial ratios are used to analyse a farm. These are: (1) profitability ratios, (2) liquidity ratios, (3) solvency ratios, (4) efficiency ratios and (5) break-even points.

This handbook describes only some of the important indicators. The analysis is based on the figures given in Table 3 and Table 6.

4.1 Profitability ratios

Profitability ratios include indicators that the farm manager or owner or shareholders would like to know first, before other indicators. The indicators in this group are:

Earnings on sales ratio. This ratio shows how much net profit is earned from selling one baht of products. This ratio focuses on management decisions that affect operating efficiency and pricing policies. It reflects the decisions on sales and sales projection, pricing of products, procurements and administrative expenses. The formula is:

$$\begin{aligned}\text{Earnings on sales} &= \text{Net profit} \div \text{sales} \\ &= 131\,350 \div 576\,000 = 0.228\end{aligned}$$

Return on equity ratio. This ratio gives the investor's point of view of the farm. The ratio informs that one baht of her own money invested in the farm gives the owner 0.195 baht net return over a one-year period. In other words, the rate of return for her own money is 19.5 percent.

$$\begin{aligned}\text{Return on equity} &= \text{Net profit} \div \text{owner's equity} \\ &= 131\,350 \div 675\,000 = 0.195\end{aligned}$$

Return on investment ratio. This ratio informs that from one baht of the total amount of money invested (equity capital and borrowed capital), the farm can generate 0.111 baht net return over one year; the rate of return on total investment is 11.1 percent. This rate of return should be greater than the interest rate paid on borrowed funds. If it is greater, the excess is added to the return on equity, which increases the rate of return on equity. Otherwise, the rate of return on equity will diminish.

$$\begin{aligned}\text{Return on investment} &= \text{Net profit} \div \text{total assets} \\ &= 131\,350 \div 1\,185\,000 = 0.111\end{aligned}$$

4.2 Liquidity ratios

This is another group of indicators of interest to the farm owners and shareholders. The ratio shows the ability of a farm to meet its financial obligations when they become due. It informs whether the farm has sufficient cash or the ability to liquidate assets into cash when its financial obligations become due. The indicators in this group comprise:

Net working capital. This ratio tells whether the farm – for whatever reason – can or cannot repay all its outstanding short-term debts immediately. The question is whether or not the farm has sufficient cash on hand and other current assets that can be converted into cash quickly. In this example, the farm has a very high net working capital (relative to outstanding current liabilities). Had the creditors asked the farm to repay all its short-term outstanding debt, the

farm would be able to do so without difficulty. Actually, the farm still has THB 65 000 left after paying all short-term debts.

$$\begin{aligned}\text{Net working capital} &= \text{Current assets} - \text{current liabilities} \\ &= 75\,000 - 10\,000 = 65\,000\end{aligned}$$

Current ratio. This ratio is a derivative of the ratio given above. This indicator is shown in the form of the ratio of current assets to current liabilities. The ratio tells how much the farm has in current assets when compared to one baht of current liabilities. In this example, given that the current liabilities is one baht, the farm has as high as THB 7.5 of current assets.

$$\begin{aligned}\text{Current ratio} &= \text{Current assets} \div \text{current liabilities} \\ &= 75\,000 \div 10\,000 = 7.5\end{aligned}$$

Quick ratio. Creditors often warn that there are some inventory items that cannot be easily converted into cash. Or they can be converted into cash but the amount is much lower than their true market value. In this case, the quick ratio has been introduced as a new measure of liquidity. This example shows that the farm's liquidity is very high, 6 percent greater than the value of current liabilities.

$$\begin{aligned}\text{Quick ratio} &= (\text{Current assets} - \text{inventories}) \div \text{current liabilities} \\ &= (75\,000 - 15\,000) \div 10\,000 = 6.0\end{aligned}$$

4.3 Solvency ratios

This set of indicators shows whether or not the farm has a very high level of debts. It makes the owner, shareholders and creditors feel relaxed. Or worried! If unexpected negative situations occur, the farm would still be able to pay its outstanding debts. The farm would not be forced legally to shut down its operation. The solvency indicators are:

Debt-equity ratio. This ratio tells whether, to operate, the farm uses equity capital greater or less than debt capital. In other words, it shows that if the farm were to shut down, the owner could or could not repay all outstanding debts. In this example, total liabilities are only 31.1 percent of its equity. Or, if the equity of the farm is THB 1.00, the total amount of liabilities is only THB 0.311.

$$\begin{aligned}\text{Debt-equity ratio} &= \text{Total liabilities} \div \text{owner's equity} \\ &= 210\,000 \div 675\,000 = 0.311\end{aligned}$$

Equity-assets ratio. This ratio tells how much of the farm's total investment is financed by equity capital. In this example, the ratio shows that 57 percent of the investment in all assets is financed by the owner's equity. The rest is financed from other sources i.e. debts and government support. When the ratio is greater than 50 percent, financial solvency of the farm is high.

$$\begin{aligned}\text{Equity-assets ratio} &= \text{Owner's equity} \div \text{total assets} \\ &= 675\,000 \div 1\,185\,000 = 0.569\end{aligned}$$

Debt-assets ratio. This ratio tells how much of the total investment is financed by borrowed capital. In this case, only 17.7 percent of the total investment in assets is financed by borrowed capital. When the ratio is less than 50 percent, the farm's financial solvency is high.

$$\begin{aligned}\text{Debt-assets ratio} &= \text{Total liabilities} \div \text{total assets} \\ &= 2\,100\,000 \div 1\,185\,000 = 0.177\end{aligned}$$

4.4 Efficiency ratios

This group of indicators shows whether the farm has used its assets efficiently. It comprises the following ratios:

Total assets turnover ratio. This tells when the farm makes an investment of THB 100 in total assets, how much net sales can be generated from the investment. In this example, the farm can generate THB 0.486 of net sales from an investment of THB 1.00 in total assets. This ratio alone cannot indicate whether the figure is good or bad. It has to be compared with a reference point. Each type of farm has a different standard. The value for a fish farm differs from that of a shrimp farm. Even in fish culture, the figure for a tilapia farm should be compared with other tilapia farms; it cannot be compared with a seabass farm.

$$\begin{aligned}\text{Total assets turnover ratio} &= \text{Net sales} \div \text{total assets} \\ &= 576\,000 \div 1\,185\,000 = 0.486\end{aligned}$$

Fixed assets turnover. This indicator determines the level of technology used in production. When the farm makes a huge investment in a new technology that uses less labour (capital-intensive technology), it will have very high fixed costs and low variable cost per unit of output. This type of investment has a very high risk compared to a farm that uses labour-intensive technology, i.e. low fixed costs and high variable cost. At a certain level of production, the farm can have very high profit or very high loss. In this example, the farm has invested THB 1.927 in fixed assets to generate THB 1.00 of net sales. Similar to the ratio given above, it cannot be concluded that the level is too high or too low. The figure should be compared with other tilapia farms.

$$\begin{aligned}\text{Fixed assets turnover ratio} &= \text{Fixed assets} \div \text{net sales} \\ &= 1\,110\,000 \div 576\,000 = 1.927\end{aligned}$$

4.5 Break-even analysis

The analysis attempts to find out at what level of production revenue from sales will be equal to total production cost. Or at any given level of expected selling price, what level of production revenue will equal total production cost. It gives the minimum level of production the farm should have in order to break even. Or the minimum level of price the farm should sell at in order to break even. Table 9 provides actual data from a tilapia farmers' group in Phanthong District, Chonburi Province.

Table 9.
Example of a profit and loss statement

BANGHAK AQUACULTURE GROUP		
PROFIT AND LOSS STATEMENT		
31 December 2019		
Fixed cost (THB/rai)		687.06
Land rent	399.54	
Depreciation of ponds	143.20	
Depreciation of equipment	144.32	
Variable cost (THB/rai)		36 533.60
Fingerlings	6 833.33	
Feed	20 776.27	
Fuel	6 164.00	
Harvest cost	2 760.00	
Total cost (THB/rai)		37 220.66
Stocking rate (fingerlings/rai)		1 360.00
Size of fingerlings (g)		100.00
Average output (kg/rai)		1 000.00
Size of output (g)		1 000.00
Average output price at farm (THB/kg)		48.00
Total income (THB/rai)		48 000.00
Total cost (THB/rai)		37 220.66
Profit (THB/rai)		10 779.34
Total cost (THB/kg)		37.22
Profit (THB/kg)		10.78

The format of the income statement in Table 6 is slightly different from this profit and loss statement. The expenses section has been regrouped into fixed and variable expenses. Fixed expenses are those that do not change with level of production, variable expenses are those that change with level of production. The adjustment provides another dimension of analysis as shown hereunder:

Fixed cost breakeven. This indicator gives the level of production that will cover all fixed costs. The calculation below shows that the farm has to produce at least 60 kg tilapia/rai. The break-even level is very low because the farm has a very small investment in fixed costs.

$$\begin{aligned}\text{Fixed cost breakeven} &= \text{Total fixed cost/rai} \div [\text{output price} - (\text{total variable cost} \div \text{kg})] \\ &= 687.06 \div [48 - (36\,533.60 \div 1\,000)] = 60\end{aligned}$$

Variable cost breakeven. This calculates the level of production the farm should have in order to recover all its variable costs. The calculation below shows that the farm should produce at least 761 kg of tilapia to recover its variable costs.

$$\begin{aligned}\text{Variable cost breakeven} &= \text{Total variable cost/rai} \div \text{output price} \\ &= 36\,533.60 \div 48 = 761\end{aligned}$$

Total cost breakeven. This indicates the level of sales the farm will need to recover all its fixed and variable costs. The level of production that will recover all fixed and variable costs is 775 kg. This level will generate profit for the farm.

$$\begin{aligned}\text{Total cost breakeven} &= \text{Total cost/rai} \div \text{output price} \\ &= 37\,220.66 \div 48 = 775\end{aligned}$$

Price-variable cost breakeven. This indicates the minimum level of price the farm should sell at to recover all its variable costs. Given a yield of 1 000 kg, the farm should sell at the price of THB 37.00/kg to recover all variable costs. At prices below this level, the farm would run at a loss and not have enough revenue to cover some of the variable costs and all the fixed costs.

$$\begin{aligned}\text{Price-variable cost breakeven} &= \text{Total variable cost/rai} \div \text{yield/rai} \\ &= 36\,533.60/1\,000 = 37\end{aligned}$$

Price-total cost breakeven. This indicates the minimum level of price the farm should sell to recover all its total cost (all variable and fixed costs). To recover all its total cost, the minimum price level the farm should sell its tilapia at is THB 37.22. Any price above this level would generate profit for the farm.

$$\begin{aligned}\text{Price-total cost breakeven} &= \text{Total cost/rai} \div \text{yield/rai} \\ &= 37\,220.66/1\,000 = 37.22\end{aligned}$$

CHAPTER IV

DEVELOPMENT OF TILAPIA PRODUCTS TO MEET QUALITY STANDARDS

1. Standards for quality tilapia products

Quality and safety are major criteria in consumer decision-making when purchasing food. The National Bureau of Agricultural Commodity and Food Standards (NBACFS) and the Department of Fisheries (DOF) are core agencies that have developed agriculture- and aquaculture-related standards to ensure that the products are safe for human consumption and comply with trade standards. This section summarizes standards to ensure the safety and quality of tilapia products. The standards encompass good aquaculture practices for tilapia farms, hygiene for postharvest handling and transportation, and tilapia product quality and safety.

1.1 Good aquaculture practice standards

Good aquaculture practice (GAP) is a voluntary standard. The major requirements of the GAP standard under the Thai Agricultural Standard – TAS 7405 (2010): Good Aquaculture Practices for Tilapia Farms – are:

- **Farm site**
 - The farm shall be registered with the DOF.
- **General management**
 - Effluent disposal shall comply with relevant laws and regulations.
- **Fry**
 - Healthy and non-infectious fry shall be used.
 - Fry origin records are available.
- **Feed**
 - Formulated feed, feed supplement and other ingredients registered with the official authority (if such inputs are subject to registration) and the valid date of expiration shall be used.
 - If feed is prepared on the farm, feed ingredients shall be free from veterinary drugs and legally prohibited substances.
 - Any other inputs shall be free from contamination according to national laws and regulations.
- **Health management**
 - If tilapia become sick and veterinary drugs or chemical treatment are necessary, only registered veterinary drugs or chemicals shall be used, and the instructions on labels shall be strictly followed.

- Prohibited veterinary drugs and chemicals shall not be used.
- In the event of disease outbreak, the farmer shall immediately inform the official authority and appropriately manage carcass disposal and water discharge.
- **Farm sanitation**
 - Household discharge shall be separated from the culture pond.
 - Toilets shall be hygienically designed in a separate area to prevent sewage contamination in the culture pond.
 - A sanitary system for waste disposal from the farm (e.g. dead fish) shall be available.
- **Harvest and postharvest handling**
 - Movement records are available.
 - On inspection, veterinary drugs or chemical residues shall not be found or exceed the maximum residue limits in the cultured fish.

Good farm records at all stages of production facilitate inspection and farm certification processes.

1.2 Hygiene standards for postharvest handling and transportation

Postharvest handling and transportation of tilapia shall be carried out in a hygienic manner to ensure consumer safety and fish quality. Handling practices shall comply with TAS 9023: Code of Practice for General Principles of Food Hygiene and TAS 7410: Code of Practice for Fish and Fishery Products – Part One on General Requirements. The main requirements for handling during harvest and transportation of farmed tilapia are:

- **Operation area**
 - This must be clean. There must be no evidence of solid waste, filth, leftovers or wastewater.
- **Materials, utensils, containers, tools and equipment**
 - Surfaces must be smooth, without cracks and easy to clean; they must be water-resistant with no traces of rust.
 - They must be designed for easy use and cleaning.
 - Equipment must be cleaned and sterilized regularly.
 - After cleaning, materials, tools and equipment should be stored appropriately to avoid contamination.
 - Containers should have drainage outlets and should be strong enough to be stacked in several layers.

- **Workers**
 - Personnel must be in good health and without any open wounds.
 - Personnel must undergo annual health check-ups, both for contagious and gastrointestinal diseases.
 - Personnel should attend hygiene and good practice seminars or training regularly.
 - Personnel must wash their hands before and after working and also after using the toilet.
 - Personnel uniforms must be clean, with headgear, waterproof aprons and boots; gloves must be clean, water-resistant and not torn; wearing of accessories is not permitted.
 - Personnel must not eat or smoke while working.
 - Personnel must not cough on the products.

- **Water and ice**
 - Water must be fresh and clean; ice must be produced from clean water.
 - Containers must be in good condition, clean, hygienic, easy to clean and without any traces of rust.
 - Ice transportation must be hygienic.

- **Management and treatment of fish during and after harvest**
 - Fish should be supplied with enough oxygen to keep them alive.
 - Clean the fish immediately after harvest and do the grading quickly.
 - Lower the temperature of the container holding the fish to nearly 0°C
 - Record the origin of the harvest.

- **Hygienic control during transportation**
 - Transport the fish quickly and keep them fresh.
 - Containers and transport vehicles must be clean, hygienic, suitable for the type of fish being transported and, if possible, refrigerated.
 - Care must be taken in transport preparation and procedures; protect products from insects, animal and pathogens that can cause contamination.

1.3 Product quality and safety standards

Thailand has been upgrading the quality and safety of tilapia products to gain higher recognition among domestic consumers and from export markets. This section summarizes the main requirements for live, fresh, chilled and frozen tilapia products under the TAS 7001 (2013) standard.

- **Quality**
 - Fresh whole tilapia shall have complete organs, deep-red gills, naturally glossy scales and no obvious defects, such as abnormalities, body wounds, broken bellies or bruises generated during harvesting and transportation.
 - The fish shall be free of parasites and any signs of infection or disease found by visual inspection.
 - The fish shall be clean and free of foreign matter found by visual inspection.
 - The fish shall be free of alien flavour and odour such as that of mud or grass.
- **Packaging and packing**
 - The package shall be made of water-resistant material, clean, hygienic and free of any smell and alien material. It should be durable for transportation and able to maintain temperature and product quality for consumer safety.
 - Products shall be packed in proper packaging according to their types, styles and sizes. Content size should conform with package size.
 - Live tilapia shall be housed with necessary equipment such as aerators and water filters.
 - Fresh chilled or frozen tilapia shall be packed in the facility with no change in the products' temperature.
 - If ice is used, ice shall be produced from clean water and not reused.
- **Labelling and marking for consumer packages**
 - The name of the produce (black tilapia [*pla nil dum*]), red tilapia [*pla nil daeng* or *pla tubtim*]), types and styles of product (live, fresh, chilled or frozen tilapia) shall be specified.
 - Size code and net weight shall be specified using the metric system.
 - If any food additive is used, indicate its name and functional class in compliance with relevant laws and regulations.
 - Indicate the name and address of the producer, exporter, re-packer and/or distributor.
 - Indicate country of origin, produce lot or code number, day/month/year of production and/or a statement of best before day/month/year.
 - Indicate storage means and/or temperature to preserve tilapia for safe consumption as well as freshness during transportation, storage and distribution.

- The label of the produce for the domestic market shall be in Thai. If a foreign language is added, translation shall be consistent with the Thai version. Product labelling for export shall accord with the requirements of the trading country.
- **Labelling and marking for non-retail containers**
 - Indicate the address of the wholesaler, packer and/or lot number.
 - Specify the name of the produce, type and style of the product.
 - Source of produce: Indicate the province, source and/or farm's location, dates of harvest and transportation as well as transportation method.
 - Commercial information: Indicate size code and/or net weight in the metric system.
 - If any food additive is used, indicate its name and functional class in compliance with relevant laws and regulations.
- **Food additives, contaminants and veterinary drug residuals**
 - Use of food additives, maximum levels of contaminants and maximum limits for veterinary drug residues shall comply with relevant laws and regulations and/or standards.

2. Development of tilapia products and distribution channels

2.1 Product development

Tilapia have very high potential to be processed into multiple product forms. Most processed products are traditional ready-to-eat forms such as grilled tilapia, pickled tilapia and dried tilapia to cater to local consumers in the locality and nearby areas. Processing of these products creates employment for local people. More jobs and income could be generated if the variety of processed products is increased.

In this context, the Fishery Technological Development Division (FTDD) of the DOF conducted research on product development. The fields of study included: (1) how to manage fish after harvest until delivery to consumers, (2) developing new aquatic animal products including packaging technology and product development, (3) innovative use of aquatic animals as well as by-products to increase more value added and (4) develop tools, practices and processes to be applied in aquatic animal manufacturing.

The division provides technical support and extension service to maintain or improve standards of firms involved in assembling, handling, primary processing and manufacture of aquatic products.

The DOF acknowledges the importance of processing to increase value added and has a programme for value addition of tilapia products that supports a network of small and medium enterprises in many provinces in small-scale primary processing of aquatic animal products. Technologies, innovations and research results are applied for value addition, product and brand design and packaging. The programme takes into account such factors as local wisdom, availability of raw materials and consumer demand. Some examples of successful products

include local tilapia sausage, normal tilapia sausage, fried tilapia with herbs, one day sun-dried tilapia, tilapia cookies, ground tilapia and pounded tilapia. They are now sold in supermarkets, including high-end markets.

2.2 Market channels for tilapia products

The DOF reported that in 2018 Thailand produced around 216 600 tonnes of farmed tilapia, 86 percent of which came from pond culture. In the same year, the country exported about 11 000 tonnes of tilapia valued at around THB 400 million. The main exports were whole fish frozen, chilled and fillet products. The major markets were the United States of America, the Near East and the European Union. However, domestic consumption remains the major source of demand for tilapia products (Figure 18), which can be classified into three levels:

- **Community markets.** Most products may or may not have brands or labels. Examples are grilled tilapia, pickled tilapia, dried tilapia and tilapia sticks.
- **Modern trade markets.** Products must have safety certificates to assure consumers of product safety. Products must have brands and labels, including source of origin (traceability information). Most products sold in this market are fresh and frozen tilapia with appropriate packaging, and ready-to-eat products such as one day sun-dried tilapia, tilapia sausage, local tilapia sausage and pounded tilapia.
- **High-end markets.** Customers with high purchasing power who usually prefer premium and high-quality products. Price is their secondary consideration. Thus, tilapia products sold in this market must be perceived as out of the ordinary, preferably presented with an interesting history, assurance of nutritive quality and a list of nutritional contents; also features that attract the attention of buyers. Examples are tilapia cookies and tilapia red curry on rice.

Figure 18. Examples of tilapia products



3. Hygiene standard guidelines for tilapia processing facilities

The product development of tilapia should strictly follow quality standard practices. This section highlights hygiene guidelines developed by the FTDD as minimum requirements for local processing, primary processing and manufacturing facilities.

3.1 Local fish-processing facilities

- **Location.** They must be at a remote distance from contaminated sites. Processing buildings should have appropriate space and be separate from residential areas.
- **Tools, equipment and materials.** They should be made from materials that are water-resistant, rust-free and easy to clean.
- **Production requirements.** Raw materials must be fresh and clean. Use food standard ingredients. Containers must be clean and kept in closed areas with no dust. In addition, production processes must follow technical manuals strictly. Production statistics must be recorded regularly.
- **Sanitary requirements.** Water used in processing must have the same quality as drinking water. Hand-washing sinks should be installed in front of production rooms and toilets in sufficient quantity for the complement of workers. There must be efficient solid waste disposal and wastewater drainage systems.
- **Buildings, tools, equipment and surrounding areas.** They must be well maintained and regularly cleaned.
- **Workers.** Personnel must be in good health and attend seminars or training on hygiene and sanitization.

3.2 Primary processing facilities

- **Location.** They must be at a remote distance from contaminated sites. Processing buildings should have appropriate structure and design and have separate closets for workers' belongings. Surrounding areas must be clean and have an efficient wastewater management system.
- **Production units.** They must be separate from residential buildings. There should be separate rooms to store raw materials and finished products. Building floors must be of strong material, smooth but with non-slip surfaces, clean, free of water slick, and have a good drainage system. Walls and ceilings should be made from easy to clean material. Light should be adequate and light bulbs covered. Good air ventilation is required.
- **Tools and equipment.** These must have smooth surfaces, be easy to clean, water-resistant and free from rust. They must have reasonably useful lives. Cleaned tools and equipment should be kept in appropriate areas. A regular cleaning schedule is essential.
- **Workers.** Personnel must be in good health and attend training or seminars on hygiene and sanitization.

- **Production process.** During the production process, raw materials must be sequenced clearly, have details of origin, be of good quality and refrigerated appropriately. A production process that requires boiling must undergo random but regular checks for micro-organisms and physical defects and chemical contamination.
- **Finished products.** These must be stored separately from the production site.
- **Water.** Water used in processing must have the same quality as drinking water and be free of foreign materials.
- **Ice.** This must be of the same quality as ice for human consumption and free of foreign materials. Ice containers must be clean, hygienic and regularly checked for micro-organisms.
- **Hand-washing sinks.** These must be clean and function properly. Install enough sinks for workers to use.
- **Toilets.** These must be clean and well-maintained and in sufficient quantity for the workers in the factory. The faucets should have a sensor system (to avoid using hands). Waste management must be efficient and hygienic.
- **Chemical substances.** These must be legally certified and stored properly with clear labels. Cleansing and toxic chemicals must be kept separately from processing chemicals.
- **Pest control.** The factory should have a regular schedule to check for and eradicate rats, insects and other pests.
- **Tools for cleansing.** They should be made from material that is water-resistant and in sufficient number. Storage rooms should be separate and clean. Cleansing and septic liquid must be approved for use in food-processing facilities.
- **Solid waste and leftovers.** Raw materials should be managed appropriately and removed from the production area regularly. Waste bins should be made of easy-to-clean material. Waste storage areas must be separate from production areas, kept clean and hygienic.
- **Production control.** The factory should have sufficient supervisors to manage and control production quality throughout the entire production line. They should be highly knowledgeable about the hygienic and quality control aspects of food processing.
- **Quality control.** Different types of raw materials require different hygienic and product safety control.

3.3 Manufacturing facilities

- **Structure and design.** The site and surrounding areas must be swamp-free. The cleaning system must be efficient to avoid contamination in the production site and surrounding areas. Areas for different activities should be properly allocated. Floors, walls and ceilings should be of strong material and easy to clean. The facility must have a good water drainage system and be well illuminated and ventilated.
- **Materials, tools and equipment.** These must have smooth surfaces, be easy to clean, water-resistant and free from rust with appropriate design. Tools must be cleaned before they are stowed away. Measuring equipment and tools must be carefully maintained and regularly checked for accuracy. Solid waste containers should be made of stainless steel or strong aluminium and easy to clean.
- **Chemical substances.** All chemical substances must be legally approved for use in the production of food.
- **Packaging materials.** These must be safe and have capacity to maintain quality and protect products from contamination.
- **Cleaning and hygiene.** The facility must have a good and efficient cleaning system that protects it from insects, rodents and other pests; a hygienic solid waste management system and a good wastewater drainage system are essential.
- **Regulations.** Regulations concerning water, ice, hand washing, feet cleaning, aprons, gloves, boots, changing rooms, storage chests, tool cleaning areas, canteens and toilets must be followed.
- **Workers.** Personnel must be free from contagious diseases, gastrointestinal diseases and undergo an annual medical check-up. They must wear proper clothes in the processing plant and attend seminars and training on food safety standards.
- **Production control.** Regulations on production control concerning raw materials, mixing formulas, cleanliness, quality, production lines, separate storage of raw materials and finished products, temperature control and quality testing by a laboratory equipped with proper instrumentation must be adhered to.

CHAPTER V

BUSINESS PLAN TO ACHIEVE MUTUAL GOALS WITH PARTNERS ALONG THE VALUE CHAIN

1. The importance of developing a business plan

In a market system where businesses operate competitively, a business enterprise needs to consider both internal and external factors in the preparation of its business plan. This makes it aware of the positive and negative influences on the business, which inform its strategies and operations. There are three purposes of a business plan:

- It serves as a roadmap for business operations to achieve desired goals. It comprises business goals, missions, objectives, target markets, business strategies, budgets and expected financial results. The plan will include a strategic plan and an annual plan of operation.
- It shows the actual performance and the potentials of the business. It provides useful information for business partners to consider collaboration with the business.
- It is a tool to raise funds. Investors and creditors will use it to assess the risks to and returns from the business.

2. Components of a business plan

A business plan must be inclusive and in line with the goals and missions of the business. The components of a business plan are outlined in Table 10.

Table 10.
Components of a business plan

Component	Content and purpose
1. Executive summary	Describes briefly and clearly details the business plan in simple, precise and concise language. It should motivate and create trust among readers.
2. General company description and business ideas	Basic information such as products, target markets and customers, site, facilities and equipment, organizational structure, management team, business concept, objectives of the business, and contributions to society.
3. SWOT analysis	Analysis of the business environment including market analysis, consumer behaviour, target markets, opportunities, threats to the business, strengths and weaknesses. The analysis informs the formulation of a long-term strategic plan for the business.
4. Marketing plan	Includes analysis of potential consumers in the target market/s and a marketing strategy.
5. Product and service development plan	Explains production processes; specifies the inputs, processes and outputs. Outputs include both products and services. Also describes quality control activities, management of inventories and other internal procedures.
6. Management plan	Describes the management team, organizational structure, business partners and milestone schedules, i.e. targets and time frames for achieving each target.

Table 10. (continued)

Component	Content and purpose
7. Risk and risk management plan	Shows the result of risk analysis and explains the strategies to mitigate each potential risk or groups of risks.
8. Financial plan	Financial assumptions, financial estimation for (usually) a five-year period. Expected financial results shown in standard financial reports such as balance sheets, income statements, cash-flow statements and break-even analysis.
9. Appendix	Additional information to help readers gain a better understanding of the business such as photographs of products, factories, office, product certificates, market research reports, trademarks, awards and other relevant information.

3. Developing a business plan

The steps in developing the plan are shown in Figure 19. The first step is proposing business ideas. The firm needs to conduct market research that would also indicate financial feasibility. The next step is to develop the business plan. The plan should indicate clearly the direction of the business operation, lay down clear and practical key performance indicators (KPIs) and ways to motivate and gain trust from partners. A business plan normally goes through several revisions before it is implemented and evaluated. If the business plan is rushed and haphazard, partners will doubt its credibility making it difficult to convince prospective investors and financial institutions to invest or extend credit. Many businesses fail because of a poorly formulated business plan.

Figure 19. Framework of business plan formulation



3.1 Business ideas

To reiterate, the drafting of a business plan starts with a business idea or ideas. The idea may come from research or from the evaluation of the business environment and prospects or from decisions of senior executives. The basic principle is that those who are developing the business plan have to first review and assess the business idea(s). In doing so, they need to consider these four features of a business concept:

- An understanding of target customers, their attitudes and values (because the business plan must lead to the satisfaction of customers’ needs and the achievement of business goals). The goals can be both business and social.
- The target market(s) is substantial or large enough in terms of the number of customers, volume of business, availability of products to be sold and level of competition.
- The innovations that the business can offer, i.e. new products or services, or both.
- Managerial skills and the availability of resources needed under the business plan.

3.2 Formulating a business plan

A business plan is a roadmap; it shows how the business will operate to achieve its goals within a specified time frame. A good business plan provides clear and workable details of how the business should operate, including strategies to manage risks. A good business plan should have the following properties:

- It clearly describes business ideas and concepts and has clear objectives and KPIs such as increase in sales, reduction in costs and increase in net income of, say, farmer members).
- It covers important matters that would persuade readers to agree to the plan. It describes the practical aspects of the business operations – personnel, business opportunities, production processes, capital requirement and sources, target markets, risk management and other relevant factors.
- It uses simple, precise and concise language. It can describe the importance of the business proposal and shows a strong intent to achieve the goals. The business plan should not be overlong.
- It should explain the functional relations of all the parts. It must be credible; the data used in the preparation should come from reliable sources, for example, from a market research analyst, from prospective customers, partners, official agencies and other authoritative and credible sources.

3.3 Pitfalls to avoid

There are critical pitfalls to avoid in the formulation of a business plan. Targets that are not measurable or quantifiable do not inspire staff and employees. It is impossible to place a time frame on a target that is not measurable. Setting the business targets takes into consideration the resource constraints of the business. At the start, the details of inputs, their sources and procurement processes need to be specified. Descriptions of the production process, details of outputs to be produced, details of the organizational structure and the administrative structure should be included. The aim is to gain readers' confidence in the plan.

Failure to recognize the values of target customers is another pitfall. Incorrect forecasts can be the result of insisting on one's own ideas and opinions while ignoring the need to match the kinds of products and services that have to be produced; customers' needs are not assessed and there is no real or specific target market.

Lack of business experience. The likely result is that the proposed business plan is not well accepted. This could be mitigated by seeking advice from resource persons or organizations. Members of the business plan development team should be experienced and skilled professionals.

4. Preparing a business plan document

4.1 Executive summary

This should be concise and precise. It should stimulate the interest of readers to look for more details in other parts of the plan. It should be the last item to write after finishing the other parts; this makes it easier to outline and describe the connections among the various sections. Important points to be mentioned are:

- business idea or ideas;
- type of business and its objectives;
- products and services and their competitive advantages;
- target consumers;
- business trends and market opportunities;
- capital required;
- financial returns; and
- long-term goals.

4.2 General company description and business idea(s)

This is the first part to prepare. It comprises detailed descriptions of the history of the business, legal status, statements of the vision and mission, strategies, business ideas, business plans, objectives and the contributions of the business to the community. This part tells the main competencies of the business and its competitive advantages. It should also describe the relations between business ideas and the values that will be generated for the business and the community. Sources of information and support are rules, regulations, strategic plan, annual reports, experts and resource persons. Details of the company description and business ideas include:

- type of business, legal status and business history;
- operational framework;
- main competencies and competitive advantages;
- outstanding competencies of the management team; and
- value creation for the business and community.

4.3 SWOT analysis

This part describes long-term strengths, weaknesses, opportunities and threats of the proposed business plan. The analysis should cover the competition, target markets, consumption behaviour of target customers, proposed strategies, competitive advantages, main competencies of the business and existing innovations. Sources of information are the strategic plan, market research and resource persons. However, the information should be vetted and the management team should agree on a common conclusion. Details of the SWOT analysis comprise:

- the current business environment and positive and negative impacts on the business;
- core competencies that can be included in business strategies to raise business capabilities;

- competitive advantage opportunities;
- size of target market(s);
- consumer behaviour in target market(s);
- main competitors and their competitive advantages; and
- appropriate strategies.

4.4 Marketing plan

The marketing plan must describe the target market(s) clearly. It should explain the benefits to customers and community that the business can generate. The analysis of target customers should reveal their consumption behaviours. The results should be used to specify target markets and develop a marketing strategy. Sources of information are the strategic plan, market research and specialists or resource persons. The details of the marketing plan comprise:

- main target consumers and the expected volume of business;
- secondary target consumers and how to reach them;
- marketing targets and potentials; and
- marketing strategies and quantifiable indicators.

4.5 Product and service development plan

A product and services development plan describes the production processes; for example, inputs used, tools and equipment, capital, labour and raw materials as well as production technology, production lines, production steps and information on products and/or services. This part should also mention expansion possibilities and constraints, quality control and inventory management. It should describe the network of business partners and explain the values generated for the benefit of the business and the community. Details of the product and service development plan comprise:

- production process and production sections;
- sources of workers, raw materials, production technology, capital and costs;
- cost advantages of product development in terms of direct and indirect costs;
- degree of product differentiation and product life cycle;
- input procurement alternatives, availability and expected constraints; and
- human resource development measures and complementary strategic partners.

4.6 Management plan

The management plan illustrates the operational processes of staff and management at various time periods with a milestone schedule. It should describe important weekly, monthly and quarterly activities throughout the plan period. Information sources include meetings of directors/executives, management team and staff, legal contracts and agreements.

Details of the management plan comprise:

- staff under the organizational structure;
- adequacy of skilled and professional staff to carry out the business plan;
- administrative structure to achieve the business targets in each period;
- conformity of the administrative plan with long-term business opportunities;
- conformity of the administrative plan with the rules and regulations of the business;
- the staff incentive and reward system; and
- control and monitoring mechanisms.

4.7 Risk and risk management plan

The business plan is basically a forecast. There is a probability that the forecasts and assumptions are not realized because of some risks. The business plan should then describe the risks and detail a risk management plan. This is to build confidence in the proposed business plan. Information may be gathered through a survey or from other firms in the industry. Seek recommendations from resource persons/experts. Details of the risk and risk management plan comprise:

- action to follow when sales fall below targets;
- measures to implement when supply and costs of raw materials are not as planned, i.e. schedules are delayed and/or quantities are insufficient;
- measures to implement when there are insufficient skilled and professional workers;
- measures to implement when production costs are higher than expected; and
- what to do with products that are out of date.

4.8 Financial plan

The financial plan is one of the more important parts of the business plan. Creditors, investors and managers use the information presented in the financial plan to make their decisions. The plan should constitute detailed forecasts for the next five years. The results are shown in pro-forma financial statements, including the balance sheet, income statement and financial ratio analysis. The plan should indicate the appropriate rate of return on investment to owners/members and business partners, and reassure creditors of the company's ability to repay debt. Details of the financial plan comprise:

- assumptions used in the preparation of financial reports;
- expected cash flows in each period;
- expected financing activities in each period;
- results of financial ratio analysis and expected financial risks; and
- the dividend and repayment plan.

5. Case study of the Pho Phra farmers' group

The Pho Phra tilapia farmers' group is located at Moo 8, Pho Phra District, Amphoe Muang, Petchaburi Province. The group was established in 2003 under an MOAC project to improve the income of small farmers. Farmers joining the group were encouraged to raise tilapia. At the time of this case study (2016), there were 20 members and the average size of their farms (earthen ponds) was 10 *rai* or 1.66 ha. It had THB 700 000 of total capital, comprising a THB 500 000 loan with no interest from the MOAC and share capital of THB 200 000 from 20 members (100 shares per member at THB 100/share). The group used the grant as its working capital and re-lent it to members at an interest rate of 3 percent.

These are the details of the group's business plan:

Business ideas. The members would use the group as a vehicle to develop the tilapia value chain with business partners, with support from local government offices. The aim was to sustainably increase the value added of their farm produce. The proposed activities were: input procurement (working capital, fish seed, feed, therapeutants and chemicals), quality standard production, preparation of a business plan, processing and selling of fish to business partners under contracts.

Vision. To develop the tilapia value chain, increase the value added of tilapia products and ensure sustainable tilapia farming.

Objectives. The goal was to raise the quality standards of products, reduce production costs, increase production efficiency and strengthen bargaining power in the market.

Strategy

- **Functional upgrading.** This was undertaken by reorganizing the group so that it could support value chain development and integrate smoothly into the value chain for the purpose of value addition.
- **Process upgrading.** This was achieved through activities such as research and development, training of members to raise their production to quality standards, efficient procurement of inputs, assembling, processing, and marketing of products – through business partners – to target customers.
- **Product upgrading.** This focused on product development to meet quality standards and to create a product brand that would create loyalty among target customers.

Business targets

- Reduce production cost by 10 percent through group or bulk purchases from business partners.
- Increase production efficiency by 10 percent by adopting the quality standard tilapia production system.
- Increase value added by 20 percent by selling fresh and processed tilapia products through business partners.

Strengths of the group and business partners

- The 20 members had more than ten years' experience in earthen pond tilapia farming. They expressed a common thrust to use their group to realize their and their business partners' common goal of increasing value added of tilapia products (produced by the group and business partners).
- The group already had THB 700 000 of working capital.
- Tilapia farms were favourably located close to major markets and tourist centres. Nearby private companies and government fishery stations sold fingerlings and feed.
- Increasing numbers of consumers were developing a taste for tilapia products, especially those that met the GAP standard.

Weaknesses of the group

- The managerial skills and competencies of the management team needed improvement.
- Members did not have a common operational plan to buy inputs or sell products as a group. Lacking bargaining power, their production costs were high. Furthermore, members lacked the technical knowledge and skills to farm tilapia with higher yield, higher quality and lower production cost.

Business opportunities

- The popularity of tilapia products had been increasing in the domestic and export markets, particularly processed forms such as dried tilapia and frozen fillets.
- The group had few competitors. The competitors needed more experience and most were located in less favourable areas.

The value of tilapia products at target markets. The group planned to produce fresh tilapia products (from big fish) and dried tilapia products (from smaller fish) at around 200 tonnes and 50 tonnes, respectively in 2017 and increase output to 350 tonnes and 80 tonnes in 2020. This would generate total income to the group of around THB 17.5 million in 2017 and THB 30.1 million in 2020.

Consumer behaviour in target markets. The DOF encourages farmers to adopt the GAP standard for tilapia production and comply with food safety standards for processed tilapia products. The products are promoted and sold in 'one tambon, one product' or OTOP shops and widely sold in local markets, supermarkets and in some overseas markets.

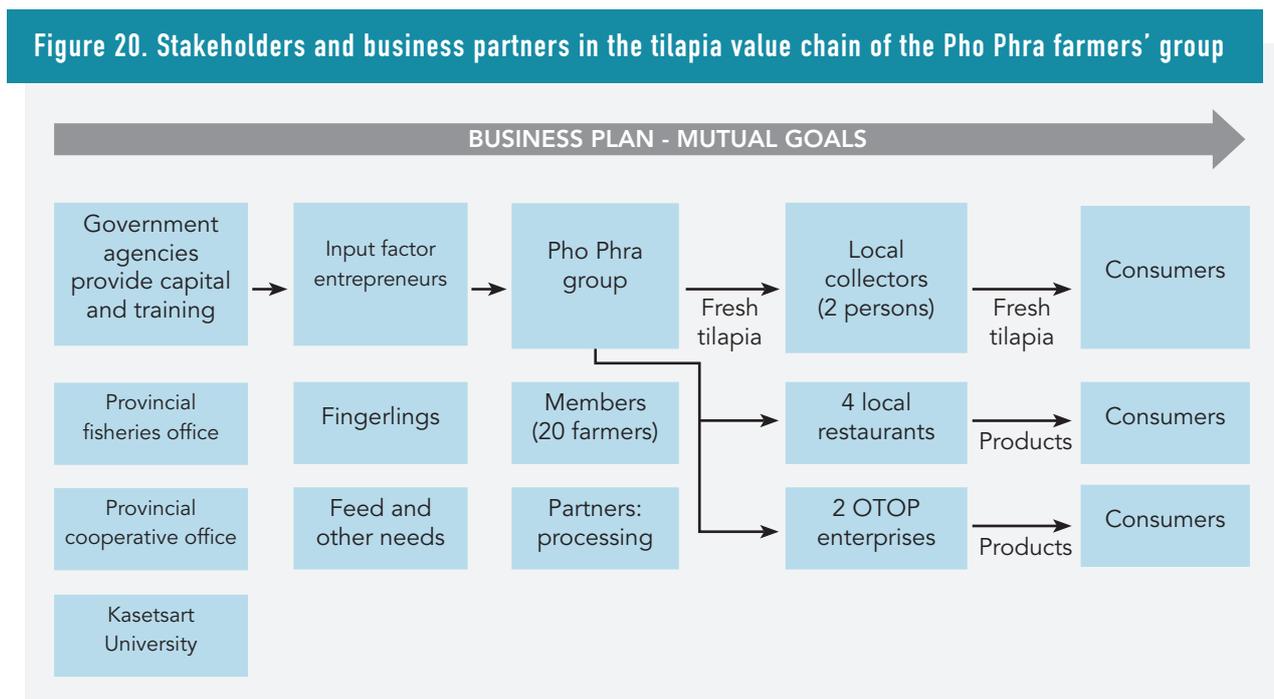
Target customers

- Four restaurants and two local assemblers are the prime customers of fresh tilapia weighing one kilogram.
- OTOP shops sell processed products to high-income customers who prefer products that meet food safety standards.
- Consumers in local and provincial markets who prefer dried fish.

Marketing strategies (marketing mix)

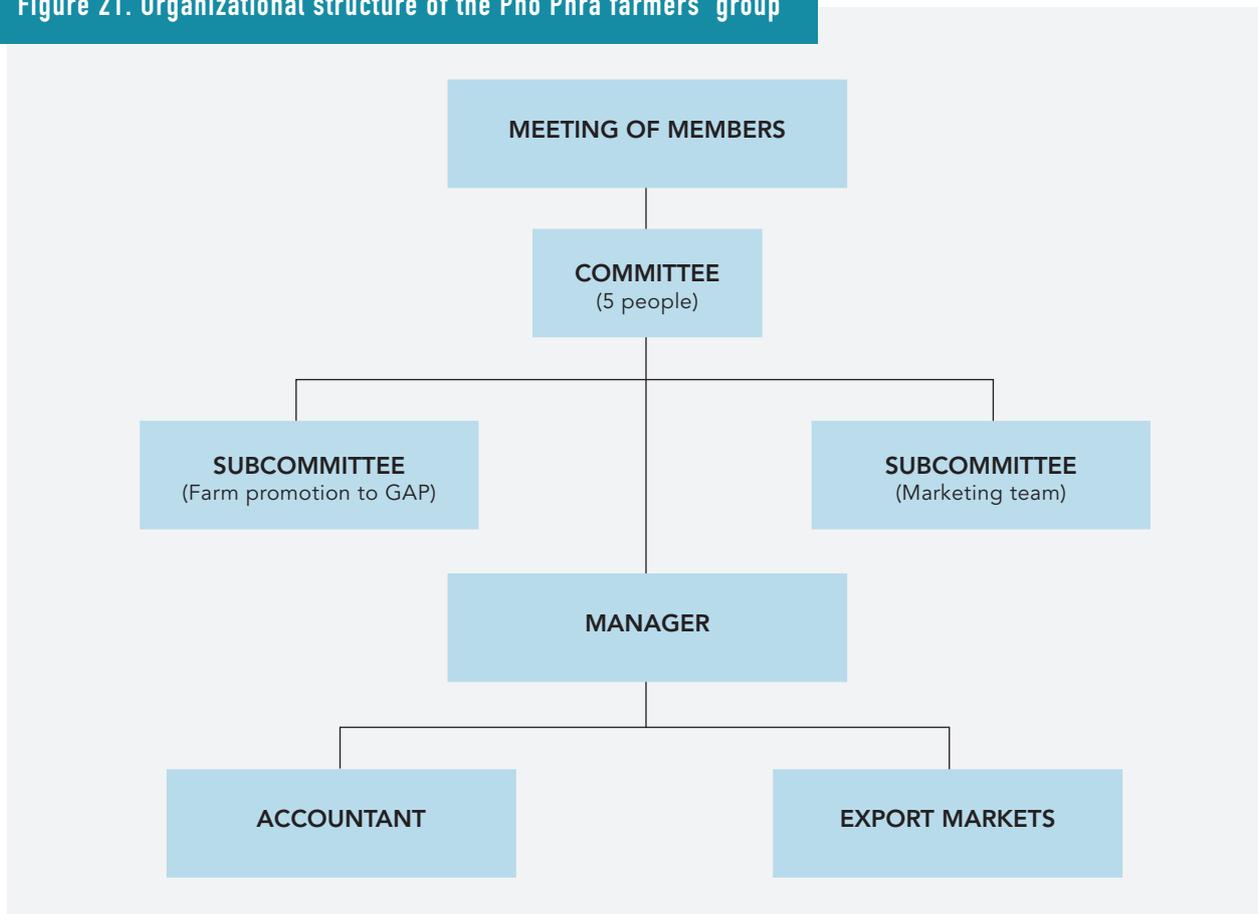
- **Product strategy.** The Pho Phra group’s product development plan relied on training to enable them to meet GAP and food safety standards, in collaboration with the provincial fisheries office.
- **Price strategy.** Contractual arrangements set prices. The group planned to enter into contracts with business partners, local assemblers and restaurants. The expected farm-gate price would be THB 70/kg of fresh and dried tilapia.
- **Location strategy.** The products would be sold through eight business partners: four local restaurants, two local assemblers and two OTOP shops (one in the locality, the other in Bangkok).
- **Promotion strategy.** The group designed the brand ‘Pho Phra’ as part of the effort to win confidence and loyalty of customers. In addition, they introduced new packaging, new products and had their products approved under food safety and quality standards.

Pho Phra tilapia value chain mapping. The business partners in the proposed Pho Phra tilapia value chain are shown in Figure 20.



Organizational structure and responsibilities. The organizational structure of the Pho Phra farmers' group is shown in Figure 21.

Figure 21. Organizational structure of the Pho Phra farmers' group



Each component has the following responsibilities:

- The committee monitors and controls business operations of the group to conform to the policy guidelines approved by members at the general meeting.
- The manager is responsible for general administration of the group's businesses in accordance with the policy guidelines and business plan.
- The subcommittee on farm promotion coordinates with government offices to raise members' farming practices to the GAP standard.
- The subcommittee for marketing facilitates market access, trading and product promotion with business partners along the market segment of the chain.
- The accountant and financial staff follow their job descriptions in line with the group's rules and regulations; they prepare financial reports for management and reporting purposes.

Financial plan. The group's financial plan is shown in a balance sheet for the period 2017 to 2020 (Table 11).

Table 11.
The forecast balance sheet of the Pho Phra farmers' group

PHO PHRA FARMERS' GROUP				
BALANCE SHEET				
31 December				
All figures in THB				
Detail	2017	2018	2019	2020
Assets				
Current assets				
Cash, bank deposits	100 000	95 000	141 000	105 000
Accounts receivable	500 000	500 000	500 000	500 000
Inventories	90 000	600 000	600 000	700 000
Fixed assets				
Land, buildings, equipment	100 000	80 000	60 000	40 000
Total assets	790 000	1 275 000	1 301 000	1 345 000
Liabilities and owner's equity				
Current liabilities				
Accounts payable	50 000	500 000	500 000	500 000
Long-term liabilities				
Long-term loan	500 000	500 000	500 000	500 000
Total liabilities	550 000	1 000 000	1 000 000	1 000 000
Owner's equity				
Share capital	200 000	200 000	200 000	200 000
Retained earnings	40 000	75 000	101 000	145 000
Total owner's equity	240 000	275 000	301 000	345 000
Total liabilities and owner's equity	790 000	1 275 000	1 301 000	1 345 000

BIBLIOGRAPHY

Barnard, F.L., Akridge, J.T., Dooley, F.J., Foltz, J.C. & Yeager, E.A. 2012.

Agribusiness management. Fourth edition. Routledge.

DOF. 2010. *The 2010 – 2014 tilapia development strategy*. Bangkok, Department of Fisheries. (in Thai)

ILO. 2016. *Value chain development for decent work: how to create employment and improve working conditions in targeted sectors*. Geneva.

NBACFS. 2010. *Thai agricultural standard TAS 7405-2010: good aquaculture practices for tilapia*. Bangkok, National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperatives. Also available at www.acfs.go.th.

NBACFS. 2013. *Thai agricultural standard TAS 7001-2013: tilapia*. National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperatives, Bangkok. Also available at www.acfs.go.th.

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