YANGON UNIVERSITY OF ECONOMICS

MASTER OF PUBLIC ADMNISTRTION PROGRAMME

A STYDY ON SMALL-SCALE FISH FARMING IN KAYIN STATE

(Case Study : Hpa-an Township)

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EMPA - 64 (16th Batch)

August, 2019

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MASTER OF PUBLIC ADMNISTRTION PROGRAMME

A STYDY ON SMALL-SCALE FISH FARMING IN KAYIN STATE

(Case Study : Hpa-an Township)

A thesis submitted in partial fulfillment of the requirements for the
Master of Public Administration (MPA) Degree

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YANGON UNIVERSITY OF ECONOMICS
MASTER OF PUBLIC ADMINISTRATION PROGRAMME

This is to certify that this thesis entitled **"A STUDY ON SMALL-SCALE FISH FARMING IN KAYIN STATE (Case Study: Hpa-an Township)"** submitted as a partial fulfillment in the requirements for the degree of Master of Public Administration (MPA) has been accepted by the Board of Examiners.

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ABSTRACT

This thesis studies on the small-scale fish farming which is cultured in Kayin State. The study aims to examine the production of the small-scale fish farming and to identify the problems that are being faced. As a sample size, 47 fish farmers from Hpa-an township were targeted to conduct the in-depth interviews by sample selection. Both quantitative and qualitative data, descriptive method are used. It was found that although some farmers received the trainings, the barriers are still existing such as water quality management, water quality monitoring and feeding system. The farmers cannot feed the fish regularly in the exact time frame due to the weakness of the right practices. The market is choose in their villages and nearby, due to easy to sell out the fish when harvesting time. But all production of the area cannot support to the local demand because of the small numbers of produced fish, and still rely on the supply of Yangon fish production. Land utilization is very important constraint for encouraging the famers for the sustainable development of fish farming and expansion activities.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my sincere thanks to Master of Public Administration Programme Committee, Yangon Univerisity of Economics for providing an opportunity to undertaken this study thesis. I would like to extend my deepest gratitude to Professor Dr. Tin Win, Rector and Professor Dr. Ni Lar Myint Htoo, Pro-Rector of Yangon University of Economics for the permission on the attending of the Degree of Master of Public Administration Programme.

I am also profound gratitude to Professor Dr. Kyaw Min Htun, Pro-rector (Retired), Yangon University of Economics. My sincere special thanks goes to Dr. Phyu Phyu Ei, Professor,Head of Department of Applied Economics and Program Director of EMPA Programme, U Thein Naing, Associate Professor, examiner for constructive comments, valuable suggestions and kind interest of completion of this thesis.

I would like to express my heartfelt gratitude to my thesis advisor, Dr. Tin Tin Wai, Professor of Department of Applied Economics, Yangon University of Economics, who gave me a lot of advices and strong guidance starting from thesis title identification to finalization of thesis writing. I wish to acknowledge my thankfulness to Daw Aye Aye Zaw, Director and team of Department of Fisheries, Hpa-an State office and U Saw Samon Phite, Deputy Director of Kawkareik District DOF official of Kayin State, and U Thein Zaw, Coordinator and team of World Fish Organization, for supporting and providing me the necessary data during the survey time in the bad weather condition.

Last but not least, I offer my deep gratitude and grateful thanks to my colleagues, class-makes, friends and the respondents and each individual for their kind help, giving ideas and comments in various ways until the finalizing of this thesis writing.

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LIST OF ABBREVIATIONS

ADB	Aisan Development Bank
ARC	Agriculture and Rural Development Cooperation
BFDA	Brackish water Fish Farmers Development Agencies
CIEC	Centro de Investigaciones Economicas
CIHEAM	International Centre for Advanced Mediterranean Agronomic Studies
DOF	Department of Fisheries
DOP	Department of Population
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization
FFDA	Fish Farmers Development Agencies
FMO	Fish Marketing Organization
GDP	Gross Domestic Product
GMP	Good Manufacturing Practices
GHP	Good Hygiene Practices
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit
HAAPPC	Hazard Analysis Critical Control Point System
IFT	Institute of Food Technologists
IYAFA	International Year of Artisanal Fisheries and Aquaculture
JICA	Japan International Cooperation Agency
JIRCAS	Japan International Research Center for Agriculture Science
JVC	Joint Venture Cooperation system
km	kilometer
KOICA	Korea International Cooperation Agency
MOALI	Ministry of Agriculture, Livestock and Irrigation
MT	Metric Tonnes
NACA	Network of Aquaculture Center in the Asia Pacific
NGO	Non-Governmental Organization
SEAFDEC	Southeast Asia Fisheries Development Center
SOBA	The Ayeyarwady State of the Basin Assessment
SSF	Small-scale Fisheries
USD	United States Dollar

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

Fish is one of the most important foods for the Myanmar people since more than 70% of animal protein is taken from fishery products. It has been reported that people in rural areas, particularly those who live far from the main river systems suffer from a deficiency of animal protein due to insufficient supply of fish. The majority of those are needy farmers and depend only on crop cultivation for their livelihoods. In Myanmar, 70% of population are living in the rural area (DOP, 2014) and mostly consuming the fish as of the survey report. Per capita consumption of fish is estimated at 42.5 kg/year, one of the highest in the world (OED, 2017). As of Fishery statistics of DOF, 2018, the per capital consumption reached to 56 kg/year. To fulfill the nutrient and food security of rural communities, DOF set up the policies. Small-scale aquaculture is focused as a national level and is taking into account the strategy. The policies on rural development which includes Policies_Livelihood improvement and income generation are drawn under the Rural Development Strategy for Poverty Reduction, set up by the Ministry of Agriculture, Livestock and Irrigation.

For food security and safety in terms of livestock and fisheries sectors and to develop rural area sustainably, DOF includes "Development of small-scale aquaculture for socio-economic development of rural people and extending of commercial fish farming" in its Plan of Action.

Main cause for small-scale fishery farming by the rural communities is easy to implement due to the low technique, no high investment and increase of income level. In countrywide, the communities who are living in Ayeyarwaddy, Bago, Central Dry Zone, Shan, Kayin are implementing this aquaculture mostly. In rural area, this type of fishery farming can be fulfill not only the nutrient food but also earning supplementary income for the economic development. DOF is implementing the

projects in cooperation with international, local organizations in the rural areas including Kayin state.

The people living in Kayin state are mostly working in Thailand for earning income for the social-economic development according to the migration survey and geographical situation of 2014 Census (DOP, 2016). But, the supplementary income is from agriculture and aquaculture. The more the implementation of small-scale fishery farming systematically is increased, the more expansion can be considered to improve the economic situation, including the transforming to commercial farming. Therefore, DOF provides trainings for hatching for quality seed, pond management and the improvement of paddy cum fish culture, integrated aquaculture and extension techniques (famer-to-farmer technique dissemination). This farming can enhance the improvement of livelihood of the rural people by expansion area. In Kayin State, the fish farming is potential livelihood for increasing income generation of farmers due to high local demands, especially in the tourism season. On the other hand, it can be accessed to the good water quality which is very crucial source in the farming. Nevertheless, the local supply is insufficient to support to the demands. Therefore, this study analyzes how the fish farming is effective in Hpa-an Township, although the farming method and fingerling are provided by the related department and many fish ponds are not existing.

1.2 Objectives of the Study

The objectives of the study are to examine the production of the small-scale fish farming in Hpa-an Township and to identify the problems that being faced in the fish farming.

1.3 Method of Study

The secondary data was collected from Department of Fisheries, FAO, International organizations, relevant internet websites and reports. As the primary data, the quantitative and qualitative data were collected from total 47 fish farmers by conducting in-depth interviews. Purposive sampling was used to choose fish farm villages for survey and, to divide area location and number of ponds and to select the interview respondents. The descriptive method is used for analyzing and describing the findings.

1.4 Scope and Limitations of the Study

The study focuses on only 5 villages which are located in Hpa-an township due to total less number of farming in the study area. Although there is official definition on size of small –scale fish farming, which is less than 10 acres, this study targeted only the pond size less than 5 acres in total, depending on the location and maximum pond properties of the farmers. Therefore, the total pond size exceed 5 acres is excluded in the Study.

1.5 Organization of the Study

The study comprises five chapters. Chapter (1) includes introduction which formed with Rationale of the study, Objectives, Method of Study, Scope and Limitations and Organization Structure. Chapter (2) presents the overall information of small-scale fishery farming and Chapter (3) is related to the activities of DOF and other organizations supporting to the fish farming in rural areas. Chapter (4) concerns about the survey analysis on the fish farming. Chapter (5) includes the findings and recommendations on the small-scale fish farming.

CHAPTER II
LITRACTURE REVIEW

2.1 Fish Farming

The related information of fish farming consists of its overview, roles, methods, selection of fish species and nutrition and development of a fishery sector.

2.1.1. Overview of Fish Farming

Fish had provided an important people's nutrient food and livelihood in the world since several years ago. Fish catches have increased rapidly during many decades due to usage of high technologies which include powerful engines and sonar equipment. However, the growth of fish catching stopped over a decade ago due to overfishing which led a cause of real problem for being decreased in stocks. Then, the fish farming became urgent needs to increase the production in order to fulfil the world demands. The aquaculture comprises of the forms of culturing the aquatic animals and plants in fresh and brackish water. The objective of aquaculture is to increase the production of food in above level, than produced naturally. In fish farming technologies, it includes the removing of unwanted plants and animals, replacement by suitable/desirable species, the improvement of these species by breeding and selection, and the improvement of food availability by using fertilizers. Fish farming can be mixed with agriculture, animal husbandry and irrigation system which can lead to a better utilization of local resources and ultimately to higher production for getting net profits. The integrated fish farming is formed with this design of farming (Carballo et al., 2008).

The sector of small-scale fisheries has been firmed in the rural areas for the local communities as traditions and values. Many small-scale fishers are self-employed and usually provide fish or direct consumption within their households or communities. Women 's involvement is significant in the sector, particularly in the post-harvest and processing time. It is estimated that about 90 % of all people directly rely on capture fisheries work in the small-scale fisheries sector. The contribution of

small scale fisheries is about half of global fish catches for direct consumption, and is being increased to two-third of total fisheries sector. The small-scale aquaculture also contributes to total aquaculture production globally and to the livelihood development of rural area in terms of provision of food, livelihoods and income-generating opportunities, improving social activities and enhancing the quality of life, particularly of poor rural communities (FAO, 2018).

(a) Characteristics of Small-scale Fish Farming

The characteristics of small –scale producers vary depending on the location, especially small-scale fisheries are mainly supporting to local communities by reflecting the historic linkage to fishery resources nearby, traditions and values, and supporting social development. In addition, the employment is high opportunity for full- or part-time fishers, fish farmers and fish workers. The sector activities provide crucial supplements to the livelihoods seasonally or occasionally. These activities may be a recurrent sideline activity or become especially important in times of difficulty. Many small-scale fishers, fish farmers and fish workers are self-employed and directly providing the food to households and communities and in the field of commercial fishing, processing and marketing, they are working.

(b) Type of Aquaculture Farm

Fish farming can be defined in the range from large scale enterprises to backyard subsistence ponds. Farming systems can be distinguished according to input levels. The inputs are usually low in extensive fish farming, and the natural food production plays a vital role. As a result, the pond productivity is relatively low. Fertilizer may be used to increase pond fertility and fish production. A moderate level of inputs is used in semi-intensive farming and fish production is increased by the use of fertilizer and/or supplementary feeding. It occurs higher labour and feeding cost but higher fish yields more than compensate for this usually.

In terms of intensive fish farming, a high level of inputs is used and the fingerlings are put in the ponds with as many as possible. The supplementary food stands in the main feeding, and natural food production is not much considered. In this system the high feeding costs and risks, due to high fish stocking densities and thus increased susceptibility to diseases and dissolved oxygen. Small-scale freshwater fish farming shortage, can become difficult management problems. Because of the high production costs, it is forced to fetch a high market price in order to make the fish farming economically feasible (Carballo et al., 2008).

2.1.2 Roles of Fish Farming

The role of aquaculture is standing on the supply for the human consumption. In addition, according to medical research, eating fish frequently is much benefited for health condition as Omega-3 fatty acids are typically found in most of fish.

Agriculture specialists struggle with improving their skills to meet food demands in line with increasing population. Aquaculture is no different, and in fact, plays a critical role in this arena. Fish farming is typically much efficient than animal husbandry and other forms of agriculture. The land can allow for construction of fish ponds in ten times or more consumable product than raising the cattle or pork in the same land, with the requirement of less input significantly.

The aquaculture does not exist without drawbacks. The high concerntration of aquatic species can be alternative depending on their locations: landlocked fish pond, or a floating cage in a saltwater. The species can destroy existing wild habitat, and increase local pollution levels or negatively impact local species genetic makeup. The benefits of fish farming are;

1) Fish growth in ponds can be controlled: the fish species raised are the ones the farmer selected.
2) The fish produced in a pond are the owner's property; it is secure and can be harvested at will. But, fish in wild waters are uncertain to make an individual share in the common catch as the fish is able to be catched freely.
3) Fish in a pond are usually close at hand.
4) Effective land use: effective use of marginal land e.g. land that is too poor, or too costly to drain for agriculture can be profitably devoted to fish farming if it is suitably prepared (Carballo et. al, 2008).

2.1.3 Methods of Fish Farming

There are several methods for fish farming such as pond culture, cage culture, and the fish can be cultured in the dams and reservoirs. The monoculture and polyculture are limited based on comprising of one or more species in the pond.

(a) Pond culture

The freshwater fish are mostly raised in ponds. Water is taken from lake, bay, well, river or other natural source. The water in a pond is discharged or partially

replaced to certain some percentage of the total water in a system is retained and recirculated. However, the yield of highest fish production of the pond systems only replace water evaporation and loss of seepage and do not flow through. In general, water flowing makes the reduction of the fish production in the tropics. The size of fish farming ponds range starting from a few hundred square meters. The land is main location for ponds with a gentle slope. The shape of ponds vary in rectangular or square, and ponds have well finished dikes and bottom slopes and do not collect run-off water from the surrounding watershed. The availability of sufficient water is important to fill all ponds within a period of time and it is quite essential to maintain the same pond water level.

(b) Other Methods of Fish Farming

Although fish farming in ponds is the most common method, fish can be cultured in dams, reservoirs and cage system.

(i) Dams and Reservoirs

Nowadays, dams and reservoirs are increasingly used for aquaculture. The fry and fingerlings are cultured in the waters of dams and reservoirs and later harvested with nets. This method of raising fish is more difficult than in ponds, because these waters cannot be controlled: draining is impossible and removal of predators is difficult. The feed or fertilizers are not be able to used so natural fish production is sufficient for the stocked fish to grow.

(ii) Cage culture

The only water availability is flowing water or large water bodies where it is difficult to divert water into a pond, in several parts of the world. In such waters, fish may be grown up in small cages. In swampy area, the cage culture can also be practiced.

(c) Monoculture

In monoculture, it is found that only one fish species is raised in the pond. An advantage of monoculture is that it is easier to give certain supplementary foods to the fish as there is only one fish species to consider with regard to food preference. As for disadvantage, a single disease may kill all fish in a pond, as different species has different diseases.

(d) Polyculture

Raising one or more fish species in the pond is found in polyculture. The various natural food resources are utilized. The natural food for fish species vary

based on their preference which are related to the position of the fish in the pond (e.g. bottom-living or mid-water living fish). For example, mud carp live mostly on the bottom of the pond and feed on mud and dead material which found on the bottom. Tilapia species live in the deeper part or bottom of the pond as some species feed on plants and others on plankton. The advantage of this culture is for combining different species in the same pond, in which way, the total fish production can be raised to a higher level than only one species or even with the different species separately.

2.1.4 Selection of Fish Species and Nutrition

When selecting fish species suitable for farming various biological and economic factors are important to pay attention including market price and demand (not when fish are produced for own consumption), growth rate, ability to reproduce in capacity, simple culture of the young fish (larvae or fingerlings), match between available fish feeds and the food preference of the selected fish species.

It is better to select fish species which can be easily reproduced by own self or bought on small-scale freshwater fish farming the fish market or from a fish supplier, fish hatchery station or culture extension service.

In aquaculture system, feeding costs are generally highest and important in the total cost of production. Therefore, the fish species of plant-eating (herbivorous) or plant- and animal-eating (omnivorous) are preferable as the natural food resources occurring in the pond, is available to feed. As for these species, the cost of feeding is generally low. Carnivorous (predatory) fish species mostly rely on a high protein diet and are more expensive to produce. Although the feeding costs are high, most carnivorous species are sold with higher market prices.

Fish species that are hardy and which can tolerate unfavorable culture conditions will survive better in relatively poor environmental conditions (e.g. tilapia). When a new fish species is introduced, it is better to consider not only the effect of the environment on the fish species, but also the influence of the species on the environment.

The two types of food in the pond are naturally produced fish food inside and supplemented fish food supplied from outside the pond to the fish. The composition of algae (phytoplankton) and tiny animals (zooplankton) are the natural fish food, in which produced in the pond itself and can be increased by fertilizing the pond.

Supplementary fish food is produced for supplying the fish to increase the amount of fish food in the pond further.

2.1.5 Development of a Fishery Sector

In many countries, the fishery sector contributes to development and by playing a critical role for food security and nutrition, poverty reduction, employment and trade. Asia accounts for more than 87 % of the world total, with China alone having almost 14 million people engaged as fishers or fish farmers. Apart from the primary production sector, fisheries and aquaculture provide numerous jobs in ancillary activities such as processing, packaging, marketing and distribution, manufacturing of fi sh-processing equipment, net and gear making, boat construction and maintenance, research and administration (Martini, 2013).

In trade markets, fish is one of the most traded of food commodities, fruit and vegetables follows second in value. At the same time, fisheries serve an important role for the local food supply in many coastal developing nations (Martini, 2013). According to FAO estimates, capture fisheries and aquaculture supplied the world with about 148 million tonnes of fish in 2010 (with a total value of US$ 217.5 billion), in which approximately 128 million tonnes was utilized as food for people. Developing countries are already the most important producers of wild capture and aquaculture fish, and will be the source of most future growth in fish production.

Total production of fisheries in Asia is the most percentage in the world. And the fishery production of Southeast Asian region is increased from 39.5 million MT in 2012 to 45.3 million MT in 2016 with an annual average rate of increase of 1.5 million MT or 3.5%, where the total contribution to the world's total fishery products in 2016 was approximately 22.4%. The aquaculture production in 2016 was 25.1 million MT and excess over half of the total fish production (marine & aquaculture), which was registered as 45.3 million MT (SEAFDC, 2018).

(a) Fishery sector's Future Trends to Sustainable Development Goals

Aquaculture now contributes nearly half of the global fish production and,by the year 2030, estimates are that an additional 27 million tonnes, over 50% from the current, will be needed to meet the growing demand for food fish. In worldwide, aquaculture provides mainly social and economic services, such as through:

1) contributing to global and regional food supplies;

2) national food security, including meeting demands of growing urban populations;
3) providing direct self and paid employment for rural and peri-urban communities;
4) creating upstream and downstream employment through services, supplies and trading activities;
5) contributing increasingly to national and international trade; and
6) generating household and national income. (Phillips R. P., 2010)

World capture fisheries will change depending on the climate condition such as EI Nino years. The production amount will fluctuate between 91.3 million tonnes in minimum and 93.7 million tonnes in maximum. There is a wide consensus that over the years, the state of the world's marine fish stocks has not improved overall. Overfishing occurs as the results of suboptimal fishing capacity and effort, some are sustained by subsidies and IUU fishing methods.

The contribution of aquaculture to the supply of fish for consumption overtook the wild-captured fish in 2004. Since late of 1980s, with lack of capture fisheries production, aquaculture became responsible for filling the gap between supply and demand of fish for consumption. The potential for sustainable aquaculture development, in particular in coastal developing countries, can help decrease the pressure on wild stocks, produce fish at affordable prices for food security and high value seafood for international markets. However, the current aquaculture production model will need to improve its sustainability performance drastically by minimizing negative impact on ecosystems, diversifying feed sources to lessen wild catch inputs.

The main players fisheries and aquaculture sectors are enhancing the common sustainable solutions in terms of international trade and innovations. It is needed a higher level of cooperation and partnership to share knowledge and experiences to improve policies, innovations (e.g. in best fisheries practices and gears, feed and seed production, vaccine production and animal health protection, value addition, logistics and services to promote marketing and distribution). Relating to the targets of SDG 14, the achievement is a unique opportunity to channel these reforming at the local and national levels and the cooperation and partnership on the regional and international arena (UNCTAD, 2018).

Globally, the effort to achieve sustainability is adjusted by the indivisibility and interconnection of marine ecosystems, the long-distance fleets, the common

dynamic and nature of fishery resources, and the inter achievement of countries through international trade and bilateral fishing agreements. To eliminate the current gaps between developed and developing countries, and to make future progress the zero-overfishing target set by the 2030 Agenda, the global community needs to strengthen its efforts to support developing nations for pursuing of sustainability. The solutions consist of: 1).enhancing regional and global partnerships to share management knowledge and enhance the institutional and governance capacity of developing countries;2) adjusting fishing capacity to sustainable levels through policy and regulations, including judicious use of targeted incentives, while eradicating subsidies that contribute to overcapacity and overfishing or support IUU fishing; 3) establishing a trading system for fish and fish products that promotes resource sustainability;4) encouraging a global mechanism and financial support to accelerate parties' fulfilment of legally binding and voluntary instruments (FAO, 2018). Sustainable aquaculture has the potential to contribute significantly to 'Oceans/blue economy' by promoting the socio-economic development of coastal populations in Africa, the Caribbean, Asia and the Pacific. It can increase supply to meet the demand and stabilize fish prices, in particular during the periods of price hikes of other food commodities (UNCTAD, 2018).

2.2 Situation of Small-scale Fish Farming in Developing Countries

In developing countries, the small-scale fish farming varies on the farming culture, market access and the common type of challenges are also existing.

2.2.1 Fish Farming Culture

Fish provides high quality animal protein for human consumption. A farmer can integrate aquaculture and existing farm for creating secondary income source and better water management on the farm.

Indonesia is standing in third position of largest aquaculture production globally according to the report of State of World fisheries & aquaculture. 5 million tonnes was produced and exported 4950 thousand tonnes in 2016 (FAO, 2018).The freshwater, brackish-water pond, cage net, mariculture, cage and paddy fields are the main source for aquaculture system in Indonesia. Among other types of culture, over 800,000 households involved in the freshwater pond culturing system. Aquaculture

contributes 7.89% to the country's GDP in 2015 and 30% of growth is expected in 2030.

The Indonesia government has a strong policy to support aquaculture growth. The government developed the strategies relating to aquaculture sector in terms of development of nursery, hatchery and grow-out production system, entrepreneurship, infrastructure, business and environment issues and technologies. Common carp, catfish and nile tilpia are mostly cultured species. Among them Talapia is mostly produced inclusive of export amount. Although the aquaculture production is targeted to meet the highest percentage in 2030, some challenges are still existing such as insufficient infrastructure, disease, land use issues and high feed cost.

India is also standing in the high rank for fish production through aquaculture in the world. It pocesses more than 10 percent of the global fish diversity. Currently, in the world, the country ranks second in total fish production with an annual fish production of about 9.06 million metric tonnes as of 2019 data.

The largest and fastest growing prawn species, *Macrobrachium rosenbergii*, is cultured either under monoculture or polyculture in combination with major carps. The aquaculture production in India can be classified into freshwater and brackish water production. There are 429 Fish Farmers Development Agencies (FFDA) and 39 Brackish water Fish Farmers Development Agencies (BFDAs) for promoting freshwater and coastal aquaculture. India major carps and shrimp are some of the important species cultured in India. Besides, ornamental fish culture and seaweed farming, are slowly gaining importance in the aquaculture scenario in the last few years as alternative livelihood supporting sectors as small-scale activities.

Importance of fish culture as an economically promising enterprise was gradually implemented in India. Later, non-availability of quality fish seed and lack of scientific culture know-how constrained the growth and further development of carp culture.

The research and development efforts during the last six decades have placed carp farming as an important economic enterprise as a fast growing industry. The national mean production levels from still-water ponds has gone up from about 600 kg/ha/year in 1974 to over 2.9 tonnes/ha/year at present, and several farmers are even demonstrating higher production levels of 8–12 tonnes/ha/year. While the focus was on the development of breeding and culture technologies for different species of carp, other species such as catfish, murrels.

The Low- input system is increased by using low-cost inputs such as organic and inorganic fertilizers, aquatic weeds etc. The supplementary feeding is provided in Medium-input system for increment of the fish production. The main features of this technology also includes proper pond preparation, stocking density, periodic fertilization and regular feeding with oil-cake-bran mixture (protein 25–27 percent) coupled with water quality and monitoring for fish health.

In High-input system, higher stocking density combined with higher feed inputs is the typical characteristics of intensive culture system which aims at higher fish production. The three Indian major carps, namely, catla, rohu labeo and mrigal carp contribute over 90 percent of the total Indian aquaculture production. During the 1970s, three exotic carps, namely, silver carp ; grass carp and common carp now form a second important group, were introduced into the carp polyculture system in the country.

The carp culture was virtually revolutionized by raising the average Indian production from still-water ponds from 0.6 tonnes/ha/year in 1974 to over 2.90 tonnes/ha/year at present. Over recent years, aquaculture has not only led to substantial socio-economic benefits such as increased nutritional levels, employement, income and foreign exchange, but has also brought vast un-utilized and under-utilized land and water resources under culture. With freshwater aquaculture being compatible with other farming **s**ystems, it is largely environmentally friendly and provides for recycling and utilization of several types of organic wastes (FAO, 2013).

The government of India promotes the policies:1) micro and macro level survey to identify suitable sites for farming, 2) preparation of site specific project reports, 3) technical advice on various aspects of farming,4) training farmers/entrepreneurs in farming, 5) arrange visit of farmers from one state to other state for learning different aspects of farming, 6) conduct workshop/symposium,/farmer meets for the benefit of farmers/entrepreneurs and 7) promote ecofriendly aquaculture.

Aquaculture may have started as early as 1691 in Thailand although this was for ornamental gold fish rather than for food. Aquaculture appears to be a relatively recent development because of the former abundance of wild fish. The native riverine catfish has been farmed on a small scale in pens and ponds in Central Thailand since the middle of the 19th century. DOF, Thailand promoted rice-fish farming in Northern

and Central Thailand in the 1950s, but this system is still not well developed so far. An exception thing is the farming of snakeskin gourami southeast of Bangkok where farmers converted unproductive rice fields in relatively saline soils of the lower Chiengrak-Klong Dam irrigation scheme to an extensive fish farming system.

Water for small-scale rural aquaculture is generally available, especially in floodplain and irrigated areas. But, the water supply for aquaculture is restricted in drought-prone areas in the northeast where there is significant poverty and in ponds inappropriately located in hilly areas (ADB, 2005).

Nile tilapia was introduced to Thailand in 1965 and since then, has become the most important cultured fish species, accounting for 41 percent of total freshwater aquaculture production in 2007 according to the report of DOF, Thailand (2009). In Central Thailand, all tilapia producers have a very strong commercial orientation. Management regimes are extremely diverse, but production systems falling under the semi-intensive umbrella dominate output for 75–80 percent of tilapia produced. These are managed as polycultures in which tilapia comprise the greatest percentage of stocked fish, and are fertilized, normally with pig or chicken manure (Belton, 2014).

In 2001, more than 600 million fry of tilapia, the dominant fish in small-scale freshwater aquaculture, both from mixed sex and mono sex male (through hormone-induced sex reversal), were produced. This seed supply represented 45% of the estimated total fish seed (1.520 million) produced in the country. The Government's share in producing fish seed was about 17%, two thirds of which were produced in inland fisheries stations.

Although much of Thai aquaculture includes intensive farming systems, several aquaculture systems with relevance to small-scale farmers were developed over the past few decades in former ricefields such as farming of snakeskin gourami, Nile tilapia seed production, giant freshwater prawn *(Macrobrachium rosenbergii)* farming, and inland culture of (marine) shrimp (*Penaeus monodon*). Most farmers who grow these species are now better off as many were relatively poor rice farmers before aquaculture was taken up (ADB, 2005).

The government also set up the polices for the development of aquaculture sector such as to increase fishery production both in quantity and quality for both domestic consumption and sale abroad, to increase production from aquaculture sufficiently for the needs of domestic consumption, to accelerate research in order to

support commercial aquaculture and assist the industry, to increase the trade volume, improve quality standards and reduce costs of production.

Extensive fish culture is a traditional system in Bangladesh. Ponds were originally constructed close to homesteads for multiple purposes including drinking, bathing and other domestic uses, irrigation, watering livestock and providing earth to elevate houses above the level of flood waters. Declining availability of wild fish coincided with increasing availability of hatchery produced seed, improving transport links and market access, and promotional efforts by a number of institutions and projects during the 1980s and 1990s. These factors have contributed to a general increase in numbers of such ponds brought under fish culture, and their deliberate management for this purpose. The uptake of improved management strategies such as regular application of feeds and fertilizers and the stocking of fish species in complementary combinations and at optimal densities and sizes remain patchy however, with producers adopting a variety of strategies depending to their knowledge, resources and inclinations. Belton *et al*., 2012 reported the median area of ponds devoted to homestead carp culture in Mymensingh to be 0.08ha. The pond owner can adequately manage the ponds of this size in approximately an hour or less each day, as a result of which, homestead carp culture generates no primary on-farm employment.

Operating costs are comprised mainly of fingerlings and, if improved management techniques are used, small quantities of inorganic fertilizers and 'raw' feeds, most commonly rice bran and mustard oil cake purchased from off-farm. Rent is rarely incurred since ponds are normally borrow pits dug on homestead land and pond construction costs are usually also incidental. The activity is normally practiced for either partially or completely subsistence purposes, and therefore usually contributes only a minor, potentially important, portion of household income among those who practice it.

Carps produced in these systems which are not consumed at home are sold primarily through local auction markets. Despite the fact that quantities produced by individual households are small, aggregate production is very substantial because of the large numbers of producers involved. In 2008, total recorded carp production in Bangladesh was 696,053 tonnes according to the FAO statistics,2010, which a large portion have originated from homestead pond systems (Belton, 2014).

Currently pond aquaculture has been practiced in a total area of about 3.72 lakh ha which is 7.89 % of total inland water. Pond aquaculture is producing about 17.20 lakh mt fish which contributing 44.34% of total inland production in 2016-17. The pond fish production involves composition of culture produces an average 4618 kg/ha whereas there are records of 90 MT/ha production of Pungas under intensive farming. Among three types of system, the semi-intensive system mostly used for pond culture fish farming (DOF, 2018).

Fish-holding systems commonly used in Ghana include floating cages, earthen ponds and concrete tanks. Aquaculture has a great potential in Ghana where it has the capacity to link the huge gap existing between fish demand and supply, and even produce in excess of domestic demand for export. Ghana has the potential for, and places much value on the development of, brackish and inland water aquaculture and culture-based fisheries as an important means of increasing national fish production.

Although fish farming is a fairly new business activity in Ghana, its practice is becoming widespread, especially in the Ashanti, Central, Eastern, Volta and Western regions of the country. The aquaculture subsector consists mainly of small-scale operators who practice on a subsistence level using the semi-intensive system of production in earthen ponds. Many farmers use the extensive culture system by which dams, dugout ponds and reservoirs are used for fish rearing. A few commercial fish farmers who use intensive culture systems contribute about 75 percent of Ghana's total aquaculture production. Pond-based culture system is the dominant production system in the southern and central belts of Ghana, accounting for over 98 percent of farms, and is mainly small scale by using semi-intensive in nature. In the last couple of years, the dominant culture system for tilapia production has changed, and the majority of cultured tilapia is now being farmed intensively in cages, particularly in Lake Volta.

All farmed fish in Ghana, between 75 percent and 93 percent are derived from floating cages culture while at least 7 percent are harvested from ponds. The cage farming of tilapia is concentrated in Lake Volta and has developed as a business activity at an annual growth rate of 73 percent between 2009 and 2014.The first cage fish farm in Ghana was established in 2001. Cage farms currently account for less than 2 percent of farms by number but much more by catch output. Several medium-sized cage farms are installed in areas such as Kpeve in South Dayi District of Volta Region, Sedom in Asuogyaman District and Akrusu in Upper Manya Krobo District

of Eastern Region. Fish farming is Largely carried out in extensive or culture-based fisheries in the Northern, Upper East and Upper West regions in the north of Ghana. These fisheries exist at irrigation sites, reservoirs and earthen dams.

2.2.2 Accessing to Markets of Small-Scale Fisheries

Market channel and practices are different based on the concerned countries, such as Indonesia, China, India. In Bangladesh, the simple channel operates in primary and secondary market levels up to Upazila. Beparies handle a large volume of fish and sell their purchases to Aratdars and to retailers. Beparies who can be local or non-local traders do not generally hold any trade licences. Some Beparies get advance business loans from the Aratdars during lean periods and on the condition that the purchases will be sold out through Aratdars. From the higher secondary markets, fish flow-down to the town and peripheral village primary markets through retailers.

A new pattern ,with the growth in commercial pond fishery, is emerging in the marketing channel that affects production points, primary markets/landing areas, higher secondary markets and consuming areas/retail markets. After harvesting pond, fish farmers directly approach to Aratdars at the higher secondary market. Fish farmers get 8-10% of the total sale proceeds from the lot of each catch. The farmers pay the transportation costs to the Aratdars in the markets and arrange bidding for open sales of fish to paikers/retailers.

In China, according to the origin of aqua-production, the products enter the coastal and inland producers' markets. From there, the products enter state, collective or private markets and processors. A portion is delivered to producers operating at this market level. It reaches the consumers' market and acknowledged that the liberalization of the aquatic products market has resulted in a prosperous aquatic market, which means that the share of the state-run marketing channel is decreasing rapidly while the total number of transactions is increasing dramatically.

India is formed by several states with different languages, traditions and castes. A significant proportion of the Indian population does not eat animal protein including fish. Therefore, fish produced by one state is moved to other states. As for Andhra Pradesh, it exports its aquatic products to West Bengal. Bigger fish weighing 2 kg or more have high demand in West Bengal markets. The smaller sized fish are sold in local markets. In the local markets, cycle vendors and small merchants buy small quantity of fish at pond bunds from small farmers and sell to the domestic

consumers. The middlemen finalize the deal by negotiating with both producer and wholesaler, for commission from both parties. Middlemen take a commission of US$ 10.87 from both the producer and the wholesaler for every truckload (5 t) of fish, which is about 5% of the total sale value of the fish.

In Thailand, domestic freshwater fish marketing is complex as it consists of many types of markets and a larger number of intermediaries and participants. The flow of freshwater fish marketing with distribution of product volume traded at different levels of traders market. Structure of freshwater products is classified into three major market levels: primary markets, intermediate markets and terminal markets. Fish farmers distribute their harvest to every level but the highest proportion (35%) is sold to primary markets through fish collectors. Most of small-scale fish farmers rely on fish collectors who have experience and more information about fish market outlets. Also, it may not be worthwhile for fish farmers to transport small volumes of fish.

After buying fish at fish farms, collectors will transport and sell the product in the central assembly markets, which are either state-owned or private. State assembly markets are managed by the Fish Marketing Organization (FMO), where fish are sold through registered fish agents. On the other hand, private assembly markets are run by private persons where fish traders are non-registered fish agents. Fish collectors who are collecting fish from the primary markets are involved directly in selling. The fish farmers can bring their produce directly to these markets and sell directly without resorting from any intermediaries. However, in some markets, both fish farmers and agents collect fish from the primary markets. Fish brought to these markets by farmers are sold through fish agents, for which the farmers pay a commission.

Fish agents, both FMO and private, as well as fish collectors in the assembly markets distribute most fish to wholesalers (44% of total fish volume), then to retailers (16%) and fish processors/cold storage (14%). Wholesalers distribute most of the fish directly to retailers (about 55% of total fish volume), while 4% is sold to processors/cold storage and 1% is exported. Fish exported by wholesalers to nearby neighboring countries (like Myanmar) are mostly catfish.

Processors/cold storage have another route of processed fish distribution: 13% of total fish production is distributed to wholesalers; 6% is sold directly to retailers and another 6% is exported. Most of fish exported are chilled and frozen. During the past years, the volume of many species that are exported fluctuated.

Retailers are the last channel before the fish reach the consumer. From the marketing channel and percentage of freshwater fish distribution, it can be deduced that 93.4% of total cultured freshwater fish is consumed domestically, of which 74.3% is bought fresh/alive and 19.1% is bought in several processed forms. Exports account for 7% of total freshwater fish production, mostly in chilled/frozen form. As far as marketing channels in rural areas are concerned, small-scale wholesalers and retailers buy the fish directly at the fish farms nearby. Species of fish traded in rural areas are low-priced species of small size that consumers are able to afford.

At the primary market level, the main constraint for Bangladeshi and Indian fish farmers are lack of bargaining power and market information and barriers to entry in the market. Lack of transport is another important constraint preventing producers from sending produce to higher markets. The farmers often end up being paid lower prices by the existing buyers, as the product cannot be kept for long periods because icing facilities are absent in almost all primary markets.

Small business-oriented services are emerging in several rural areas in Asia, and leading to significant improvements in profitability of small aquaculture enterprises. While globalization has opened new markets for aquaculture products, it has also required stricter standards related to food safety, traceability and other nontariff requirements. The smaller producers face major constraints, especially with respect to the export market. On the other hand, it is increasingly difficult to participate in the modern value chains. The farmers who are able to access markets can find themselves disadvantages due to their weak bargaining position. Requirements being driven by retailers and public concerns for certification of the safety and quality of aquaculture products along with the social and environmental impacts of aquaculture production can add further hurdles to market access, with small farmers set to face particular difficulties in some developing countries. Medium and larger enterprises comprise increasingly significant contributions to aquaculture production.

Risk management strategies for larger buyers and the need for large and regular supplies of aquaculture product reinforce the trend towards larger operations. This trend can have positive implications for food supplies, such as supplying growing urban populations with low cost product, and creating employment, but can have negative implications for small scale farmers, who face difficulties in competing

and accessing the necessary services, finance and markets to remain competitive (Phillips et al., 2010).

2.2.3 Challenges of Small-scale Fish Farming

According to the FAO, it was found that the challenge today is to help building the capacity of smallholders and their organizations so that the farmers can deliver what the market requires, and in turn encourage businesses to adapt their models to be inclusive and supportive of small-scale producers (Bill Vorley et al., 2008). It also means bringing together different players and skills along the value chain for sustainable enterprise development. At the same time, the establishment, maintenance and enforcement of appropriate legal, regulatory and administrative frameworks in developing countries (producers of majority of aquaculture products) are key requirements towards responsible and sustainable aquaculture sector.

The frameworks still do not cover all aspects of aquaculture and its value chain and provide economic incentives that encourage best practices so that prompting and assisting farmers to elaborate, support and enforce self-regulating management codes and promote sustainability. Small to medium enterprise aquacultures tend to be highly innovative and entrepreneurial by taking calculated financial and technical risks.

The challenges are mostly found relating to the environment, climate change impacts, resource use, genetic and biodiversity, and biosecurity. Due to climate changes, it happens loss of activities and revenue in aquaculture area. The impact of water resources, wild stocks and land utilization are major challenges for aquaculture farming. A national policy sets priorities on which strategies and plans can be developed and supported by donors. In order to succeed long term, aquaculture needs to be effective for profits and it is essential that reliable markets are secured with a potential value chain that ensures financial viability for all participants.

This aspect needs serious consideration during the design phase, as it might influence key design criteria, such as: species selection to reflect market demand, price and seasonality, system design which in turn influences input costs, margins and risk, production scheduling, processing and transformation. Small-scale fish farmers can gain the advantages of economy of scale in accessing services and markets, which are otherwise limited to large commercial farmers. Insufficient access to capital and cash liquidity is one of the most commonly stated constraints to aquaculture

development. It is therefore important that financial structures are in place to provide responsible and reasonably priced lending to project beneficiaries as the famers expand, especially when the project is focusing on other elements rather than financing, such as technical development, risk minimization or capacity building.

Small-scale farmers may lack the credibility and collateral for accessing formal credit, sometimes resulting in unfavorable borrowing from informal sources. It is ensure land tenure is equally important, and development of pond farming or other forms of extensive or semi-extensive aquaculture are highly dependent upon a reliable access to suitable water resources (Huntington, 2017)**.**

2.3 Contributing the Policies to the Global Agenda

Several countries and regional organizations have incorporated reference to the SSF Guidelines in relevant policies and strategies, and new initiatives by NGOs and development partners are increasingly addressing small-scale fisheries issues in new ways and more explicitly.

The SSF Guidelines follow a human rights–based approach and see small-scale fisheries through a broader lens, looking beyond the fisheries and aquaculture sector. The guidelines promote a holistic approach to small-scale fisheries governance and management that takes fishery-based livelihoods into consideration.

On 22 November 2017, the seventy-second session of the General Assembly of the United Nations proclaimed 2022 as the International Year of Artisanal Fisheries and Aquaculture (IYAFA). The IYAFA is intended to sensitize public opinion and governments about the importance of adopting specific public policies and programs to promote sustainable artisanal fisheries and aquaculture, paying particular attention to the most vulnerable rural areas, constrained by poor governance and low capacity for sustainable resource use. The IYAFA will also provide a unique opportunity to promote the objectives of the SSF Guidelines. The five years leading to 2022 provide ample opportunity to chart a road map for action.

At the regional level, the incorporation of the SSF Guidelines in relevant policies, strategies and initiatives provides an enabling policy environment for change. Regions are using different entry points to put those policies and strategies into action, as an example, SEAFDEC organized a workshop on the human rights–based approach and gender equity in regional implementation of the SSF Guidelines in September 2017 in Bangkok (FAO, 2018).

2.4 Review on Previous Studies

Saw Moe Oo (2013) studied the status of Aquaculture Farms for the fish farms in Twante and Maubin Township. The objective was to explore the farming system and fish farming management in order to recommend the potentials of aquaculture development in future. As the findings, it was highlighted that the training and capacity building programs to aquaculture technology and extension activities should be provided pior to the future aquaculture development. The recommendation includes the provision of services such as the financial supporting and facilitate access to inputs such as fish seed, feed, fuel,etc. for aquaculture sector development.

Wine Wai Wai Win (2014) conducted a research on the Large Scale and Small scale fish farming in aquaculture sector. It was recommended that the urgent needs to consider the foundation on which to extend the aquaculture sector to ensure the sustainable development. In order to fast growing aquaculture industry in Myanmar, both government and private organization need to follow more environmentally friendly technologies which have no negative impact on community.

As a study result of the project focused on a farmer participatory small-scale in Assam state of India, it was found that some farmers from non-project areas visited the project areas to get technical assistance from the project beneficiaries. Some of the project's extension workers also provided technical services in non-project areas. The extension poster prepared on the basic concept of rural aquaculture was appreciated and widely circulated. The initiatives under the project have made a significant contribution to the promotion of aquaculture in the area. However, more field trials under the guidance of scientists are required to refine and improve the technologies for increasing production per unit area of pond.

CHAPTER III

MYAMAR AQUACULTUER SECTOR AND FISH FARMING

3.1 Background of the Myanmar Fisheries

The role of fishery in Myanmar's history started in the mid of 1800s in the time of King of Ava. The Burma Fisheries Act, 1875 was also enacted in the colonial period for the purpose of raising the revenue from the sector. In 1948, the institution for fishery was set up as Fisheries Bureau under Agriculture and Rural Development Cooperation (ARC) (Khin, 2008). In 1972, the Division of Fisheries was upgraded to Department level in order to enhance the activities.

After 1988, the State Law and Order Restoration Council government promulgated Union of Burma of Foreign Investment Law in line with market-oriented economic system and introduced the "open-door policy". The foreign investment was promoted with four policies including two policies which targeted (i) to increase the utilization of abundant resources, (ii) to increase the export. As the beginning of fishery sector in the foreign market initiation, the cooperation between Myanmar Fishery Enterprise and fisheries importers based in Hong Kong and Singapore started from a pilot project, which supported to increase the shrimp export. Then, cooperation projects transformed to Joint Venture Cooperation system (JVC).

From 1988 onwards, the market oriented economic system has been adopted in Myanmar. Since then, all fishery business in Myanmar was carried out by the private sector.

Fishery sector has been growing as an important role of Myanmar's socio-economic development and food diet after agriculture production since some decades ago. It has been the fourth largest contributor to the national gross domestic product (GDP), and the fourth source of foreign exchange earning obtained was the fishery sector (DOF, 2017).

3.1.1 Roles of Aquaculture and Fish farming

The aquaculture sector was institutionalized in 1954 with the establishment of an Aquaculture Section within the Agriculture and Rural Development Corporation. Aquaculture expanded based on the capture and nursing of wild carp species fingerlings (i.e., rohu, catla, and mrigal). Tilapia was introduced from Thailand in the late 1950's followed by common carp from Israel and Indonesia in 1964. From there, the sector rapidly grew. In 1988, the annual growth rate of the sector was estimated to be as high as 40%, and the expansion of the sector continued with the introduction of hybrid clarias (1990) and pangasius culture (1994).

In 2000, the aquaculture sector continued its expansion, and Myanmar's first aquaculture plan was implemented, with a focus on shrimp and finfish aquaculture development. The sector had a production yield of 0.5 million metric tonnes. In 2004, Myanmar was listed among the world's top 10 aquaculture-producing nations, with a production value of USD 1.231 billion. By 2010, more than 20 species were cultured and the freshwater pond surface area reached 87, 134 hectares (ha).

Production more than doubled in a decade (2004 to 2014) with an average fitted annual growth rate of 8.7% based on DOF data.

At the regional level, freshwater aquaculture production reaching more than 900,000 metric tonnes annually makes Myanmar the third largest freshwater fish aquaculture sector in Southeast Asia , and is larger than Thailand since 2007, behind Indonesia and Vietnam (FIGIS, 2016). In 2017, aquaculture production in the Ayeyarwady Basin reached an estimated 958,000 metric tonnes , accounting for 91% of the total aquaculture production of the country. The total area dedicated to aquaculture is approximately 278,841 acres in 2017, accounting for an estimated 57% of total aquaculture area in the country (DOF, 2017).

Fish farming also generates a lots of employment about twice as much per acre as paddy farming. Approximately 20% of domestic fish consumption relies on the fish farming in Myanmar.

3.2 Fishery Production in Myanmar

In accordance with the Central Statistical Organization's data (2018), the fishery sector in combining with livestock sector has been contributing to 8% of Myanmar GDP.

3.2.1 Production

The country's fishing waters including Exclusive Economic Zone (EEZ) is about 486,000 km^2 and the continental shelf area is 228,781. The length of its continental coastline is 2,832 km divided into three coastal regions, the Rakhine Coastal region, the Ayeyarwaddy and Gulf of Mottama (Mataban) region (the Delta Zone), and Tanintharyi The continental itself spreads over 228,751 square kilometers with the Exclusive Economic Zone (EEZ), extending a distance of 200 nautical miles from the shoreline.

The 2832 km of Myanmar costal line area is the capture area for marine fishery and the inland water bodies of 8.1 million ha is the rivers, streams and lakes and 491345 acres (ponds) are for aquaculture production.

The type of fisheries in Myanmar is determined by nature of catch. It can be classified into freshwater fisheries and marine fisheries. Freshwater fisheries consist of (a) aquaculture, (b) leasable, (c) open fisheries. Marine fisheries include (a) inshore fisheries and (b) off-shore fisheries.

The production of freshwater fisheries and marine fisheries is described as following Table;

Table(3.1) Fishery Production (2008-2009 to 2017-2018)

(Thousand Metric Tonnes)

No.	Year	Total	Freshwater Fisheries			Marine Fisheries
			Aquaculture	Leasable Fisheries	Open Fisheries	
1.	2008-2009	3542.19	775.25	209.72	689.71	1867.51
2.	2009-2010	3921.97	858.76	237.46	764.97	2060.78
3.	2010-2011	4163.46	830.48	250.04	913.12	2169.82
4.	2011-2012	4478.35	899.05	282.64	963.82	2332.84
5.	2012-2013	4716.22	929.38	290.00	1012.97	2483.87
6.	2013-2014	5047.40	964.12	304.44	1076.59	2702.25
7.	2014-2015	5316.95	999.63	315.36	1147.76	2854.20
8.	2015-2016	5591.83	1014.42	338.69	1241.98	2996.74
9.	2016-2017	5675.47	1048.69	339.23	1251.13	3036.42
10.	2017-2018	5877.46	1130.35	341.02	1253.95	3152.14

Source : Fishery Statistics, 2018 (DOF)

The freshwater fishery production in 2017-2018 was 2.725 million MT while the marine fisheries reached to 3.152 million MT. Aquaculture production contributed 19.23% to the total fishery production. In 2008-2019, the total freshwater fishery production accounted 1.674 million MT and reached to 2.725 million MT tonnes in 2017-2018. Within 10 years, 62.74% of growth rate was significantly obtained as the production has been increased year by year. In aquaculture sector, the production is increased to 1130.35 million MT and the growth rate was 45.8 % from 2008 to 2018.

3.2.2 Export Market

Total landed value of fish in the country amounted to US$ 711.72 in million (DoF, 2018) as shown in (Table 3.2). Fish is also a major export commodity for raw material and processing products to foreign countries. The exported amount of fish and fishery product was (0.57) million metric tonnes and the value of which was (711.72) million in US$ in 2017-2018. It was exported to 46 different countries. The exported amount was 10% of the total production of fish in Myanmar in the period of 2017-2018.

Fish and Fish products is increased to 45.100 $ million in January 2019 according to the CEIC data source.

The total production of fishery reached to 5.87 million metric tonnes in 2018 and the amount of production has been increasing yearly in ASEAN region. Based on DOF data, it mentions that for national fish production (5.87 million metric tonnes) and subtracting exports (0.57 million metric tonnes) gives the total available fish for consumption in Myanmar at approximately 5.30 million metric tonnes, suggesting a per capita consumption is over 56 kg/per year.

In Myanmar, aquaculture areas have been increased from 30282 acres in 1990-1991 to 491345 acres in 2017-2018 and reached to the highest percentage of the fishery production.

Table (3.2) Fishery Exports (2013-2018)

Metric Tonnes (US $ in Million)

Year	Fish		Prawns		Others		Total	
	Qty	Value	Qty	Value	Qty	Value	Qty	Value
2013-2014	237142.31	286.93	16508.97	61.98	91616.08	187.36	345267.36	536.27
2014-2015	225974.93	258.61	17527.33	56.89	94788.33	166.75	338290.59	482.25
2015-2016	246970.93	274.25	13673.49	49.64	108326.47	178.74	368970.89	502.63
2016-2017	290580.04	319.04	13082.46	58.21	135044.01	228.57	438706.51	605.82
2017-2018	394135.80	385.81	15905.44	60.78	158186.09	265.13	568227.33	711.72

Source: Fishery Statistics, 2018(DOF)

Top ten countries for exports of Myanmar fisheries are the countries from Asia, Southeast Asia, Middle east and western countries. According to data of 2016-2018, the list of top ten countries for the export market is described in Table (3.3).

Table (3.3) Top ten country list for the export with volume amount and the value (2016-2018)

No.	2016-2017			2017-2018		
	Countries	MT	US$-Million	Countries	MT	US$-Million
1.	Thailand	211097.950	198.709	Thailand	301984.934	258.808
2.	China	100200.229	190.119	China	117797.366	197.963
3.	Malaysia	11629.971	35.349	Singapore	27407.662	36.637
4.	Japan	6049.425	24.583	Malaysia	12603.042	33.325
5.	Saudi	21129.795	23.919	Saudi	25411.982	28.879
6.	Singapore	15076.495	22.710	Japan	7132.693	27.672
7.	Bangladesh	11117.243	15.393	USA	5086.237	18.852
8.	UAE	13884.501	14.897	UAE	13815.933	15.425
9.	UK	6609.502	12.516	UK	7386.898	14.338
10.	USA	3525.811	12.146	Bangladesh	11696.075	14.292

Source: Fishery Statistics,2018 (DOF)

Among top ten countries for export markets, Thailand stands in the first position from from 2016 to 2018. Singapore became third country in 2018. However, the demand of Bangladesh was significantly decreased.

3.2.3 Common Species and Feeding for Fish Farming in Myanmar

At present, over 20 species of fresh water fishes are being cultured which consists of Rohu, Common carp, Indian major carps, Chinese carps, Tilapia,

Pangasius and walking catfishes and Pacu. Rohu *(Labeo rohita)* is as the most common and commercial cultured species which is native to Myanmar (DOF, 2018).

Although giant freshwater prawn and tilapia exist, but stocking these species is limited by the absence of proper seed production (Belton et al., 2015). According to the fishery statistics of DOF (2018), there have been 491345 acres of total freshwater prawn and fish farms in the country.

Rohu made up 80% of the fish harvest from 2006 to 2016 in the primary fish growing regions of Myanmar (Belton et al., 2017).Currently, rohu remains a dominant species representing 70% of Myanmar's aquaculture production (Belton et al., 2015).

Fingerlings are either sourced from a hatchery and wild source (carp and tiger shrimp) or, in a few cases, depend entirely on wild stock (swamp eel, mud crab) (MYFish, 2014). Fingerling production is under-developed in Myanmar, with a small number of hatcheries operating at a limited technological level. Fingerling production is concentrated in the Yangon and Mandalay Regions according to the fishery statistics 2016, but most of the production is used to stock natural waterbodies (Belton et al., 2015). In addition to government hatcheries, an increasing number of private hatcheries and backyard hatcheries (approximately 100 units) support the sector (Belton et al., 2015). The production reached 631.16 million fry and fingerlings by DOF hatcheries and 37 private hatcheries had produced 2462.83 million fry and fingerlings in 2018 (DOF, 2018).

Stocking size differs according to the region and the strategy deployed by producers:

1) In Yangon and Ayeyarwady Regions, farmers prefer to stock yearlings 12 to 15 centimeters to shorten the culture cycle and reach market size within 9 months, with smaller farms stoking larger fingerlings.
2) In the Lower and Middle Ayeyarwady Basin, it is common practice to stock fingerlings from 2 to 5 centimeters and to have a longer grow-out period (Joffre, 2017).

The recent increase in productivity is mostly due to improved management practices, stocking larger fingerlings to reduce the culture period from 12 to 9 months and increase in feed use (Belton et al., 2017). Carp polyculture with organic fertilization and supplementary feeding is not practiced by small-scale aquaculture farmers as frequently as in other regions of Myanmar. Feeding is normally limited to the use of raw feed such as groundnut meal, soybean, meal and rice bran. Coconut cake is an

important feed component for freshwater prawns. The use of manufactured pellet feed is apparently limited.

Table (3.4) Major species for fish farming in Myanmar

Unit-million (Seed)

No.	Myanmar Name	Common Name	Scientific Name	2013-14	2014-15	2015-16	2016-17	2017-18
1.	Nga Myit Chin	Rohu	*Labeo rohita*	384.861	397.569	419.600	455.631	434.623
2.	Nga Khone Ma	Tarpian	*Barbodes gonionotus*	73.478	89.541	100.879	79.120	89.759
3.	Shwe Wa Nga Gyin	Common Carp	*Cyprinus carpio*	41.914	38.751	35.981	46.795	41.818
4.	Tilapia	Tilapia	*Tilapia spp:*	13.571	11.492	11.792	15.446	14.329
5.	Nga Dan	Stripped Catfish	*Pangasius sutchi*	7.111	5.675	7.787	8.301	9.310
6.	Pa Cu (Yae Cho Nga Mote)	Freshwat -er Pomfret	*Piritusspp:*	5.569	7.325	8.265	7.810	8.455
7.	Nga Khaung Pwa	Catla	*Catla*	7.054	6.976	6.877	9.191	7.987
8.	Myetsar Nga Gyin	Grass Carp	*Ctenophar yngo-don idella*	5.598	5.483	5.378	7.074	7.337
9.	Ngwe Yaung Nga Gyin	Silver Carp	*Hypophtha l-michtys molitrix*	5.533	4.715	4.146	6.432	6.72
10.	Nga Gyin Phyu	Mrigal	*Cirrhina Mrigala*	2.854	2.275	3.190	4.735	6.197

Source : Fishery Statistics 2018, DOF

DOF hatchery stations produced 22 species for aquaculture sector. Among them major 10 species are produced depending on local and foreign demands.

3.3 Small-scale Aquaculture and Fish Farming

Small-scale fish farming and capture fisheries are encouraged by the government for the food security and poverty alleviation, especially for the rural people. In Myanmar, two types of small-scale aquaculture are found as costal aquaculture and pond culture fish farming.

Small-scale fish farming usually stands as main family livelihood operated by family members. Generally the fish ponds areas are not more than ten acres in total comprising a good number of half to one to two acre fish ponds. Households who farm fish operate little agricultural land on average (0.5 acres and 1.4 acres for households with specialized nurseries and grow out farms respectively) and this farming is defined based on farm size which is less than 1 acre . Sometimes integrating with other business such as poultry farming or plantation. In small-scale farm semi-intensive culture system is widely used and the ponds are fittled with inlet and outlet water pipes for drainage or in areas with easy access to enough, good and clean water source. Almost of all farms and ponds are in capability of water exchange by gravity or engine whenever needed.

Such ponds are made by manual labors mainly based on availability of funding, land, topography, way of water drained, type of farming and farmer's idea, the ponds are subsequently small in size, not in proper design, irregular in shape and shallow in depth. Before stocking with fish seeds or fingerlings, the pond management has to do first with technical treatment such as drying, liming, fertilization up to some extent and finally filled in with water. When the water turns green taken a indication of fully furnished with natural food, the fish from hatcheries are stocked to be in accordance with pond size, culture period, season and to harvest after the targeted period.

3.3.1 Costal Aquaculture

Coastal aquaculture in Myanmar is mainly limited to shrimp farming, with smaller quantities of mud crab and groupers farmed. The sector contributes significant export earnings, and shows potential for future development and diversification. Extensive brackish waters, tidal estuaries and clean marine environments exist along a long coastline of nearly 3000 km, with significant scope for coastal aquaculture development. Most coastal aquaculture in Myanmar is practiced with traditional methods, but intensification of shrimp farming in particular is gathering pace.

Because of low urbanization and industrialization in coastal areas, water pollution caused by chemical and industrial waste is negligible providing opportunities for production of high quality products. However, degradation of the resource base and habitats, such as coastal mangroves and coral reefs, is a concern.

Investment in coastal aquaculture so far is focused on export commodities; and it appears to be mainly wealthier individuals/companies who are directly involved, with shrimp as the main item, and smaller quantities of crab and grouper. Investment by larger companies/individuals has proved important in developing technology and infrastructure for aquaculture, for example, private sector investment support to shrimp hatcheries, and employment, such as several hundred people involved in Myeik (women in soft-shell crab farm) and input supplies (mud crab, trash fish, and grouper fry supply to cage farms in the Thanintharyi division).

3.3.2 Pond culture Fish Farming

There are two major aquaculture (pond) systems practiced in Myanmar, i.e. freshwater pond and brackish water pond culture.

Freshwater fish farming has grown rapidly in Myanmar over the last two decades and plays an increasingly important role in national fish supply, (Ben Belton M. F., 2017)**.**The small-scale aquaculture consists of family ponds, hatchery and additional services, nursing, licensed fish pond; and aquaculture support services (feed production; naturally occurring fodder supply).

Freshwater fish ponds are defined as small, medium and large. In the analysis that follows, the growout farms are divided into three size categories as follows: 'small' (<10 acres, 51% of growout farms); 'medium' (between 10 and 40 acres, 28%); 'large' (40 acres and above, 21%). Among growout farms, 80% are 'semi-intensive', which defined simply as those where fish are fed exclusively on agro-processing byproducts such as rice bran and peanut oilcake. 'Intensive' farms (defined here as those using pelleted fish feeds at any time during the production cycle) account for 16% of growout farms. Four percent of growout farms sampled are 'integrated' with poultry houses built above ponds that provide nutrients for fish in the form of droppings and spilt feed.

In order for development of small-scale fish ponds, the pond size (less than 50x 25 feet) is allowed to do farming without license issued by the Department of Fisheries and therefore land converted to fish ponds below 60 m^2 is not controlled or

recorded. However, such small-scale ponds, managed initially with minimal investment have proven highly successful contributions to the livelihoods of poor farming families in neighbouring countries, especially where large fingerlings can be stocked or nursed in “hapas” before release. It is highly recommended that future poverty focused food security development involving small-scale pond aquaculture be considered also in Myanmar.

3.3.3 Aquaculture Production, Income Generation and Labour Inputs

By 2017, annual freshwater aquaculture production was more than 1130.35 thousand metric tonnes. This rapid growth of aquaculture is illustrated in the production statistics presented in the section below.

Aquaculture generates much higher earnings per hectare than crop farming. The average gross margin earned by fish farmers with grow out farms is nearly $650/acre ($1600/ha). Surveyed crop farming households in ‘aquaculture cluster’ village tracts make an average annual gross margin of just $150/acre ($380/ha) across all field crops. Gross margins for individual crops in these village tracts range from $85/acre ($210/ha) for monsoon paddy, to $175/acre ($430/ha) for black gram.

Aquaculture creates more on-farm employment opportunities than agriculture. Considering all inputs of family labor, hired casual labor and hired long-term labor, fish farms require almost four times more labor per acre than crop farms (94 person days/year, versus 24 person days/year) (Belton, 2014) . Fishers and fish farmer population including shrimp farmers is 48672 in 2016-2017 (DOF, 2017).

Table (3.5) Total aquaculture ponds and production

No.	Year	Area of Aquaculture Ponds (Acres)	Production of Aquaculture Ponds (Thousand Metric Tonnes)
1.	2008-2009	440585	775.25
2.	2009-2010	442702	858.76
3.	2010-2011	443695	830.48
4.	2011-2012	448468	899.05
5.	2012-2013	449692	929.38
6.	2013-2014	450324	964.12
7.	2014-2015	469153	999.63
8.	2015-2016	478002	1014.42
9.	2016-2017	487525	1048.69
10	2017-2018	491345	1130.35

Source: Fishery Statistics, 2018(DOF)

3.3.4 Pond culture, Stocking density and Disease control

(a) Pond culture

Intensive systems in Myanmar are limited to a small number of specialized marine farms producing fin fish and white shrimp (*Litopenaeus vannamei*) and a few farms producing pangasius and pacu. Polyculture in a semi-intensive system dominates the sector, with rohu accounting for 50 to 80% of the stocked biomass (Belton et al., 2017). In these systems, where fish derive nutrients from both natural feed produced in the pond (phytoplankton and zooplankton) and from external inputs of supplemental feed, productivity ranged from as little as one tonne per hectare (t/ha) to a maximum of 10 t/ha, with a mean of 3.7 t/ha (Olivier Joffre, 2017).

Integrating fish farming is also found in some areas such as with poultry farms and plantation for supplementary income. The number of fish ponds and total areas are listed in the Table (3.6) and Table (3.7).

Table (3.6) Total area of fish ponds in Myanmar (2012-2018)

No.	Year	Area of Fish Ponds (Acres)
1.	2012-2013	221395
2.	2013-2014	222028
3.	2014-2015	232515
4.	2015-2016	239671
5.	2016-2017	245807
6.	2017-2018	247007

Source: Fishery Statistics 2018,DOF

Table (3.7) Number of fish ponds in Regions and States

No.	States/Regions	2014-2015	2015-2016	2016-2017	2017-2018
1	Kachin	2313	2312	2312	2344
2	Kayah	798	819	893	893
3	Kayin	589	675	711	731
4	Chin	296	296	296	296
5	Sagaing	6374	7128	7580	7580
6	Taninthayi	1065	1120	1120	1120
7	Bago	27158	28324	31121	31146
8	Magway	425	425	425	425
9	Mandalay	7609	7970	7902	7873
10	Mon	979	995	995	1001
11	Rakhine	20	20	20	20
12	Yangon	65848	66015	67038	66444
13	Shan	3408	3408	3408	3408
14	Ayeyarwady	115462	119993	121811	123551
15	Nay Pyi Taw	171	171	175	175

Source: Fishery Statistics 2018,DOF

(b) Stocking Density

The standardize stocking density is based on the fish species and pond area. The stocking is calculated as 2500 fingerling units per acre if the fish species are culture in long-term period, maximum 2 years such as Ronu. Short –term fish culturing needs 5000 fingerlings per acre for fish species such as tilapia, tarpian, which can be harvested after 6 months.

(c) Fertilizer Usage

Use of fertilizers is extremely limited. Pond fertilization is a simple, low cost technique that can significantly improve farm productivity by stimulating blooms of plankton that provide natural food for fish. However, only 25% of farms surveyed used any kind of fertilizer, and fertilizers accounted for less than 1% of total operating costs. On average, more productive farms spent a smaller share of their feed budgets on rice bran than less productive farms, and a higher share on pelleted feeds.

(d) Disease Control

Non-infectious diseases are common in aquaculture and, although the farmers generally receive less attention than exotic diseases, can have equally devasting effects on production over a very short period. Inadequate management, poor water quality, inappropriate nutrition, aquatic environmental degradation, and exposure to chronic or acute contamination have all been linked to mass mortalities of a wide range of cultured and wild species.

The approaches for disease prevention are (i) control of movement of animals onto farm/site, (ii) destruction of clinically sick animals,(iii) emergency harvest of clinically healthy animals, (iv) sanitary measures such as disinfection or fallowing prior to re-stocking.

3.4 Roles of Department of Fisheries

Department of Fisheries (DOF) under Ministry of Agriculture, Livestock and Irrigation is the responsible institution for the management of fishery sector in Myanmar. In order for sustainable improvement of the sector DOF sets up the objectives as follows;

i. To promulgate the fisheries laws and implementation of action plans in line with the sustainable development goals.

ii. To be availability of qualified information and collection of statistical data related to fisheries sector in line with the standard indicators.

iii. To conduct systematic implementation of fisheries co-management and ecosystem approach to improve the fisheries management.

iv. To develop the aquaculture industry by implementation of advanced techniques including Good Aquaculture Practices.

v. To implement research and development, extension and awareness services, and human resources development oriented towards sustainable use of fisheries resources.

vi. To compliance with quality standards of fishery products aligned with the market requirements.

Main policy targets on ensuring food security, food safety and sustainable development of fisheries sector by conservation of fisheries resources in accordance with the fisheries laws.

The responsibilities of DOF for development and management in fisheries are as follows;-

(1)Conservation and rehabilitation of fishery resources;

(2)Promotion of fisheries researches and surveys;

(3)Collection and compilation of fishery statistics and information;

(4)Extension services;

(5)Supervision of fishery sectors;

(6)Sustainability of fishery resources;

The conservation of fisheries resources and the maintenances of ecological system are the main factors in the development of fisheries. Regarding the maintenances of ecosystem in fisheries, the management of conservation in the freshwater bodies (ponds, lakes, rivers, dams) and includes marine ecosystem approach in marine water and its habitats to numerous plants, animals.

3.4.1 Policies for Fishery Development in Myanmar

Ministry of Agriculture, Livestock and Irrigation sets up the main objectives as follows;

i. To support rural development through extension of aquaculture activities.

ii. To increase export earnings from shrimp aquaculture

iii. To sustain and increase the fisheries resources of both inland and marine waters

iv. To accelerate the integrated fisheries development process without impacting on the natural environment

v. To adopt and implement an extension programme to ensure sustainable fisheries development

The Ministry of Agriculture, Livestock and Irrigation (MOALI) had set up the main policy on the poverty reduction and rural development including the aquaculture sector. MOALI launched the drafting a National Aquaculture Development Plan to preserve the country's fish supplies (Thiha, 2018).

The Government of Myanmar promulgated the four laws for the purposes of management in fishery industry and protecting the fishery resource more efficiently, such as "Law relating to the fishery rights of foreign fishing vessels (1989)", "Aquaculture Law (1989)", "Myanmar Marine Fisheries Law (1990)", "Freshwater Fisheries Law (1991)". In order for more effective management in legal aspect, the existing laws are being amended as drafting stage. The Freshwater Law has been empowered to the respective state and region authorities. The amendment for combining of "Law relating to the fishery rights of foreign fishing vessels (1989)" and "Myanmar Marine Fisheries Law" is still being drafted as Union Fishery Law. To harmonize the modernization of aquaculture farming, Aquaculture Law also being amended.

Fisheries sector of Mya Sein Yaung (Emerald Green) development project supported 30 million kyats as revolving fund for each villages of 375 villages where have potential to develop in fisheries sector in 15 Regions and States in the fiscal year of 2017-2018 from the funding sources of government's capital budget (DoF, 2018). The loan also can be accessed from the Myanmar Livestock and Fishery Bank.

3.4.2 Policy Strengthening with Regional Countries and Global Organizations

Since 2007, DOF has participated the ASEAN Rapid Alert system on food and feed, which is on-going network for notification of direct or indirect risks to human health deriving from food or feed between competent authorities. It is strengthening the Inspection and Certificate Unit such as Good Manufacturing Practices (GMP), Good Hygiene Practices (GHP) and Hazard Analysis Critical Control Point System (HACCP). Myanmar is one of the members of Network of Aquaculture Center in the

Asia Pacific (NACA), which is mainly support for the expertise and facilities of members for the mutual benefit and can be access via NACA Agreement, international treaty and the member of SEAFDEC (Southeast Asian State of Fisheries Development Center).

3.4.3 Technical Assistances by DOF

DOF provides the trainings to its officials and the famers by the plan of Departments and in cooperation with international organizations to sustain the aquaculture fish farming in Myanmar. In country wise, there are 3 training centers developed by DOF and fishery hatching station are also existing in 27 locations.

The followings are location of training centers;

1) Institute of Fisheries Technology - IFT, Gyogone (Yangon Region)
2) Upper Myanmar Fisheries Training Center, Sagaing (Sagaing Region) and
3) Lower Myanmar Fisheries Training Center, Pyapon (Ayeyarwady Region)

For farmers on small-scale aquaculture fisheries, the following courses are developed by DOF

i. General Knowledge of fish culture
ii. Procedure of site selection, pond construction, pond preparation and pond management for Fish culture
iii. Knowledge of book keeping and legal procedure of fish pond construction and license for farmers
iv. Small-scale hatchery and seed production
v. Management model of the core farmer by selling fish seeds
vi. Guideline for farmer to farmer aquaculture extension approaches
vii. Site preparation for paddy cum fishery

In the field of aquaculture, a total of 48672 fish and shrimp farmers were involved in various aquaculture systems. As Myanmar's aquaculture is mainly based on pond cultured system, mostly men labours are working in fish/shrimp ponds. There are 57957 number of permanent men labours working in 2016-2017 fiscal year (DOF, 2017).

3.4.4 International Assistances to Fishery Development

The international organizations have been supporting on the improvement of the aquaculture farming including the small-scale fishery farming in cooperation with DOF. The following Table (3.8) shows the information of international cooperation.

Table (3.8) Cooperation with international organizations

Name of Partner	Duration of Period	Project name	Targeted Region
JICA	2009-2013	Small-scale aquaculture Extension for Promotion of Livelihood of Rural Community in CDZ Project (SAEP I)	Ayeyarwaddy, Bago, Kayin
JICA	2014-2019	Small-scale aquaculture Extension for Promotion of Livelihood of Rural Community in CDZ Project" (SAEP II)	Magway, Mandalay, Sagaing
KOICA	2014-2019	Project for Development of Inland Fish Farming Technology	Thayetkone Fisheries Station in Mandalay
MyCulture Funded by World Fish	2015-2018	Promoting sustainable growth of aquaculture in Myanmar to improve food security and income for communities in the Ayeyarwady Delta and Central Dry Zone	Ayeyarwaddy Delta
GIZ	2016-2021	Myanmar Sustainable Aquaculture Programme (MYSAP)	Ayeyarwaddy,Central Dry Zone, Rakhine and Shan States
JIRCAS	2017-2021	Development of Sustainable and environmental friendly aquaculture techniques in coastal waters in Myanmar (JIRCAS)	Tanintharyi Division and Myeik Coastal
MYFish	2017-2020	Improving Fishery Management in Support of Better Governance of Myanmar's Inland and Delta Fisheries (MYFish-2) (AUD-2.64 millions) funded by WorldFish Center from 2017-2020	Ayeyarwaddy and Central Dry Zone
World Fish	2017-2021	The Development of Rice-Fish System (RFS) in the Ayeyarwady Delta Myanmar (Rice-Fish)	Ayeyarwaddy Delta
CIHEAM	2015-2016	Small-scale fishery and aquaculture in Myanmar for institutional support and extension service to the private sector (fishermen and aquaculturists).	Yangon

Source: Fishery Statistics, 2018(DOF)

Most of organizations are supporting the small-scale fish farming techniques to the rural communities, especially people who can less access to this farming from least developing regions. Not only the farmers but also the instiutation have the benefits by receiving the technical assistances.

CHAPTER IV
SURVEY ANALYSIS

4.1 Survey Profile

Kayin state lies in the southeast of Myanmar, sharing most of its eastern border with Thailand. Inside Myanmar, it has common borders with Mandalay Region and Shan state to the north, with Kayah state lying to the north-east, and Mon state and Bago Region to the west. Kayin state is the 3rd highest migrant population to Thailand because of its geographical location.

Kayin state comprises of Hpa-an, Hlaing Bwe, Thandaunggyi, Kawtkareik, Kyar Inn Seik Gyi, Hpa Pon, Myawaddy townships, where the fish farming are existing. 731 ponds are existing in Kayin State, less number comparing to other regions like Chin state and Magway Region (DOF, 2018)**.**Although it was 399 ponds in 2009, it has been increased to 731 ponds gradually within 10 years. According to the information of DOF Kayin State, total farmers 337 are farming the pond culture in Kayin (DOF, 2018). Among townships, the number of acres for fish farming in Hpan-an is 78.11% of total acres of Kayin State.

Fishery production of Hpa-an township mostly relies on the open-fishery farming (Inn fishery system) due to the many sources of rivers, creeks and stream are existing in that area rather than pond culture. Total production of aquaculture in Hpa-an is 864000.26 viss as of data (2018-2019) and it was found that 65.87 % of famers are small-scale owners based on the data of Kayin State DOF.

In Hpa-an township, the fish farming of 29 villages is 76.32% of whole Hpa-an district, which comprises of Hpa-an and Hlaing Bwe townships in Kayin State according to the Kayin DOF's annual report.

The survey was conducted in 5 villages as a sample size by interviewing with individual farmers.

4.2 Survey Design

The information of study was obtained by interviewing process with farm owners from 5 villages of Hpa-an township by formulating questionnaires. The study is formulated in combination of secondary data and primary data. Secondary data is obtained from the FAO reports, the statistics of DOF and other international organizations relating to the fish production. As a primary data, it was collected from farm owners and DOF officials from Kayin State through formal and informal interviews, questionnaires by conducting the field survey. The data collection period was divided into two parts in April and June. The answers of farmers were collected by organizing all farmers of each village.

The questionnaire survey was used to study the production amounts, the technologies in current use and market situation through interview with fish farmers. Field observation was done to identify the current status of pond management, culture system and benefit of fish production at field level. As sampling, 47 fish farmers were asked by using questionnaires for obtaining primary data.

The study location was selected based on the number of fish farmers from above 5 villages, where at least three small-pond holders are cultivating among villages. The sample size was 20 % of total fish farm owners of Hpa-an township.

Hpan-an is one of potential resource for aquaculture production due to its natural sources such as farm lands, existence of vacant/ virgin lands, water availability, better water quality and accessibility of transportation. For this reason, it was selected to have a study on small-scale fish farming, which is contributing to the food security, poverty reduction and can be targeted in commercialize farming in the future.

Based on the survey, the issues and constraints were obtained from primary data and the necessary requirements such as barriers on technologies, market and production are provided by the fish farmers.

Description in tabulation, frequency distribution, charts and diagrams applied to compare and understand the situation of small-scale fish farming in Hpa-an, is used for more identification in the development of aquaculture sector in the study area. Besides, the culture system, feeding, species, market situation, usage of technologies can be explored through the tabulation description.

4.3 Survey Results

4.3.1 Profiles of Fish Farmers

The fish farmers are classified based on the cultured years and their professional years in fish farming range from 2 to 10 years and over 10 years. The survey result shows that the oldest fish farmers are range from 60 to 71 years old and the youngest is 30 years old. It was found that male owners contributed to 80.9 % of total survey famers, and the female owner was 19. 1%. The fish farming is a supplementary income for all farmers' livelihood as some are operation the paddy fields and working odd jobs and 38.3 % rely on the remittance. Farmers whose primary income source of paddy plantation stand on the same level as remittance in the percentage of 38.3%. Education level also showed that 48.9% of famers could complete the primary education, 12.8% passed the high level education, 14.9% were not access to any education. Only one male could obtain the university education. Although, education level and fish production are not directly related significantly, there are some considerable facts in knowledge level for adapting the technologies. The income source of famers is shown in the Table (4.1).

Table (4.1) Income sources of farmers

Sr.	Income Sources	No. of Respondents	Percentage
1.	Remittance from family members in Thailand	12	25.5
2.	Remittance from family members work in other cities	6	12.8
3.	Odd jobs	7	14.9
4.	Paddy plantation	18	38.3
5.	Others	8	17

Source : Survey data,2019

4.3.2 Fish Farming

As a small-scale size level, total fish pond areas of respondents are ranged from 0.02 to above 1 acre. The majority of fish farmers posses in the range of 0.02 to 0.1 acre in average. The 80.4% of famers own only one pond, and the remaining famers have 2 ponds and only 8.7% of farmers own 3 ponds at the maximum. Most of

pond area is not over 1 acre and only in the range of 0.02 to 0.1 acre. The total number of pond areas owned by farmers are shown in the Table (4.2).

Table (4.2) Number of pond areas

No.	No. of Farmers	Percentage	Owned Acres (range)
1.	15	31.9	0.02-0.1
2.	9	19.1	0.1 -0.2
3.	12	25.5	0.2-0.3
4.	3	6.4	0.3-0.5
5.	7	14.9	0.5-0.8
6.	1	2.1	0.9 and above

Source: Survey data,2019

It was found that, the ownership of ponds are solely and community-owned. The 93.6% of respondents showed their purpose of fish farming is not only for the family consumption but also selling in some extent. Some farmers usually donate the fish before and in the harvesting time to the community- event, religious affairs and relative ceremony such as weddings, or personal donation. 97.9 % out of 47 farmers responded that their incomes are not only relying on the selling fish, it is targeted as a supplementary income.

Poly-culture system is used for cultivating the fish species and (6.4%) of the farmers used the mono-culture as well. 21.3% out of 47 farmers responded that there is planation and poultry farming on the pond embankment, which is also integrated one for earning family income.

4.3.3 Culture System and Species

In the survey result, it was observed that 38.3% of fish farm owners practice the stocking density of fingerling units between 500 to 1000 per pond depends on the pond area, 14.9 % applied the maximum stocking density of 4000 to 6000 per pond, and 6.4% used the stocking density as their own idea and estimation, so it was very high density and all fingerling were dead after input. Basically, the stocking density depends on the pond area, measured per acre. Based on the pond area, there have different in stocking density. The standard level is 2500 units per acres if the fish species are family carp species such as rohu, grass carp, mrigal. tilarpia and common

carp, tarpian can be raised 5000 per acre. The only semi-intensive system is raised as a small-sale fish farming in this area as a result of their feeding system and nature of stocking density. But it is difficult to identify the systematic semi-intensive system or not due to their own management system in feeding methods. The farmers have different understanding on technology and practices in the real situation. It was observed that only 93.6 % used the low stoking density. The following Table (4.3) shows the situation of stocking density in a period of farming.

Table (4.3) Situation of stocking density

No.	No. of Respondents	No. of Fingerlings	Percentage
1.	18	500-1000	38.3
2.	15	1000-2000	31.9
3.	3	2000-3000	6.4
4.	1	3000-4000	2.1
5.	7	4000-6000	14.9
6.	3	Above 6000	6.4

Source : Survey data, 2019

The traditional combination of species, poly- culture was used in the study area. Therefore, at least two different types of species are selected to culture such as combination of the column feeder and bottom feeder. Rohu (*Labeo rohita)*, Common carp (Barbodes gonionotus), Tarpian (*Cyprinus carpio*) and Talapia (*Tilapia spp:*) are major species of the study area because of the local demand. Rohu is a column feeder, preferably vegetables including algae, diatoms, higher plants and detritus. The other species are bottom feeder, consuming the algae, diatoms, higher plants and detritus. Although some famers have willingness to culture the catfish species, it is not fully supported and encouraged by the DOF as well due to the expensive in feeding cost and the production and sometimes that species such as African catfish threaten to other native species' disappearance. The following Table (4.4) describes how the farmers response relating to the cultured fish species of the study area.

Table (4.4) Common cultured species in Hpa-an Township

Cultured Species	Number of Respondents	Percentage
Rohu(Nge Myint Chin)	26	55.3
Tilapia	14	29.8
Common Carp (Shwe War Nga Gyin)	13	27.7
Tarpian (Nge Kone Ma Gyi)	39	83
Catfish (Nga Ku)	1	2.1
Other	3	6.4

Source: Survey data,2019

4.3.4 Fish Production in the Study Area

Total production varies based on the pond area and systematic implementation of the training received including the feeding system and other pond management. Due to the extreme weather situation such as flooding, the production volume is lost in 2018. As a survey result, in 2018 the total production is in a range of 5 viss (8.16465kg) to 80 viss (130.6344 kg)and above.13 (27.7 %) produced the fish in the range of 30 to 50 viss and 10 to 20 viss as common amount. Only 6.4% produced the 80 viss and above at the maximum amount. Due to the practice of small-scale farming and vary in the pond size areas, it could be shown as the total production of each farmer. 53.2 % suffered the severe situation of flooding in 2018 and encountered the loss of fish and 4.3 % suffered very poor water quality due to very high stocking density and over feeding. The Table (4.5) shows the total weight of fish produced in 2018. Therefore, there was no productive amount as last 2 years.

Table (4.5) Total weight of fish produced in 2018

Production Per Crop (viss)	Number of Respondents	Percentage
5-10	8	17
10-20	13	27.7
20-30	4	8.5
30-50	13	27.7
50-80	2	4.3
80 and above	3	6.4
Pond pollution	2	4.3

Source: Survey data,2019 (2018)

In 2017, frequency of the production per crop were in a range of 50 to 80 viss at the maximum, while 80 viss and above, and 10-20 viss follows 19.6% and 17.4 % respectively. It was found that the total production volume increased comparing with volume in 2016. The price of fish was from the range of 3500-4000 per viss depends on the fish weight. It was found that there haven't happened any extreme weather and the total produced weight is described in Table (4.6).

Table (4.6) Total weight of fish produced in 2017

Production Per Crop	Number of Respondents	Percentage
5-10	1	2.2
10-20	8	17.4
20-30	7	15.2
30-50	6	13
50-80	14	30.4
80 and above	9	19.6
No culture	1	2.2

Source : Survey data,2019

As of the survey result of 2016, the range of 30-50 viss (17%) was the maximum productive weight. On the other hand, it was found that, some farmers (34%) did not culture the fish in that year. The farmers whose production amount of between 50 and 80 viss were 12.8% as shown in Table (4.7).

Table (4.7) Total weight of fish produced in 2016

Production Per Crop (viss)	Number of Respondents	Percentage
5-10	5	10.6
10-20	4	8.5
20-30	3	6.4
30-50	8	17
50-80	6	12.8
80 and above	5	10.6
No culture	16	34

Source: Survey data,2019

In the period of 2018, 2017 and 2016, the total sale amount varied based on the production weight respectively. In 2018, most of farmers earned the sale in the

range of 20000 and 40000 kyats per crop, the maximum sale amount was between 150000 and 250000 kyats in 2017, and the highest sale amount received in 2016 between 10000 and 150000 kyats. The condition of 3-year sale amounts were shown in Table (4.8).

Table (4.8) Total Sale amounts in 2016, 2017 and 2018

Sale amount	Percentage of Respondents in 2016	Percentage of Respondents in 2017	Percentage of Respondents in 2018
20000-40000	8.9	6.5	32.6
40000-60000	4.4	10.9	6.5
60000-100000	6.7	19.6	15.2
100000-150000	17.8	10.9	6.5
150000-250000	6.7	23.9	22.9
250000-400000	6.7	15.2	19.6
400000 and above	8.9	10.9	8.7
N/A	40	2.2	10.9

Source :Survey data,2019

4.3.5 Practice of Technology and Aspects of its Utilization

(i) Receiving Training for Aquaculture

Mostly, 65.2 % of farmers received the trainings provided by DOF and other organizations, while the remaining 34.8 % have not ever attended. Those farmers who did not receive any training from DOF are learning the method from neighbors and based on their experiences. DOF, by itself and in cooperation with other organization such as World Fish and JICA provided the trainings on basic knowledge of fish farming, site selection, pond digging, renovation and management, Hatchery methods, Feeding system, System of Water exchange, monitoring on water quality status, Fencing method by using net, Awareness program on natural disaster prevention (eg. extreme hot weather, flood), Training on Accounting and recording for fish farming in Hpa-an township.

(ii) Feeding

Kinds of feed for fish farms are rice bran, soybean and groundnut meal, and manufactured pellet. Most of farmers used the rice bran (95.7%), the soybean and

groundnut meal were used in (27.7%). 72.3 % of famers use the manufactured pellet in a combination with rice bran. Only 46.8 % farmers responded their feeding include natural food such as algae. In actual, the fish consume the natural food such as algae as a main food. Rice bran, manufactured pellet are the supplementary feed for increasing the productivity. Table (4.9) shows the kind of feeds used by fish farm owners and the total feeding cost in the study area.

Table (4.9) Kinds of feed and feeding cost

Description	Description	No. of Respondents	Percentage
Kinds of feed	Rice bran	45	95.7
	Soybean and Groundnut meal	13	27.7
	Manufactured pellet	34	72.3
	Natural food	22	46.8
	Other	1	2.1
Cost of Rice Bran/Soybean and Groundnut	20000-50000	39	83
Cost of manufactured pellet	50000 and 100000	14	29.8
	100000 and above	15	31.9

Source: Survey data,2019

The cost for supplementary feed varies on the kinds of feeding and ranged from 20000-50000Ks per production cycle period if the rice bran and groundnut meal/oil cake will be fed. Otherwise, the feeding cost of combination with manufactured pellet is between 50000 to 100000 Ks and it was over 100000 Ks if the formulated feed only used. Although, the fertilizer is supportive to emerge algae, 93.2 % famers did not use it due to unusual practice and efforts.

The method of feeding practice naturally by feeding in scattering (93.6%) and only 38.3 % follows the right time frame and volume systematically.

(iii) Fingerling Availability

Based on the survey result, the sources of fingerling availability are different. natural stocking, own hatching, DOF' provision with FoC, purchasing from DOF, purchasing from Thailand, private hatchery business, and donation of other organizations are 7 ways to get the fingerlings. Among them, purchased from DOF

and other organizations' donation are leading to the most percentage in 63.8 % and 61.7 % respectively. Only 4.3 % who buy the seeding from Thailand spent 100-150 kyats per fingerling to be more productive weight. Per fingerling (1 to 3 inches) cost 50-80 kyats in the DOF hatchery station and some farmers used the fingerlings from own hatching.

(iv) Disease

Regarding the fish disease, 93.6 % out of 47 farmers responded that no fish disease occurred in their culturing period. 7% of farmers encountered the disease outbreak, asked the treatment method to the neighboring fish farmers.

(v) Pond management and Water quality management

Water quality is important for aquaculture and it refers to all factors such as physical, chemical and biological those are influence the wellbeing of aquatic biota. The quality is no factor should exceed the certain upper limits of toxic compounds, or fail to remain within some minimum –maximum range for life sustaining physical-chemical factors such as PH, dissolved oxygen, temperature, etc. When newly established or some existing ponds with wild species, renovated for the systematic culturing. 63% responded that the ponds have ever renovated and the rest 37 % expressed the renovation was not done. A few percentage in 10.6 % exchanged the water as the pond size is bigger than others. The majority describes that not necessary on water exchange since the water volume reduced starting from December and no more water in March. The farmers are not worry on water quality for next production cycle. Although the farmers received the training on the monitoring for water quality, 55.3 %, above half of farmers in the study area follows and practices obtained.

4.3.6 Barriers on Technologies

Regarding the technologies, around 59.6% of farmers agreed that it is a little true on no easy for getting fingerlings. For the fish species, over 87.2 % do not understand on the quality of species as the answer is neutral. Above 19.1% only encountered in difficulty on fish feed purchasing and (46.8%) pointed out the expensive on fish feed. Enough water volume can be access for the fish farming. Over 74.5 % reacted that more cost in adoption of technologies than the farming traditionally. Half of the farmers disagree on the production amount is unchanged by using technology, the other half still remain in the neutral comment. The following Table (4.10) shows the farmers' rating regarding the barriers on technologies. Mostly,

78.7 % of farmers declared that there are difficulties on using technologies in some extense.

Table (4.10) Barriers on Using Technologies

Subject	Totally true	True	Neutral	A little true	Totally not true
Not easy to get the fingerlings	2.1%	8.5%	25.5%	59.6%	4.3%
Expensive in fingerlings price	-	17.0%	70.2%	10.6%	-
Not getting the quality fish species	-	2.1%	87.2%	6.4%	4.3%
Difficult to buy fish feed	2.1%	19.1%	19.1%	53.2%	10.6%
Expensive in price of fish feed	10.6%	46.8%	36.2%	4.3%	2.1%
Not getting the quality fish feed	-	6.4%	78.7%	10.6%	2.1%
Not access to enough water for fish farming	-	10.6%	10.6%	31.9%	44.7%
Not aware on the new technologies (pond renovation Systematic fish farming and feeding)	2.1%	17.0%	25.5%	53.2%	2.1%
Do not know-how of the technologies	2.1%	14.9%	44.7%	38.3%	-
No production amount changes although the technologies used	-	8.5%	38.3%	40.4%	10.6%
More cost on technologies used than traditional one.	8.5%	74.5%	10.6%	4.3%	-
Pond size is small	4.3%	48.9%	29.8%	12.8%	4.3%

Source: Survey data,2019

4.3.7 Market Situation

Some villages located within one hour distance from Hpa-an township are easy to access the transportation for the trading and other economic activities. But, the 63.8 % of fish farmers are usually sold out their produced fishes in their villages and 44.7 % sold out nearby villages due to the small size of fish and less amount in the harvest time. Almost, the farmers sold out to the fish collector at their villages if the produced amount was medium by considering the transportation cost. In addition, the farmers have no regular dealer in the city market due to unsTable production amount.The market situation was described in the Table (4.11) and (4.12) respectively.

Table (4.11) Market situation of study area

Sr.	Description	No. of Respondents	Percentage
1.	Selling in the village	30	63.8
2.	Selling in the village nearby	21	44.7
3.	Selling in the market nearby	4	8.5

Source: Survey data,2019

Table (4.12) Causes for no access to the market

Sr.	Reasons for not selling in the market	No. of Respondents	Percentage
1.	Small size fish	18	42.9
2.	Less amount of harvested fishes	32	76.2
3.	Transportation accessibility is not smooth	1	2.4
4.	No regular customer in the market	12	28.6
5.	Others (Fish collector, dealer)	7	16.7

Source: Survey data,2019

4.3.8 Credit System, Licensing and the Expansion

Out of 47 respondents, only 27.3% received the loan through DOF regional and state funds under Rural Development programme and other international organizations. 72.7 % of famers used loan from Emerald green project in amount of 1million and 2 million kyats respectively with rate of 12% per annum in the study area. The maximum period of loan access, which the farmers obtained is 3 years, based on the response of 10 farmers, who only apply for loan in the study area. It was found that the other organizations provided small loan in the project period. The interest is settled in twice a year separately, which made a burden for some farmers who obtained the loan due to the short-term fish crop season.

Table (4.13) Credit availability

Sr.	Source of loan availability	Percentage
1.	DOF	9.1
2.	Emerald green project	72.7
3.	Association	-
4.	International organizations (INGO, NGO)	18.2
5.	Private Lender	-

Source : Survey data,2019

The credit is provided depending on the property of licensing, which is officially issued by DOF if the pond size is over 55x25 feets. The application for licensing is linking with the Department of Agriculture Land Management and the government land policies, especially for converting the paddy / crop land, which cannot be used in fish farming due to the soil destroyed. Depends on the approval of the central land policy authorization for utilization of poor paddy land as fish pond, DOF issue the license. The initial licensing fees are around 10000 kyats and tax is collected 900 kyats per acre annually. The least aquaculture production states/ regions including Kayin state are allowed such minimum tax rate. 39.1 % paid the tax, the rest are exemption and still under applying for the licensing.

The willingness on the further expansions of the aquaculture in the study area depends on the land availability and profit maximization. 42.6% responded that land availability is the constraint and manpower is still less for guarding the pond during the crop season.

CHAPTER V
CONCLUSION

5.1 Findings

Based on the survey result, the 80.4 % farmers who possess one pond are the majority, and the pond area of 31.8 % farmer is ranged from 0.02 to 0.1 acres. The farmers practiced the poly-culture system and widely use in low-stocking density method. As a small-scale level, production cycle starting from pond renovation/preparation to harvested time is 7 months.

The rate of production per crop depends on training receiving and practically cultivation by using modern techniques. On the other hands, the impact of natural disasters made huge damage to farmers. So, it was found that, the production was decreased mostly in the time of disaster affected. The unsystematic input of stocking density caused the pond destroyed and tiny size fish producing at the harvested time. The fertilizers were not used properly for getting the natural food and it happened higher cost for purchasing the manufactured pellets. Because of unawareness of 87.2% of farmers on the quality of fingerlings, the healthy fish could not be cultivated.

Although the training received, some barriers still existing, especially for water quality management, monitoring and feeding system. Majority of farmers cannot feed timely, from the same place and with right amount systematically. In addition, the farmers are still using in the tradition system. Feeding system and water quality and natural feed are very important to increase the production. So, the implementation is more effective than receiving trainings. DOF hatchery station of Kyone Doe and Zar Tha Pyin in Tha Htone are located not far away from the villages. Therefore, the availability of fingerling is not very difficult.

Market for the small-scale farmers is still in their villages and nearby by consideration the transportation charges for the low production amounts and habits of fish collectors' existence. The credit system is supportive to continue their farming

and can cover the total cost anyway. However, according to the survey result, the willingness and difficulties to pay the interest rate in each six months, will be still constraints in future. The disaster impact is more considerable factors to promote their business and including the expansion. It was found that there are farmers who would like to stop the aquaculture. According to the informal interview of concerned officials, it was found that the local aquaculture production cannot cover the whole population of the state. Therefore, it is still relying on the import from Yangon market side for the local consumption. In addition, Hpa-an is a tourism attractive area and expected to the number of tourist and local travellers will be increased year by year. The demand of fish will be still in huge amount.

Land use policy is a big barrier for getting the license, which is official document for ownership of properties and borrowing money.

5.2 Recommendations

In order for the improve of small-scale aquaculture farming in Myanmar, not only for the purpose of food security, poverty reduction, but also for commercializing, it is recommended to set up more effective programs such as providing the training in more times, monitoring and consultation with farmers for solving their difficulties from the technical points.

It is recommended to persuade farmers to follow the guidelines and instructions exactly for fish farming trained by DOF so that the rate of production will be increased. The annual production amount, cost and profits should be recorded in a document to consider better approaches for improvement of farming. In addition, it is suggested to emphasize more on provision of the healthy fish seeds and fingerlings and to develop the advanced hatching techniques in the hatchery stations.

As a financial supporting, it should be more considerable on the interest rate and their settlement situation, as only one production cycle the famers culture within 6 months. The methods for prevention the flood disasters should be disseminated to the village level, while most of villages are located around Than Lwin river, creeks and streams.

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Questionnaire for Small-scale Fish Farming in Hpa-an Township

This questionnaire is mainly used for the research of Master of Public Administration, Yangon University of Economics (2017-2019)

1.1 HouseHold Information

Name	Village Name	VT	Male/Female	Education	Age

2. Information of Fish Farming (**FISH PRODUCTION, SALES, INPUT USE IN THE LAST COMPLETED PRODUCTION CYCLE**)

2.1 Fish Farming

2.1.1	No. of Fish Ponds	……..Pond॥ Acre…….. (or) Feet……
2.1.2	Approximately how long have you raised fish?	Years……
	Types of Ponds	(One or More answers, Click tick) ☐ 1. Community owned ☐ 2. Individual owned ☐ 3. only one fish is cultured ☐ 4. Two or more species are cultured ☐ 5. Existing of animal poultary site (or) plantation on pond
		Choose only one answer, Click tick
2.1.3	How many production cycle have you completed (Manage the fish pond (or) from stocking input to harvest time)	☐ 4 month ☐ 1 year ☐ 6 month ☐ 7 month
2.1.4	Fish farming only for family consumption	☐ Yes ☐ No
2.1.5	Fish farming not only for family consumption also sale	☐ Yes ☐ No
2.1.6	Donation of fish for social activities	☐ Always ☐ Sometimes ☐ Almost of it
2.1.7	Does your household income relies on fish farming?	☐ Yes ☐ No
2.1.8	Family income gets from other source. (per month)	☐ Remittance from family members in Thailand……..(Ks) ☐ Remittance from family members work in other cities in Myanmar……(Ks) ☐ Other ways……...

2.2 Fish Production and Sale

		Can choose one or more answers, please Tick.
2.2.1	Cultured Fish species	☐ Ronu ☐ Tilapia ☐ Terpian ☐ Common Carp ☐ Other species (to describe)……
2.2.2	How many fingerlings input?	☐ Rohnu (Units……) ☐ Terpian (Units……) ☐ Tilapia (Units……) ☐ Other species(To describe)……..(Units……)
2.2.3	(a) Produced fish size (Per unit such as Rohnuı common carpı tilapia type)	☐ 20-30 (kyat thar) viss ☐ 30-50 (kyat thar) viss ☐ Above 50 kyat thar
	(b) Produced fish size (Cat fish, small fish size species, per unit)	☐ 5-10 Kyat Thar ☐ Below 5 Kyat Thar
2.2.4	Amount of produced fish (2018)	Fish species ……...Viss(weight)…….. Fish species……Viss(weight)……..
2.2.5	Amount of produced fish (2017)	Fish species ……...Viss(weight)…….. Fish species……Viss(weight)……..
2.2.6	Amount of produced fish (2016)	Fish species ……...Viss(weight)…….. Fish species……Viss(weight)……..
2.2.7	Total sale amount (2018)	Fish species……(Lakh) Kyat ……. Viss…… Fish species……(Lakh) Kyat ……. Viss……
2.2.8	Total sale amount (2017)	Fish species…….(Lakh) Kyat ……. Viss…… Fish species……,(Lakh) Kyat ……. Viss……
2.2.9	Total sale amount (2016)	Fish species……,(Lakh) Kyat ……. Viss…… Fish species……,.(Lakh) Kyat ……. Viss……
2.3.10	Fish size for sale	…….Kyat thar (Rohnu, Common carp, etc.)

		……..Kyat thar (Catfish, small size fish,etc.)

2.3 Use of Inputs in fish production

	Inputs	**Can choose one or more answers**	**How much does it cost if purchased**
2.3.1	Types of Pond property	☐ Purchased ☐ Heritage ☐ Land in owned fence ☐ Vacant land	…….Kyats (Lakh)
2.3.2	Source of fingerlings availability. (can choose one or more answers) ☐ Natutal stocking ☐ Own hatching ☐ Getting from DoF with FOC ☐ Purchased from DoF ☐ Purchased from Thailand ☐ Purchased from private hatchery business ☐ Donated by other organizations		
2.3.3	10 to 3 inches ……. Per unit……. (kyat) source of purchasing……. 3 inches and above….. Per unit…… (kyat) source of purchasing……. (Eg. Source of purchasing …Thailand/ DoF)		
2.3.4	What kinds of fish feed do you use?	☐ Rice bran Manufactured pellet ☐ Soybean/ groundnut meal ☐ Natural food ☐ Others…….	Total feed cost (Rice bran, etc.) (Manufactured pellet)…….. Total feed cost (manufactured pellet)……
2.3.5	Cost of Fertilizer kyat……..		Labour changes/ set up cost (including pond renovation ı harvesting) Total cost (Kyats)……
2.3.6	Lime Kyat…….		Fencing kyat……
2.3.7	Net Kyat……		Others (to describe)……. Kyat…….
2.3.8	Transportation cost Kyat……. (From pond renovation to sale)		

3.1. Used technologies in fish farming and market condition

	Used technologies	**Choose the correct one**
3.1.1.	Type of Fish farming system	☐ High stocking density ☐ Low stocking density
3.1.2	Are your ponds renovated	☐ Yes ☐ No
3.1.3	Is water exchanged?	☐ Yes ☐ No
3.1.4	Do you monitor the water quality status?	☐ Yes ☐ No
3.1.5	How do you feed the fish?	☐ Time period/ volume ☐ Feed with scattering ☐ With Plate or baskets
3.1.6	Does the fish disease occur?	☐ Yes ☐ No
	If occurred,	☐ Ask to the skill person on fish farming ☐ Ask to the staff of DoF ☐ Neighbor fish farmers
3.1.7	Have you ever attended the trainings relating to fish farming?	☐ Yes ☐ No
3.1.8	If you have ever attended, please choose the followings ☐ Basic knowledge of fish farming ☐ Selection site, pond digging, renovation and management ☐ Hatchery methods ☐ Feeding system ☐ System of Water exchange, monitoring on water quality status ☐ Method for selection of fingerlings ☐ Fencing method by using net ☐ Natural disaster prevention method (Eg. Extreme hot weather, flood) ☐ Training on Accounting and recording method for fish farming ☐ Others…….	Describe name of organization for training provision …… …… …….. …….. …… …….. …….. …… …… ……
3.1.8	Did you receive the loan?	☐ Yes ☐ No

3.1.9	If yes, from which source did you receive?	☐ DOF ☐ Emerlad green project ☐ Association ☐ International organizations (INGO, NGO) ☐ From private lender
3.1.10	How much did you get loan? (per year) How many years did you get?	……(Lakh) Kyat …….(year)
	How much interest do you pay for loan?	……% 1 year
3.1.11	Where do you sell the produced fish?	☐ Sell in the village ☐ Sell in the village nearby ☐ Sell in the market nearby
3.1.12	Reason for not selling in the market. (one or more can be choose)	☐ Small size fish ☐ Less amount in harvested fish ☐ Transportation accessibility is not smooth ☐ No stable in wholesale dealer ☐ Others ☐ No consumer availability

4.1 Do you prefer the fish farming traditionally rather than by using technologies?

☐ Yes ☐ No

If yes, write down the reason.

……..

4.2 Are you difficult in using technologies for fish farming?.

☐ Yes ☐ No

4.3 Please describe your opinion on the following barriers in using technologies.

Subject	Totally true 1.	True 2.	Nutral 3.	A little true 4.	Totally not true 5.
	Tick in the preferred place based on the matters mentioned above (1 to 5)				
	1	2	3	4	5
Not easy to get the fingerlings					
Expensive in fingerlings price					
Not getting the quality fish species					
Difficult to buy fish feed					
Expensive in price of fish feed					
Not getting the quality fish feed					
Not access to enough water for fish farming					
Not aware on the new technologies (pond renovationı Systematic fish farming and feeding)					
Do not know-how of the technologies					
No production amount changes although the technologies used					
More cost on technologies used than traditional one.					
Pond size is small					

4.4 Do you have any willingness to expend the farming?

☐ Yes ☐ No

4.5 Do you pay tax on fish farming to DOF? Yes☐ No☐

4.6 If yes, how much do you have to pay per year? …….Kyat

4.7 How much does the initial cost for licensing ? …….Kyats

4.8 Do you have any difficulties for loan? Yes☐ No ☐

S

ဘားအံ မြို့ နယ် တဝိုင်တနိုင် ငါးမွေးမြူရေး လုပ်ငန်းနှင့် ပက်သက်သော မေးခွန်းလွှာ

ဤမေးခွန်းလွှာအား ရန်ကုန်စီးပွားရေး တက္ကသိုလ် ပြည်သူ့ရေးရာ စီမံခန့်ခွဲမှု မဟာဘွဲ့ အတွက် ကျမ်းပြုစာတမ်းတွင် အသုံး ပြုရန်သာ ဖြစ်ပါသည်။

1.1 ငါးမွေးမြူရေး လုပ်ကိုင်သော အိမ်ထောင်စု အကြောင်းအရာ

အမည်	ရွာအမည်...	ရွာအုပ်စု	ကျား၊မ	ပညာရေး	အသက်

2. ငါးမွေးမြူရေး ဆိုင်ရာ အချက်အလက်များ (ငါးထွက်ရှိမှု၊ ရောင်းချရမှု၊ ငါးမွေးမြူရေးတွင် အသုံးပြုသော အရင်းအနှီး)

2.1 ငါးမွေးမြူရေး

2.1.1	ငါးကန်အရေအတွက်	.....ကန်။ ဧက.....(သို့) ပေ.....
2.1.2	ငါး လုပ်ငန်း လုပ်ကိုင်သည့် စုစုပေါင်းနှစ် မည်မျှနည်း။	နှစ်ပေါင်း.....
	ငါးမွေးကန် အမျိုးအစား	(အဖြေတခု ထက်မက ရွေးချယ်ပေးပါ။ အမှန်ခြစ်ရန်) ☐1. အများပိုင် ☐2. တဦးတည်းပိုင် ☐3. ငါးတမျိုးသီးသန့်သာ မွေးမြူသည်။ ☐4. ငါး ၂ မျိုး ၊ ၃ မျိုးမွေးမြူသည်။ ☐5. ငါးကန်ပတ်ဝန်းကျင်တွင် တိရစ္ဆာန် မွေးမြူသည် (သို့) အပင်စိုက်သည်
		အဖြေတခုသာ ရွေးချယ်ပေးပါ၊ အမှန်ခြစ်ရန်
2.1.3	ငါးမွေးသည့် ကာလ မည်မျှကြာသနည်း။ (ငါးကန်ပြုပြင်သည် (သို့) ငါးသားပေါက်ထည့် သည် မှ ငါး ဖော်သည့် ကာလ အထိ)	☐ 4 လ ☐ 1နှစ် ☐ 5 လ ☐ 6 လ
2.1.4	မိသားစု စားသုံးရန်အတွက်သာ ငါး မွေးမြူသည်။	☐ ဟုတ်ပါသည်။ ☐ မဟုတ်ပါ။
2.1.5	မိသားစု စားသုံးရန်အတွက်သာ မက ရောင်း ရန် အတွက်ပါ ငါးမွေးမြူ သည်။	☐ ဟုတ်ပါသည်။ ☐ မဟုတ်ပါ။
2.1.6	လူမှုရေးလုပ်ငန်းများ အတွက် ငါးကို အခမဲ့ပေးလှူပါသည်။	☐ အမြဲတမ်း ☐ တခါတရံ ☐ အမြဲတမ်းနီးပါး
2.1.7	မိသားစု၏ ဝင်ငွေသည် ငါးလုပ်ငန်းတခုထဲမှ ရရှိသည်။	☐ ဟုတ်ပါသည်။ ☐ မဟုတ်ပါ။
2.1.8	မိသားစုဝင်ငွေသည် အခြားနေရာများမှ ရရှိသည်။(တစ်လ)	☐ ထိုင်းနိုင်ငံရှိ သားသမီးများမှ ပို့ငွေ.....(ကျပ်) ☐ မြန်မာနိုင်ငံရှိ တခြားမြို့များတွင် အလုပ်လုပ်နေသော မိသားစုဝင်များ၏ ပို့ငွေ.....(ကျပ်) ☐ တခြားနည်းလမ်း.....

2.2 ငါး ထုတ်လုပ်မှုနှင့် ရောင်းချမှု

		အဖြေတခု (သို့) တခုထက်မက ရွေးချယ် နိုင်သည်။ အမှန်ခြစ်ပါ။
2.2.1	မွေးမြူသည့်ငါး အမျိုးအစား	☐ ငါးမြစ်ချင်း ☐ တီးလားပီးယား ☐ ငါးခုံးမကြီး ☐ ရွှေဂါ ငါးကြင်း ☐ တခြားငါး (ဖော်ပြရန်).....
2.2.2	ငါးသားပေါက် မည်မျှထည့်သွင်းခဲ့သနည်း	☐ ငါးမြစ်ချင်း (ကောင်ရေ.....) ☐ ငါးခုံးမကြီး (ကောင်ရေ.....) ☐ တီလားပီးယား (ကောင်ရေ.....) ☐ တခြားငါး(ဖော်ပြရန်).....(ကောင်ရေ.....)
2.2.3	(က) ထွက်ရှိသော ငါး အရွယ်အစား (ငါးမြစ်ချင်း၊ ရွှေဂါငါးကြင်း၊ တီလားပီးယား အမျိုးအစား) တကောင်နှုန်း	☐ ၂၀-၃၀ သား ☐ ၃၀-၅၀ သား ☐ ၅၀ သား အထက်
	(ခ) ထွက်ရှိသော ငါး အရွယ်အစား (ငါးခူ၊ ငါးသေးအမျိုးအစား) တကောင်နှုန်း	☐ ၅-၁၀ ကျပ်သား ☐ ၅ ကျပ်သားအောက်
2.2.4	2018 နှစ်တွင် ထွက်ရှိသော ငါး ပမာဏ	ငါး အမျိုးအစား.....ပိသာပေါင်း (အချိန်)..... ငါး အမျိုးအစား.....ပိသာပေါင်း (အချိန်).....
2.2.5	2017 နှစ်တွင် ထွက်ရှိသော ငါး ပမာဏ	ငါး အမျိုးအစား.....ပိသာပေါင်း (အချိန်)..... ငါး အမျိုးအစား.....ပိသာပေါင်း (အချိန်).....
2.2.6	2016 နှစ်တွင် ထွက်ရှိသော ငါး ပမာဏ	ငါး အမျိုးအစား.....ပိသာပေါင်း (အချိန်)..... ငါး အမျိုးအစား.....ပိသာပေါင်း (အချိန်).....
2.2.7	စုစုပေါင်း ငါးရောင်းရငွေ (2018)	ငါး အမျိုးအစား .....။.(သိန်း) ကျပ် ..... ပိသာပေါင်း ..... ငါး အမျိုးအစား .....။.(သိန်း) ကျပ် ..... ပိသာပေါင်း .....
2.2.8	စုစုပေါင်း ငါးရောင်းရငွေ (2017)	ငါး အမျိုးအစား .....(သိန်း)ကျပ် ..... ပိသာပေါင်း။.....

		ငါး အမျိုးအစား .....။.(သိန်း) ကျပ် ..... ပိသာပေါင်း .....
2.2.9	စုစုပေါင်း ငါးရောင်းရငွေ (2016)	ငါး အမျိုးအစား .....(သိန်း)ကျပ် ပိသာပေါင်း..... ငါး အမျိုးအစား .....(သိန်း)ကျပ် ပိသာပေါင်း.....
2.3.10	ရောင်းချသည့် ငါးအရွယ်အစား	.....ကျပ်သား (ငါးမြစ်ချင်း၊ ရွှေဂါငါးကြင်း၊ စသည်) .....ကျပ်သား (ငါးခူ၊ စသည် ငါး အသေးအမျိုးအစား)

2.3 ငါးမွေးမြူရာတွင် သွင်းအားစု အသုံးပြုမှု

	ထည့်သွင်းပစည်းများ	တခုထက်မက ရွေးချယ်နိုင်သည်။	ဂယ်ယူရပါက မည်မျှကုန်ကျသနည်း
2.3.1	ကန် ပိုင်ဆိုင်မှု	☐ ဂယ်ယူသည်။ ☐ အမွေရသည်။ ☐ ခြံပရဟုဏ် အတွင်းရှိမြေ ☐ မြေလွတ် မြေရိုင်းမြေ	.....ကျပ်(သိန်း)
2.3.2	ငါးသားပေါက်များ အား ရရှိသည့် နေရာကို ဖော်ပြပါ။ (အဖြေတခုထက် မကရွေးချယ်နိုင်သည်။) ☐ သဘာဂအတိုင်း ပေါက်ဖွားသည်။ ☐ ကိုယ်တိုင် သားဖောက်သည်။ ☐ ငါးလုပ်ငန်းဦးစီးဌာန မှ အခမဲ့ရ ရှိသည်။ ☐ ငါးလုပ်ငန်းဦးစီးဌာန မှ ဂယ်ယူသည်။ ☐ ထိုင်းနိုင်ငံ(တောင်ပေါ်)မှ ဂယ်ယူသည်။ ☐ ငါးသားဖောက် ရောင်းသူထံမှ ဂယ်ယူသည်။ ☐ အခြား အသင်းအဖွဲ့အစည်းများမှ အခမဲ့ရရှိသည်။		
2.3.3	1 to 3 လက်မ ..... တကောင်..... (ကျပ်) ဂယ်ယူသည့်နေရာ..... 3 လကွေ့ နှင့် အထက်..... တကောင်..... (ကျပ်) ဂယ်ယူသည့်နေရာ..... (ဥပမာ။ ဂယ်ယူသည့်နေရာ...တောင်ပေါ်၊ငါးလုပ်ငန်းဦးစီးဌာန)		
2.3.4	မည်သည့် အစာအမျိုးအစား ကို ကျွေးပါသနည်း	☐ ဖွဲနု ☐ ဆန်ကွဲ ☐ အစာတောင့် ☐ ပဲဖတ် ☐ နှမ်းဖတ် ☐ သဘာဂအစားအစာ	စုစုပေါင်း အစာဖိုး (ဖွဲနု. ဆန်ကွဲ၊ စသည်)..... (ကျပ်) စုစုပေါင်းအစာဖိုး (အစာတောင့်).....

		☐ အခြား (ဖော်ပြပါ.).....	ကျပ် (တလ ကုန်ကျငွေ)
2.3.5	မြေဩဇာ အသုံးပြုမှု (ကုန်ကျစရိတ်) ကျပ်.....		အလုပ်သမား ငှါးရမ်းခ (ငါးကန်ပြုပြင်ခြင်း၊ ငါး ဖော်ယူခြင်း) ကျပ်(စုစုပေါင်း).....
2.3.6	ထုံး ကျပ်.....		မြေဩဇာခြင်း ကျပ်.....
2.3.7	ပိုက်ကွန် ကျပ်.....		တခြား (ဖော်ပြရန်)..... ကျပ်.....
2.3.8	သွားလာစရိတ် ကျပ်..... (ငါးကန်ပြုပြင်ခြင်းမှ ငါးရောင်းချသည်အထိ)		

3.1. ငါးမွေးမြူရေးတွင် အသုံးပြုသော နည်းပညာများ နှင့် ဈေးကွက်အခြေအနေ

	အသုံးပြုသော နည်းပညာများ	အမှန်ရွေးပါ
3.1.1.	ငါးမွေးမြူသည့် ပုံစံသည်..	☐ ကန်ကျပ်စနစ် ☐ ကန်ကျယ်စနစ်
3.1.2	ငါးကန်အား ပြုပြင်သည်	☐ ဟုတ်ပါသည် ☐ မဟုတ်ပါ။
3.1.3	ရေလဲလှယ်ပေးသည်။	☐ ဟုတ်ပါသည် ☐ မဟုတ်ပါ။
3.1.4	ရေ အရည်အသွေးကောင်းမွန် အောင် စောင့်ကြည့်သည်။	☐ ဟုတ်ပါသည် ☐ မဟုတ်ပါ။
3.1.5	ငါးစာကို မည်သို့ကျွေးသနည်း	☐ အချိန်၊ ပမာဏဖြင့် ကျွေးသည်။ ☐ ကျဲဖြန့်ကျွေးသည် ☐ အစာဗန်း၊ခြင်းတောင်း
3.1.6	ငါးရောဂါ ဖြစ်ပွားခဲ့ဖူးပါသလား	☐ ဖြစ်ခဲ့သည် ☐ မဖြစ်ခဲ့ပါ။
	ဖြစ်ပွားခဲ့ပါက..	☐ ငါးအကြောင်းကျွမ်းကျင်သူကို မေးသည်။ ☐ ငါးလုပ်ငန်း ဦးစီးဌာနမှ ဝန်ထမ်းကို မေးသည်။ ☐ အိမ်နီးချင်း ကို မေးသည်။
3.1.7	ငါးမွေးမြူရေးနှင့် သက်ဆိုင်သော သင်တန်း တက်ဖူးပါသလား	☐ တက်ဖူးသည် ☐ မတက်ဖူးပါ

3.1.8	သင်တန်းတက်ဖူးပါက အောက်ပါတို့ကို ရွေးချယ်ပေးပါ။ ☐ ငါးမွေးမြူရေးဆိုင်ရာ အခြေခံ အကြောင်းအရာ ☐ မြေနေရာ ရွေးချယ်ခြင်း၊ ကန်တူးဖော်ခြင်း ၊ကန်ပြုပြင်ခြင်း၊ ကန်စီမံခန့်ခွဲခြင်း ☐ သားဖောက်သည့် နည်းလမ်း ☐ အစာကျွေးသည့် စနစ် ☐ ရေလဲလှယ်၊ ရေအရည်အသွေး စောင့်ကြည့်သည့် စနစ် ☐ ငါးသားပေါက်ရွေးချယ်သည့် နည်းလမ်း ☐ ကန်တွင် ပို့က်ဖြင့် ကာသည့် နည်းလမ်း ☐ သဘာဝဘေးအန္တရာယ် မှ ကာကွယ်သည့် နည်းလမ်း။(ဥပမာ၊ ရာသီဥတု ပူခြင်း၊ ရေကြီးခြင်း) ☐ ငါးမွေးမြူရေးနှင့် ပက်သက်ပြီး စာရင်းပြုစုခြင်း၊ မှတ်တမ်းသွင်းခြင်း ☐ သင်တန်း ☐ တခြား (ဖော်ပြပါ).....	သင်တန်းပေးသော အဖွဲ့အား ဖော်ပြပါ။ ....
3.1.8	ငါးမွေးမြူရန် ချေးငွေရှိခဲ့ ပါသလား။	☐ ရရှိသည်။ ☐ မရပါ။
3.1.9	ချေးငွေ ရရှိခဲ့ပါက မည်သည့်နေရာမှ ရရှိခဲ့သနည်း။	☐ ငါးလုပ်ငန်း ဦးစီးဌာန ☐ မြစိမ်းရောင် စီမံကိန်း ☐ အသင်း အဖွဲ့များ ☐ နိုင်ငံခြား အဖွဲ့အစည်းများ (INGO, NGO) ☐ တခြားသူဆီမှ ချေးယူသည်။
3.1.10	ချေးငွေကို မည်မျှရရှိခဲ့သနည်း။ (တနှစ်စာ) နှစ်ပေါင်း မည်မျှ ရရှိခဲ့သနည်း။	.....(သိန်း) ကျပ် .....(နှစ်)
	ချေးငွေ အတွက် အတိုးနှုန်း မည်မျှပေးရသနည်း။	.....% တနှစ်
3.1.11	ငါးကို မည်သည့်နေရာတွင် ရောင်းချသနည်း။	☐ ငါးကို ရွာထဲတွင်သာ ရောင်းချသည်။ ☐ အနီးအနား ရွာတွင် ရောင်းချသည်။ ☐ အနီးအနားရှိဈေးတွင်ရောင်းချသည်။
3.1.12	ငါးကို ဈေးတွင် မရောင်းရသည့် အကြောင်းရင်းမှာ (တခုမက ဖြေဆိုနိုင်ပါသည်။)	☐ ငါး အရွယ်အစားသေးခြင်း။ ☐ ဖမ်းသည့် ငါးပမာဏ နည်းပါးခြင်း။ ☐ လမ်းပမ်းဆက်သွယ်ရေး မကောင်းခြင်း။ ☐ ဖောက်သည်အတည်တကျမရှိခြင်း တခြား (ဖော်ပြပါ)..... ☐ စားသုံးသူ မရှိခြင်း။

4.1 သင်သည် မိရိုးဖလာ ငါးမွေးမြူရေးကို နည်းပညာအသစ် သုံးခြင်းထက် ပိုမိုကြိုက်နှစ်သက်သည်။

☐ ဟုတ်ပါသည်။ ☐ မဟုတ်ပါ။

ဟုတ်ပါသည် ဟု ဖြေပါက၊ အကြောင်းရင်းကို ဖော်ပြပါ။

.....

4.2 ငါးမွေးမြူရာတွင် နည်းပညာအသစ်များ သုံးခြင်း သည် သင့်အတွက် အခက်အခဲ ရှိ သည်။

☐ ဟုတ်ပါသည်။ ☐ မဟုတ်ပါ။

4.3 ဟုတ်ပါသည်ဟု ဖြေပါက အောက်တွင်ဖော်ပြထားသော အခက်အခဲများနှင့် ပက်သက်ပြီး သင်၏ အမြင်ကို ဖော်ပြပါ။

အကြောင်းအရာ	လုံးဝမှန်ပါသည်။ 1.	မှန်ပါသည်။ 2.	မပြောတတ်ပါ 3.	အနည်းငယ်သာ မှန်ပါသည်။ 4.	လုံးဝမမှန်ပါ။ 5.
	အထက်တွင်ဖော်ပြထားသော အရာများမှ (နံပါတ်၁ မှ ၅) ကြိုက်နှစ်သက်ရာ နေရာတွင်သာ အမှန်ခြစ်ပေးပါ။				
	1	2	3	4	5
ငါးသားပေါက် ရရှိမှု မလွယ်ကူခြင်း					
ငါးသားပေါက် ဈေးနှုန်းကြီးခြင်း					
ကျန်းမာသည့် ငါး မရရှိခြင်း					
ငါးစာ ရရှိရန် ခက်ခဲခြင်း					
ငါးစာ ဈေးကြီးခြင်း					
အရည်အသွေးကောင်းသော ငါးစာမရရှိခြင်း					
ငါးမွေးမြူရာတွင် လုံလောက်သည့် ရေမရရှိခြင်း					
နည်းပညာသစ်အား မသိရှိခြင်း။ (ကန်ပြုပြင်ခြင်း၊ စနစ်တကျ ငါးမွေးမြူခြင်း၊ငါးစာကျွေးခြင်း)					
နည်းပညာသစ်အား နားမလည်ခြင်း					
နည်းပညာ သုံးသော်လည်း ငါးထွက်ရှိမှုပြောင်းလဲမှု မရှိခြင်း					
နည်းပညာသစ်သည် မိရိုးဖလာ လုပ်ကိုင်သည်ထက် ပိုကုန်ကျစရိတ်များခြင်း					
ပိုင်ဆိုင်သည့် ငါးကန်မှာ သေးငယ်ခြင်း။					

4.4 လက်ရှိငါးလုပ်ငန်း ကို ထပ်တိုးချဲ့ရန် စိတ်ဆန္ဒရှိပါသလား။

☐ ရှိသည်။ ☐ မရှိပါ။

4.5 ငါးမွေးမြူခြင်းအတွက် ငါးလုပ်ငန်း ဦးစီးဌာနတွင် လိုင်စင်(အခွန်)ဆောင်ရပါသလား။ ☐ဆောင်ရသည်။ ☐ မဆောင်ရပါ။

4.6 လိုင်စင်ဆောင်ရပါက တနှစ်ကို မည်မျှပေးရသနည်း။.....ကျပ်

4.7 ကနဦး လိုင်စင်ကြေး ဘယ်လောက်ပေးရပါသလဲ။.....ကျပ်

4.8 ချေးငွေ ရယူရန် အခက်အခဲ ဖြစ်ပါသလား။ ☐ ဖြစ်သည်။ ☐ မဖြစ်ပါ။