MUD CRAB (*Scylla spp.*) AQUACULTURE IN THE PROVINCE OF SAMAR

A Thesis

Presented to

The Faculty of the College of Graduate Studies

Samar State University- Mercedes Campus

Catbalogan City

In Partial Fulfillment

of the Requirements for the Degree

Master in Fisheries Technology

Major in Aquaculture

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by

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March 2012

APPROVAL SHEET

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ACKNOWLEDGMENTS

The writer wishes to express his thanks and profound gratitude to the following persons for their unselfish support that made this thesis a reality:

Dr. Simon P. Babalcon, Jr., President of Samar State University, for giving the researcher permission to pursue the graduate course;P

Dr. Marilyn D. Cardoso, Dean of the Graduate School of the Samar State University for her scholarly advice, intellectual guidance, and assistance in the statistical analyses of data;

Dr. Latip S. Abdurahman, Acting Dean, for the constant encouragement and fatherly advice extended to the writer during his studies and in the conduct of the research;

Dr. Lolito O. Amparado, Acting Campus Director of SSU-Mercedes Campus and thesis adviser for his personal attention and guidance in making this piece of work a success;

The members of the panel of examiners: Dr. Latip S. Abdurahman, Dr. Marilyn D. Cardoso, Prof. Ricardo T. Severo, Jr., and Center Director Norberto T. Berida, for their constructive comments and suggestions for the improvement of this research output; and

Mr. Erwin de la Cruz and his colleagues at Samar State University-Mercedes Campus, most especially to Nilo C. Albina, Marlou Leguidleguid, Joselito V. Buco, Olimpio B. Bacsal, Mat Palanas, Manuel A. Cadiz, Jr., Cesar F. Pacolor, and Dindo R. de Guzman, for sharing their time and effort in the

preparation of the manuscript.

Grateful acknowledgment is likewise extended to Mrs. Herminia L. Amparado of the Office of the Provincial Agriculturist; Mr. Rolando C. Ay-ay, Provincial Fishery Officer; the Agricultural Technologists in the different coastal municipalities of Samar; and fish farmers for their whole-hearted support and cooperation in supplying the necessary data and information on mudcrab farming.

Deep gratitude also goes to his parents, brothers, sisters, parents-in-law, sisters-in-law, brothers-in-law, and relatives for their continued motivation and moral support.

Finally, to his wife Norma and son Christian Jude, the writer is forever indebtred to them for their understanding, love, and inspiration which led to the realization and completion of this write-up.

R D J

DEDICATION

To my loving wife –Norma

and son – Christian Jude

ABSTRACT

This study aimed to assess the mud crab (Scylla spp.) aquaculture in selected coastal municipalities in the Province of Samar. The study employed the descriptive method of research. The respondents were 86 mud crab farmers in the 9 coastal municipalities and 2 cities of the Samar Province and 25 fisheries technologists. The instrument used in the study was a self-structured questionnaire on personal information, project profile and production status, farming activities in mudcrab culture, problems, and training needs in mud crab aquaculture technology. Comparing the extent to which the problems are felt by the respondents, t-test results revealed significant difference wherein the computed t-value of 5.08 is higher than the tabular value of 1.68 at 0.05 level of significance which led to the rejection of the null hypothesis. It was the fisheries technologist-respondents who most felt the problems in mud crab farming as compared to the fish farmer-respondents. Due to fish farmers' lack of educational awareness, particularly on the scientific methods and approaches as well as on the recent advances on mud crab farming technology, the fish farmer-respondents considered the various training areas presented "slightly necessary". On the other hand, the fisheries technologists who have the mandate of disseminating appropriate aquaculture technologies for poverty alleviation and food security felt the urgency and the necessity to undergo in-service trainings for them to acquire relevant knowledge and skills thus, enhance their competencies in the effective delivery of technical services to their clientele.

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THE PROBLEM AND ITS SETTING

Introduction

As the phenomenon of increasing population throughout the world is in occurrence, poverty pushes human society to engage in diversified means to augment income and lessen hunger among the poor. Government policies are being implemented to alleviate this human condition. Global consumption of finfish and shellfish as food has doubled since 1973 with evidence suggesting that the large increase in the aquatic resource production in recent decades has resulted from enormous growth in seafood demand in developing countries (Delgado *et al.*, 2003:1).

In 2005, the Philippines ranked 8th among the top fish producing countries in the world with its total production of 3.62 million metric tons of fish, crustaceans, mollusks, and aquatic plants. The country's 0.459 million metric ton aquaculture production of fish, crustaceans and mollusks in 2003 ranked 11th in the world with a share of 1.1 percent to the global aquaculture production of 42.3 million metric tons. In terms of value, the country's aquaculture production of fish, crustaceans and mollusks has amounted to over 600 million dollars (http:// www. fao.org.com.).

Aquaculture is an important sector in Philippine fisheries and the most dynamic since the decline of catches from marine fishing in 1976 (Aypa, 1995:137). It continues to increase in volume and in value output filling the gap

between supply and demand for fish and other aquatic products improving nutrition, creating new or additional employment, as well as contributing to the household economy particularly in rural areas.

All sectors of the country posted increases in poverty incidence between the years 2003 and 2006. Fishermen, farmers, and children comprised the poorest three sectors with poverty incidences of 49.9 percent, 44.0 percent, and 40.8 percent, respectively. Region VIII recorded at 35.3 percent in 2003 and 40.7 percent in 2006 (www.nscb.gov.ph) . The Samar province posted a poverty incidence level of 40.7 percent in 2000 (NEDA, 2000) and 47.6 percent in 2006 (NSO, 2009). The population growth of the province is substantially increasing from 641,124 in the year 2000, with 695,149 in 2007, 788,200 in 2009 (NSO, 2009) and a projected population size of 806,100 in 2010 (PPDO, Samar Province, 2009). With these statistical data, it is expected that there will be a greater demand for food and protein requirements most specially for those living below the poverty line.

Samar is the second major fish producing province in the region. In 2007, fish production totaled to 47,662 metric tons, contributing 24.9 percent to the region's total fish production (http://www.ncsb.gov.ph.). During the first quarter of 2009, the annual total fish production of the province was recorded at 4,961 metric tons with 1,395 from commercial fisheries, 1,871 metric tons from municipal fisheries, and 1,695 metric tons from aquaculture (NSO, 2009). Therefore, the aquaculture sector must strive to become an active partner in

effecting economic development in order to attain the food security agenda of the government by ensuring that production in the inland bodies of water and the coastal areas of the province of Samar will be both profitable and sustainable.

Region VIII (Samar and Leyte) has the most extensive mangrove area with 120,521 hectares (Gonzales, 1977:121). Samar has 4,294 hectares of fishponds (NSO, 2009) and 6,500 hectares of existing and undeveloped mangrove areas (CENRO-Samar, 1998). These are potential sites for aquaculture development such as the production of mud crab (*Scylla spp.*). If given the appropriate technical and substantial financial support from the government and other sectors of the society, the living conditions of the rural poor will be more or less improved by the next decade. Even with the availability of vast resources for aquaculture development and in spite of the attention accorded to it, the pace of development of the industry has not been substantial and significant. Average brackishwater production in the Samar province of 450 kilograms hectare per year in 2004 as reported by Amparado (2005) is still low as compared to the national average of 760 kilograms per hectare per year in 1990 (Goco, 1990:3-4) and 500 to 800 kilograms per hectare per year in 1995 (SEAFDEC Aquaculture Department, 2000).

According to Librero (1978), the development of aquaculture industry in the Philippines is constrained by the following factors: (1) low productivity; (2) lack of trained manpower; (3) poor system of technology transfer; and (4) the general lack of accurate data base. As pointed out by Gaduang (1978:1), if we are

to close the gap between production and demand for fish, the government must provide essential services for aquaculture development. These services are research to generate new ideas and techniques, extension to assist farmers in putting into practice the results of research, education to provide trained personnel to the private as well as to the public sector, and supportive services to provide adequate capital, markets, input supplies, and infrastructures.

The development of mud crab farming will have been spinned-off as associated with most seafood enterprises. There will be an increased demand for transport services, packing, processing, all of which will provide employment and business development opportunities. Processing of blue swimming crab meat from wild fisheries has lead to considerable investment in processing plants in Indonesia and in the Philippines. The market for pasteurized, canned crab meat is very large. One company in the United States alone, Phillips has a need for 30,000 tons of processed crab meat per annum. Special market exists for banquet-sized (over 1 kg) mud crab, which have their highest product requirement around New Year and Chinese New Year celebrations.

The demand for mud crabs in the international market is high. Countries with high consumption include Germany, Malaysia, Australia, Hong Kong, and Spain. Other importing countries are Korea, Singapore, United States of America, Taiwan, and Japan (Asian Aquaculture, 1997:12).

Lequin (1999) states that the Eastern Visayas region has potential mangrove areas for mud crab culture. Raising them would optimize land use.

Mangrove areas are the natural habitat of mud crabs. Crablets can easily be made available to interested aquaculture farmers for their operation. Technology of mud crab culture is likewise available locally. There are also existing potential sources of feeds like by-catch fish and mussel meat considering that Samar is a fisheries-based province. The province also boasts of other feedstuffs such as apple snails and other animal products.

Finally, the researcher got the desire to gather relevant data and information on mud crab aquaculture in the province of Samar in order to have a clear picture of the overall situation vital to the formulation of a workable program towards sustainable fishery development. Hence, this study.

Statement of the Problem

This study aims to assess the mud crab (*Scylla spp.*) aquaculture in selected coastal municipalities in the province of Samar. Specifically, it shall seek to answer the following questions:

1. What are the profiles of the respondents in relation to:
    1.1. sex;
    1.2. age;
    1.3. civil status;
    1.4. educational attainment;
    1.5 length of experience on mud crab farming;
    1.6. average monthly income; and
    1.7. training attended related to mud crab culture?

3. What is the status of mud crab aquaculture in the Samar Province with respect to:

2.1. fishfarm profile; and

2.2. production status?

3. What are the farming activities of mud crab farmers in relation to:

3.1 installation of net enclosure;

3.2 pond preparation;

3.3. stocking;

3.4. feeding;

3.5. water management;

3.6. pond repair and maintenance;

3.7. sampling;

3.8. harvesting;

3.9. post-harvest ; and

3.10 marketing?

4. Is there a significant relationship between the extent of farming activities adopted by the mud crab farmers and their personal and professional variates?

5. What are the problems of the mudcrab industry in the coastal municipalities of Samar and to what extent are they felt by the different groups of respondents?

6. Is there a significant difference on the problems of the mud crab culture industry as felt by the different groups of respondents?

7. What are the training needs of the mud crab farmers in the coastal municipalities of Samar in order to improve the adoption of the mud crab culture technology?

Hypotheses

Based on the questions proposed in this study, the following hypotheses will be tested:

1. There are no significant relationships between the extent of farming activities adopted by mudcrab farmers and personal and professional-related variates.

2. There is no significant difference on the problems of the mudcrab culture industry as felt by the different groups of respondents.

Theoretical Framework

The study is primarily anchored on the theory of Allen, Botsford, Schurr, and Johnston (1984) that the evolution of the relationship between man and his domesticated crops or food sources is more a pervasive than a selective process. It is accompanied by technological development necessary to fully exploit new stocks and to increase productivity. The need arises then to shift from an almost total dependence on domesticated sources which can be achieved by increased development of aquaculture production.

The approach used reflects three functionally important areas of information about aquaculture systems:

1. **Biological Performance**. In order to sustain life, all aquatic organisms must perform a series of biological functions including reproduction, growth and development, uptake of nutrients, respiration, and excretion.

2. **Physical System**. It presents a wide spectrum of choices that might be made to fulfill the objectives of production. Although physical systems can be widely-used in form and function, they all share a number of unifying characteristics. The characteristics include: a) maintenance of water quality; b) provisions of adequate space to allow growth; c) a means of supplying the nutritional requirements of the culture organisms; and d) a means of interfacing various stages in the production process, each designed to enhance productivity of different life stages of the organism.

3. **Economic System**. It involves the attainment of the goal of the culture system to achieve certain level of profitability or return of investment.

Republic Act 8435 otherwise known as "The Agricultural and Fisheries Modernization Act," provides that it is a declared policy that the goals of the national economy are a more equitable distribution of opportunities, income and wealth; a sustained increase in the amount of goods and services produced by the nation for the benefit of the people; and an expanding productivity as the key to raising the quality of life for all, especially the underprivileged. Moreover, Republic Act 8550 (The Philippine Fisheries Code of 1998) clearly stressed that "to achieve food security is the overriding consideration in the utilization, management, development, conservation and protection of fishery resources in

order to provide the food needs of the population."

The Food and Agricultural Organization of the United Nations (FAO) on the Technical Conference on Aquaculture, Kyoto, Japan (1976:8-9) states the declaration on problems, opportunities and potential for the culture of fish and other fishery aquatic products. It declares:

1. That aquaculture, imaginatively planned and intelligently applied, provides a means of revitalizing rural life and supplying products of high nutritional value, and that aquaculture, in its various forms, can be practiced in most countries, coastal and land- locked, developed and developing;

2. That aquaculture has a unique potential contribution to make for the enhancement and maintenance of wild aquatic stocks and thereby for the improvement of capture fisheries, both commercial and recreations;

3. That aquaculture can, in many circumstances, be combined with agriculture and animal husbandry with mutual advantage, and contribute substantially to integrate rural development;

4. That aquaculture provides intellectual challenge to skilled professionals of many disciplines, and rewarding activity for farmers and other workers at many levels of skill and education;

5. That aquaculture provides now, and will continue to provide, options for sound investment of money, materials, labor and skills; and

6. That aquaculture merits the fullest possible support and attention by national authorities for integration into comprehensive renewable resource,

energy, land and water use policies and programs, and for ensuring the natural resources on which it is based are enhanced and not impaired.

Finally, the principle of sustainable development adheres to the concept of management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Such development conserves land, water, plant and animal genetic resources that is environmentally non-degrading, technically appropriate, economically viable, and socially-acceptable (Csavas, 1995:8).

Conceptual Framework

Figure 1 presents the schema which conceptualizes the study. The base of the schema are the municipalities and cities of the Samar Province where mud crab aquaculture is being practiced by the fish farmers. An analysis of the profile of respondents and the profile of fish farms and their production status will be made through the data supplied in the questionnaire and from the information gathered through interview. The extent of farming activities, problems, and training needs will be determined through the perceptions of the different groups of respondents involved in the study. From these, findings and implications will be made in order to improve technology adoption and enhance production for a sustainable mud crab aquaculture development.

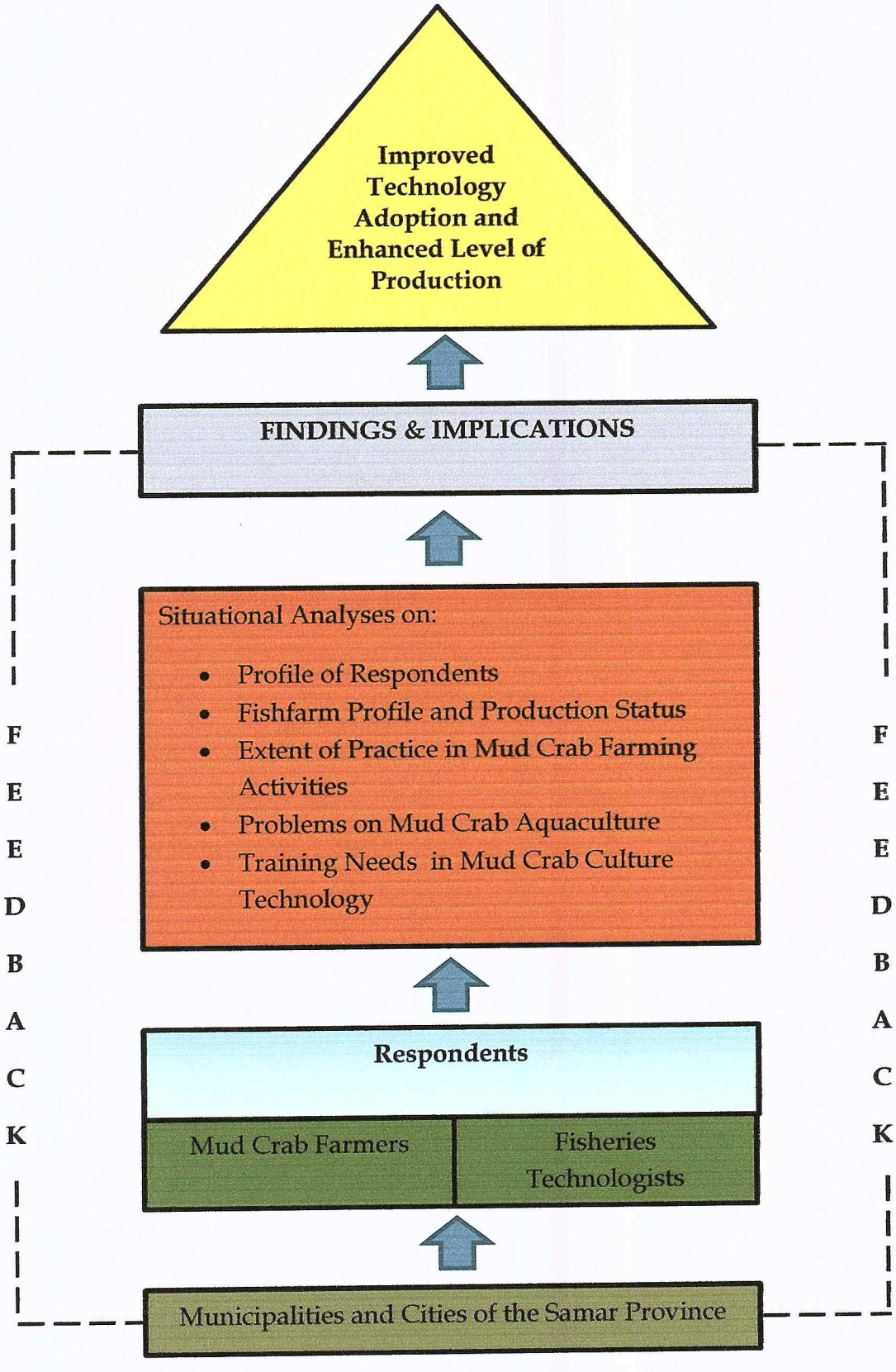

Figure 1. The conceptual framework of the study.

Significance of the Study

Mud crab culture is one of the fishery endeavors being undertaken by fish farmers in the Samar province. Assessing the status of its production, culture activities, problems, and training needs would give impetus in the rapid rural countryside development by the maximization of idle and underutilized resources through adoption of appropriate, environment - friendly, and responsible aquaculture practices generating employment, increasing income, and improving economic conditions of fisherfolk in coastal communities.

Through this investigation, practices and problems which are deterrent to obtaining high aquaculture productivity could be identified and remedial measures can be instituted in order to solve existing problems.

The results of the study will benefit the following sectors of the society:

Mud crab farmers. The results of the study will provide them with the necessary information of the level and extent of adoption on the various activities of mud crab culture technology. Through this information they will be able to develop their competencies and capabilities to improve production of the crops being cultivated. Moreover, this will serve as an avenue to strengthen their technical know-how on the mud crab culture technology through trainings and technology transfer services offered by various government agencies and other sectors of society offering socio-economic and aquaculture productivity enhancement services.

Extension workers. The findings of this study will give them the

picture of what strategies are needed in order to improve the economic conditions of the mud crab farmers through improved and effective delivery of extension services.

Policy makers. The results of this study will provide them with adequate information on developing a framework for fisheries planning and development responsive to the food security agenda, poverty mitigation program, and sustainable agri-fisheries development of the province of Samar in particular, and the country in general.

Researchers and educators. Researchable areas identified from the results of the study will give them the challenge to conduct in-depth studies and investigations to generate useful information worthy of dissemination to the ultimate users through technology transfer programs of research institutions and extension functions of higher institutions of learning.

The students. This study will serve them an important educational material for their acquisition of knowledge and skills on the status of mud crab aquaculture as well as the production practices of mud crab farmers.

The community. The good practices adopted by the farmers as revealed in this study could be adopted by members of the communities whose human and material resources warrant their adoption in order to improve their economic conditions by engaging on this profitable aquaculture venture.

The future researchers. This study could be replicated or improved by those aspiring to undertake investigations of similar nature.

Scope and Delimitation of the Study

The study is on the assessment of the mud crab aquaculture industry in the nine (9) coastal municipalities and two (2) cities of Samar Province, namely: Sta. Margarita, Pagsanghan, Gandara, Tarangnan, Jiabong, Motiong, Paranas, San Sebastian, Sta. Rita and the cities of Calbayog and Catbalogan.

Documentary analysis, questionnaire, and interview were the instruments used to gather pertinent data.

The questionnaire focused on the following: personal and professional characteristics of the respondents, profile of mud crab farms, production status, the extent of culture activities as practiced by the fish farmers themselves, problems encountered, and training needs.

The respondents in this study was limited to mud crab farmers and fisheries technologists assigned in the various local government units included in the research area.

The study was conducted in the school year 2010 - 2011.

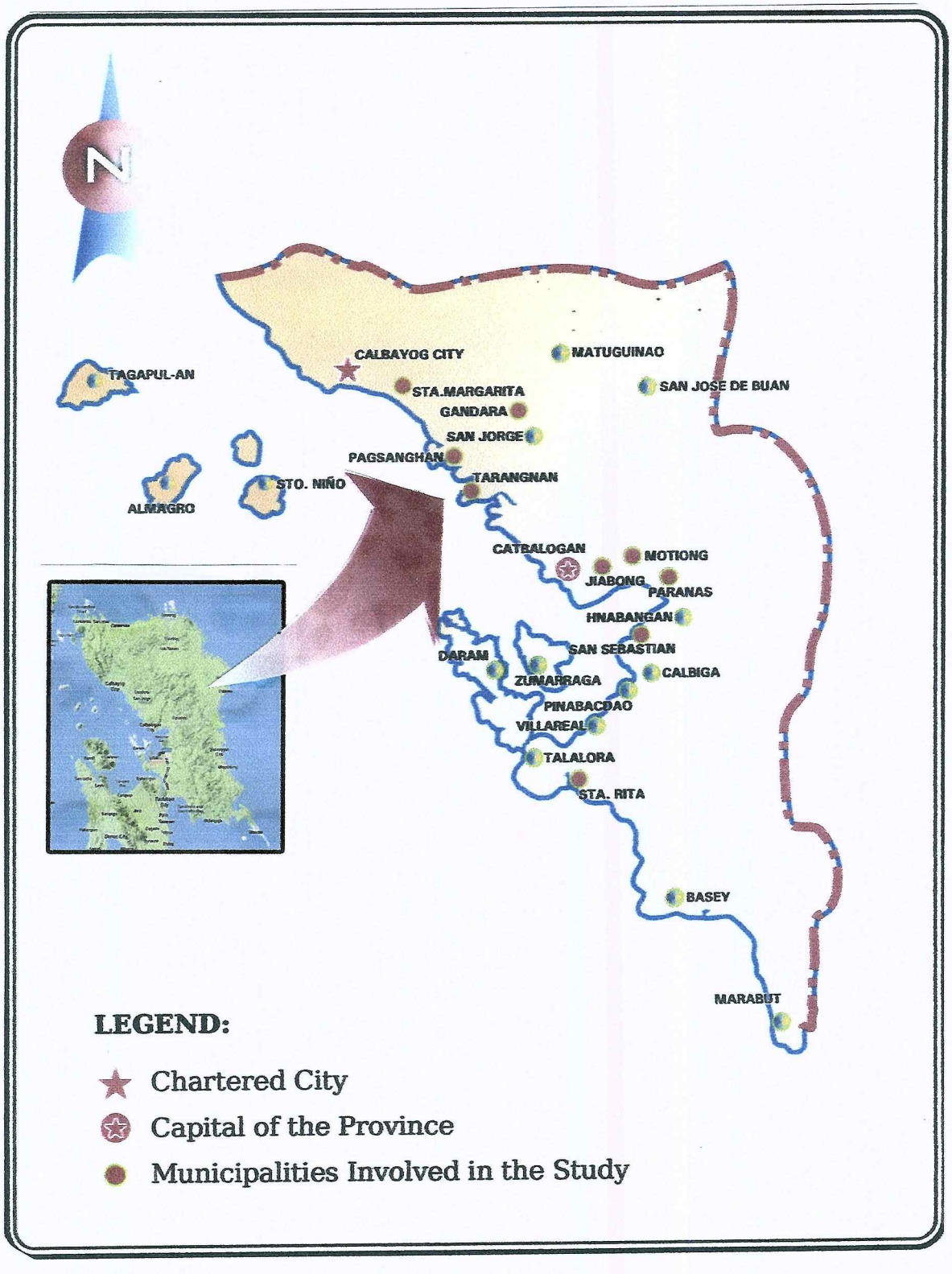

Figure 2. The Map of Samar Showing the Locale of the Study.

Definition of Terms

For clarification purposes the terms used in this study are herein defined. Unless otherwise documented, these definitions are the researcher's formulations to suit their use in this study.

Aquaculture. This refers to fishery operations involving all forms of raising and culturing fish and other fishery species in fresh, brackish and marine areas (R. A. 8550).

It likewise refers to the farming of aquatic organisms -fishes, mollusks, crustaceans, and aquatic plants. Farming implies some form of intervention to enhance production such as regular stocking, feeding, protection from predation, and individual or corporate ownership of stock being farmed (Aqua Farm News, 1994:6).

In this study, this refers to the raising of milkfish, tiger shrimps, tilapia, and grouper in combination with mudcrabs in ponds.

"**Aligue**". As used in the study, it refers to the local term of ripened eggs of female mud crab deposited in its carapace.

Aquasilviculture. It refers to the raising of mud crab/shrimp within or under mangroves (Melana *et al.*, 2000). As used in this study, this means the cultivation of mudcrabs and other fish species in mangrove areas.

Brackishwater culture. It refers to the production of fish and other fishery products in water of salinity ranges from 0.05 to 25 parts per thousand (Bautista and Serrano, 1987:9). For this study, this means the type of water which is a

combination of freshwater and saltwater used as a culture medium for mudcrab farming and usually its source comes from rivers and creeks.

By-catch fish. As used in this study, these refer to low-valued, small-sized fish and other fishery products locally available that are considered trash-fish used as feeds for mud crabs. Usually, they include small-sized slipmouth, silversides, goby, puffer fish, cardinal fish, squid juveniles, mojarras, etc.

Coastal municipalities and cities of Samar. As used in the study, these refer to the municipalities with registered fish farmers in the Samar Provincial Agriculture Office involved on the culture of mud crab which include: Sta. Margarita, Gandara, Pagsanghan, Tarangnan, Catbalogan City, Jiabong, Motiong, Paranas, San Sebastian, Sta. Rita and Calbayog City.

Crablet. As used in the study, this refers to a match- box size or one peso- coin size mud crab used as culture stock by mud crab farmers.

Educational attainment. It is the highest grade or year level of education completed (BFAR/BASS, June 2002:28). In this study, this refers to elementary, secondary, undergraduate, and graduate levels of education.

Extension services. The term refers to the provision of training information, and support services by the government and non-government organizations to the agriculture and fisheries sectors to improve the technical, business and social capabilities of farmers and fisherfolk (Department of Agriculture Administrative Order No. 6, 1998:6). In this study, this refers to technical assistance extended to fish farmers in order to improve their

production activities in mudcrab farming.

Extension worker. The term refers to the professional who undertakes development activities to alleviate the living conditions in a community (Balagapo, undated). In this study, this refer to the 25 fisheries technologists in the different coastal municipalities and cities of the Samar province.

Farming activities. As used in the study, these refer to the accepted procedures and practices in mud crab farming related to the installation of culture structure, stocking, pond preparation, feeding, water management, pond repair and maintenance, sampling, harvesting, post-harvest, and marketing.

Fattening. It is the feeding of harvested lean mud crabs with trash fish, carabao hide, chicken intestinal organs, and other supplemental feeds to increase their weight so as to command high price in the market.

Feeds. These are composed of naturally - occurring products and many of the by-products of milling or other processing of such materials which contained recognized nutrients that are needed by animals (Cruz, 1980;2). In this study, these refer to "lab-lab", algae, by-catch fish, and apple snail given to mudcrabs during the culture period to promote growth.

Feeding. As used in the study, it refers to the administration of food materials to the cultured mud crab during the entire culture period.

Fish and other aquatic products. These include not only finfish but also mollusks, crustaceans, echinoderms, marine mammals and all other species of aquatic flora and fauna and all other products of aquatic living resources in any

form (R.A. 8550;7). In this study, they refer to mudcrab, shrimps, milkfish, tilapia, grouper, and by-catch fish.

Fish farmer. This term refers to persons that rear fish and other aquatic products. As used in the study, it refers to the 86 mudcrab farmer-respondents in the eleven coastal municipalities and two cities of Samar province.

Fishpond. It is a land-based facility enclosed with earthen or stone material to impound water for growing fish (R.A. 8550:8). In this study, it refers to the facility used for the culture of mudcrabs from juvenile stage up to marketable size and also termed as fish farm.

Food security. It refers to any plan, policy or strategy aimed at ensuring adequate supplies of appropriate food at affordable prices. Food security may be achieved through self-sufficiency (i.e., ensuring adequate food supplies through a combination of domestic production and importation), or through pure importation (R.A. 8435).

Fully developed fishpond. It is a clean leveled area enclosed by dikes, at least one foot higher than the highest floodwater level in the locality and strong enough to resist pressure at the highest flood tide. It consists of at least a nursery pond, a transition pond, a rearing pond or a combination of any or all said classes of ponds, and a functional water control system and producing in a commercial scale (DAO No.3 1998). As used in the study, it refers to mud crab farm provided with dikes enough to impound considerable amount of

water during the culture period, with water control structures, and net enclosures, either in totally cleared area or with mangroves growing inside the compartments.

Harvesting. It means the gathering of fat and marketable-size mud crab and other fishery products cultured , either partial or total harvest.

Industry. This means the method of organization and facilities that through effective coordination of capital, management, and labor produce goods and services to meet the needs and desires of society (Good, 1959:376). As used in the study, this means mud crab culture industry.

Lab-lab. It refers to the biological association of microbenthic plants and animals serving as natural food for milkfish in nursery and rearing ponds (Villaluz, 1953:234). In this study, it refers to one of the natural food of mud crab during the initial month of culture.

Marketing of produce. It refers to the activities which involve the distribution and sale of harvested mud crab from fish farms to buyers.

Molting. This means the shedding of the exoskeleton to allow for growth in crustaceans (Stickney, 1979:350). In this study, it refers to the shedding off of the external skeleton of mud crabs as part of growth and development.

Monoculture. It means cultivating one species of fish (Bautista and Serrano, 1987:14). As used in this study, it refers to the cultivation of mud crab as a single species cultured in ponds and in pens.

Mud crab. A cultivable aquatic crustacean organism belonging to

Family ***Portunidae*** and Genus *Scylla.* This is also known as giant crab or mangrove crab and locally called "alimango" (Pagcatipunan, 1992:1). In this study, this refers to the aquatic organism primarily cultured in ponds by 86 fish farmer-respondents.

Mud crab farmer. As used in the study, it refers to the 86 respondents who are involved directly on the growing and/or culturing of mud crabs in the nine (9) municipalities and two (2) cities of the Samar province. It is also termed fish farmer.

Mud crab species. These refer to the kinds of mud crabs cultivable in ponds and pens scientifically and locally known as *Scylla serrata* (giant crab), *Scylla tranquibarica* (*manginlawod*), and *Scylla olivacea* (*amamakhaw*).

Net enclosure. This refers to the netting materials, knotted or knotless Gauge No. 14, fastened to bamboo posts and embedded into the muddy bottom at 0.75 meter in order to confine the mud crabs or prevent them from escaping over the dikes of the fishpond.

Ownership status. This means the state or condition wherein the person who owns and operates the farm exercise technical initiative and takes full economic risk and responsibility in the administration and operation of the farm (BFAR/BASS, 2002:41). In this study, this refers to the state of the fish farm area being utilized by the fish farmers through land title, lease agreement, or permit.

Polyculture. It means the growing of two or more species of mud fish in certain body of water (Bautista and Serrano, 1987:15). In this study, it refers to

the combined culture of mud crab in pond with other fish species such as milkfish, shrimp, tilapia, and grouper.

Pond preparation. This refers to the various activities undertaken prior to stocking of crablets in ponds.

Post-harvest technique. It refers to all techniques and processes done on the fish after harvest whether or not a change in physical or chemical form occurs (Espejo, 1992:78). In this study, it refers to the handling of mud crab in a good condition after the harvesting process.

Production. It means the elaboration of organic matter by the organism in a specified area of volume over a given period (Stickney, 1979:356). In this study, it refers to the average volume of harvested products in weight under a given unit of space, expressed in kilograms per hectare.

Repair and maintenance. This means the effort to rehabilitate worn-out conditions of materials and facilities such as net enclosures, dikes, gates, and other fishpond structures in order to protect loss of cultured stocks from the fishpond or pens.

Respondents. They **refer** to the persons being interviewed or supplier of data who are knowledgeable of the operation and management of aquaculture farm (BFAR/BASS, 2002:54). As used in the study, these refer to 86 mud crab farmers, and 25 fisheries technologists who are involved in the study

Salinity. This refers to the measure of the total amount of dissolved salts in a sample of water in parts per thousand by weight when all the carbonates

have been converted to oxide, bromide and iodide have been replaced by chloride, and all organic matter have been oxidized (Stickney, 1979:537). For this study, this refers to the degree of saltiness of water used in mud crab farming.

Samar Province. A topographical name that replaced the name Western Samar by virtue of Republic Act 5650, and one of the three provinces of the whole island of Samar with Catbalogan City, as the capital town.

Sampling. As used in this study, it means the measurement of carapace length and weights of cultured mud crabs at regular time intervals which serve as basis for feeding adjustments.

Selective harvest. In this study, it means the gathering of fat and marketable-sized mud crabs, usually greater than 300 grams in weight.

Soft-shelled crabs. This refers to mud crabs that are newly-molted characterized by their soft body covering.

Stocking. In this study, it refers to the release of crablets into ponds and pens for growing purposes.

Stocking rate. This means the total number of crablets stocked per unit area.

Technologists. These refer to persons who are specialists in a branch of science of technical processes (Webster's Encyclopedic Dictionary, 1992:1015). As used in the study, these refer to the twenty-five respondents of the study who are Agricultural Technologists (ATs) and Aquaculturist of the province of Samar that undertake technical services and development activities in the aquaculture sector.

Temperature. As used in the study, this means the degree of hotness of water in the culture system measured using a thermometer.

Training needs. It refers to the knowledge, skills, and competencies required by the mud crab farmers in order to adopt the mud crab culture technology as well as to enhance their production methods, techniques, and capabilities for the attainment of improved quality of life.

Water management. This refers to the various activities in pond culture which involves the monitoring and maintenance of water conditions inside the culture system which include water freshening, maintenance of favorable water depth, and monitoring of water parameters.

Chapter 2

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter presents the various information related to the study that were taken from published materials as well as in unpublished sources such as theses, dissertations, reports, and electronic materials.

Related Literature

The Fisheries Code of 1998 (Republic Act 8550) provides for the development, management and conservation of the fisheries and aquatic resources of the country. This code is a consolidation of prior fishery laws and an update of prior laws related to the fisheries. Some provisions are quite new and innovative, while others are reiterated or improved from old ones.

The policies embodied in the code are the following:

1. A flexible policy towards the attainment of food security shall be adopted in response to changes in demographic trends of fish consumption, emerging trends in trade of fish and other aquatic fishery products in domestic and international markets, and the law of supply and demand.

2. Manage fishery and aquatic resources in a manner consistent with the concept of integrated coastal area management in specific natural fishery management areas, appropriate supported by research, technical services and guidance provided by the State. With these policies, the State ensures the

attainment of a) the conservation, protection and sustained management of the country's fishery and aquatic resources; b) poverty alleviation and the provision of supplementary livelihood among municipal fisher folk; c) the improvement of productivity of aquaculture within ecological limits; d) the optimal utilization of offshore and deep-sea resources; and e) the upgrading of post-harvest technology.

Bernacsek (1996) writing on the role of fisheries in food security stated that there are clear indications that fisheries quantity production is approaching real limits to further growth. The Philippine fisheries policy should emphasize growth in value-added products and increase profitability, rather than on quantity output. A new development climate needs to be created which will facilitate active entrepreneurial exploration of new markets for fish and fishery products and new export opportunities. Parallel to this policy shift, he added, is the sustainability of domestic production which needs to be achieved through effective management in order for producers to be able to provide a secured source of raw materials for processors and marketers.

Aquaculture has played major roles in national development. As stressed by Bautista and Serrano (1987:6) these include: food production, recycling of wastes and low grades fishery products, employment, stock improvement, baitfish production, recreation, export industry development, stabilization of market conditions, and control of water pollution and eutrophication. Moreover, aquaculture provides excellent opportunities for employment and income

generation in the more economically depressed areas. As a matter of fact, it has employed a large number of people either directly in fish farming activities (as for example, fishpond/fish pen/fish cage operators, caretakers, construction workers, pump tenders, vehicle/machine operators, harvesting aides) or indirectly employed in related or ancillary industries (as net manufacturers, boat makers, fry gatherers, and bamboo suppliers) (Baluyot, 1989:4).

Aquaculture has also been the best means of alternative livelihood for fishing communities whose traditional income has been substantially affected by over-exploitation of coastal municipal fishing grounds. The introduction of small - scale aquaculture in many areas was shown to create employment and over-exploitation of coastal municipal fishing grounds. The introduction of small-scale aquaculture in many areas shown to create employment, and improved the socio-economic status of sustenance fishermen. As pointed out by Baluyot (1988), aquaculture development also spurs the establishment and growth of related industries in support of production as feed milling, fish processing, ice-making, cold storage, net manufacture, and even construction. In major aquaculture producing countries, the manufacture of fish/shrimp feeds and support equipment, supplies and materials has expanded side by side with the expansion of aquaculture.

Relative to aquaculture operations, the Code of Practice for Aquaculture (Department of Agriculture Order No. 214, Series of 2001) outlines the general principles and guidelines for environmentally-sound design and operation for

the sustainable development of the industry. It specifies the following:

1) **For site selection/evaluation**. The potential sites for aquaculture shall be thoroughly evaluated by the Bureau of Fisheries and Aquatic Resources in consultation with the Department of Environment and Natural Resources, the Local Government Units, and National Fisheries and Agriculture Resource Management Councils (NFARMC) to ensure that ecological and social conditions are sustained and protected. Among others, it include: (a) water source in the area shall be evaluated as to its quality and quantity; (b) freshwater effluents and flood levels, offshore currents and existing water uses shall be determined; the soil and ecosystem for sitting and construction of ponds shall be ascertained; long-term climatological records for the last five (5) years shall be acquired to determine the occurrence of floods, droughts, storms and other calamities in the area.

2. **On farm design and construction.** The proven and accepted designs and construction procedures shall be adopted to overcome problems related to flood levels, storms, erosion, seepage, water intake and discharge points, encroachment on mangroves, and wetlands as well as social impacts. The following practices shall assure this goal: (a) the Environmental Impact Statement (EIS) shall be required to be submitted to the Department of Environment and Natural Resources for review and evaluation before initiating any development or construction; (b) the embankments shall be so designed as to prevent erosion and reduce seepage; (c) the farm shall be properly designed in

such a way that the arrangement of the pond compartments, water control structures and all other facilities shall mutually harmonize with each other giving the most efficient water management and manipulator of the stocks; (d) the structural design shall consider storms and flood levels; (e) the required buffer zone shall be maintained as well as vegetative cover for exposed earthwork: (1) for brackish water, a buffer zone of at least 100 meters from the sea to the main peripheral dike and 50 meters along the river banks (for typhoon prone areas) and 50 meters from the sea and 20 meters along the river banks (for non-typhoon prone areas) shall be left undisturbed for ecological reasons and physical protection from flooding and wave action.

3. **On stock selection and stocking practices.** The following practices shall assure increased production of good quality and disease-free stocks promoting profitable fish farming: (a) moderate and appropriate stocking density by species shall be employed; (b) stock only healthy fry and fingerlings. Genetically, improved fish species for stocking shall be sourced from government and accredited non-government hatcheries.

4. **On feed and feed use management.** The following shall be adopted to improve the efficiency of supplemental feeds and feed management in aquaculture and reduce the amount of waste entering the ponds: (a) feeds shall be selected as to their high utilization rates to reduce nutrient pollution from uneaten feeds and excretory products; (b) the feeds characteristics shall include balanced levels of amino acids and other nutrient appropriate for the age of the

fish, high palatability to stimulate rapid consumption, and high stability to prevent rapid nutrient release; (c) the good feeding practices shall include frequent feeding in small quantities of feed several times through the day, using feeding trays and even distribution of feeds in the pond (d) the records of daily feed application shall be kept to assess feed conversion ratio (FCR).

Taxonomy, Biology and Distribution of Mudcrab. Crabs comprise about 4,500 species of Arthropods in the Order *Decapoda* Class *Crustacea*. The mud crab locally known as "alimango" belongs to the Genus *Scylla* under Family *Portunidae* (Villaluz, 1953:149). However, not all mud crab raisers know which kind of mud crabs are the best one to raise because they all look the same at a glance. But most of us are unaware that there is a very high quality and most expensive type of *Scylla* or giant mud crabs or king crabs. There are four kinds: *Scylla serrata, Scylla olivacea, Scylla tranquebarica* and *Scylla paramamosain.* But *Scylla serrata* is widely cultured in the Philippines because of its bigger size and is easy to raise and fatten. They grow faster and attain a weight of 1 kilogram after six months of culture. If feeding is regularly done they will thrive in a pond with no problem and seldom you can see them dig burrows in the mud so the dikes will not be damaged (www.bfar.gov.ph.).

Triño (1997:1) described *Scylla serrata* as morphologically characterized by greenish in color with white polygonal markings on the swimming and walking legs, chilepeds, carapace and with orange claws. They have deep serrated and pointed frontal spines at the dorso-posterior side of the merus. This species is

called "giant crab."

These large marine and estuarine crustaceans live in soft muddy bottom in sheltered estuaries, tidal flats and rivers lined with mangroves. However, females carrying eggs are present in deeper waters up to 50 km offshore in tropical to warm temperate waters. Mud crabs vary in color from dark olive-brown to greenish and blue-black and patterns of lighter colored cover the walking legs (www.da.gov.ph.)

Mud crabs are widely distributed in the Philippines and throughout the Indo-Pacific Region (Pagcatipunan, 1982:1). However, the farming of this crustacean species is a significant industry in Vietnam, Indonesia, Sarawak, and elsewhere in Southeast Asia (www.fishfarmer-magazine.com.)

Feeds and Feeding. Mud crabs are scavengers and highly cannibalistic in nature (Triño, 1997:1). They feed on mollusks (snails, clams or oysters), trash fish entrails, fish visceral, animal entrails and almost any kind of animal (Pagcatipuan, 1992:5). In ponds, mud crabs browsed on decaying organic matter at the bottom and preyed on zooplankton and other slow moving animals in the pond water. Existing literatures indicated that aquatic macrophytes such as ***lumut, digman, kusay-kusay,*** and sea grasses are inhabited by abundant animal organisms like copepods, nematodes, polychaetes, and crustaceans which are all known food of mud crabs (Triño, 1997:7)

Being highly cannibalistic in nature, when another crab undergoes molting the hard-shelled ones attack the molting crabs and devour them

(www.wikipedia.org/scylla). Carnivorous crabs are all predatory; although they may eat dead putrefying flesh of animals (New Standard Encyclopedia, 1990: 321).

The commonest form of predation is probably the eating of mollusks, both bivalves and gastropods. These are dug up or otherwise waylaid (caught), crack with the claws and the meat is picked out of the shell and eaten. Mud crab cultured in ponds feed on natural food such as algae, crustaceans, and other animal matter.

Some farmers feed them with trash fish or other available animal products at the rate of 5 - 7 percent of the body weight and feeding is usually done after dark (Pillay, 1990). Triño (1997:10) pointed out that the recommended feeding rate ranged from 5 to 20 percent of the crab biomass per day. Furthermore, he cited that Yalin and Questang (1994) recommended a daily ration of 10 percent of the crab biomass when crab length is less than 6 centimeters and 5 percent when the length is equal to or greater than 6 centimeters.

Ecological Requirements. According to Villaluz (1953:151), mud crab has its natural characteristics of burrowing into its natural habitat, the mud. They prefer brackish water ponds which contain no less then one meter in depth. Seville, *et al.* (1987:3) reported that the incidence of crab holes can be minimized and prevented by maintaining the water depth at least one meter deep to provide sufficient coolness to the pond, hence, crabs will no longer look for a

more cooler refuge, like burrowing into the dikes. About two-thirds of the water should be changed daily maintaining an average depth of 1 meter. Soil seal should be installed after each water change.

Ladra (1992) mentioned that mud crabs are eurythermal and euryhaline, i.e., they can tolerate a wide range of temperature and salinity. They can withstand water temperature ranging from 12 - 35 degrees Celsius but their activity and feeding fall rapidly at temperature below 20 degrees Celsius. The optimum temperature requirement for fast growth is 23 - 32 degrees Celsius. Crabs are able to survive in salinity ranges of 2 - 43 parts per thousand but their optimum salinity requirement is from 15 - 30 parts per thousand. Mud crabs are oxyregulator, hence, have a well developed ability to exploit oxygen from the air. Under severe condition of hypoxia, they leave the water and breathe air. The requirement for pH is alkaline but they grow well at pH 8.0 - 8.5 (Triño, 1997:10).

Growth. Arriola (1940) stated that mud crab (*Scylla serrata*) molts as it grows. They molt 12 - 15 times for 186 days, throwing off their appendages with consequent regeneration is characteristics of this species. Internal fertilization occurs in the crab. Spawning activity is all year round with its peak occurring from May to September. Young crabs under cultivation molted at an interval of 27 to 50 days. They reach marketable size after five to six months and mature for a period of nine to ten months (Pagcatipunan, 1992:5). Likewise, crabs measuring 6 to 15 centimeters carapace length can grow 2.7 centimeters per month for males and 2.3 centimeters per month for female (Le Reste, Feso and

Ramelson, 1976 as cited by Pagcatipunan, 1992:5).

Mud crab cultured in ponds remain buried during the day, emerging at sunset to spend the feeding, which occurred intermittently even when unlimited food is available. If no food is present the amount of time spent on the substrate surface is halved. Major prey groups were burrowing bivalves, attached bivalves and small crabs. *Scylla serrata* showed a preference for small crabs as prey, because of their larger mass and higher energy content compared with other prey organisms (Hill, 1979).

Culture Practices. Tung and Sri as cited by Cheong (1991:13) reported that culture of *Scylla serrata* has been practiced in Kwang Tung Province in China from as early as 1891. Commercial culture of crabs were undertaken in the Philippines, Thailand, Sri Lanka and India (Cheong, 1991).

In ponds the crabs prefer brackish water which contain no less than one meter of water in depth. Crablets are stocked in the rearing ponds and are reared either in monoculture or in polyculture with milkfish (Pagcatipunan, 1992). Stocking rates vary with sizes ranging from 5.2 to 30 pieces per square meter. Ponds are provided with bamboo fence to minimize damage of dikes due to the burrowing habits of mud crabs.

In the Philippines, Castaños (1997) of the Southeast Asian Fisheries Development Center (SEAFDEC), Iloilo, Philippines mentioned the requisites of growing mud crabs in brackishwater ponds:

1. Choose a suitable site. Make sure marine or brackish water is

sufficient all year-round, relatively unpolluted or free from sources of pollution. Fresh water must be available particularly in summer. The site must be accessible and secured from poachers. Mud crab grow best at 18 - 30 parts per thousand salinity and 25 - 30 degree Celsius temperature.

2. Construct rectangular ponds ranging from size 5,000 to 10,000 square meters. Allow for 0.6 to 1.0 meter water depth. Level the pond bottom. Make the pond gates and dikes structurally strong and free of leaks. Construct shelters or small hiding places for mud crab; use sawed-off bamboos or used PVC pipes. Place these 'hides' at strategic areas around the pond. Canals or trenches are optional though these can serve as refuge for mud crab and make harvest and water change easier. Catwalks are also optional though these can help facilitate feeding, monitoring, and stock sampling.

3. Prepare the ponds. Totally drain the pond, dry for two weeks until the soil cracks, and remove extraneous species (fish, weeds, etc.). Treat undrainable areas with ammonium sulfate and quick lime (1:5 ratio) at the rate of 0.5 kilogram per square meter. Alternatively, use *Derris* root (5 percent rotenone) at 0.5 - 2.0 grams per ton of pond water or tea seed cake at 12 grams per ton for less than 15 parts per thousand or 20 - 30 grams per ton for more than 15 parts per thousand.

4. Install nylon net fence using "A" net having 1 - 2 centimeters mesh close to the perimeter dike. Support the net fence vertically with bamboo or wooden posts and horizontally with bamboo splits embedded 50 - 70

centimeters along the base. Install plastic strips or sheets (50 centimeters width) along the top edge of the net fence to prevent mud crab from climbing over the top. Install mounds or used tires as additional shelters in the middle of the pond, high enough so that the top portion remain above water even when the pond is flooded to its limit (60 - 100 cm).

5. Grow natural food. Following the plankton method, introduce at most 0.8 - 1.0 meter water depth into the pond. Check the screens at the pond gate to prevent entry of unwanted species in the pond.

6. Stock mud crab. Stocking can be done one to two weeks after flooding. Use mud crab juveniles weighing 30 - 40 grams or measuring 5 - 10 cm. carapace width. Stock 5,000 to 10,000 juveniles per hectare. Note that mud crab juveniles need to be nursed for one to two weeks in net cages if smaller juveniles are stocked (1 -2 cm carapace length). In the nursery, stocking density is 120 juveniles per square meter. Mud crab juveniles are fed with trash fish, *Acetes*, or green filamentous algae (*lumut*). Cover the net cages with coconut fronds to serve as shelter and to increase surface area for attachment by crabs. Sort the stock every week, and stock the five centimeter juveniles in grow-out ponds. In stocking newly arrived juveniles in grow-out ponds, acclimate them first by sprinkling pond water to the crabs placed in a basin. Do this for 30 minutes, or until the juveniles are completely submerged. If the pincers are tied, cut the knots. Do not cut the pincers. Release the juveniles evenly around the pond. It's best to stock early in the morning or late in the afternoon when it is

cool.

7. Take care of the mud crab stock by: (a) regularly changing the water (10 - 30 percent per spring tide cycle); (b) checking for leaks in the dikes and gates, and tears in the net cages and fences; and (c) feeding with chopped trash fish, animal hides/entrails and snails (golden ***kuhol***). Feed at 10 percent then at 6 percent crab body weight as culture progresses; assume 100 percent then 80 percent survival. Feed the mud crab twice a day, half of the food in the morning, half in the afternoon. Feeding trays may be used; or feed may be broadcast.

Mudcrab Fattening Practices. Mud crab fattening has been practiced in the Philippines. Early methods involved placing crabs in holes along the seashore. In Bolinao, Pangasinan mud crabs were cultured and fattened in concrete tanks (Ladra,1992:151).

Another mud crab fattening method is through the use of a bamboo cage with a dimension of 1.83 meters long, 9.2 centimeters wide, and 2.3 centimeters high which holds one thin mature crab each (IIRR,1995:8). In Capiz, crabs fed with trash fish, soft-shelled snails, kitchen leftovers, mussel meat, and animal entrails obtained an average weight increase of 110 grams after 15 days of confinement/fattening (Ladra, 1992:153).

In Sri Lanka, experiment trials on mud crab fattening in concrete tanks (5x5x1m) with either concrete and earthen pond bottom showed an average weight increase of 96 grams in 35 days when clam meat and abattoir waste were

used as feed (De Silva, 1992;155). Fishpond method of mud crab fattening is usually undertaken in ponds with varying sizes ranging from 10 to 20 meters wide, 20 to 40 meters long and 1 to 2 meters deep dikes. The dikes are provided with bamboo slat fence of 2.5 centimeters wide and 0.91 - 1.52 meters long. The bamboo slat fence is anchored to posts (8-13cm dia.) at a 45 degree angle towards the inside pond (IIRR:9). In New Washington, Aklan, 500-square meter undeveloped ponds were stocked with 150-200 grams crablets at two to three crabs per square meter. The crabs after 10 to 15 days obtained a growth increment of 110 grams per crab. Fattening of mud crabs in pens was practiced in Panguil Bay in Mindanao. The pens measured 2 x 2 x 1.5 meters made of bamboo poles and erected in the muddy, intertidal area near the fishermen's houses (Ladra, 1992:152). In Basilan Province, mud crab for fattening are penned underneath the houses of Muslim fisherfolks. Chicken wire and discarded nettings are used.

Mudcrab Collection and Other Culture Practices. According to Cowan (1984) in Taiwan mud crab *Scylla serrata*, are fished and cultivated. Crabs are caught using gill nets and baited traps and pots. Grower of mud crab depend on the seedlings collected from the sea. Mud crab are polycultured in combination with either two or more species: prawn, milkfish and seaweeds. Pond construction water management, feed, stocking and harvesting in the polyculture system are included. Monoculture of crabs only involves holding and fattening

of female crabs because female crabs packed with red-orange eggs are highly-priced gourmet food.

Griño (1977) stated that mud crab (*Scylla serrata*) in Western Visayas, are usually cultured in combination with milkfish. Crablets are usually collected from open sea by using scoop nets and crab lift net (*bintol*). Rearing period ranges from 4-5 months. During the initial months of culture, crabs feed on lab-lab. As the lab-lab grow thinner supplementary feeds in the form of trash fish, toads, carcasses of dead animals are given.

At least one of the swimming crabs, *Scylla serrata*, has long been an incidental product of brackish water pond culture in Southeast Asia. In the Philippines and perhaps elsewhere young *S. serrata* are occasionally stocked in fish ponds but usually they enter of their own accord. They may be even encouraged as possible predators on small fish and shrimp because they may burrow in the banks, but generally they are tolerated and harvested along with the fish and shrimp crop. In this manner, with no management whatsoever, the production of *S. serrata* from brackish water pond in Taiwan in 1966 was 168,102 kg per hectare more than that of any other single species except the ubiquitous milkfish and Java tilapia. Similarly, milkfish ponds in Java produce an average of 200 crabs/ha/year.

Aquasilviculture is a new trend in aquaculture production. This employs a multiple-use management practice integrating aquaculture with mangrove forestry. This is presently practiced in Vietnam, Indonesia, Thailand, and the

Philippines (Bagarinao and Flores, 1995:32). In the Philippines, sites have been established in various parts of the country, particularly in the provinces of Quezon, Oriental Mindoro, Negros Occidental, Bohol, Cagayan, and Guimaras wherein the species cultured include milkfish, shrimps crabs, tilapia, and siganids. This aquaculture practice has shown varying degrees of success ranging from poor to good harvests. Poor harvests were due to poaching, typhoon, and lack of skills in pond management.

Research Studies in Mud Crab Culture. Studies on mud crab, *Scylla* species, was conducted by the Aquaculture Department of the Southeast Asian Fisheries Development Center, Iloilo, Philippines (SEAFDEC Asian Aquaculture, 1997). Laviña and Buling were successful in their first attempts at hatching mud crab with rates varying between 75 - 90%. The larvae survived salinity levels as low as 15 parts per thousand until the 14th day of rearing. Other larvae were able to survive in salinities of 30 - 32 parts per thousand for 8 - 13 days. Zoea molting was hastened by lowering the salinity to 25 - 27 parts per thousand.

In 1979, a study was conducted to find out at what salinity levels did the germ cells of male and female crabs attain maturation. The study recorded gonadal condition indices to be highest at 28 parts per thousand from February to June and at 20 to 22 parts per thousand from July to November 1978. Baliao (1981) studied the culture of mud crab at different stocking densities. Survival, growth, feed conversion, production, and carapace size of crab were monitored.

Crabs stocked at 5,000 per hectare had the highest average weight and percentage survival. In 1983, Baliao conducted another study and found mud crab culture in brackishwater ponds in combination with milkfish to be feasible. Solis (1992) conducted a study on the abundance of juvenile mud crab in mangrove and non-mangrove areas in Tinagong Dagat and Sapian Bay in Capiz. Results showed that mud crabs were caught by baited conical bamboo traps operated during the full moon and new moon periods, set during the low tide and harvested during the next low tide. Abundance peaked in March - April and dipped in July - August. Mud crabs caught in the mangrove areas ranged 2 to 10 centimeters carapace width with 3 - 14 centimeters in non-mangrove areas. Smaller crabs were caught from January - May; larger ones were caught in November.

On broodstock development, Millamena (1997) evaluated the reproductive performance of mud crab (mean body weight = 343 - 380 grams) fed with different diets. The highest number of spawning of 88 percent was obtained in treatments given with a combination of natural food (squid, mussel meat, ad trash fish) and artificial diet. The fecundity was 7,855 eggs per female body weight, with an egg fertilization of 88 percent. Those fed with natural food got the highest values of the above parameters and those fed with purely artificial diet obtained intermediate values.

Survival and growth of megalopa to crablets was investigated using various unprocessed natural food (squid, mussel meat, trash fish, and *Artemia*).

Results showed best survival in crabs fed with squid (45.6%), followed by trash fish (41.5%), *Artemia* (31.5%), and mussel meat (28.5%) (SEAFDEC Asian Aquaculture, 1997).

Related Studies

Relevant findings of studies conducted related to mudcrab aquaculture were reviewed to shed light to the current study.

Duzon (2003) investigated the adoption of aquaculture technology in selected towns of Samar as inputs for improving instruction in Samar State Polytechnic College-Mercedes Campus, Catbalogan, Samar. Results showed that milkfish, shrimps, tilapia, grouper, and crabs were the primary species being cultured. It was concluded that Samar is wanting of the introduction of other potential cultivable species such as catfish and mudfish considering that there are freshwater areas which are potential for aquaculture. Also, it was found out that fish farmers were short of knowledge and capabilities on aquaculture.

This study has similar bearing on the present study considering that it focused on brackishwater aquaculture in the coastal municipalities of Samar wherein some of the fish farmer respondents in his investigation were the same persons involved in the present study. However, the said research differed from the present study since it focused specifically on mud crab aquaculture- its production status, farming activities, problems, and training needs.

Amparado (2005) conducted a survey on the aquaculture industry in the Samar province wherein the results of which served as basis for the extension program of Samar State University. It was concluded that production levels in aquaculture in the Samar province are low compared to the national average which could be attributed to the inefficient adoption of appropriate aquaculture technologies such as intensification and commodity diversification as well as maximization of available production area. In addition, farming activities in freshwater aquaculture were "slightly practiced" while "moderately practiced" in brackishwater and mariculture. The low level of farming practices could be due to lack of educational awareness among the fish farmers, their low motivational desire to adopt the technology attributed to inadequate financial resources and inefficient technology delivery system. Finally, short - term trainings on fish health management, cooperative development, design and construction of culture systems, feeding and nutrition, post-harvest technology, milkfish culture, tilapia culture, tiger shrimp culture, grouper in cages, and aquasilviculture are necessary to improve the level of awareness of fish farmers.

This study is similar to the present study considering that mud crabs being grown in brackishwater ponds is one of the cultivable species under investigation and the same locale which is the province of Samar. Moreover, both studies looked into the extent of farming activities, problems, and training needs. However, differences were on the area of concerns. The former study covered the three major areas of aquaculture production, that is, freshwater

aquaculture, brackishwater aquaculture, and mariculture. It likewise included technology delivery system in the entire aquaculture industry of the province whereas the major focus of the present study is on mud crab as a specific commodity in brackishwater aquaculture, and findings will be limited to the improvement and enhancement of its culture system and technology adoption in the coastal municipalities of Samar.

A survey of crablets population in Bobon, Northern Samar and its relation to lunar phase was conducted by Gaureno (2004). Results showed that mudcrab species *Scylla oceanica* could be gathered by local fishermen using collapsible at different lunar phases. However, crablets were abundant and could be collected in great number during new moon.

This survey has similarity with the present study since both dealt with mudcrab as the commodity of investigation. It differed from the present study, since it focused on the survey of crablets population and collection from the wild while the present study gave emphasis on its culture practices as well as the socio-professional characteristics of the mudcrab farmers. In addition, the former was conducted in Northern Samar while the latter limited its scope within Samar province.

Studies on the culture of mudcrab (*Scylla serrata*) in ponds were conducted at the Brackishwater Fishpond of Samar State University, Catbalogan City. Inovejas and Polancos (2010) cultured mudcrab in ponds fed with by-catch fish and golden apple snail for 90 days at 0.5 crab per square meter stocking rate.

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Studies on the culture of mud crab (*Scylla serrata*) in ponds were conducted at the Brackishwater Fishpond of Samar State University, Catbalogan City. Inovejas and Polancos (2010) cultured mud crab in ponds fed with by-catch fish and golden apple snail for 90 days at 0.5 crab per square meter stocking rate. Results showed that average weights of crabs fed with by-catch fish was 307.62 grams; a daily weight increment of 2.86 g/crab; and 45.33% survival rate. For those fed with golden apple snail, the average weight was 347.86 grams; a daily weight increment of 3.31 g/crab; and 52 percent survival. However, average daily weight increment between the two feeding variables did not differ significantly.

Severo, Amparado, and Amparado (2011) conducted a field study on the effect of apple snail (*Pomacea canaliculata*) and by-catch fish on the growth, production, and nutrient composition of mud crab (*Scylla serrata*) in ponds. Results revealed that after 120 days, the obtained mean weights of mud crabs were: 471.59 grams (fed with apple snail and by-catch fish combination); 442.04 grams (fed with by-catch fish); and 424.27 grams (fed with apple snail). Mean daily weight increments in gram per crab per day were 3.33 (fed with apple snail), 3.72 (fed with apple snail and by-catch fish), and 3.47 (fed with by - catch

fish). Survival rates ranged from 45.33 - 45.67 percent and a production average which ranged from 1,887.27 - 2,185.60 kilograms per hectare. Results of proximate analysis showed that mud crabs fed with apple snail recorded 18 percent protein, 0.86 percent fat, and 1.78 percent carbohydrate. Those fed with combined apple snail and by-catch fish resulted to 18.40 percent protein, 0.94 percent fat, and 2.21 percent carbohydrate. Mud crabs fed with by-catch fish obtained 18.40 percent protein, 0.85 percent fat and 1.69 carbohydrate. It was concluded that apple snail is a potential feed source for mud crabs but it can be administered as an effective feedstuff in combination with by-catch fish.

These two studies showed similarity with the present study considering that it dealt with the cultivation of mud crab in pond and the site of investigation was within the study locale. They differed since the present study investigated the mud crab culture industry in the different coastal municipalities of Samar province, embracing a wider scope of investigation related to mud crab culture industry.

SEAFDEC Aquaculture Department Highlights (2010) reported several studies and recent advances on mud crab:

A study on larval feeding was conducted using umbrella-stage brine shrimp *Artemia* as substitute for rotifer in feeding day 2 zoea until megalopa stage. Based on survival, results showed that rotifer was still a more superior food for early zoeal stage. In another experiment, higher survival of crab larvae was obtained when the experimental species were fed with *Artemia* enriched

with DHA protein SELCO.

Cannibalism is one of the major causes of low survival in crab hatchery and nursery with serotonin being implicated as a key physiological regulator of agonistic behavior. A series of experiments were undertaken to determine the effect of tryptophan (trp), a precursor of serotonin, and exogenous serotonin on aggressive behavior and dominance in crab. Results showed that those fed with diet containing 1 percent tryptophan had the lowest frequency and intensity of attacks compared with crabs which received 0 or 0.5 percent tryptophan diets.

The effect of serotonin injection on the antagonistic behavior of dominant and subordinate mud crab was likewise investigated. It was found out that injection of serotonin at 3 microgram per gram body weight to mud crab significantly reduced the frequency and intensity of attacks by dominant crabs and likewise increased the defensive stance of subordinate crab.

Several feeding experiments were done to determine growth and survival of mud crab (3 - 6 g body weight). The stocks were given two diets containing the same dietary energy levels but at different protein contents. The stocking rate was 0.1 crab per square meter and a daily ration of 80 - 90 percent formulated diet and 10 - 20 percent trash fish with a culture period of 159 (run 1) - 145 days (run 2). Results showed a percentage survival of 16 - 52 percent (during the cold months) for the first run and 31 - 79 percent for the second run. Final mean weights of 800 - 900 grams, with some crab reaching weights of 800 - 930 grams. Formulated diet at 90 percent of the ration was able to sustain crab

growth.

The series of experiments and investigations conducted by the Southeast Asian fisheries Development Center have similarities with the present undertaking because the subject commodity is mud crab, as well as the area of investigation particularly on feeding and growth. However, differences occurred because data were obtained from experiments conducted under controlled laboratory conditions while the present study gathered data from actual field experiences of mud crab farmers.

Chapter 3

METHODOLOGY

This chapter presents the various aspects in conducting the study. This discusses the research design, instrumentation, validation of the instrument, sampling procedure, data gathering procedure, as well as the statistical tools and treatment of data.

Research Design

The study employed the descriptive method of research. This design was adopted by the researcher considering that the aim of the investigation was to present the facts and status of the adoption of the mud crab culture technology in the Samar province. Descriptive research method describes and interprets what is. It is concerned with conditions of relationships that exists; practices that prevail; beliefs, processes that are going on; effects that are being felt, or trends that are developing (Best as cited by Calderon and Gonzales, 1993:61).

The study looked into the status of the mud crab industry and to what extent the accepted farming practices were being adopted by the mud crab farmers, as well as their perceptions on the problems and training needs related to this technology.

The researcher also established if there were significant relationships on the extent of farming activities adopted by mud crab farmers to their personal and professional characteristics. The data were gathered through structured

questionnaire. The Chi-square test was used to determine significant relationships while t-test for independent samples was employed to determine significant difference of the perceptions on the extent to which the problems of the mud crab industry are felt by the fish farmer and fisheries technologists-respondents.

Instrumentation

In order to obtain valid and reliable data, the researcher employed the use of the questionnaire as the primary data-gathering instrument. This was supplemented by structured interview and documentary analysis.

The Questionnaire. The instrument used for data gathering was a self-structured questionnaire. Two sets of questionnaires were prepared. One for mud crab fish farmers and another for fisheries technologists. However, a vernacular version was made on the questionnaire for mud crab farmers and administered to those who cannot fully understand the English version.

The questionnaire administered to the mud crab farmers consisted of five parts. Part I elicited personal information of the respondents, which include sex, age, civil status, highest educational attainment, trainings attended relevant to mud crab farming, and average monthly income. Part II focused on the profile of mud crab farm and production status. Part III centered on the extent of mud crab farming activities as practiced by the fish farmer respondents categorized as installation of culture structure and net enclosure, pond preparation, stocking, water management, feeds and feeding, fish health

management, repair and maintenance, sampling, harvesting, post-harvest techniques, and transport and marketing of produce. Part IV deals with the problems of mud crab aquaculture. Finally, Part V was on training needs of fish farmers on mud crab aquaculture.

On the other hand, the questionnaire administered to fisheries technologists consisted of Parts I, IV, and V. An open-ended question was provided at the end of the questionnaire to allow respondents to freely note their comments, suggestions, and relevant areas of concerns.

The respondents were allowed to supply the needed data on their personal and professional profile as well as on fish farm profile and production status.

On the part designed to gather pertinent data on farming practice, the fish farmer-respondents were requested to check whether the specific activities were practiced. For the problems in mud crab farming, the respondents were made to check a five-point scale with the following adjectival descriptions: 5 for Very much a problem (VMAP), 4 for much a problem (MAP), 3 for moderately a problem (MoAP), 2 for slightly a problem (SAP), and 1 for not a problem at all (NAP).

Those related to training needs of fish farmers, the respondents were made to check on a five-point scale with the following verbal descriptions: 5 for very much necessary (VMN), 4 for much necessary (MN), 3 for moderately necessary (MoN), 2 for slightly necessary (SN), and 1 for not necessary (NN).

Interview. A structured interview was used to obtain information from fish farmers who possessed low educational attainment regarding specific responses on the different items included in the survey questionnaire. To do this an interview schedule was made. The researcher read the questions or statements to the respondent for him/her to answer and his/her reply was written and noted.

Documentary Analysis. Data that were relevant and necessary for the organization of the study were sourced out from the municipal, city, and provincial offices, as well as in government agencies involved in the study. These data concerned on the list of mud crab fish farmers, the location of farms, and the personnel involved in extension and technology transfer services.

Validation of the Instrument

The questionnaire was developed by the researcher. After which it was submitted to his thesis adviser for comments and improvements. Then, this was referred to aquaculture technologists and faculty in fisheries at Samar State University Mercedes Campus for comments and suggestions regarding the clarity of language including its contents. Finally, this was tried out to the two categories of respondents who were not included in the study. The test-retest method was adopted at a week's interval to determine its reliability using appropriate statistical tool.

The suggestions of the thesis committee, the inputs of the technologists and faculty in fisheries, and the result of the coefficient stability (Pearson r = 0.83)

were the basis for the revision and refinement of the questionnaire.

Sampling Procedure

Two groups of respondents were involved in the study, namely: mud crab farmers and fisheries technologists. A stratified random sampling was adopted to mud crab farmers due to their large number. However, for fisheries technologists, total enumeration was used. For mud crab farmers group random sampling will be undertaken.

In determining the sample size, the Sloven's formula (Pagoso, et al., 1985:18) was adopted as follows:

$$n = \frac{N}{1 + Ne^2}$$

Where:

n = refers to the sample size

N = refers to the population of the target group

e = refers to the desired margin of error or level of significance which is set at 0.05 in this study

For this study, there were 86 fish farmer-respondents and 25 fisheries technologists.

Data Gathering Procedure

The gathering of data was done by the researcher himself. Permission was sought from the heads of local government units, as well as the Chairmen of the Barangays before the distribution of questionnaires and conduct of

interviews to the prospective respondents in the study. To facilitate gathering of data especially among the mud crab farmers, assistance of the extension workers in every municipality was sought. There was 100 percent retrieval of questionnaires distributed. In order to clarify vague responses given by the respondents in the questionnaire, a case to case interview was made for verification purposes.

Statistical Treatment of Data

The data obtained from the conduct of survey were tallied, scored, tabulated, and grouped according to the different categories of respondents. Percentage was used in describing the profile of respondents in relation to their personal and professional characteristics and in quantifying the responses on the extent of the activities as adopted by the fish farmers in mud crab culture. To identify the level of perceptions of the respondents on the problems and training needs weighted means was used. To interpret the mean values obtained, the following scale and their corresponding adjectival descriptions were adopted:

Scale Values	Problem Areas	Training Needs
4.51 - 5.00	Very much a problem	Very much necessary
3.51 - 4.50	Much a problem	Much necessary
2.51 - 3.50	Moderately a problem	Moderately necessary
1.51 - 2.50	Slightly a problem	Slightly necessary
1.00 - 1.50	Not a problem	Not necessary

The Chi-square test was applied to determine the degree of relationships between the extent of farming activities as practiced by mud crab farmers to their personal and professional attributes. The t-test for independent samples was employed to determine the significant difference on the extent of the problems in the mud crab culture industry as felt by the two groups of respondents.

For this study, the 5% level of significance was used in testing the hypotheses.

Chapter 4

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

Presented in this chapter are the findings of the study based on the data gathered from the responses of the mud crab farmers and fishery technologists who were the respondents in the investigation. Statistical analyses are likewise presented in order to test the hypotheses formulated.

Profile of the Respondents

The socio-demographic profile of the respondents are discussed in this section as regards to sex, age, civil status, educational background, average fish farmers' length of time engaged in mud crab farming, and average monthly income.

Sex. The sexes of the respondents are presented in Table 1. It can be

Table 1

Sex Distribution of Respondents

Respondents' Category	Sex		Total
	Male	Female	
Mud crab Farmers	77 (89.53 %)	9 (10.47 %)	86 (100 %)
Fisheries Technologists	14 (56.00 %)	11 (44.00 %)	25 (100 %)
TOTAL	**91 (81.98%)**	**20 (18.02%)**	**111 (100%)**

noted that majority are males with 89.53 percent among mud crab farmers and 56.00 percent among fisheries technologists. The female respondents comprised 10.47 percent for mud crab farmers and 44.00 percent for fisheries technologists.

Age. The ages of the two groups of respondents are reflected in Table 2. Among mud crab farmers the ages ranged from age brackets 25 – 34 and 65 and above. Majority of them or 42 (48.84%) are aged 45-54, followed by 20 (23.76%) who belong to age bracket 55-64; 15 (17.44%) at age bracket 35-44; and 6 (6.98%) with age bracket 65 and up. The least number of the mud crab farmers which is 3 (3.49%) belong to age bracket 25 - 34 years.

Table 2

Distribution of Respondents as to Age

Age (Groups)	Respondents' Category				Grand Total	Percent (%)
	Mud crab Farmers		Fisheries Technologists			
	No.	%	No.	%		
65 - up	6	6.98	-	-	6	5.41
55 - 64	20	23.76	6	24.00	26	23.42
45 – 54	42	48.84	7	28.00	49	44.14
35 – 44	15	17.44	10	40.00	25	22.52
25 – 34	3	3.49	2	8.00	5	4.51
TOTAL	86	100	25	100	111	100
Mean (in years)	50.66	-	46.64	-	48.65	-
SD (in years)	8.82	-	8.69	-	8.76	-

Meanwhile, among fisheries technologists out of 25 respondents, 10 (40.00%) are aged 35 - 44; 7 (28.00%) are aged 45 - 54; 6 (24.00%) belong to age bracket 55 - 64; and 2 (8.00%) with ages at age bracket 25 - 34. In general, mud crab farmers posted the average age of 50.66 with standard deviation of 8.82 while the fisheries technologists posted an average age of 46.64 with standard deviation of 8.69.

Civil Status. As shown in Table 3, all mud crab farmers are married individuals. However, among the 25 fisheries technologist-respondents, 22 (88.00%) are married and 3 (12.00%) are single individuals. In terms of civil status, married individuals dominated among the total respondents.

Table 3

Distribution of Respondents' Profile as to Civil Status

Age (Groups)	Respondents' Category				Grand Total	Percent (%)
	Mud crab Farmers		Fisheries Technologists			
	No.	%	No.	%		
Single	-	-	3	12.00	3	2.70
Married	86	100	22	88.00	108	97.30
Widow/	-	-	-	-	-	-
Widower	-	-	-	-	-	-
TOTAL	86	100	25	100	111	100

Educational Background. Reflected in Table 4 are the educational backgrounds of the two groups of respondents. Among mud crab farmers, 26 (30.23%) are baccalaureate degree holders, followed by 19 (22.09%) who are in

Table 4

Profile of Respondents in Terms of their Educational Background

Educational Background	Respondents' Category				Grand Total	Percent (%)
	Mud crab Farmers		Fisheries Technologists			
	No.	%	No.	%		
Master's Degree Holder	-	-	4	16	4	3.60
With Master's Units	1	1.16	3	12.00	4	3.60
Baccalaureate Degree Holder	26	30.23	18	72.00	44	39.64
College Level	10	11.63	-	-	10	9.01
High School Graduate	9	10.47	-	-	9	8.11
High School Level	13	15.12	-	-	13	11.71
Elementary Graduate	8	9.30	-	-	8	7.21
Elementary Level	19	22.09	-	-	19	17.12
TOTAL	**86**	**100**	**25**	**100**	**111**	**100**
Fields of Specialization (Baccalaureate and Graduate Studies)						
Fisheries-related Courses	5	5.81	9	36.00	14	12.61
Non-fisheries Related Courses	81	94.19	16	64.00	97	97.39
TOTAL	**86**	**100**	**25**	**100**	**111**	**100**

the elementary level; 13 (15.12%) obtain secondary level of education; 10 (11.63%) at the college level; 9 (10.47) graduates from the secondary course; and 8 (9.30%) completed elementary education. However, 1 (1.16%) earned units in the graduate course. Among fishery technologist-respondents, majority of them, that is, 18 (72.00%) are baccalaureate degree holders, followed by 3 (12.00%) with master's units and 4 (16.00%) are full-fledged master's degree holders.

As to their fields of specializations, among mud crab farmer-respondents, 5 (5.81%) had fisheries-related courses and 81 (94.19%) earned their baccalaureate and graduate education along agriculture, nursing, commerce, engineering, education, etc. For fisheries technologist-respondents, on the other hand, 9 (36.00%) are schooled in fisheries-related courses while 16 (64.00%) earned their education related to agriculture, animal science, forestry, and foods technology. Considering that majority of the fish farmer respondents are educated, the dissemination of the mud crab culture technology will not be a problem, however, their fields of specializations were not related to fisheries. Hence, measures should be undertaken in order to ensure effective technology adoption.

Length of Experience of Respondents Related to Mud Crab Farming. Table 5 presents the data on the length of experience of the two groups of respondents along mud crab farming. The greatest number of mud crab farmers which is 30 (34.88%) have 6 - 10 years of experience, followed by 24 (27.90%) with 1 - 5 years, then 20 (23.26%) with 11 - 15 years. The least are those with 16 - 20 years with 6 (6.98%) and 21 - 25 years with 6 (6.98%) number of fish

farmers. Among fisheries technologists ranged from 1 - 35 years with the most number of 6 (24.00%) who have acquired 16 - 20 years.

Comparing the two groups of respondents, fisheries technologists have longer years of experience having a mean of 16.52 years and SD = 10.34 as compared to the mud crab farmers with a mean of 10.57 years and SD =7.63.

Table 5

Length of Experience of Respondents Related to Mud Crab Culture

Length of Experience (in years)	Respondents' Category				Grand Total	Percent (%)
	Mud crab Farmers		Fisheries Technologists			
	No.	%	No.	%		
31 - 35	-	-	2	8.00	2	1.80
26 - 30	-	-	4	16.00	4	3.60
21 - 25	6	6.98	1	4.00	7	6.31
16 - 20	6	6.98	6	24.00	12	10.81
11 - 15	20	23.26	4	16.00	24	21.62
6 - 10	30	34.88	3	12.00	33	29.73
1 - 5	24	27.90	5	20.00	29	26.13
TOTAL	86	100	25	100	111	100
Mean (in years)	10.57		16.52		13.54	-
SD (in years)	7.63		10.34		8.99	-

Average Monthly Income of Respondents. Shown in Table 6 are the average monthly income of the two groups of respondents. The range of income

Table 6

Average Monthly Income of Respondents

Average Monthly Income (in Pesos)	Respondents' Category				Grand Total	Percent (%)
	Mud Crab Farmers		Fisheries Technologists			
	No.	%	No.	%		
29,001 - 30,000	1	1.16	-	-	-	-
28,001 - 29,000	1	1.16	-	-	1	0.90
27,001 - 28,000	-	-	1	4.00	1	0.90
26,001 - 27,000	-	-	-	-	-	
25,001 - 26,000	-	-	1	4.00	1	0.90
24,001 - 25,000	-	-	-	-	-	
23,001 - 24,000	-	-	-	-	-	
22,001 - 23,000	-	-	1	4.00	1	0.90
21,001 - 22,000	-	-	-	-	-	
20,001 - 21,000	-	-	-	-	-	
19,001 - 20,000	6	6.98	1	4.00	7	6.30
18,001 - 19,000	-	-	-	-	-	
17,001 - 18,000	-	-	1	4.00	1	0.90
16,001 - 17,000	1	1.16	-	-	1	0.90
15,001 - 16,000	-	-	-	-	-	-
14,001 - 15,000	2	2.33	-	-	2	1.80
13,001 - 14,000	-	-	2	8.00	2	1.80
12,001 - 13,000	2	2.33	4	16.00	6	5.41
11,001 - 12,000	1	1.16	2	8.00	3	2.70
10,001 - 11,000	-	-	4	16.00	4	3.60
9,001 - 10,000	5	5.81	4	16.00	9	8.11
8,001 - 9,000	1	1.16	1	4.00	2	1.80
7,001 - 8,000	4	4.65	-	-	4	3.60
6,001 - 7,000	2	2.33	1	4.00	3	2.70
5,001 - 6,000	2	2.33	-	-	2	1.80
4,001 - 5,000	6	6.98	-	-	6	5.41
3,001 - 4,000	8	9.30	-	-	8	7.21
2,001 - 3,000	-	-	-	-	-	-
1,001 - 2,000	15	17.44	-	-	15	13.51
1,000 and below	20	23.25	-	-	20	18.02
TOTAL	**86**	**100**	**25**	**100**	**111**	**100**
Mean (in pesos)	**PhP 6,006.05**		**PhP 8,736.80**		**PhP 7,371.42**	

of mud crab farmers is from PhP 1,000 and below and PhP 29001 - PhP 30,000 on the average per month. However, 20 (23.25%) of them with PhP 1,001 - PhP 2,000 followed by 15 (17.44%) with PhP 2,001 - PhP 3,000, then by 8 (9.30%) average monthly income with PhP 3,001 - PhP 4,000. Varied monthly incomes of mud crab farmers can be attributed to diversified production areas, the number of cropping per year, and stocking rates.

For fisheries technologists, the average monthly income ranged at brackets PhP 7,001 -PhP 8,000 and PhP 28001 - PhP 29,000. Majority of the respondents belong to brackets PhP 10,001 - PhP 11,000 and PhP 13001 - PhP 14,000 which are the basic salary ranges of agricultural technologists. Those who have higher monthly incomes occupy the positions of aquaculturists/agriculturists and supervising agriculturists. Those earning below PhP 10,000 occupy the positions of fishery technicians and fishery agents.

Comparing the two groups of respondents, the mean monthly income of mud crab farmers is PhP 6,006.05 while the fisheries technologists is PhP 8,736.80.

Trainings Attended by the Respondents Related to Mud Crab Farming. Table 7 gives us the number of trainings attended by the two groups of respondents related to mud crab farming. Among mud crab farmers, 2 (2.33%) attended 1 - 5 times at the national level; and 8 (9.30%) attended 1 - 5 times at the local level. None of the respondents attended trainings at the regional level. For the fisheries technologists, 1 (4.00%) attended 1 - 5 times at the national level;

1 (4.00%) at the regional level; and none of them attended trainings at the local level.

Table 7

Trainings Attended Related to Mud Crab Culture Attended by Respondents

Number of Trainings Attended	Respondents' Category				Grand Total	Percent (%)
	Mud Crab Farmers		Fisheries Technologists			
	No.	%	No.	%		
National Level:						
1 - 5	2	2.33	1	4.00	3	2.70
None	84	97.67	24	96.00	108	97.30
TOTAL	**86**	**100**	**25**	**100**	**111**	**100**
Regional Level:						
1 - 5	-	-	1	4.00	1	0.90
None	86	100	24	96.00	110	99.10
TOTAL	**86**	**100**	**25**	**100**	**111**	**100**
Local Level:						
1 - 5	8	9.30	-	-	8	7.21
None	78	90.70	25	100.00	103	92.79
TOTAL	**86**	**100**	**25**	**100**	**111**	**100**

It can be noted that both groups of respondents were inadequate in terms of trainings attended related to mud crab farming. The trainings were supposed to enhance their competence as to knowledge and skills on this aquaculture venture.

Status of Mud Crab Aquaculture in the Samar Province

This portion discusses the mud crab farming industry in Samar Province particularly on the profile of mud crab farms, culture methods adopted, and

production status.

Mud Crab Farm Profile

Presented in the succeeding sections are data gathered related to utilization of areas for mud crab production, status of ownership of fish farms, tools and equipment used in the production activities, and the culture methods employed by the fish farmer.

Areas of Mud Crab Farms. Table 8 and 9 present the fully-developed and productive areas of mud crab farms surveyed for the study. The mean area of fully-developed mud crab farms is 3.77 hectares and SD= 17.95. However, majority of the respondents declared 1 - 5 hectares and less than 1 hectare fully developed areas with 47.67% and 36.05%, respectively.

Table 8

Fully-developed Areas of Mud Crab Farms

Fully-developed Area (in hectares)	Number of Mud Crab Farmer	Percentage (%)
31 - up	1	1.16
26 - 30	1	1.16
21 - 25	1	1.16
16 - 20	3	3.49
11 - 15	2	2.33
6 - 10	6	6.98
1 - 5	41	47.67
Less than 1	31	36.05
Mean (Area in hectare)	**3.77**	**100**
SD (in hectares)	**17.95**	

In terms of productive areas, the mean is 3.13 hectares and SD= 18.51. Majority of the respondents claimed to have productive areas of 1 - 5 hectares

Table 9

Productive Areas of Mud Crab Farms

Productive Area (in hectares)	Number of Mud Crab Farmer	Percentage (%)
31 - up	1	1.16
26 - 30	-	-
21 - 25	1	1.16
16 - 20	1	1.16
11 - 15	3	3.49
6 - 10	6	6.98
1 - 5	43	50.00
Less than 1	31	36.05
Mean (Area in hectare)	**3.13**	**100**
SD (in hectares)	**18.51**	

with 50.00% of the respondents and less than 1 hectare which comprised 36.05% of the total respondents. Although there are areas larger than 5 hectares up to 35 hectares but they comprised the least number from the total respondents.

It can be noted that majority of the areas developed and considered productive are smaller in size but farm management is very easy. Furthermore, not all productive areas are fully utilized. Underutilization may result in low production and waste in capital investment.

Ownership Status. Presented in Table 10 is the ownership status of mud crab farms. Majority of the surveyed mud crab farms (47.67%) operate without

permit; 17.44% with application; 10.47% with fishpond lease agreement (FLA); 4.65% with title; and 2.33% with permits to operate issued by the Local Government Units (LGUs).

Farms without permit are considered illegal, hence, these are not registered with the Agriculture Office of LGUs and the Bureau of Fisheries and Aquatic Resources.

Table 10

Status of Ownership of Mud Crab Farms

Status of Ownership	Number of Mud Crab Farmer	Percentage (%)
With fishpond Lease Agreement (FLA)	9	**10.47**
Titled Lot	4	**4.65**
With Tax Declaration	15	**17.44**
With Permit to Operate	2	**2.33**
With Application	15	**17.44**
Without Permit	41	**47.67**
TOTAL	86	**100**

Tools and Equipment Used in Mud Crab Farming. Presented in Table 11 are the list of tools and equipment necessary in a mud crab farm for a successful aquaculture operation. From the data gathered, the most common tools and equipment are digging blades, flashlight, and carpentry tools wherein 98.84% to 100% of mud crab farmers have declared their availability at their farms. However, other listed tools and equipment are very important but given

Table 11

Tools and Equipment Used in Mud Crab Farming

Type of Tools and Equipment	Number of Mud Crab Farmer			
	With Equipment Available	Percentage (%)	Equipment Not Available	Percentage (%)
Aerators	-	-	86	100
Banca used for feeding	54	62.79	32	37.21
Caretaker's hut	78	90.70	8	9.30
Carpentry tools	85	98.84	1	1.16
Chilling tank	10	11.63	76	88.37
Digging blade	86	100	-	-
Dissolved Oxygen meter	1	1.16	85	98.84
Electricity	53	61.63	33	38.37
Flat boat	57	66.28	29	33.72
Freezer/refrigerator	5	5.81	81	94.19
Feeding trays	1	1.16	85	98.84
Flash light	86	100	-	-
Generator	-	-	86	100
Harvesting nets	75	87.21	11	12.79
pH meter	-	-	86	100
Refractometer	3	3.49	83	96.51
Sampling gears	80	93.02	6	6.98
Secchi disk	1	1.16	85	98.84
Service boat	57	66.28	29	33.72
Service vehicle	10	11.63	76	88.37

less priority as manifested by their low percentage availability. Although equipment such as generator, refractometer, dissolved oxygen meter, pH meter, freezer/refrigerator, banca, and aerators are quite expensive, in the long run they will contribute to increased production through efficient and effective pond management and operation. These tools and equipment are useful in many ways, such as in the maintenance of good water quality, effective monitoring of water parameters, and efficiency in feed storage and distribution.

Culture Method. Reflected in Table 12 are the culture modes adopted by mud crab farmers. Out of 86 respondents, 67 (77.91%) adopted polyculture

Table 12

Culture Method Used by Mud Crab Farmers

Type of Culture Method	Number of Mud Crab Farmer	Percentage (%)
Monoculture	19	22.09
Polyculture	67	77.91
TOTAL	**86**	**100**
Polyculture of mud crab with other species:		
Mud crab + milkfish	32	47.76
Mud crab + tilapia	7	10.45
Mud crab + grouper	9	13.43
Mud crab + tiger shrimp	4	5.97
Mud crab + milkfish + tiger shrimp	12	17.91
Mud crab + milkfish + tilapia	1	1.49
Mud crab + grouper + tiger shrimp	2	2.99
TOTAL	**67**	**100**

wherein mud crabs are grown together with milkfish, tilapia, tiger shrimp, and grouper while 19 (22.09%) used monoculture as a method of raising mud crabs.

On polyculture, 32 (47.76%) of the fish farmers adopted mud crab and milkfish combination, followed by 12 (17.91%) who adopted mud crab + milkfish + tiger shrimp culture technique; 9 (13.43%) on mud crab + grouper; 7 (10.45%) on mud crab + tilapia; 4 (5.97%), mud crab + milkfish + tiger shrimp; 2 (2.99%), mud crab + grouper + tiger shrimp; and 1 (1.49%) on mud crab + milkfish + tilapia.

Raising mud crabs with other fish species add monetary benefits to the fish farmer. Moreover, on pond conditions, the addition of milkfish and tilapia contributes to improved water aeration. However, there are disadvantages that are worth considering. For instance, the introduction of tiger shrimp, tilapia, and grouper would compete with the primary crop in terms of food getting. Moreover, mud crab being a voracious predator would devour tiger shrimps if food becomes inadequate and newly-molted shrimps are easy and captive prey for mud crabs. The growing of grouper and mud crab is likewise disadvantageous since the former is a predator to weak and newly-molted crabs. The best combination would be mud crab + milkfish + tilapia since the two latter species are plant-oriented omnivores and consume the growing filamentous green algae which are deleterious to mud crabs as they tend to limit space and mobility of the primary stocks.

Production Status

As presented in Table 13, the production of mud crabs in a monoculture system ranged from 3.31 – 2,250 kilograms per hectare per cropping. Among 19

Table 13

Production in Monoculture of Mud Crab

Production (in kg/ha/cropping)	Number of Mud Crab Farmer	Percentage (%)
1001 – above	2	10.53
951 – 1000	-	-
901 – 950	-	-
851 – 900	2	10.53
801 – 850	-	-
751 – 800	-	-
701 -750	2	10.53
651 – 700	-	-
601 – 650	1	5.26
551 – 600	-	-
501 – 550	-	-
451 – 500	-	-
401 – 450	1	5.26
351 – 400	1	5.26
301 – 350	1	5.26
251 – 300	-	-
201 – 250	1	5.26
151 – 200	-	-
100 – 150	2	10.53
51 -100	1	5.26
50 and below	5	26.32
Mean (in kilograms)	**565.24**	
TOTAL	**19**	**100**

Table 14

Production in Mud Crab Polyculture System

Production (in kg/ha/cropping)	Number of Mud Crab Farmer	Percentage (%)
1001 – above	16	23.88
951 – 1000	2	2.99
901 – 950	-	-
851 – 900	1	1.49
801 – 850	-	-
751 – 800	1	1.49
701 -750	1	1.49
651 – 700	-	-
601 – 650	1	1.49
551 – 600	3	4.48
501 – 550	3	4.48
451 – 500	5	7.46
401 – 450	4	5.97
351 – 400	3	4.48
301 – 350	4	5.97
251 – 300	4	5.97
201 – 250	3	4.48
151 – 200	4	5.97
100 – 150	7	10.45
51 -100	3	4.47
50 and below	2	2.99
Mean (in kilograms)	**1,073.10**	
TOTAL	**67**	**100**

fish farmer-respondents it averaged 565.24 kilograms per hectare per cropping. Majority of them which comprised 26.32% declared a production of 50 kilograms and below per hectare per cropping.

In the polyculture system as reflected in Table 14, majority of the respondents which recorded at 23.88 percent declared a production above 1,000 kilograms per hectare per cropping. In this culture system, the average production was posted at 1,073.10 kilograms per hectare per cropping. Higher production was noted in a polyculture system since aside from mud crab as the primary crop, income from the culture of other species was likewise obtained.

Farming Activities Practiced by Mud Crab Farmers in the Samar Province

This part discusses the various practices in mud crab farming. Specific activities are herein listed in relation to installation of culture structure, pond preparation, stocking, water management, feeds and feeding, post - harvest techniques and transport and marketing of produce (Table 15).

Installation of culture structure. On installation of culture structure, only 16.28% of the mud crab farmers practiced the six important activities. Majority of them which comprised 83.72% do not practice the said activities.

Proper installation of culture structure permits stability of net enclosure, thus prevents mud crab stocks from escaping during the culture period. Farmers not practicing the specific activities have greater chances of losing their investments since mud crabs have the ability to dig under the dikes or crawl over

the compartment especially during incoming high tides and during night time.

Pond preparation. In this farming area, there are 10 specific activities listed. From Table 15, it can be noted from the area mean that 48.84% of the

Table 15

Farming Activities Adopted by Fish Farmer-Respondents

Farming Activities	No. of Farmers Practicing the Activities	(%)	No. of Farmers Not Practicing the Activities	(%)
A. INSTALLATION OF CULTURE STRUCTURE				
1. Posts are installed at regular intervals	18	20.93	68	79.07
2. Nets are buried into the mud at least 0.75 meter deep	17	19.77	69	80.23
3. Nets are installed at least 1.0 meter above the waterline	12	13.95	74	86.05
4. Nets are securely fastened/clipped to posts	15	17.44	71	82.56
5. Bamboo matting are provided at the main water entrance	20	23.26	66	76.74
6. Plastic sheets are lined at the top edge of the net enclosure	2	2.33	84	97.67
AREA MEAN		16.28		83.72
B. POND PREPARATION				
1. Pond bottom is cleared of dirt	68	79.07	18	20.93
2. Pond bottom is leveled gradually sloping towards the gate	38	44.19	48	55.81
3. Predators and competitors are eradicated	39	45.35	47	54.65
4. Pond bottom is exposed to direct sunlight	79	91.86	7	8.14
5. Ponds are repeatedly flushed to remove soil acidity	56	65.12	30	34.88
6. Lime is applied to correct soil acidity	12	13.95	74	86.05
7. Organic and inorganic fertilizers are applied	23	26.74	63	73.26
8. Natural food (lab-lab) are allowed to grow before stocking	42	48.84	44	51.16
9. Provisions of canals inside compartment to increase water volume	57	66.28	29	33.72
10. Shelters are provided as hiding places for mud crabs	6	6.98	80	93.02
AREA MEAN		48.84		51.16

Table 15 continued

Farming Activities	No. of Farmers Practicing the Activities	(%)	No. of Farmers Not Practicing the Activities	(%)
C. STOCKING				
1. Crabs / crablets are acclimated before stocking	13	15.12	73	84.88
2. Crabs / crablets are stocked early in the morning or late in the afternoon	64	74.42	22	25.58
AREA MEAN		44.77		55.23
D. WATER MANAGEMENT				
1. Adequate water supply is available the whole-year round	69	80.23	17	19.77
2. Water exchange is effected every high tide during the entire culture period	73	84.88	13	15.12
3. Water conditions are monitored regularly	54	62.79	32	37.21
AREA MEAN		75.97		24.03
E. FEEDS AND FEEDING				
1. Natural food (lab-lab) is grown during pond preparation	40	46.51	46	53.49
2. Type of artificial feed given:				
2.1 By-catch fish	84	97.67	2	2.33
2.2 Mussel meat	7	8.14	79	91.86
2.3 Apple snail	4	4.65	82	95.35
2.4 Carabao hide	-	-	86	100
2.5 Chicken entrails	-	-	86	100
2.6 *Kulapot*	42	48.84	44	51.16
3. Methods of feeding				
3.1 Broadcast	86	100	-	-
4. Amount of feed given				
4.1 Based on percentage body weight	4	4.65	82	95.35
4.2 Feed given is estimated only	66	76.74	20	23.26
4.3 Feeding to satiation	13	15.12	73	84.88
5. Feeding frequency				
5.1 Once a day	79	91.86	7	8.14
5.2 Twice a day	5	5.81	81	94.19
5.3 Thrice or more a day	1	1.16	85	98.84
6. Time of feeding				
6.1 Early in the morning	12	13.95	74	86.05
6.2 Late in the afternoon	8	9.30	78	90.70
6.3 any time of the day	30	34.88	56	65.12

Table 15 continued

Farming Activities	No. of Farmers Practicing the Activities	(%)	No. of Farmers Not Practicing the Activities	(%)
6.4 Depending on the availability of feeds	61	70.93	25	29.07
6.5 Onset of high tide	1	1.16	85	98.84
AREA MEAN		**33.23**		**66.77**
F. FISH HEALTH MANAGEMENT				
1. Inspection and monitoring of stock for any suspected disease/occurrence of mortality	9	10.47	77	89.53
2. Improvement of water quality if mortality occurs	18	20.93	68	79.07
3. Treatment of affected stocks with chemicals	-	-	86	100
4. Samples are collected and subjected to laboratory examination	2	2.33	84	97.67
5. Emergency harvest if mortality are in occurrence	12	13.95	74	86.05
AREA MEAN		**9.54**		**90.46**
G. REPAIR AND MAINTENANCE				
1. Planting of vegetation over dikes to minimize soil erosion	57	66.28	29	33.72
2. Regular checking of leakages and seepages	84	97.67	2	2.33
3. Immediate repair of worn-out dikes	72	83.72	14	16.28
4. Regular checking of gates	72	83.72	14	16.28
5. Regular inspection of netting materials	20	23.26	66	76.74
6. Immediate repair of netting materials for worn-out parts	15	17.44	71	82.56
AREA MEAN		**62.01**		**37.99**
H. SAMPLING				
1. Stocks are sampled every month to determine average weight as basis for feeding adjustment	46	53.49	40	46.51
2. Desirable number of samples are collected	32	37.21	54	62.79
3. Care is exercise in handling sampled stocks	16	18.60	70	81.40
AREA MEAN		**36.43**		**63.57**
I. HARVESTING				
1. Method of harvest	72	83.72	14	16.27
1.1 Partial harvest	68	79.07	18	20.93
1.2 Selective harvest	5	5.81	81	94.19
1.3 Total harvest				

Table 15 continued

Farming Activities	No. of Farmers Practicing the Activities	(%)	No. of Farmers Not Practicing the Activities	(%)
2. Gear used in partial harvesting				
2.1 Crab lift net	76	88.37	10	11.63
2.2 Crab pot	-	-	86	100
2.3 Manual picking	63	73.26	23	26.74
2. Number of harvest in one culture run				
3.1 Once	5	5.81	81	94.19
3.2 Twice	7	8.14	79	91.86
3.3 Thrice	11	12.79	75	87.21
3.4 Four times or more	65	75.58	21	24.42
3. Strategy adopted for undersized and thin crabs collected during harvest				
4.1 Returned to compartment and allowed to grow/fatten	69	80.23	17	19.77
4.2 Stocked in separated compartment and allowed to fatten	17	19.77	69	80.23
4.3 Harvest and sold at lower price	-	-	86	100
4.4 Harvested and consumed	-	-	86	100
4. Factors influencing harvesting of crabs				
5.1 Size of stocks	26	30.23	60	69.77
5.2 Market price	66	76.74	20	23.26
5.3 Culture period	18	20.93	68	79.07
5.4 Disease problem	-	-	86	100
5.5 Natural calamities	6	6.98	80	93.02
AREA MEAN		35.13		64.87
J. POST HARVEST TECHNIQUES				
1. Crabs are sold alive	86	100	-	-
2. Crabs are shucked and meat are frozen	-	-	86	100
3. Crabs are segregated according to size and weights	1	1.16	85	98.84
4. Crabs are segregated according to sex	3	3.49	83	96.51
AREA MEAN		26.16		73.84
K. TRANSPORT AND MARKETING OF PRODUCE				
1. Containers used in transport of produce				
1.1 "buri" *bayong*	43	50.00	43	50.00
1.2 Carton boxes	8	9.30	78	90.70
1.3 Styrophore boxes	9	10.47	77	89.53
1.4 Plastic fish trays	57	66.28	29	33.72

Table 15 continued

Farming Activities	No. of Farmers Practicing the Activities	(%)	No. of Farmers Not Practicing the Activities	(%)
2. Mode of sale				
2.1 Through brokers/wholesalers	86	100	-	-
2.2 Direct to consumers	-	-	86	100
3. Location of mud crab buyers				
3.1 Calbayog City	-	-	86	100
3.2 Cebu City	-	-	86	100
3.3 Manila	1	1.16	85	98.84
3.4 Sta. Margarita	59	68.60	27	31.40
3.5 Jiabong	6	6.98	80	93.02
3.6 Paranas	1	1.16	85	98.84
3.7 Tacloban City	-	-	86	100
AREA MEAN		**23.10**		**76.90**
GRAND MEAN		**36.84**		**63.16**

farmers had practiced the activities while 51.16% did not adopt the listed farming tasks. Significantly, out of 86 fish farmers, 79 (91.86%) practiced "exposure of pond bottom to direct sunlight." Preparing the pond bottom prior to stocking provides favorable culture substrate and medium for mud crabs since dirt, predators, competitors, and obnoxious substances are eliminated or removed. The application of lime and organic fertilizers ensures a conditioned soil necessary for the growth of natural food to nourish crablets particularly during the first month of the culture period. The provision of canals and shelters protects the stock from intense sunlight and serves as hiding places or refuge in time of molting.

Stocking. The purpose of the activities under stocking is to minimize stress on the organism to be stocked in order to reduce mortality. Acclimation of crabs/crablets is practiced by 13 (15.12%) of the fish farmers and stocking crabs/crablets during cooler parts of the day is practiced by 64 (74.42%) of the fish farmer-respondents. In general, 44.77% of them practiced the two activities while 55.23% did not.

Water management. Effective water management provides the cultured stock with adequate, fresh, clean, and continuous water supply. Regular monitoring of water parameters enable the fish farmer to effect remedial measures in time of critical periods as regards to temperature, salinity, and water volume. From the data obtained, 75.97% of the fish farmers practiced the listed activities with 24.03% who did not practice.

Feeds and feeding. This section presents the data gathered as regards to types of natural and artificial feeds given or provided and feeding administration. Out of the total fish farmer-respondents, 40 (46.51%) grew "lab-lab" as natural food during pond preparation. While 46 (53.49%) were dependent on artificial feeds given to mud crabs for the entire culture period. As to type of artificial feed given, by-catch fish was the most common with 84 (97.67%) of the respondents who adopting the farming practice. Moreover, other feed sources such as mussel ("tahong" and "kulapot") and apple snail ("kuhol") were likewise given as supplemental feeds particularly in areas where these feedstuffs were abundant at reasonable prices. On the method of

feeding, "broadcast" was most practiced. The feeds were distributed by estimation as practiced by 66 (76.74%) of the fish farmer-respondents. "Feeding to satiation" was undertaken by 13 (15.12%) and feeding "based on percentage body weight" by 4 (4.65%) of the fish farmers. "Feeding of stock once a day" is adopted by 79 (91.86%) of the respondents and "depending on the availability of feeds" by 61 (70.93%) of them.

In order to provide proper nourishment to the cultured species and to ensure good growth and high survival rates, as well as to prevent cannibalism adequate supply of natural and artificial feeds should be made available. Feeding the stock once a day particularly late in the afternoon is most favorable since mud crabs are active hunters at night due to their nocturnal feeding behavior. When the pond water is calm and during daytime, mud crabs tends to become inactive and burrow themselves on the soft mud or take refuge in shady places and beneath shelters.

Fish health management. This area in mud crab culture was not practiced by the fish farmers as noted in the area mean with only 9.54% of the farmers practicing the listed activities. The rationale behind this major activity is to prevent mass mortality of the cultured stocks and to effect measures before the onset of incidence of any disease-causing factors which will greatly affect the overall health conditions of the cultured species.

Repair and maintenance. The fish farmers who practiced the listed activities were: 84 (97.67%) on "regular checking of leakages and seepages"; 72 (83.72%)

on "immediate repair of worn-out dikes"; 72 (83.72%) on "regular checking of gates". Other activities which were less practiced include: 57 (66.28%) "planting of vegetation over dikes to prevent soil erosion"; 20 (23.26%) -"regular inspection of netting materials"; and 15 (17.44%) on immediate repair of netting materials for worn-out parts". In general, the listed activities on repair and maintenance were practiced by 62.01% of the fish farmer-respondents.

Sampling. Determining the sizes and weights of the stock at certain time of the culture period which serves as basis for feeding adjustments was not fully practiced by the fish farmers. From the area mean 36.43% of those practiced the activities and 63.57% did not.

Harvesting. This part presents the techniques in harvesting produce after the growing period. As to methods, partial, selective, and total harvesting were practiced. However, majority of the fish farmers opt for "partial harvest" wherein 72 (83.72%) practiced the method, followed by "partial harvest" with 68 (79.07%) of the fish farmers practicing it. The gears used was crab lift net with 76 (88.37%) of the respondents practicing it and 63 (73.26%) resorted to "manual picking".

Harvesting of mud crabs was done continuously about four times or more in one cropping period. This being practiced by 65 (75.58%) of the fish farmers. On the other hand, 69 (80.23%) of the fish farmers returned harvested thin crabs to ponds and allowed to fatten for a number of days. The main consideration in harvesting mud crabs was "market price" adopted by 66 (76.74%) of the fish farmers.

Post-harvest techniques. All fish farmers sold their harvested crops alive to buyers. Others claimed that crabs were segregated according to sex with 3 (3.49%) and 1 (1.16%) with mudcrabs segregated according to sizes and weights.

Transport and marketing of produce. It can be gleaned from Table 15 that "buri" and plastic bags were the primary containers used in transporting mud crabs from the farm to the buyers' site. Meanwhile, styrophore and carton boxes were also used by few fish farmers. The harvested products were sold directly to wholesalers in the municipalities of Sta. Margarita, Pagsanghan, Jiabong and Paranas. It was known that many of the fish farmers sell their produce to buyers in areas nearest to their farms.

In general, from the total specific activities listed on the farming of mud crab, 36.84% of the respondents have practiced the required activities while 63.16 have never complied.

Comparison Between the Extent of Farming Activities Adopted by Mud Crab Farmers and Their Personal and Professional Variates

This part presents the results of the comparative analysis of the extent of farming activities adopted by mud crab farmers in relation to their socio-demographic characteristics.

Age. Table 16 summarizes the comparison of the extent of farming activities practiced by the fish farmers and their age. Chi-square analysis showed a computed value of 31.43 which is lesser than the tabular value of 55.758 at .05 level of significance, hence the result is not significant. In this case,

the age of the respondents is not associated with the extent of farming activities practiced.

Table 16

Comparison Between the Extent of Farming Activities Adopted by the Mud Crab Farmers and Their Age

	Farming Practices											
Age	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**Total**
25-34	6 3.90	22 19.50	4 3.57	9 9.10	25 25.21	2 1.90	16 23.41	4 436	23 26.60	3 418	13 13.83	127
35-44	12 1486	79 7430	14 13.62	38 3467	100 96.06	9 7.25	54 56.61	20 16.63	94 101.36	15 15.92	49 52.72	484
45-54	26 37.12	185 185.59	34 3403	83 86.61	241 239.94	15 18.12	146 141.40	38 41.54	272 253.20	44 39.77	125 131.68	1209
55-64	25 21.40	99 107.00	19 19.62	51 49.93	132 138.33	12 10.44	81 81.52	27 23.95	146 145.97	22 22.93	83 75.92	697
65-up	15 6.72	35 33.62	6 6.16	15 15.69	45 43.46	3 3.28	23 25.61	5 7.52	38 45.87	6 7.20	28 23.85	219
Total	**84**	**420**	**77**	**196**	**543**	**41**	**320**	**94**	**573**	**90**	**298**	**2736**
x^2 comp	**31.43**											
x^2 tab	**55.758**			**df= 40; a = 0.05**								

Evaluation/Decision: Not Significant/Accept Ho

Legend: A – Installation of Net enclosure
B – Pond Preparation
C – Stocking
D – Water Management
E – Feeds and Feeding
F – Fish Health Management
G – Repair and Maintenance
H - Sampling
I – Harvesting
J – Post-Harvest Techniques
K – Transport and Marketing Procedure

Sex. The sex of the fish farmer-respondents being correlated to the extent of the farming activities adopted is presented in Table 17. Statistical analysis revealed a significant relationship since the computed x^2 value of 57.85 is higher than the tabular x^2 value of 18.307 at .05 level of significance and resulted in the rejection of the null hypothesis. This implies that males are more likely to adopt the farming activities compared to their female counterpart.

Table 17

Comparison Between the Extent of Farming Activities Adopted by the Mud Crab Farmers and their Sex

	Farming Practices											
Sex	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**Total**
Male	60	369	68	179	481	38	284	87	551	81	269	2467
	7457	372.85	68.36	173.99	482.04	36.40	284.07	83.45	546.84	79.90	264.54	-
Female	24	51	9	17	62	3	36	7	65	9	29	312
	9.43	47.15	8.64	22.01	60.96	460	35.93	10.55	69.16	10.10	33.46	-
Total	**84**	**420**	**77**	**196**	**543**	**41**	**320**	**94**	**616**	**90**	**298**	**2779**
x^2comp	**57.85**											
x^2 tab	**18.307**			**df= 10; a = 0.05**								

Evaluation/Decision: Significant/Reject Ho

Legend: A – Installation of Net enclosure
B – Pond Preparation
C – Stocking
D – Water Management
E – Feeds and Feeding
F – Fish Health Management
G – Repair and Maintenance
H - Sampling
I – Harvesting
J – Post-Harvest Techniques
K – Transport and Marketing Procedure

Length of Experience in Mud Crab Farming. Table 18 shows the comparison between the extent of farming activities as practiced by the mud crab farmers versus their length of experience. The Pearson Chi-square test revealed no association or relationship since the result is not significant, considering that the computed x^2 value of 26.68 is lesser than the tabular x^2 value of 55.758 at .05 level of significance.

The result of the statistical analysis implies that shorter or longer period of fish farmers' experience on mud crab farming does not affect the extent of their farming practice.

Table 18

Comparison Between the Extent of Farming Activities Adopted by the Mud Crab Farmers and their Length of Experience

Length of Experience (in years)	Farming Practices											
	A	B	C	D	E	F	G	H	I	J	K	Total
1-5	36 26.46	140 132.32	26 2426	63 61.75	169 171.08	14 12.92	92 100.82	30 29.62	174 180.53	26 28.36	92 93.89	862
6-10	21 28.95	138 144.76	25 26.54	70 67.55	190 187.15	17 1413	111 110.29	43 32.40	200 197.49	32 31.02	96 102.71	943
11-15	16 17.99	92 89.96	15 16.49	45 41.98	119 116.30	6 8.78	72 68.54	16 20.13	122 122.73	20 19.28	63 63.83	586
16-20	6 5.62	27 28.09	6 5.15	10 13.11	35 36.32	2 2.74	22 21.40	4 6.29	40 38.33	6 6.02	25 19.93	183
21-25	5 497	23 2487	5 456	8 11.61	30 32.15	2 2.43	23 18.95	1 5.57	37 33.93	6 5.33	22 17.64	162
Total	84	420	77	196	543	41	320	94	573	90	298	2736
x^2 comp	**26.28**											
x^2 tab	**55.758**			**df= 40; a = 0.05**								

Evaluation/Decision: Not Significant/Accept Ho

Legend: A – Installation of Net enclosure
B – Pond Preparation
C – Stocking
D – Water Management
E – Feeds and Feeding
F – Fish Health Management
G – Repair and Maintenance
H - Sampling
I – Harvesting
J – Post-Harvest Techniques
K – Transport and Marketing Procedure

The result of the statistical analysis implies that shorter or longer period of fish farmers' experience on mud crab farming does not affect the extent of their farming practice.

Educational Background. The comparison between the extent of farming activities as adopted by fish farmers and their educational qualifications is presented in Table 19. The Pearson Chi-square test revealed that the computed x^2 value of 743.78 is greater than the tabular x^2 value of 79.082 , thus the result is significant and the null hypothesis is rejected. It can be concluded that there is

Table 19

Comparison Between the Extent of Farming Activities Adopted by the Mud Crab Farmers and their Educational Background

Educ'l Back-ground	Farming Practices											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**Total**
Elem Level	17 18.50	97 92.70	14 16.95	43 43.16	128 119.56	3 119.56	71 69.80	16 20.70	129 126.17	19 19.82	65 65.62	602
Elem Grad	10 8.88	42 4450	10 8.14	19 20.72	59 57.40	2 433	31 33.51	11 9.94	63 60.57	8 9.51	34 31.50	289
High Sch. Level	9 11.86	56 59.44	11 10.87	30 27.67	71 76.66	2 5.79	46 4476	15 13.27	85 80.90	13 12.71	48 42.07	386
High Sch. Grad	5 8.69	39 43.58	9 7.97	20 7.97	55 56.21	8 424	33 32.81	10 9.73	62 59.31	9 9.32	33 30.85	283
College Level	18 10.66	54 53.43	9 9.77	21 2488	62 68.92	10 5.20	38 40.23	14 11.93	72 72.23	11 11.42	38 37.82	347
College Grad	25 2436	130 122.11	23 22.33	61 56.85	163 157.50	14 11.89	93 91.95	28 27.22	152 27.26	29 26.10	75 86.44	793
Master's Units	0 1.04	3 5.24	1 0.96	2 2.44	5 6.75	2 0.51	5 3.94	0 1.17	10 7.13	1 1.12	5 3.71	34
Total	**84**	**421**	**77**	**196**	**543**	**41**	**317**	**94**	**573**	**90**	**298**	**2734**
x^2 comp	**743.78**											
x^2 tab	**79.082**			**df= 60; a = 0.05**								

Evaluation/Decision: Significant/Reject Ho

Legend:
- A – Installation of Net enclosure
- B – Pond Preparation
- C – Stocking
- D – Water Management
- E – Feeds and Feeding
- F – Fish Health Management
- G – Repair and Maintenance
- H - Sampling
- I – Harvesting
- J – Post-Harvest Techniques
- K – Transport and Marketing Procedure

significant relationship between educational qualifications of fish farmer-respondents and the extent of farming practices adopted.

Average Monthly Income. It can be gleaned in Table 20 the statistical analysis on the comparison between the extent of farming activities as practiced by the mud crab farmers and their average monthly income.

Table 20

Comparison Between the Extent of Farming Activities Adopted by the Mud Crab Farmers and their Average Monthly Income

Income (in PhP)	Farming Practices											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**Total**
1,000 & Below	0 7.92	44 43.72	6 7.82	21 20.45	68 57.57	2 405	32 32.89	4 9.23	70 60.31	10 9.42	27 30.62	284
1,001 - 5,000	29 50.83	286 280.80	50 50.23	144 131.32	356 369.76	25 26.02	208 211.21	55 59.31	404 387.31	59 60.52	199 196.68	1824
5,001 - 9,000	10 7.27	34 40.18	6 7.19	13 18.79	56 52.91	2 3.72	35 30.22	11 8.49	53 55.42	9 8.66	32 28.14	261
9,001 - 13,000	13 7.08	40 39.10	7 6.99	17 18.29	47 51.49	3 3.62	29 29.41	11 8.26	49 53.93	8 8.43	30 27.39	254
13,001 - 17,000	11 3.51	17 19.40	4 3.47	6 9.07	27 25.54	3 1.80	14 1459	6 410	20 26.76	5 418	13 13.59	126
17,001 - 21,000	16 5.82	33 32.18	8 5.76	13 13.94	36 42.37	4 2.98	27 2420	8 6.80	36 4438	8 6.93	20 22.54	209
21,000 above	5 1.56	10 8.62	2 1.54	3 403	12 11.35	4 0.80	4 6.48	3 1.82	8 11.89	1 1.86	4 6.04	56
Total	84	464	83	217	611	43	349	98	640	100	325	3014
x^2 comp	**111.34**											
x^2 tab	**79.082**			**df= 60; a = 0.05**								

Evaluation/Decision: Significant/Reject Ho

Legend:
- A – Installation of Net enclosure
- B – Pond Preparation
- C – Stocking
- D – Water Management
- E – Feeds and Feeding
- F – Fish Health Management
- G – Repair and Maintenance
- H - Sampling
- I – Harvesting
- J – Post-Harvest Techniques
- K – Transport and Marketing Procedure

From the table above, the computed x^2 value of 111.34 is greater than the tabular x^2 value of 79.082 at .05 level of significance, resulting on the rejection of the null hypothesis. Therefore, there is a significant relationship between average monthly income of fish farmer-respondents and the extent of the adoption of the farming activities in mud crab aquaculture.

Problem Areas in Mud Crab Farming in the Coastal Municipalities of Samar

Presented in Tables 21 and 22 are the levels of perceptions of the two groups of respondents on the problems of mud crab farming in Samar Province.

Based on the responses of the mud crab farmer-respondents, as reflected in Table 21, problem areas considered "much a problem" include: "lack of government support to mud crab farmers" (WM=4.24); "lack/inadequate number of extension workers to assist fish farmers on the operation of mudcrab farms" (WM= 3.65); "lack of credit facilities" (WM= 3.60), and "lack of equipment to monitor water parameters" (WM= 3.52). The latter being identified is one of the pressing problems in mud crab farming as justified by the unavailability of equipment at the mud crab farms being surveyed as reflected in Table 11.

The problem areas described as "moderately a problem" are: "lack of educational materials on mud crab technology" (WM=3.42); "unavailability of continuous supply of feeds" (WM= 2.99); "low survival of crops" (WM = 2.71); "high capital investment for the construction of ponds and net enclosures" (WM= 2.69); and "unstable price for the product" (WM= 2.64). Those claimed as "slightly a problem" are related to: "lack of technical knowledge related to mud crab farming" (WM= 2.47); "rising cost of crablets" (WM = 2.37); "high cost of feeds" and "cannibalism" (WM = 2.36); "security of fish farm" (WM = 2.12); "inadequate market information" (WM = 1.98); "conflict with non - aquaculture

Table 21

Status of Problems in Mud Crab Farming as Perceived by Mud Crab Farmers

Problem Areas	RESPONSES					TOTAL	WM	I
	VMAP (5)	MAP (4)	MoAP (3)	SAP (2)	NAP (1)			
1. Conflict with non-aquaculture activity such as land use	5	8	10	10	53	86	1.86	SAP
2. High capital investment for the construction of ponds and net enclosure	7	11	26	32	10	86	2.69	MoAP
3. High cost of feeds	5	9	23	24	25	86	2.36	SAP
4. Unavailability of continuous supply of feeds	6	24	26	25	6	86	2.99	MoAP
5. Lack of credits facilities	29	23	17	8	10	86	3.60	MAP
6. Lack of crablets in the locality	6	7	5	6	62	86	1.71	SAP
7. Rising cost of crablets	6	11	14	33	22	86	2.37	MoAP
8. Water quality problems (salinity, temperature)	3	3	12	10	58	86	1.64	SAP
9. Cannibalism	4	8	20	37	17	86	2.36	SAP
10. Security of fish farm	5	8	18	16	39	86	2.12	SAP
11. Lack of skilled labor	4	9	6	12	55	86	1.78	SAP
12. Unstable price for the product	4	12	31	27	12	86	2.64	MoAP
13. Lack of technical knowledge on mud crab culture	6	16	15	24	25	86	2.47	SAP
14. Inadequate market information	4	8	10	24	40	86	1.98	SAP
15. Low survival of crops	5	16	25	29	11	86	2.71	MoAP
16. Lack/inadequate number of extension workers to assist fish farmers on the operation of mud crab farms	26	22	23	12	3	86	3.65	MAP
17. Lack of educational materials on the mud crab culture technology	14	30	25	12	5	86	3.42	MoAP
18. Lack of government support to mud crab farmers	47	22	10	5	3	86	4.24	MAP
19. Lack of equipment to monitor water quality parameters	21	23	28	8	6	86	3.52	MAP
20. Distance of mud crab buyers from fish farm	2	4	8	3	68	86	1.50	NAP
21. Mortality of crabs during long transport	3	3	8	10	63	86	1.50	NAP
22. Damage to mud crab during harvest	2	3	2	4	-	11	0.42	NAP
GRAND MEAN							2.43	SAP

LEGEND:

Scale	Numerical Value	Interpretation
5	4.51 - 5.00	Very much a problem (VMAP)
4	3.51 - 4.50	Much a problem (MAP)
3	2.51 - 3.50	Moderately a problem (MoAP)
2	1.51 - 2.50	Slightly a problem (SAP)
1	1.00 - 1.50	Not a problem (NAP)

activities such as land use" (WM = 1.86); "lack of crablets in the locality" (WM = 1.71); and "water quality problem" (WM = 1.64).

Finally, problem areas considered "not a problem" has something to do with "distance of mud crab buyers from fish farm", "mortality of crabs during transport" (WM = 1.50) and "damage of mud crabs during harvest" (WM = 0.42).

The responses of the fisheries technologists on the problem areas in mud crab farming are presented in Table 22. Problem areas considered as "much a problem" are related to: "high capital investment for the construction of ponds and net enclosure" (WM = 4.16); "high cost of feeds" (WM = 4.04); "rising cost of crablets" (WM = 4.00); "lack of crablets in the locality" (WM = 3.96); "lack of technical knowledge on mud crab culture" (WM = 3.88); "lack of educational materials on mud crab culture technology" (WM = 3.72); "lack of credit facilities" (WM = 3.60); "conflict with non-aquaculture such as land use" (WM = 3.56); "instable price for the product" (WM = 3.56); and low survival of crops" (WM== 3.52). With the exception of "damage of mud crab during harvest" which is considered by the fisheries technologist as "not a problem" with a weighted mean of 1.20, all other problem areas are rated as "moderately a problem."

Table 22

Status of Problems in Mud Crab Farming as Perceived by Fisheries Technologists

Problem Areas	RESPONSES					TOTAL	WM	I
	VMAP (5)	MAP (4)	MoAP (3)	SAP (2)	NAP (1)			
1. Conflict with non-aquaculture activitiy such as land use	5	11	5	1	3	25	3.56	MAP
2. High capital investment for the construction of ponds and net enclosure	11	9	3	2	-	25	4.16	MAP
3. High cost of feeds	11	7	4	3	-	25	4.04	MAP
4.Unavailability of continuous supply of feeds	6	5	10	2	2	25	3.44	MoAP
5. Lack of credits facilities	9	4	6	5	1	25	3.60	MAP
6. Lack of crablets in the locality	10	8	3	4	-	25	3.96	MAP
7. Rising cost of crablets	7	13	3	2	-	25	4.00	MAP
8. Water quality problems (salinity, temperature)	7	5	5	4	4	25	3.28	MoAP
9. Cannibalism	6	5	9	3	2	25	3.40	MoAP
10. Security of fish farm	4	9	6	4	2	25	3.36	MoAP
11. Lack of skilled labor	4	7	7	4	3	25	3.20	MoAP
12. Unstable price for the product	7	6	7	4	1	25	3.56	MAP
13. Lack of technical knowledge on mud crab culture	6	12	5	2	-	25	3.88	MAP
14. Inadequate market information	4	7	9	3	2	25	3.32	MoAP
15. Low survival of crops	5	6	11	3	-	25	3.52	MAP
16. Lack/inadequate number of extension workers to assist fish farmers on the operation of mud crab farms	5	11	4	3	2	25	3.56	MAP
17. Lack of educational materials on the mud crab culture technology	6	9	7	3	-	25	3.72	MAP
18. Lack of government support to mud crab farmers	6	12	3	4	-	25	3.80	MAP
19. Lack of equipment to monitor water quality parameters	11	7	4	2	1	25	4.00	MAP
20. Distance of mud crab buyers from fish farm	3	12	5	2	3	25	3.40	MoAP
21. Mortality of crabs during long transport	4	8	8	5	-	25	3.44	MoAP
22. Damage to mud crab during harvest	-	-	-	5	20	25	1.20	NAP
GRAND MEAN							3.52	MAP

LEGEND:

Scale	Numerical Value	Interpretation
5	4.51 – 5.00	Very much a problem (VMAP)
4	3.51 – 4.50	Much a problem (MAP)
3	2.51 – 3.50	Moderately a problem (MoAP)
2	1.51 – 2.50	Slightly a problem (SAP)
1	1.00 – 1.50	Not a problem (NAP)

Comparison of the Perceptions of the Two Groups of Respondents on Problem Areas in Mud Crab Farming

The compared perceptions of the two groups of respondents are reflected in Table 23. The general perception of the mud crab farmers on the problem areas presented is described as "slightly a problem" while the fisheries technologists considered them as "much a problem." Although there is a disparity in general perceptions between the two groups of respondents,

Table 23

Summary of Perceptions of the Two Groups of Respondents on Problem Areas in Mud Crab Farming

Problem Areas	RESPONDENTS' CATEGORY				OVER-ALL MEAN	I
	Mud Crab Farmers		Fisheries Technologists			
	Mean	I	Mean	I		
1. Conflict with non-aquaculture activity such as land use	1.86	SAP	3.56	MAP	2.71	MoAP
2. High capital investment for the construction of ponds and net enclosure	2.69	MoAP	4.16	MAP	3.42	MoAP
3. High cost of feeds	2.36	SAP	4.04	MAP	3.20	MoAP
4.Unavailability of continuous supply of feeds	2.99	MoAP	3.44	MoAP	3.22	MoAP
5. Lack of credits facilities	3.60	MAP	3.60	MAP	3.60	MAP
6. Lack of crablets in the locality	1.71	SAP	3.96	MAP	2.84	MoAP
7. Rising cost of crablets	2.37	MoAP	4.00	MAP	3.18	MoAP
8. Water quality problems (salinity, temperature)	1.64	SAP	3.28	MoAP	2.46	
9. Cannibalism	2.36	SAP	3.40	MoAP	2.88	MoAP
10. Security of fish farm	2.12	SAP	3.36	MoAP	2.74	MoAP
11. Lack of skilled labor	1.78	SAP	3.20	MoAP	2.49	SAP
12. Unstable price for the product	2.64	MoAP	3.56	MAP	3.10	MoAP
13. Lack of technical knowledge on mud crab culture	2.47	SAP	3.88	MAP	3.18	MoAP
14. Inadequate market information	1.98	SAP	3.32	MoAP	2.65	MoAP
15. Low survival of crops	2.71	SAP	3.52	MAP	3.12	MoAP

Table 22 continued

Problem Areas	RESPONDENTS' CATEGORY				OVER-ALL MEAN	I
	Mud Crab Farmers		Fisheries Technologists			
	Mean	I	Mean	I		
16. Lack/inadequate number of extension workers to assist fish farmers on the operation of mud crab farms	3.65	MAP	3.56	MAP	3.61	MAP
17. Lack of educational materials on the mud crab culture technology	3.42	MoAP	3.72	MAP	3.57	MAP
18. Lack of government support to mud crab farmers	4.24	MAP	3.80	MAP	4.02	MAP
19. Lack of equipment to monitor water quality parameters	3.52	MAP	4.00	MAP	3.76	MAP
20. Distance of mud crab buyers from fish farm	1.50	NAP	3.40	MoAP	2.45	SAP
21. Mortality of crabs during long transport	1.50	NAP	3.44	MoAP	2.47	SAP
22. Damage of mud crab during harvest	0.42	NAP	1.20	NAP	0.81	NAP
OVERALL MEAN	2.43	SAP	3.52	MAP	2.98	MoAP

LEGEND:

Scale	Numerical Value	Interpretation
5	4.51 – 5.00	Very much a problem (VMAP)
4	3.51 – 4.50	Much a problem (MAP)
3	2.51 – 3.50	Moderately a problem (MoAP)
2	1.51 – 2.50	Slightly a problem (SAP)
1	1.00 – 1.50	Not a problem (NAP)

however, there are problem areas that they are in agreement and both considered as "much a problem", particularly the ones related to "lack/inadequate number of extension workers to assist fish farmers on the operation of mud crab farms", "lack of government support to mud crab farmers", and "lack of equipment to monitor water quality parameters. In addition, the two groups of respondents agree on "damage of mud crab during harvest" as "not a problem".

It can be further observed that the numerical values of the perceptions of

the two groups of respondents vary as to problem areas; hence, t-test analysis is conducted in order to determine if they differ significantly. The results are presented in Table 24.

Table 24

Statistical Analysis on the Perceptions of the Two Groups of Respondents on the Problem Areas in Mud Crab Farming in Samar Province

Statistical Measures	Fish Farmers' Perceptions	Fisheries Technologists' Perceptions
Mean (x)	2.43	3.52
Number of cases (n)	22	22
Degrees of Freedom (n – 2)	42	
Critical value, t	1.68	
Computed value, t	7.08	
Interpretation at .05 level of significance	Significant Ho: Rejected	

It can be gleaned from Table 24, the statistical measures considered. Results revealed that the computed t value of 7.08 is higher than the critical t value of 1.68 at .05 level of significance. The result is significant; hence the null hypothesis that "there is no significant difference in the extent to which the problems of the mud crab industry are felt by the different groups of respondents" is rejected. This suggests that the problem areas in mud crab farming technology in the Samar province are most felt by the fisheries technologists compared to the fish farmers themselves. This is so because the

fisheries technologists have the basic knowledge of the management and operations of aquaculture farms. Considering the minimal compliance of fish farmers with the requisites for a successful mud crab farming operations, as evidenced by inadequate educational opportunities such as trainings and seminars, as well as the lack of extension workers disseminating the appropriate mud crab farming strategies, they could not clearly identify that the areas presented are important contributors for a successful and profitable aquaculture endeavor. However, their production and management operation could be improved if only the activities presented herein were followed and fully implemented.

Training Needs in Mud Crab Farming in the Coastal Municipalities of the Samar Province as Perceived by the Two Groups of Respondents

The training needs of the mud crab farmers are presented in Tables 25 and 26. From the listed training areas, "production of soft-shelled mud crabs" is rated by the fish farmer-respondents as "not necessary." However, all other training areas are claimed to be "slightly necessary". From the experiences of the mud crab farmers in their aquaculture operations, problems were encountered; however, measures are undertaken so as to pursue their desire to earn and to satisfy their personal needs. Although the income derived from mud crab farming is not substantial based on the data gathered, still they are able to sustain their entrepreneurial endeavors.

The mud crab farmers could not realize the impact and beneficial effects of the training areas presented in terms of production and income, as well as the

Table 25

Training Needs of Fish Farmers in Mud Crab Culture

Training Areas	RESPONSES					TOTAL	WM	I
	VMN (5)	MN (4)	MoN (3)	SN (2)	NN (1)			
1. Feasibility Study Preparation	7	8	25	16	30	86	2.37	SN
2. Pond Construction and Installation	2	12	22	25	25	86	2.31	SN
3. Stock Management	2	10	20	31	23	86	2.27	SN
4. Aquasilviculture	4	6	10	27	39	86	1.94	SN
5. Feeds and Feeding	3	10	24	13	36	86	2.20	SN
6. Water Quality Management	2	6	7	17	54	86	1.66	SN
7. Farm Record Keeping	3	6	8	29	40	86	1.87	SN
8. Post-harvest Techniques	2	6	11	21	46	86	1.80	SN
9. Responsible Aquaculture Management	2	5	11	21	47	86	1.77	SN
10. Identification of Fat Female Crabs	2	6	4	5	69	86	1.45	NN
11. Mud Crab Fattening	2	10	12	23	39	86	1.99	SN
12. Production of Soft-shelled Mud crabs	2	3	6	7	68	86	1.42	NN
GRAND MEAN							1.92	SN

long-term effect for sustainable aquaculture operations. Nevertheless, they could not be blamed for these because the major problems previously cited were never addressed by concerned agencies of the government. The fisheries technologists themselves who should serve as frontline personnel in the dissemination of appropriate aquaculture technologies for sustainable development strongly agree that majority of the problem areas presented are of utmost necessity.

Presented in Table 26 are the responses of the fisheries technologists on the training needs in mud crab culture in the Samar Province. From the tabular

data, the necessity of training programs in all training areas of mud crab farming can be noted as shown in the weighted means and the verbal descriptions as "much necessary". The fisheries technologists who serve as change agents, extension workers, and primary sources of information for technology transfer deemed the training areas very important to make them

Table 26

Training Needs of in Mud Crab Culture as Perceived by Fisheries Technologists

Training Areas	RESPONSES					TOTAL	WM	I
	VMN (5)	MN (4)	MoN (3)	SN (2)	NN (1)			
1. Feasibility Study Preparation	16	3	3	3	-	25	4.28	MN
2. Pond Construction and Installation	12	8	5	-	-	25	4.28	MN
3. Stock Management	15	6	1	2	1	25	4.28	MN
4. Aquasilviculture	10	9	2	3	1	25	3.96	MN
5. Feeds and Feeding	10	11	1	2	1	25	4.08	MN
6. Water Quality Management	12	6	4	2	1	25	4.04	MN
7. Farm Record Keeping	12	7	5	1	-	25	4.20	MN
8. Post-harvest Techniques	15	4	5	1	-	25	4.32	MN
9. Responsible Aquaculture Management	10	8	6	1	-	25	4.08	MN
10. Identification of Fat Female Crabs	9	7	5	2	2	25	3.75	MN
11. Mud Crab Fattening	9	6	5	4	1	25	3.72	MN
12. Production of Soft-shelled Mud crabs	11	7	4	3	-	25	4.04	MN
GRAND MEAN							4.09	MN

LEGEND:

Scale	Numerical Value	Interpretation
5	4.51 - 5.00	Very much necessary (VMN)
4	3.51 - 4.50	Much necessary (MN)
3	2.51 - 3.50	Moderately necessary (MoN)
2	1.51 - 2.50	Slightly necessary (SN)
1	1.00 - 1.50	Not necessary (NN)

effective agents for countryside development. From the weighted means, it is obvious that their first priorities are on post-harvest techniques, feasibility study preparation, pond construction and installation, and stock management.

Chapter 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter contains the significant findings of the study, the conclusions derived from the findings, and the recommendations herein proposed.

Summary of Findings

The following are the major findings of the study:

1. In terms of ages of the two groups of respondents, the average age of the mud crab farmers was 50.66 years with a standard deviation of 8.82 and for fisheries technologists it was 46.64 years with a standard deviation of 8.69.

2. As to sex distribution, majority of the respondents were males which comprised 81.98% of the total number of respondents. Among mud crab farmers, 89.53% were males and 10.47% females. For fisheries technologists, 56% were males and 44% females.

3. As regards civil status, all fish farmers were married while among fisheries technologists, 88% were married and 12% were single.

4. Relative to educational background, for the mud crab farmers the highest value of 30.23% was baccalaureate degree, followed by 22.09% at elementary level and 11.63% college level. However, one fish farmer has earned units in the masteral course. For fisheries technologist-respondents,

majority of them (72%) earned their baccalaureate degrees, 16% were full-fledged master's degree holders and 12% with master's units.

5. The average length of experience of the respondents related to mud crab culture were 10.57 years for mud crab farmers and 16.52 years among fisheries technologists. Standard deviations were 7.63 and 10.34 for fish farmer-respondents and fisheries technologists, respectively.

6. In terms of average monthly income, fish farmers recorded at PhP 6,006.05 while fisheries technologists posted at PhP 8,736.80.

7. As to the number of trainings attended related to mud crab farming, only few of the respondents have availed this undertaking wherein among fish farmers 2.33% attended at the national level and 9.30% at the local level. For fisheries technologists, only 4% at the national and regional levels.

8. The areas fully developed for mud crab culture averaged 3.77 hectares. Majority of the fish farms had areas 1 – 5 hectares which constitute 47.67% and 36.05% are those with areas fully-developed less than 1 hectare. Out of the fully-developed areas, 3.13 hectares on the average are productive.

9. As to status of ownership, 47.67% operated without permit and the remaining percentage were those with application, with permit from LGUs, titled lots, and with Fishpond Lease agreement (FLA).

10. The most common tools and equipment available in mud crab farms are digging blades, flashlights, and carpentry tools.

11. On the method of culture, 77.91% of the farmers adopted

polyculture while 22.09% were on monoculture of mud crabs. Other species cultured in combination with mud crabs include milkfish, tilapia, grouper, and tiger shrimp.

12. The average production in mud crab in a monoculture system is 565.24 kilograms per hectare per cropping. However, majority of them which comprised 26.32 percent declared an average production 50 kilograms and below per hectare per cropping. In polyculture, the average production posted at 1,073.10 kilograms per hectare per cropping. Majority of the fish farmers have production levels 1,001 kilograms and above kilograms per hectare per cropping.

13. In relation to the extent of farming activities practiced by the fish farmers, 16.28% practiced proper installation of culture structure; 48.84% on pond preparation; 44.77% on the activities relative to stocking; 75.97% on proper water management; 33.23% on feeds and feeding; 9.54% on fish health management; 62.01% as to repair and maintenance; 36.43% on sampling techniques; 35.13% on harvesting activities; 26.16% on post-harvest techniques; and 23.10% related to transport and marketing of produce. In general, only 36.84% of the fish farmer-respondents practiced the listed specific activities on mud crab culture technology.

14. The correlational analysis between the extent of farming activities as practiced by the mud crab farmers revealed no significant correlation as to age and length of experience. However, significant relationship existed

between the extent of farming practice and sex, educational background, and average monthly income.

15. As regards to status of problems in mud crab farming, the fish farmers' overall mean was 2.43 and described as "slightly a problem" with 3.52 and a verbal description of "much a problem" among fisheries technologists. However, comparing the perceptions of the two groups of respondents, both are in agreement and claimed the problem areas as "much a problem" were those related to "lack/inadequate number of extension workers to assist fish farmers on the operation of mud crab farms", "lack of government support to mud crab farmers", and "lack of equipment to monitor water quality parameters."

16. Comparing the extent to which the problems are felt by the respondents, t-test results revealed significant difference wherein the computed t-value of 5.08 is higher than the tabular value of 1.68 at .05 level of significance which led to the rejection of the null hypothesis. The fisheries technologist-respondents most felt the problems in mud crab farming as compared to the fish farmer-respondents.

17. As to training needs, all training areas were regarded by the mud crab farmers as "slightly necessary" with a mean value of 1.92. On the other hand, the fisheries technologists claimed all the training areas as "much necessary" as manifested through the overall mean of 4.09.

Conclusions

Based on the findings of the study, the following conclusions were drawn:

1. The mud crab farming industry in the Samar province is dominated by male individuals comprising 89.53% as compared to 10.47% females with average age of 50.66 years. All mud crab farmers are married in terms of civil status.

2. The educational levels of fish farmers ranged from elementary to graduate levels. Majority of them (30.23%) percent were baccalaureate degree holders while 22.09 percent were schooled in the elementary grades. However, 1.16 percent earned master's units. Majority of their educational preparations were not related to fisheries which comprised 94.19 percent. The fisheries technologists, on the other hand, met the educational requirements for their respective positions but many of them were not on fisheries as their lines of specialization, as evidenced by only 36 percent who were schooled in fisheries-related courses.

3. The mud crab farmers had shorter number of years of experience on mud crab farming as compared to their fisheries technologists counterparts who have been in government service for a quite longer period of time.

4. The average monthly income of the vast majority of the fish farmers derived from the growing of mud crabs is low. This could be attributed to low production level, as well as the longer culture period wherein only two

cropping periods could be done in a year.

5. Educational opportunities for mud crab farmers such as trainings, seminars, and the like are inadequate, thus depriving them of the state-of-the-art practices and recent advances on this aquaculture technology.

6. The areas devoted to mud crab farming by the fish farmers are smaller, hence low yield and income is derived from this entrepreneurial activity.

7. Rules and regulations of the Department of Environment and Natural Resources (DENR) and the Bureau of Fisheries and Aquatic Resources (BFAR) on the establishment of mud crab farms were not complied with by majority of the fish farmers as evidenced by 47.67% of them operating without permit, thus support from government agencies and non-government organizations to improve their farm operations are limited.

8. The tools and equipment required for an efficient and effective fish farm operation are inadequate since available tools at their farms are digging blades, flashlights, and carpentry.

9. Both monoculture and polyculture methods are adopted by the mud crab farmers. Species which are of commercial value such as grouper, milkfish, tilapia, and tiger shrimp were raised in combination with mud crab.

10. The low average production in mud crab farming could be attributed to low survival rates resulting from low level of adoption on the recommended pond management practices.

11. The compliance of fish farmers on the various activities in mud crab culture is below average as evidenced by the overall mean of 36.84% among 86 respondents. Fish farmers who practiced the specified activities are assured of high survival of stock, good yield, and higher return of investment, if natural calamities such as strong typhoons and earthquakes, and flash floods which are beyond their control will never occur during the culture periods. However, appropriate knowledge and skills through attendance in training programs, adequacy of technology guides and other educational materials, and technical support of fisheries technologists are made available to the mud crab farmers.

12. It can be concluded that based on the correlational analysis, there is a significant relationship between sex, educational background, and average monthly income of fish farmers to the extent of the farming activities being practiced in mud crab culture.

13. The problems presented in the study are common as they affect the overall fish farm operations. Both respondents differed significantly on the extent to which the problems are felt. The fisheries technologists claimed utmost realization on the existence of the problems as compared to the fish farmer-respondents. However, both groups of respondents agreed and identified problem areas of utmost priority particularly on "lack/inadequate number of extension workers to assist famers on the operation of mud crab farms", "lack of government support to mud crab farmers," and "lack

of equipment to monitor water quality parameters." Providing alternative strategies or effecting total solutions to the most pressing problems will make mud crab farming a very lucrative industry for the province of Samar contributing to socio-economic development and sustainable resources utilization.

14. Due to the fish farmers' lack of educational awareness, particularly on the scientific methods and approaches, as well as on the recent advances on mud crab farming technology, the fish farmer-respondents considered the various training areas presented "slightly necessary." On the other hand, the fisheries technologists who have the mandate of disseminating appropriate aquaculture technologies for poverty alleviation and food security felt the urgency and the necessity to undergo in-service trainings for them to acquire relevant knowledge and skills thus, enhance their competencies in the effective delivery of technical services to their clientele.

15. Finally, mud crab culture is a potential lucrative industry for the Samar province considering the great demand of this commodity in local and international markets. The vast mangrove areas and idle brackishwater fishponds are favourable for the cultivation of this locally-available fish species, and will redound to broader access to livelihood opportunities in the coastal areas, thus reducing poverty incidence and improving local economy.

Recommendations

From the findings and conclusions herein presented, the following are the recommendations:

1. The local government units should look into the needs of their extension workers to make them effective agents for countryside development. Extension workers should undergo intensive training on mud crab farming technology in order to improve their technical capabilities.

2. The Department of Environment and Natural Resources (DENR) and Bureau of Fisheries and Aquatic Resources (BFAR) as regulatory agencies of the government should review their land-use plans and assess illegally-constructed mud crab farms so that the operators could comply with the necessary requirements as mandated by law. Mud crab farms constructed not in violation of existing laws, rules, and regulations should be extended full support and assistance for their legalization so that proper and appropriate taxes be enforced and necessary environmental requirements for resource use, management, and conservation be complied with and adopted.

3. The Agri-Pinoy Program of the Department of Agriculture (DA), the local government units (LGUs), as well as the extension activities of State Colleges and Universities (SUCs) should focus on this growing industry to assist fish farmers, particularly on the technical aspects of mud crab culture technology for them to become productive contributors for the progress of Samar.

4. Fisheries training centers and educational institutions should conduct skills enhancement trainings and other educational programs on the various areas of mud crab faming technology and made them accessible to farmers in the different coastal municipalities of Samar.

5. Mud crab farmers in Samar province should organize themselves into an association so that their needs and demands be heard and be given preferential attention by the government, particularly those relating to financial assistance and credit facilities.

6. Finally, a similar study should be conducted in order to validate the findings of the research made.

BIBLIOGRAPHY

A. BOOKS

Allen, Geoffrey P., Louis N. Botsford, Anthonie M. Schurr, and Warren E. Johnston. Bioeconomics of Aquaculture. New York: elsevier, 1984.

Bagarinao, T.U. and E.E. Flores (eds.) Towards Sustainable Aquaculture in Southeast Asia and Japan. Iloilo: Southeast Asian Fisheries Development Center, 1995.

Balagapo, Cirilo, Jr. Extension Guide for Agriculture Technologist in Eastern Visayas. Tacloban City: Department of Agriculture, undated.

Baluyot, Elvira A. Aquaculture Systems and Practices: A Selected Review. Rome: Food and Agriculturral Organization, 1989.

Bautista, Gobleth and Augusto E. Serrano. Manual in Fish Culture III. Quezon City: University of the Philippines in the Visayas, 1987.

Calderon, Jose F. and Expectacion C. Gonzales. Methods of Research and Thesis Writing. Mandaluyong City: National Book Store, 1993.

Cowan, L. Cultivation of Crabs (Scylla serrata) to Market Size in the Philippines. Brisbane, Queensland: Department of Primary Industries, 1984.

Csavas, Imre. "Recommendations for Responsible Aquaculture." Towards Sustainable Aquaculture Development in Southeast Asia and Japan. Iloilo: Southeast Asian Fisheries Development Center, 1995.

Good, Carter V. Dictionary of Education. New York: McGraw-Hill Book Co., 1959.

FAO (Food and Agricultural Organization of the United Nations). "Technical Conference on Aquaculture, Kyoto Japan-1976" In: Advances in Aquaculture. Surrey: Fishing News (Books) Ltd., 1979.

Hill, B.J. Aspect of the Feeding Strategy of the Predatory Crab, Scylla serrata. Marine Biology, Queensland, Queensland, 1977.

IIRR. LIvelihood Options for Coastal Communities. Silang, Cavite: International Institute for Rural Reconstruction, 1995.

Idyll, C.P. The Sea Against Hunger. New York: Crowell, 1970.

Melana, D.M., J. Atchue III, C.E. Yao, R. Edwards, E.E. Melana, and H.I. Gonzales. Mangrove Management handbook. Manila: Department of Environment and Natural Resources, 2000.

New Standard Encyclopedia. Volume V. New York: McMillan Publishing, 1990.

Ryther, J. H. Photosynthesis and Fish Production in the Sea. New york: McGraw-Hill Book Co., 1969.

Pagoso, Cristobal M. et al. Fundamental Statistics. Quezon City: Sinagtala Publishing, 1983.

Pagcatipunan R. The Culture of Mangrove Crab (Scylla serrata). Manila. Technology and livelihood Resource Centre, 1992.

Pillay, T. Aquaculture Principles and Practices. London: Fishing News Books; 1990.

Pillay, TVR and Wm Dill (eds.) Advances in Aquaculture. Surrey: Fishing News (Books) Ltd., 1979.

Villaluz, D. Fish Farming in the Philippines; Manila: Bookman Company Incorporated; 1953.

Walpole, Ronald E. Introduction to Statistics. New York: MacMillan Publishing Co. Inc., 1982.

Webster;s Encyclopedia Dictionary. New York: Lexicon Publication Inc., 1992.

Webster's Third new International Dictionary. New York: McGraw-Hill Book, 1976.

B. JOURNALS, PUBLISHED PAPERS AND DOCUMENTS

Administrative Order No. 6. Department of Agriculture, Manila, 1998.

Aqua Farm News. Volume IXI. No. 3. Southeast Asian Fisheries Development Center, Tigbauan, Iloilo, August 1997.

Arriola, F.J. Preliminary Study of the Life History of Scylla serratea (Forrskal). Philippine Journal of Science. 1940

Asian Aquaculture. Southeast Asian Fisheries Development Center, Iloilo, Philippines, 1997.

Aypa, Simeona A. "Aquaculture in the Philippines." Bureau of Fisheries and Aquatic Resources, Quezon City, 1995.

Baliao, D. "Mudcrab Production in Brackishwater Ponds." Southeast Asian Fisheries Development Center, Tigbauan, Iloilo, 1981.

Bernacsek, G. "The Role of Fisheries in Food Security in the Philippines: A Perspective Study for the Fisheries Sector to the Year 2010." Paper presented during the Second National Fisheries Workshop on Policy Planning and Industry Development, Cavite, Philippines, 1996.

BFAR/BASS. "Inventory of Fishponds and Freshwater Aquaculture Farms" Bureau of Fisheries and Aquatic Resources - Bureau of Agricultural Statistics, June 2002.

Castanos, M. "Grow Mud Crabs in ponds." SEAFDEC Asian Aquaculture. Volume XIX, No. 3, August 1997.

Cheong, C. "Formulation of Artificial Feeds for Mud Crab Culture: A Preliminary Biochemical, Physical, and Biological Evaluation." A Report on the Seminar on the Mud Crab Culture and Trade. Madras, India, 1992.

Cruz, Emmanuel M. "Feeds and Feeding." Central Luzon State University, Nueva Ecija, 1980.

DAO (Department of Agriculture Order) No. 214, Series of 2001.

Delgado, C.L., N. Wada, M.W. Rosegrant, S. Meijer, and M. Ahmed. "Production Costs, Income, and Profits in Chinese Aquaculture." NRE/IRBSD/ER, Stellenbosch, South Africa, 2003.

Department of Agriculture Administrative Order No. 3, 1998.

Department of Agriculture Administrative Order No. 6, 1998.

De Silva, L. "Results on the Trials of Mud crab Fattening." Report on the Seminar on Mud crab Culture and Trade. Bay of Bengal Programme, Madras, India, 1992.

Gaduang, Abraham B. "Extension Program for Aquaculture." Bureau of Fisheries and Aquatic Resources, Manila, 1978.

Goco, Marty. "Extension Needs in Aquaculture." Proceedings on the National Workshop on Aquaculture Development Strategies." Southeast Asian Fisheries Development Center, Iloilo, Philippines, 1990.

Gonzales, Felix R. "Mangrove and Estuarine Development in the Philippines." proceedings on the International Workshop on Mangrove Ecosystem Management, Manila, 1977.

Grino, E.G. "Notes and Observations on Practice of Culturing Scylla serrata in Western Visayas." SEAFDEC Aquaculture Department, Tigbauan, Iloilo City, 1977.

Landra, D. 'Mud Crab Fattening Practices in the Philippines." Report of the Seminar on the Mud Crab Culture and Trade. Bay of Bengal Programme, Madras, India, 1991.

Lavina, A.F. and A.S. Buling. "Propagation of the Mud crab (Scylla serrata)." Quarterly Research Report. Southeast asian Fisheries Development Center, Iloilo, 1997.

Librero, Aida R. "Socio-economic Dimensions of Aquaculture in the Rural Development of the Philippines." Fishery Industry Development Council, 1978.

Munoz, Jessica C. "Fisheries and Coastal Resources Management in the Philippines." Selected Papers Presented at the Regional Workshop on the Use of Demographic data in Fisheries and Coastal Development and Management in the Philippines and Other Southeast and South Asian Countries. Iloilo, Philippines, March 2002.

NEDA (National Economic and Development Authority). "Poverty Statistics," 2000.

NSO (National Statistic Office). "Poverty Incidence Data," 2009.

PPDO (Provincial Planning and Development Office). "Population Profile of Samar Province," 2009.

Primavera, J.H. "Philippine Mangroves: Status, Threats and Sustainable Development." Aquaculture Department, Southeast Asian Fisheries Development Center. Iloilo, Philippines, 2000.

Republic Act 8435 (The Agricultural and Fisheries Modernization Act of 1998).

Republic Act 8550 (The Philippine Fisheries Code of 1998).

SEAFDEC Aquaculture Department. Iloilo: Southeast Asian Fisheries Development Center, Tigbauan, Iloilo, 2000.

The Philippine Fisheries Code of 1998.

Trino, A. "Operations and Management of Mud Crab Framing." Southeast Asian Development Center, Tigbauan, Iloilo, 1997.

C. ELECTRONIC REFERENCES

http://www.ncsb.gov.ph

www.da.gov.ph

www.fao.org.com

www.fishfarmer-magazine.com.

http://www.seafdec.org.ph/commodities/mudcrab_fattening.html

www.wikipedia.org./scylla.

D. UNPUBLISHED MATERIALS

Altres, Carmelita T. "Fattening of Mud Crabs Using Carabao Hide, Clam Meat and Trash Fish as Feeds in Bamboo Cage." Unpublished Master's Thesis, Iloilo State College of Fisheries, Barotac Nuevo, Iloilo, 1999.

Amparado, Lolito O. "The Aquaculture Industry in Samar Province: Proposed Fishery Extension Program for Samar State University (SSU)." Unpublished Doctoral Dissertation, Samar State University, Catbalogan, Samar, 2005.

Duzon, Romeo A. "Aquaculture Technology in Selected Towns of Samars: Inputs for Improving Instruction in Samar State Polytechnic College - Mercedes Campus." Unpublished Master's Thesis, Samar College, Catbalogan, Samar, 2003.

Lequin, Remedios D. "Fattening of Mud Crab in Bamboo Pens Using Trash Fish and Chicken Intestinal Organs as Feeds." Unpublished Master's Thesis, Iloilo State College of Fisheries, Barotac Nuevo, Iloilo, 1999.

Niego, Educardo M. "Fishpond Industry in Selected Towns of Western Samar: Status and Proposals to Enrich Inland Fishery Instruction at Samar Regional School of Fisheries." Unpublished Master's Thesis, Cebu State College of Science and technology, Cebu City, 1995.

A P P E N D I C E S

APPENDIX A

REQUEST FOR APPROVAL OF RESEARCH PROBLEM

Republic of the Philippines
SAMAR STATE UNIVERSITY MERCEDES CAMPUS
Catbalogan, Samar

October 26, 2009

The Acting Dean
Samar State University Mercedes Campus
Catbalogan, Samar

Sir:

I have the honor to submit for approval one of the research problems for my masteral thesis, preferably Number 1:

1. **MUD CRAB (*Scylla spp*) AQUACULTURE IN THE PROVINCE OF SAMAR**

2. **CULTURE OF SPOTTED RABBITFISH (*Siganus canaliculatus*) IN CAGES**

3. **PROFILE AND TRAINING NEEDS OF MUSSEL FARMERS IN THE COASTAL MUNICIPALITIES OF SAMAR**

Your favorable action on this matter is highly appreciated.

Very truly yours,

(SGD.) **RENANTE DIOCTON JATULAN**
Researcher

APPROVED:

(SGD.) **LATIP S. ABDURAHMAN, Ph.D.**
Acting Dean, COFMAS

APPENDIX B

Republic of the Philippines
SAMAR STATE UNIVERSITY MERCEDES CAMPUS
Catbalogan, Samar

November 6, 2009

APPLICATION FOR ASSIGNMENT OF ADVISER

NAME:	**JATULAN**	**RENANTE**	**DIOCTON**
	(Surname)	(First name)	(Middle Name)

CANDIDATE FOR THE DEGREE: **Master in Fisheries Technology**

AREA OF SPECIALIZATION: **Aquaculture**

TITLE OF PROPOSED MASTERAL THESIS: **"Mud Crab (*Scylla spp*) Aquaculture in the Province of Samar"**

(SGD.) **RENANTE DIOCTON JATULAN**
Researcher

CONFORME:

(SGD.) **LOLITO O. AMPARADO, Ph.D.**
Designated Adviser

APPROVED:

(SGD.) **LATIP S. ABDURAHMAN, Ph.D.**
Acting Dean, COFMAS

APPENDIX C

COVER LETTER AND QUESTIONNAIRE-CHECKLIST

Republic of the Philippines
SAMAR STATE UNIVERSITY MERCEDES CAMPUS
Catbalogan City

_____
Date

Dear Respondent:

You have been selected as respondent in this research entitled "MUD CRAB (*Scylla spp*) AQUACULTURE IN THE PROVINCE OF SAMAR." The main objective of the study is to assess the present status of adoption of mud crab culture technology in order to obtain data/information vital for planning and implementation of relevant programs and projects for aquaculture development of the province.

May I therefore solicit your kind assistance to supply the needed data for this study by answering as honestly as possible every item in this questionnaire.

Rest assured that any information supplied in this instrument will be treated confidentially and will be used purely for this study ad will never jeopardize you in any way.

Thank you for your support and cooperation.

Very truly yours,

(SGD.) RENANTE DIOCTON JATULAN
Researcher

MUD CRAB (*Scylla spp.*) AQUACULTURE IN THE PROVINCE OF SAMAR

QUESTIONNAIRE-CHECKLIST

PART - I PERSONAL INFORMATION

Direction: Please read the statement and please write or check (/) the corresponding response on the space provided.

1. Name of Respondent (optional) _____

2. Address: _____

3. Sex: ____ Male ____ Female 4. Age: _____ years

5. Civil status:
   - _____ 5.1 Single
   - _____ 5.2 Married
   - _____ 5.3 Widow/widower
   - _____ 5.4 Separated
   - _____ 5.5 Others, please specify _____

6. Highest Educational Attainment:
   - _____ 6.1 Elementary level
   - _____ 6.2 Elementary Graduate
   - _____ 6.3 High School Level
   - _____ 6.4 High School Graduate
   - _____ 6.5 College Level
   - _____ 6.6 Post-Secondary Course Completed:
     - Please specify _____
     - 6.6.1 Major: _____
   - _____ 6.7 Bachelor's Degree Completed:
     - Please specify _____
     - 6.7.1 Major: _____
   - _____ 6.8 With Master's units
   - _____ 6.9 Master's Degree Completed:
     - Please specify_____
     - 6.9.1 Major: _____

7. Number of years you have been involved in mud crab culture:
   Please specify _____ years

8. Trainings attended related to mud crab culture for the last two years:

Title of Training:

8.1 National Level

_____
_____
_____
_____

8.2 Regional Level

_____
_____
_____
_____
_____

8.3 Local level

_____
_____
_____
_____
_____

9. Average Monthly income (in pesos) _____

PART II - PROJECT PROFILE AND PRODUCTION STATUS

Direction: Please write the corresponding response on the space provided.

A. FISH FARM PROFILE:

1. Location of the Fish Farm:
   - 1.1 Municipality: _____
   - 1.2 Barangay: _____
   - 1.3 Sitio: _____

2. Area of the fish farm: (Please indicate)
   - 2.1 Total area (in hectares) _____
   - 2.2 Total fully developed area (in hectares) _____
   - 2.3 Total productive area (in hectares) _____

3. Ownership status of Fish Farm: (Please check)
   _____ 3.1 With Fishpond Lease Agreement (FLA)
   _____ 3.2 Titled Lot
   _____ 3.3 Under Lease Contract
   _____ 3.4 Covered by Permit from Local Government Unit
   _____ 3.5 Without Permit to Operate
   _____ 3.6 Others, please specify _____

4. Fish farm equipment and facilities (please check)
   _____ 4.1 Digging blades
   _____ 4.2 Harvesting nets
   _____ 4.3 Electricity
   _____ 4.4 Caretaker's hut
   _____ 4.5 Flat boat
   _____ 4.6 Banca used for feeding
   _____ 4.7 Sampling gears
   _____ 4.8 Feeding trays
   _____ 4.9 Chilling tank
   _____ 4.10 Aerators
   _____ 4.11 Generators
   _____ 4.12 Refractometer
   _____ 4.13 Dissolved oxygen meter
   _____ 4.14 pH meter
   _____ 4.15 Secchi disc
   _____ 4.16 Freezer/Refrigerator
   _____ 4.17 Service boat
   _____ 4.18 Service vehicle
   _____ 4.19 Flashlights
   _____ 4.20 Carpentry tools
   _____ 4.21 Others, please specify _____

B. PRODUCTION STATUS:

1. Species cultured (please check)
   _____ 1.1 Mud crab monoculture , please specify species: _____
   _____ 1.2 Mud crab + milkfish
   _____ 1.3 Mud crab + tilapia
   _____ 1.4 Mud crab + milkfish + tilapia
   _____ 1.5 Others, please specify _____

2. Stocking rate (per hectare), please specify:
   2.1 Mud crab monoculture _____

2.2 Mud crab + milkfish :
Mud crab _____ + milkfish _____
2.3 Mud crab + tilapia:
Mud crab _____ + tilapia _____
2.3 Mud crab + milkfish + tilapia:
Mud crab _____ + milkfish _____ + tilapia _____
2.4 Others, please specify _____

3. Number of cropping per year: Please specify:
3.1 Mud crab monoculture _____
3..2 Mud crab + milkfish _____
3..3 Mud crab + tilapia _____
3.4 Mud crab + milkfish + tilapia _____
3.5 Others, please specify _____

4. Sex of mud crabs stocked:
_____ 4.1 all male
_____4.2 all female
_____4.3 mix sexes

5. Mode of culture of mud crabs:
_____5.1 grow-out culture
_____5.2 fattening

6. Culture period (in months), please specify
_____6.1 grow-out culture
_____6.2 fattening

7. Size of mud crabs at stocking (please check)
7.1 Grow-out culture
_____ 7.1.1 match box size
_____ 7.1.2 one peso-coin size
_____ 7.1.3 twenty-five centavo- coin size
7.2 Fattening (in grams), please specify) _____

8. Production of mud crab per hectare (in kilograms),
Please specify _____

9. Source of crabs/crablets for stocking, please specify: _____

PART III . EXTENT OF MUD CRAB FARMING ACTIVITIES

Direction: Please check the corresponding space beside the described farming activities as to whether they have been practiced or presently being practiced.

Farming Activities	Farming Activities Being Practiced
A. INSTALLATION OF CULTURE STRUCTURE AND NET ENCLOSURE	
1. Posts are installed at regular intervals	
2. Nets are buried into the mud at least 0.75 meter deep	
3. Net installed at least 1.0 meter above water line	
4. Nets are securely fastened/clipped to posts	
5. Bamboo matting are provided at the main water entrance	
B. POND PREPARATION	
1. Pond bottom is cleared of dirt	
2. Pond bottom is leveled gradually towards the gate	
3. Predators and competitors are eradicated	
4. Pond bottom is exposed to direct sunlight	
5. Ponds are repeatedly flushed to remove soil acidity	
6. Lime is applied to correct soil acidity	
7. Organic and inorganic fertilizers are applied	
8. Natural food (lab-lab) are allowed to grow before stocking	
9. Provision of canals inside compartment to increase water volume	
10. Shelters are provided as hiding places for mud crabs	
C. STOCKING	
1. Crabs/crablets are acclimated before stocking	
2. Crabs/crablets are stocked early in the morning or late in the afternoon	
D. WATER MANAGEMENT	
1. Adequate water supply is available the whole-year round	
2. Water exchange is effected every high tide during the entire culture period	
3. Water conditions are monitored regularly	
E. FEEDS AND FEEDING	
1. Natural food (lab-lab) is grown during pond preparation.	
2. Type of artificial feed given:	
2.1. By-catch fish	

Farming Activities	Farming Activities Being Practiced
2.2. mussel meat	
2.3. apple snail	
2.4. carabao hide	
2.5. chicken entrails	
f. others, please specify_____	
3. Method of feeding	
3.1 broadcast method	
3.2 others, please specify _____	
4. Amount of feed given	
4.1 Based on percentage body weight	
4..2 Feed given is estimated only	
4.3 Feeding to satiation	
5. Frequency of feeding	
5.1 Once a day	
5.2 twice a day	
5.3 Thrice or more a day	
6. Time of feeding	
6.1 early in the morning	
6.2 late in the afternoon	
6.3 any time of the day	
6.3 depending on the availability of feeds	
F. FISH HEALTH MANAGEMENT	
1. Inspection and monitoring of stock for any suspected disease/occurrence of mortality	
2. Improvement of water quality if mortality occurs	
3. Treatment of affected stocks with chemicals	
4. Samples are collected and subjected to laboratory examination	
5. Emergency harvest if mortality are in occurrence	
G. REPAIR AND MAINTENANCE	
1. Planting of vegetation over dikes to minimize soil erosion	
2. Regular checking of leakages and seepages	
3. Immediate repair of worn-out dikes	
4. Regular checking of gates	
5. Regular inspection of netting materials	
6. Immediate repair of netting materials for worn-out parts	
H. SAMPLING	
1. Stocks are sampled every month to determine average weights as basis for feeding adjustments	
2. Desirable number of samples are collected	
3. Care is exercise in handling sampled stocks	
I. HARVESTING	
1. Method of harvest	
1.1 Partial harvest	

Farming Activities	Farming Activities Being Practiced
1.2 Total harvest	
2. Gear used in partial harvesting	
2.1 crab lift net	
2.2 crab pot	
2.3 manual picking	
3. Number of harvests in one culture run	
3.1 once	
3.2 twice	
3.3 thrice	
3.4 four times or more	
4. Strategy adopted for undersized and thin crabs collected during harvests:	
4.1 returned to compartment and allowed to grow/fatten	
4.2 stocked in separated compartment and allowed to fatten	
4.3 harvested and sold at lower price	
4.4 harvested and consumed	
5. Factors influencing harvest of crabs:	
5.1 size of stocks	
5.2 market price	
5.3 culture period	
5.4 disease problem	
5.5 natural calamities	
J. POST-HARVEST TECHNIQUES	
1. crabs are sold alive	
2. crabs are shucked and meat are frozen	
3. Crabs are segregated according to size and weights	
4. Crabs are segregated according to sex	
K. TRANSPORT AND MARKETING OF PRODUCE	
1. Containers used in transport of produce	
1.1 "buri" *bayong*	
1.2 carton boxes	
1.3 styrophore boxes	
1.4 plastic fish trays	
2. Mode of sale	
2.1 through brokers/wholesalers	
2.2 direct to consumers	
3. Location of mud crab buyers	
3.1 Calbayog City	
3.2 Catbalogan, Samar	
3.3 Tacloban	
3.4 Cebu	
3.5 Manila	
3.6 Sta. Margarita, Samar	
3.7 Jiabong, Samar	
3.7 at the locality where the farm is located	

PART IV - PROBLEMS ON THE MUD CRAB AQUACULTURE

Direction: Please check the corresponding score according to your perception on the space provided beside the described problem area using the 5-point scale:

5 - Very much a problem (VMAP)
4 - Much a problem (MAP)
3 - Moderately a problem (MoAP)
2 - Slightly a problem (SAP)
1 - Not a problem at all (NAP)

Problem Areas	Perceptions				
	5 (VMAP)	4 (MAP)	3 (MoAP)	2 (SAP)	1 (NAP)
1. Conflict with non-aquaculture activity such as land use					
2. High capital investment for the construction of ponds and net enclosure					
3. High cost of feeds					
4. Unavailability of continuous supply of feeds					
5. Lack of credit facilities					
6. Lack of crablets in the locality					
7. Rising cost of crablets					
8. Water quality problems (salinity, temperature)					
9. Cannibalism					
10. Security of fish farm					
11. Lack of skilled labor					
12. Unstable price for the product					
13. Lack of technical knowledge on mud crab culture					
14. Inadequate market information					
15. Low survival of crops					
16. Lack/inadequate number of extension workers to assist fish farmers on the operation of mud crab farms					
17. Lack of educational materials on the mudcrab culture technology					
18. lack of government support to mud crab farmers					
19. Lack of equipment to monitor water quality parameters					
20. Distance of mud crab buyers from fish farm					
21. Mortality of crabs during long transport					
22.. Others, please specify _____					

PART V - TRAINING NEEDS OF FISH FARMERS ON MUD CRAB AQUACULTURE

Direction: Please check the corresponding score according to your perception on the space provided beside the described training area using the 5-point scale:

5 - Very much necessary (VMN)
4 - Much necessary (MN)
3 - Moderately necessary (MoN)
2 - Slightly necessary (SN)
1 - Not necessary (NN)

Training Areas	Perceptions				
	5 (VMN)	4 (MN)	3 (MoN)	2 (SN)	1 (NN)
1. Feasibility study preparation					
2. Pond construction and installation					
3. Stock management					
4. Aquasilviculture					
5. Feeds and feeding					
6. Water quality management					
7. Farm record keeping					
8. Post-harvest techniques					
9. Responsible aquaculture management					
10. Identification of fat female crabs					
11. Mud crab fattening					
12. Production of soft-shelled mud crabs					

Comments and suggestions:

_____
_____
_____
_____
_____
_____.

Thank you very much!

CURRICULUM VITAE

NAME	: **RENANTE DIOCTON JATULAN**
RESIDENCE ADDRESS	: Pier 1, Catbalogan, Samar
DATE OF BIRTH	: December 8, 1974
PLACE OF BIRTH	: Catbalogan, Samar
PRESENT POSITION	: Quartermaster I
STATION	: Samar State University Mercedes Campus Catbalogan City

EDUCATIONAL BACKGROUND

Elementary	: Pupua Elementary School Pupua, Catbalogan, Samar 1981 - 1987
Secondary	: Samar Regional School of Fisheries Catbalogan, Samar 1987 – 1991
Post-Secondary	: Diploma in Fisheries Technology Samar Regional School of Fisheries Catbalogan, Samar 1992 – 1993
College	: Bachelor of Science in Fisheries Samar Regional School of Fisheries Catbalogan, Samar 1994 – 1998
Graduate Studies	: Master in Fisheries Technology Major in Aquaculture Samar State University Mercedes Campus Catbalogan, Samar 2002 to present

POSITIONS HELD

Administrative Aide I, Samar State University Mercedes Campus, Catbalogan, Samar, 2005 – 2010

Quartermaster I, Samar State University Mercedes Campus, Catbalogan City, 2010 - present

NATIONAL CERTIFICATE

NC-I Fish Farm Worker, Technical Education and Skills Development Authority, November 2004.

NC-II Aquaculture Technician, Technical Education and Skills Development Authority, 2011.

TRAINING PROGRAMS AND SEMINARS ATTENDED

Training on Post-harvest Technology and R and D Strengthening Capabilities, Samar State University Mercedes Campus, Catbalogan, Samar, October 4 – 6, 2004.

Hands-on Training on Milkfish Fingerling Production, Bureau of Fisheries and Aquatic Resources, Tacloban City, November 20, 2002 to April 3, 2003.

Fisheries Technology Forum, Samar State Polytechnic College Mercedes Campus, Catbalogan, Samar, September 14, 2003.

PSI-FFW Conference on Promoting Youth employability, Equal Opportunities, Entrepreneurship and Employment Creation, Philippine Social Institute, Makati City, October 23 – 26, 2002.

Fishing Vessel Engineering, Department of Agriculture-Bureau of Fisheries and Aquatic Resources National Marine Development Center, Sangley Point, Cavite, April 1, 2001 to July 31, 2001.

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