# Feed management practices

*Technical Report*

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# Executive summary

The survey was conducted among fifty nine shrimp farmers at three shrimp cooperatives (Lua Tom Hoa Loi cooperative, 14/10 Hoa Nho cooperative and Doan Ket cooperative) in Soc Trang province and Ca Mau province of Vietnam, during 19th to 22nd of May. The team used a questionnaire developed by the Southeast Asia Fisheries Development Center (SEAFDEC). The questionnaire which includes five sections (personal information, technical information, feeds and feeding, production parameters, and environmental monitoring) aims to understand and assess current farming practices of shrimp farmers with focus on feed's characteristic and feeding management practices.

**The objective of the survey was:**

1. *Understanding current feeding management practices and feed characteristics of small scale shrimp farmers;*
2. *Identifying gaps and needs for application better feeding management practices;*
3. *Recommending solutions for application of better feeding management practices at small scale shrimp farms.*
4. *Selecting shrimp cooperatives for field test of better feeding management practices*

In general, most of farmers have basic understanding about feed management practices and their production performance is quite good. They have been trained in several programs of department of agriculture and rural development and projects of WWF-Vietnam. However, based on the findings, their gaps for application of better management practices are:

- *Knowledge on pond design for optimal feed consumption, environmental monitoring*
- *Knowledge on feed characteristics*
- *Knowledge on feed management practices (e.g. feeding time, feeding regime, adjustment of feed rotation, etc.)*
- *Knowledge on feed additive and their roles*
- *Skills for recording feed consumed and production parameters*
- *Knowledge on monitoring & evaluation feed efficiency and production performance*
- *Capacity to carry out environmental test onsite (e.g. dissolved oxygen, total nitrogen, total phosphorus)*
- *Knowledge on disease prevention*

**The recommendations are:**

- *Conducting Training of Trainers training on feed management practices for leaders of shrimp farmer groups*
- *Assisting leaders of shrimp farmer groups to train their members*
- *Establishing demonstration models of application of better feeding management practices*
- *Assisting farmers of demonstration models on testing production parameters and environment monitoring*

**Training program and demonstration of better feeding management practices**

The targeted shrimp farmers of the training program are 500 shrimp farmers in Soc Trang province and Ca Mau province, who come from 30 shrimp cooperatives. Most of them have been involved in the project ""Promoting certification & better Management practice among small scale shrimp farmer in Vietnam", implemented by WWF-Vietnam.

Leaders of shrimp cooperatives, officers of sub-department of aquaculture and agriculture extension center will be trained on better feeding management practices by ICAFIS.

Leaders of shrimp cooperatives, with assistance from ICAFIS will train for their farmers. Among targeted shrimp farms, 4 shrimp farms will be selected and carry out demonstration.

The demonstration farms apply better feeding management practices for one full crop. Throughout the crop, demonstration farms will receive technical assistance from ICAFIS.

# Introduction

As an activity of the USAID-funded Maximizing Agriculture Revenue through Knowledge Enterprise Development and Trade Project (USAID-MARKET), which promotes more sustainable and efficient use of aquaculture and fishery resources in the Association of Southeast Asian Nations (ASEAN) region with an emphasis on the Lower Mekong Initiatives countries. The International Collaborating Centre for Aquaculture and Fisheries Sustainability (ICAFIS) conducted a survey collection data on feed and feeding management practices of small-scale shrimp producers in two provinces of the Mekong Delta in Vietnam. The survey was conducted among 59 shrimp farmers of three cooperatives of Soc Trang and Ca Mau provinces from 19th to 22nd of May, 2014. The team used a questionnaire developed by the Southeast Asia Fisheries Development Center (SEAFDEC).

This report presents results of the survey, which covers survey methodology adopted, findings and analysis, conclusion and recommendations. The recommendations are based on the findings and analysis, of which it focuses on the needs and capacity of farmers to adopt better feeding management practices.

***Context***

In shrimp cultivation, feed is the most important cost factor, normally accounts 50-60%[1] of total production costs. Efficient feed management and feeding practices are critical important because it can reduce production costs through minimizing feed input. At the same time, it can control the environmental impacts of farming operations. Feed also can be mixed with medicine or additive substances and used for disease treatment. Efficient feed management and feeding practices depend on several factors such as type of feed, composition of feed, feeding regime, feeding facilities, etc. With regard to scale of production, feeding management at large scale is different to the one at small scale. In fact, there are more difficulties for small scale producers to operate feeding management at optimal level due to their capacity of facilities, knowledge, and awareness. For example, at large scale, feeding is usually undertaken by equipment under the control of technicians whilst at small scale, it is undertaken by hands.

***Objectives***

The primary aim of the survey is to assess and understand current practices of feeding, characteristic of feed are being adopted and used in Vietnam, and to provide recommendations for application of better feeding management practices.

The objectives were:

1. Understanding current feeding management practices and feed characteristics of small scale shrimp farmers;
2. Identifying gaps and needs for application better feeding management practices;
3. Recommending solutions for application of better feeding management practices at small scale shrimp farms.
4. Selecting shrimp cooperatives for field test of better feeding management practices

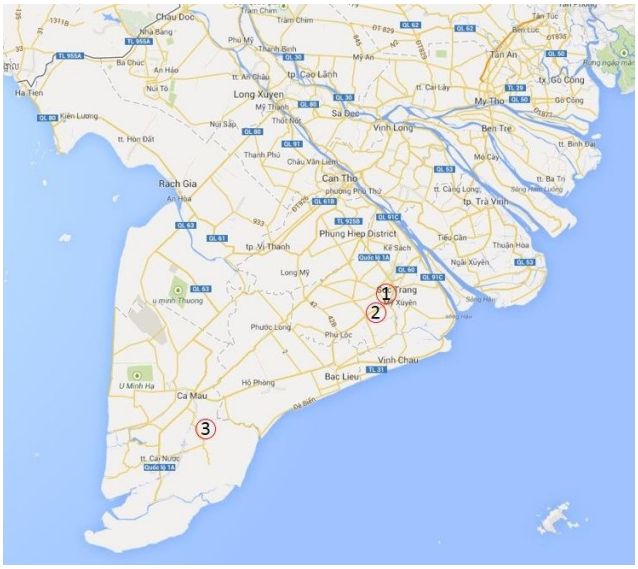
# Methodology

### *a. Samples & Site Selection*

The Mekong Delta is located in the south of Vietnam where shrimp production areas are most concentrated and developed. In 2013, total shrimp production volume of this region was 380,000 metric tons, accounts 79.8% of national shrimp production volume, while the shrimp production area was 588,000 ha (accounts 92%)[2]. Next to that, it has all kind of shrimp farming system such as extensive, semi-extensive, semi-intensive and intensive, as well as all kind cultivated species, namely black tiger shrimp and Pacific white leg shrimp. Because of the typical characteristics of shrimp cultivation, shrimp farmers in the Mekong Delta are selected for this survey. The survey team interviewed with fifty nine shrimp farmers from three shrimp cooperatives of Soc Trang province and one shrimp cooperative in Ca Mau province. This quantity is basically satisfied for both quantitative and qualitative analysis, and to provide inputs for the development of the training programs, which will be developing based on the findings of this survey.

[1] According to Dr. Le Xuan Sinh, Can Tho University.

[2] http://english.cntv.cn/20140310/102832.shtml




**Picture 1. Map of the Mekong Delta (cut from Google Maps, Google 2014)**
*(**Location 1:** Lua Tom Hoa Loi cooperative; **Location 2:** 14/10 Hoa Nho cooperative; **Location 3:** Doan Ket cooperative)*

In Soc Trang province, the survey was carried out at Lua Tom Hoa Loi cooperative and 14/10 Hoa Nho cooperative. The two cooperatives are located in My Xuyen district. Shrimp cultivation in this area has been existed for over 30 years, in extensive system at the beginning, then later shifted to semi-extensive and intensive system. In the previous years, main cultivated species was black tiger shrimp, however in recent years, because of the disease on black tiger shrimp caused devastating losses, the farmers are shifting to farm pacific white leg shrimp, which is able reach three crops per year and can bring more profit. The area is close the sea (within 40km) with entangled channel and river, where farmers get brackish water for shrimp farms. In addition, in My Xuyen district, farmers are also farming poly-culture system, namely shrimp and rice. Farmers normally do one crop of shrimp then one crop of rice and one more crop of shrimp throughout the year.

In Ca Mau province, the survey was carried out at Doan Ket cooperative, located in Tan Duyet ward, Dam Doi district. Shrimp cultivation of this region has been existed for very long time. Few decades ago, shrimp was cultivated in traditional way, farmers used wild seed (black tiger shrimp) which follows the tidal current into their wetland. Shrimp was fed naturally thanks to natural feed (e.g. plankton, mussels). In 2000s, shrimp cultivation have been developed rapidly. Farmers used seed from hatchery and farm made feed at the beginning, then later commercial feed. As in other provinces in the Mekong delta, in recent years, Pacific white leg shrimp has become dominated species in Ca Mau province although this province still has the biggest area of black tiger shrimp cultivation. Tan Duyet ward is surrounded by mangrove forest, wetland an entangled channel and river system.

### *b. Survey method*

The survey data collection was undertaken from 19th to 22nd of May. The team which comprises 3 people used a questionnaire and interview method to collect information. The team assisted each farmer to fill the questionnaire individually, and explained each question one by one. Farmers were also interviewed face to face. Regarding the questions that were difficult to farmers to understand (e.g. composition of feed, stability of feed, feeding regime, etc.), the team used semi-oriented question together with giving examples to the farmers. A visit on-site to investigate feed storage facilities and aerators was conducted.

*Questionnaire design*

The questionnaire was used in the survey (Annex 2) is developed by SEAFDEC and adjusted by ICAFIS. It comprises 78 questions on five following sections: 1) personal information, 2) technical information, 3) feeds and feeding, 4) production parameters, and 5) environmental monitoring. The questionnaire is designed to investigate both qualitative and quantitative information.

- The first section (question 1 to question 15) includes questions on age, gender, number of years of involvement in aquaculture, educational background and year of experience in aquaculture of owner, technician, and caretaker. Besides, this section also collects information on any form of technical assistance to the farmers. The objective of this section is to have an overview on

characteristic and general background of interviewees, and to investigate the correlation of farmer's characteristics and their background on feeding practices and relevant practices.

- The second section (question 16 to question 22) includes questions on species cultured, type of culture, culture system, culture environment, culture facilities, farm size, source of seed, and stocking density. The objective of this section is to understand characteristics of shrimp farming that interviewees are currently operating. It is also to identify key factors that have effects on efficiency of feeding management practices.
- The third section (question 23 to question 47) includes questions of type of feed, feed's composition, method of feed processing, feed's characteristics, feeding regime, method of feeding, and method of feed storage. The objective of this section is to understand current practices of feeding management and feed characteristics of small-scale farmers, and therefore be able to evaluate the suitability and appropriateness of feeding management practices with type of culture.
- The fourth section (question 48 to question 59) includes questions on culture duration, facilities, harvesting practices, feed consumed, size and weight at harvest, number of farmed species per kilogram, total biomass harvested, survival rate, feed conversation ratio (FCR), target FCR, number of crops per year, feed related problems. This section deals with the performance of shrimp farming and provides inputs to evaluate the effectiveness and efficiency of feed and feeding management practices. It is also to explore farmer's expectation on better feeding management practices.
- The fifth section (question 60 to question 78) includes questions on environmental monitoring practices, environmental monitoring parameters, analysis done at farm, disease management practices and other related information. The objective of this section is to understand the environmental monitoring practices that interviewees are applying, their capacity in environmental monitoring and therefore be able to assess the effect between feeding management practice and environmental practices. This section is also to collect data on disease management practices and other revelation operational activities at shrimp farm.

### *c. Data processing*

Data of the survey are classified into quantitative and qualitative variables. Quantitative variables are coded and categorized. Data are processed on Excel. Frequencies and simple descriptive statistic are presented in tables (Annex 3).

The missing information are mostly due to following reasons: 1) interviewees were not able to remember (e.g. average production volume of the three previous crops); 2) interviewees do not apply the practices mentioned in the question; 3) the information are not available at farm level (e.g. protein & fat content in feed). Qualitative variables are classified and categorized.

## Summary of Findings

***1) Personal information***

In general, most of interviewees are men and from 40 to 60 years old. Around 80% are shrimp farm owners while a few of them work as caretakers. Small scale shrimp farms are usually operated by family's members. In intensive system and at farms which have large farming areas, the owners often hire caretakers. Four fifths of interviewees do not hire technician, while there is 10% who hire technician at their farms.

Two thirds of interviewees possess length of involvement in operation more than 10 years, same as their years of experience in aquaculture. With regard to educational background, most of owners and technicians did not graduate from high school. 97% of interviewees are member of shrimp cooperatives. They often get technical assistance from sub-department of aquaculture, agriculture extension center and projects (e.g. project of World Wildlife Fund) on the subjects such as aquaculture techniques, better management practices.

***2) Technical information***

With regard to culture system and farmed species, monoculture system and black tiger shrimp are dominated. Although there is an increasing of shifting from black tiger shrimp to pacific white leg shrimp. In fact, 38% cultivate both species. Poly-culture system includes shrimp cum cap, shrimp cum rice and shrimp cum fish. There are several farms that apply both monoculture and poly-culture. Shrimp is cultivated in pond (100%).

Two thirds of interviewees farm in extensive system. 24% are intensive system. Semi-intensive culture system accounts 5%. Black tiger shrimp is cultivated in intensive and semi-intensive system, while pacific while leg shrimp is cultivated in intensive system. Brackish-water culture environment accounts 76%, and seawater culture environment accounts 24%.

Regarding pond characteristics, most of pond is at medium size (in range of 1 to 2 ha), and from 1 to 1.5 meter depth. 27% of interviewees have 1 pond, 25% have 2 ponds and 31% have more than 2 ponds.

37% of interviewees have annual production capacity less than 500kg. Farms have this annual production capacity are extensive farm which cultivate black tiger shrimp. 34% have annual production capacity from 500kg to 3000kg. 24% have annual production capacity more than 3000kg. Farms that cultivate pacific white leg shrimp often have production capacity more than 500kg per year.

With regard to shrimp seed, 100% of seed come from hatchery centers. And 97% are certified seed. 30% of farms stock black tiger shrimp at density of 1 to 5 post larvae per meter square (PL/$m^2$). 20% stock from 5 to 10 PL/$m^2$. In extensive system, stocking density of black tiger shrimp is less than 10PL/$m^2$. Semi-intensive and intensive farms stock more than 10 PL/$m^2$, these farms accounts 40%. 41% stock pacific white leg shrimp at density from 20 to 50 PL/$m^2$. This density is applied for semi-extensive system. 42% stock at density from 50 to 150 PL/$m^2$ which is usually applied for intensive system.

***3, Feed and Feeding***

In general, farms that cultivates black tiger shrimp in extensive system use natural feed, and farms that cultivated shrimp in semi-intensive and intensive system use complete feed. Farm-made feed is not used anymore due to its low performance, compared to commercial feed. 100% of feed are in type of sinking feed, pelletized and produced locally. 97% of interviewees use different type of feed for different periods (e.g. starter, grower, and finisher). Protein content is ranged among 36% to 42% while fat content is ranged among 4 to 5%, depending on growing periods of shrimp. 53% of feed are stable less than 3 hours. 31% are stable from three to twelve hours. Feed additives are widely used (79%). Of which farmers often mix feed with medicine and vitamin.

Most of farmers (76.5%) are applying feeding time properly. They feed four times per day at AM and PM. 46.5% apply feeding regime based on percentage of biomass, while 33.5% applied ad libitum regime. Most of farmers exercise broadcast feeding method. 85% adjust feed ration daily while 7% adjust it weekly. Feed are mainly stored in warehouse onsite and normally during a week. Pest control is not widely applied (only 39% apply).

***4) Production parameters***

With regard to culture duration, 59% of black tiger shrimp farmers cultivate shrimp during 5 months. 62% of pacific white leg shrimp farmers cultivate pacific white leg shrimp during 3 months. 46% of interviewees use aerator. Around a half of interviewees apply partial harvest while 36% apply total harvest.

39% of interviewees used less than 2000kg of feed per crop while 15% used more than 2000kg. With black tiger shrimp, they are often harvested at size of from 25-50 grams/shrimp, relatively 20 to 40 shrimps per kilogram. With pacific white leg shrimp, they are often harvested at size of 10 to 25 grams/shrimp, relatively at 40 to 100 shrimps per kilograms.

For extensive shrimp farm, their total biomass harvested per crop is mostly less than 50kg. For semi-intensive shrimp farm, it is ranged among 50 to 500kg. And in intensive farm, it is often higher than 500 kg. Most of interviewees was not able to recall their information for the average of last three production cycles.

At last production crop, 29% of interviewees had survival rate less than 70%. 53% had survival rate higher than 70%. All of extensive shrimp farm have survival rate less than 70%.

At last production crop, 41% of interviewees maintained FCR not higher than 1.2. 13% maintained FCR in range of 1.3 to 1.5. Regarding pacific white leg shrimp, FCR is mainly less than 1.5, and for black tiger shrimp it is often not exceed 1.7. 49% of interviewees do not have targeted FCR for next production crop. They also did not raise any problem related to feed, except about the increasing of feed price. Most of farmers do two crops per years.

***5) Environmental monitoring***

In general, environmental monitoring is practiced in most of farms. Regarding water, pH, salinity, temperature are mainly monitored, while for sediment, farmers often measure through visual observation. Fallow period is applied widely, mostly after every production crop.

All of interviewees apply pond preparation. In extensive system, the scheme includes: discharge water - dredge sludge - dry sludge - take water in from sea/river. In intensive system, the scheme includes: discharge water - dredge sludge - dry pond – liming - pump water in - water treatment with chemicals and bio-products.

The most often diseases occurred are bacterial disease and viral disease. Liming and use of prophylactics/disinfectants, and use of medicated feed are most often applied for disease prevention.

Most of water is discharged directly to environment. There is only 20% use water treatment pond before discharging. They are intensive shrimp farms.

# Conclusions and Recommendations

In general, most of farmers have basic understanding about feed management practices and their production performance is quite good. They have been trained in several programs of department of agriculture and rural development and projects of WWF-Vietnam. However, based on the findings, they are lacking:

- *Knowledge on pond design, pond preparation for optimal feed consumption, environmental monitoring*
- *Knowledge on feed characteristics (stability, protein content, type, etc.)*
- *Knowledge on feed management practices (e.g. feeding time, feeding regime, adjustment of feed rotation, etc.)*
- *Knowledge on feed additive and their roles*
- *Skills for recording feed consumed and production parameters*
- *Knowledge on monitoring & evaluation feed efficiency and production performance*
- *Capacity to carry out environmental test onsite (e.g. dissolved oxygen, total nitrogen, total phosphorus)*
- *Knowledge on disease prevention*

Based on this fact, to improve their feeding practices, it should focus on strengthening their knowledge on feeding management practices and capacity to carry out several tests of production parameters and environmental monitoring. Following technical issues should be highly consider:

- *Depth of pond (there are still a number of intensive shrimp farms that have ponds which are deeper or shallower than normal)*
- *Pond preparation scheme*
- *Selecting good/qualified seed (certified, free pathogen seed or specific pathogen resistant seed*
- *Stocking density for shrimp culture systems (extensive, semi-intensive, intensive)*
- *Feed characteristics (stability, protein content, type, etc.)*
- *Selecting type of feed for each growing period (e.g. starter, grower, finisher)*
- *Functions and usages of feed additives*
- *Feeding regime & adjustment of feed ration*
- *Methods to calculate FCR, growth rate, mortality*
- *Parameters to record*
- *Methods to carry out testing on water parameters (e.g. pH, dissolved oxygen, salinity, total phosphorus and total nitrogen)*
- *Reference on good performance of shrimp farm to monitor and evaluate their operations*
- *Methods to recognize ore diagnosis shrimp diseases*
- *Shrimp disease prevention methods*
- *Water treatment methods*

**The recommendations are:**

- *Conducting Training of Trainers training on feed management practices for leaders of shrimp farmer groups*
- *Assisting leaders of shrimp farmer groups to train their members*
- *Establishing demonstration models of application of better feeding management practices*
- *Assisting farmers of demonstration models on testing production parameters and environment monitoring*

**Training program and demonstration of better feeding management practices**

The targeted shrimp farmers of the training program are 500 shrimp farmers in Soc Trang province and Ca Mau province, who come from 30 shrimp cooperatives. Most of them have been involved in the project ““Promoting certification & better Management practice among small scale shrimp farmer in Vietnam”, implemented by WWF-Vietnam.

Leaders of shrimp cooperatives, officers of sub-department of aquaculture and agriculture extension center will be trained on better feeding management practices by ICAFIS. Training materials will be developed by SEAFDEC.

Leaders of shrimp cooperatives, with assistance from ICAFIS will train for their farmers. Among targeted shrimp farms, 4 shrimp farms will be selected and carry out demonstration.

The demonstration farms apply better feeding management practices for one full crop. Throughout the crop, demonstration farms will receive technical assistance from ICAFIS.

# Annex

## 1. Detail Findings

### *1) Personal Information*

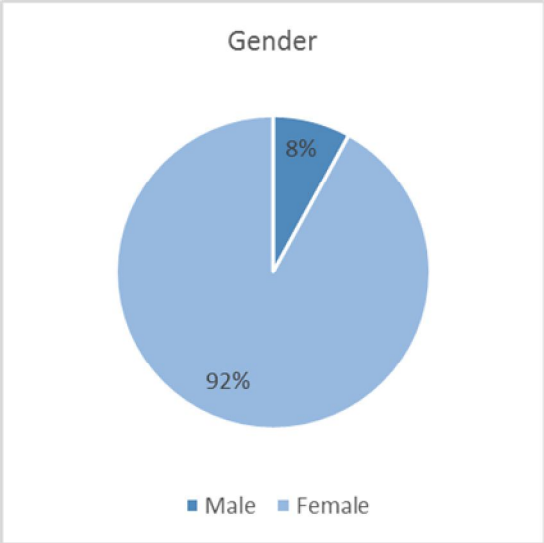



**Figure 1. Gender**

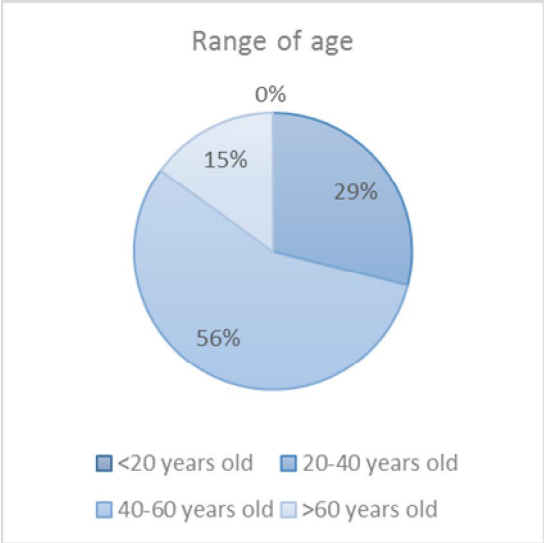



**Figure 2. Range of age**

Most shrimp farmers were interviewed are men (92%). In fact, the involvement of women in shrimp cultivation at farm level is restricted at farm level due to culture and gender perspective. Women play other roles in the value chain such as sales, marketing, logistic, etc. More than a half of farmers interviewed are from 40 – 60 years old (56%). Around one thirds of them are from 20 – 40 years old (29%) and the remaining people are above 60 years old (15%). The average age of total interviewees is 47 years old.

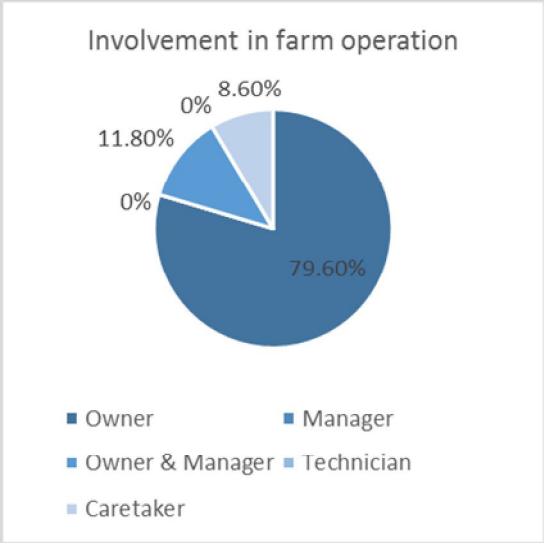



**Figure 3. Involvement in farm operation**

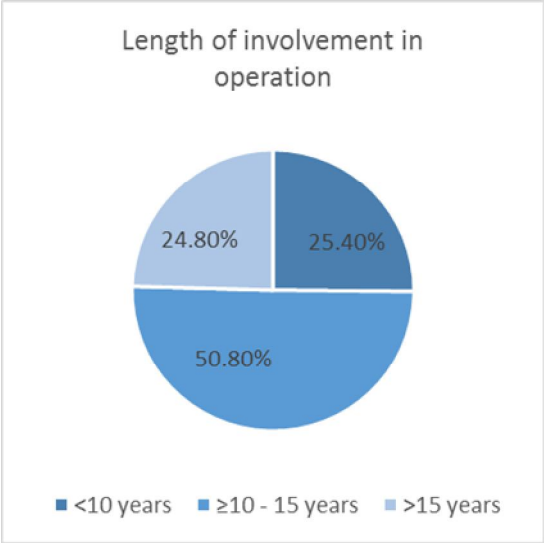



**Figure 4. Length of involvement in operation**

Most shrimp farmers are the owners (79.6%). They are also responsible for technical and other related issues at the farm. 11.8% of interviewees answered they are the owners & managers while the remaining people (8.6%) answered they are caretakers. At small scale, shrimp cultivation is usually undertaken by members of the family. In some case, only one member of the family, such as the husband or the wife does shrimp farming. For farmers who possess large area of shrimp farming, they can hire a permanent caretaker or occasional worker at stocking and harvesting events.

The length of involvement in operation is widely varied. The average length is nearly 13 years. The farmer has longest length of involvement in operation is 34 years while farmer has the shortest one is 3

years. Around a half (50.8%) of the interviewees has been involved in shrimp farming from 10 to 15 years while one fourth (24.8%) of them have been involved in shrimp farming more than 15 years, and the nearly equivalent percentage of farmers (25.4%) possesses the length of involvement less than 10 years.

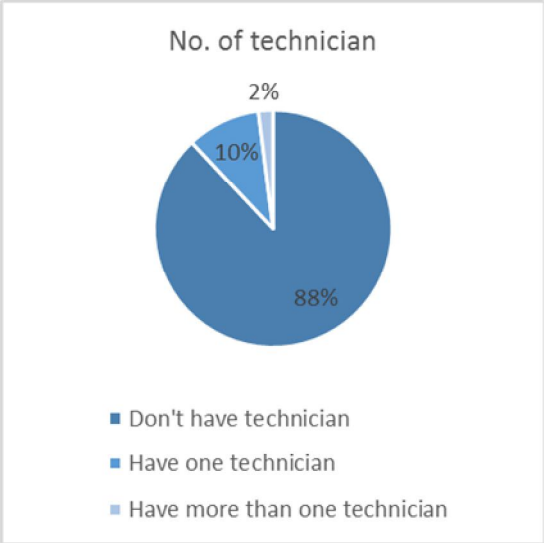



**Figure 5. No. of technician**

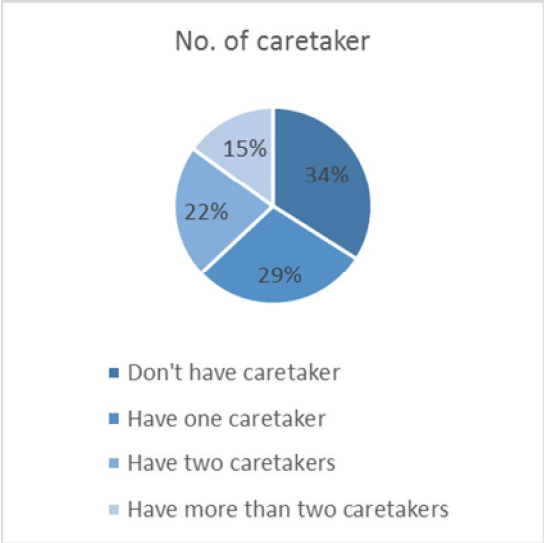



**Figure 6. No. of caretaker**

With regard to number of technician at farm, Most interviewees (88%) answered they don't hire technician. There is only 10 percent answered they have one technician, and one farmers answered he has more than one technician at his farm. For those who do not have technician, they are responsible for operating their shrimp farm.

More than one thirds (34%) of the interviewees do not hire caretaker. Shrimp farms have one caretaker (29%) or two caretaker (22%) are usually operated by members of family, for example spouses or father and son, or relatives. Shrimp farms have more than two caretakers (15%) usually have large farming areas, therefore they often hire local employees as caretakers.

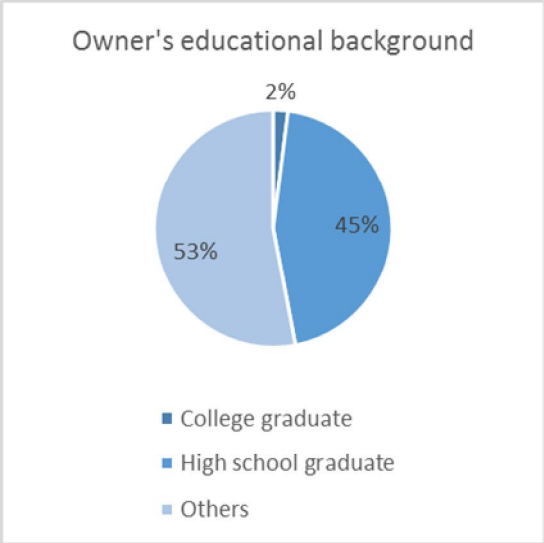



**Figure 7. Owner's educational background**

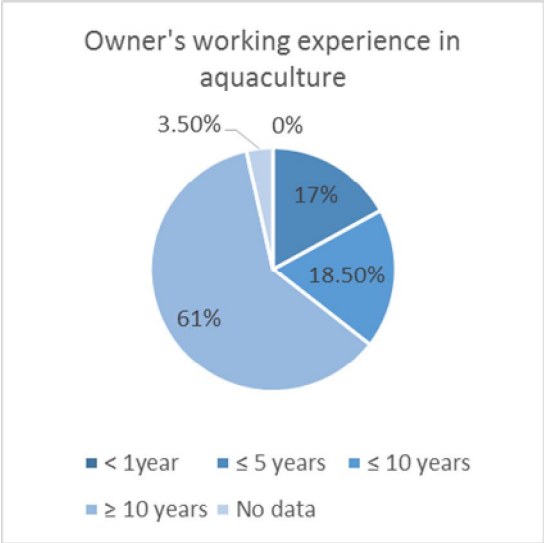



**Figure 8. Owner's working experience in aquaculture**

In general, over a half of interviewees (53%) did not graduate from high school. Most haft of them graduated (45%). There only one case graduated from college. The fact is the people in the Mekong Delta and other rural provinces of Vietnam left school at young age to make living. Regarding experience in aquaculture, more than a half of interviewees (61%) have more than 10 years of experience while a nearly one fifth (18.5%) has up to 10 years of experience. Most them said that they have started doing shrimp cultivation since 2000s when shrimp farming in the Mekong Delta was developing widely and

rapidly. There are two cases that interviewees could not remember when they started doing aquaculture, and could not be able to give an estimation.

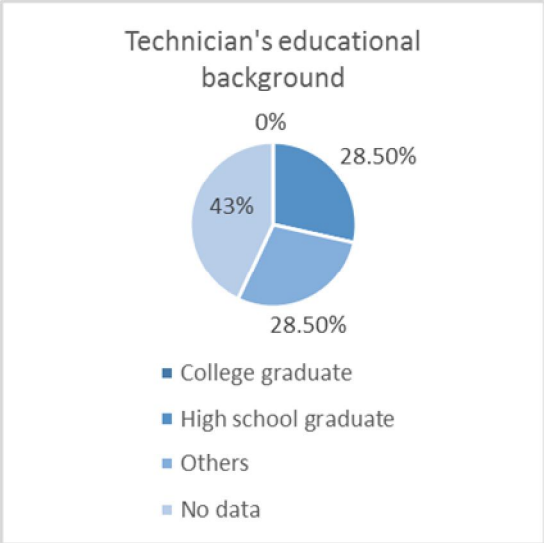



**Figure 9. Technician's educational background**

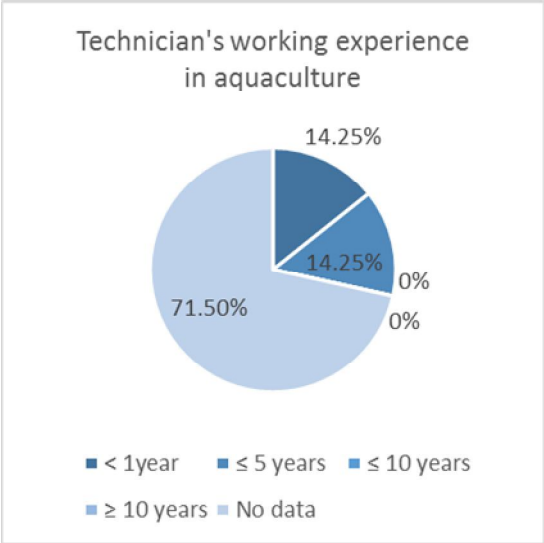



**Figure. 10 Technician's working experience in**

For shrimp farms which have technician, there is no technician graduated from college while there are two people graduated from high school and two people have lower educational grade than high school. There are three cases the owners could not remember educational background of their technicians. This is the fact at small scale shrimp farm where employments are most conducted verbally without requirements on identification and educations of employees. Because of this fact, most of the owners also could not provide year of experience in aquaculture of technicians (71.5%). There is one technician has up to five years of experience and the other one has up to one year of experience.

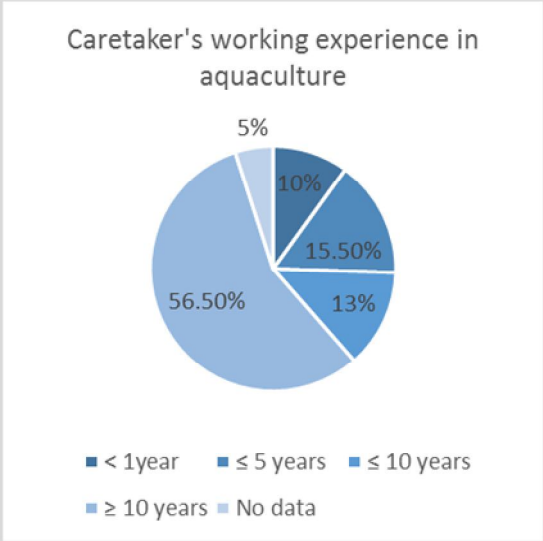



**Figure 11. Caretaker's working experience in aquaculture**

**Figure 12. Technical assistance and participation**

Regarding caretaker's experience in aquaculture, more than a half of caretakers (56.5%) have more than ten years of experience, while 13% has up to ten years and 15.5% has up to five years. The number of caretakers have up to one year of experience accounts 10%. There are two cases (5%) do not have information because of the owner was not able to recall.

Most of interviewees are members of shrimp cooperatives (97%). There are two interviewees who do not belong to any organized group. The shrimp cooperative usually comprises from ten to thirty members. In each cooperatives, there are one voted chairman and one vice chairman. Some cooperatives have their own operational regulation. In some cases, the chairman or vice chairman of the cooperative are

middlemen or feed, medicine suppliers. Being a member of a cooperative, the farmer has more benefits than those who do not, such as having more information of aquaculture practices, feed, and shrimp price and be involved in training programs, projects.

Over four fifths of interviewees (88%) are received technical assistance. These assistance are conducted by sub-department of aquaculture (local fisheries agency), a unit under department of agriculture and rural development, and by agriculture extension center. They are also received technical assistance from the project *"Promoting Better Management Practices among Small scale Shrimp farmers in Vietnam"* of the World Wildlife Fund in Vietnam (WWF-VN) because of their participation in the project. However this project only support for dozens shrimp cooperatives in three provinces of the Mekong Delta. Around one thirds of interviewees have been involved in formal training such as short courses on aquaculture practices, environmental monitoring at vocational training center.

## 2) *Technical information*

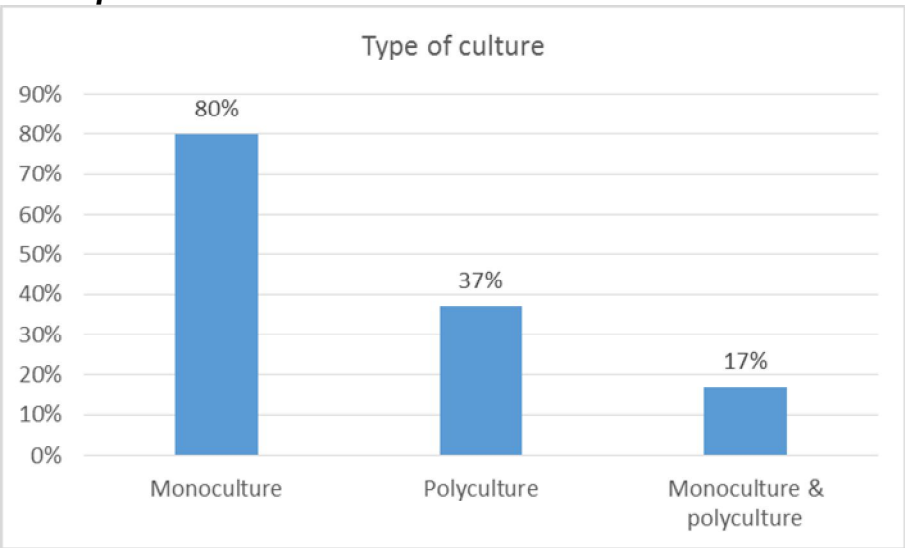



**Figure 13. Type of culture**

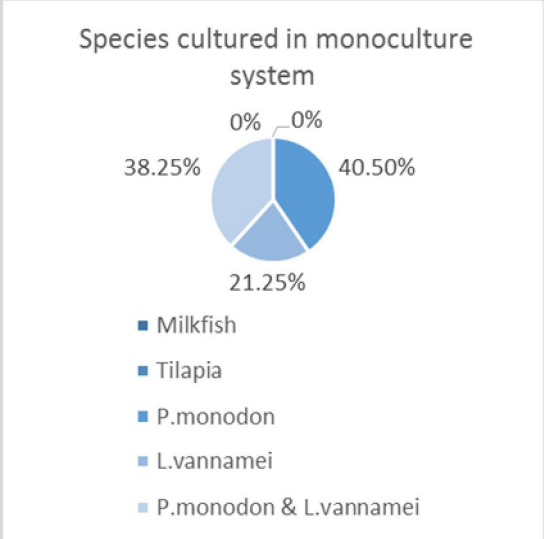



**Figure 14. Species culture in monoculture system**

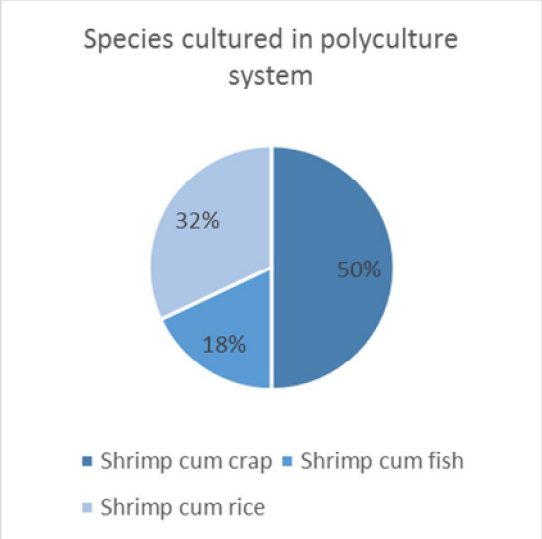



**Figure 15. Species cultured in polyculture system**

In general, monoculture system and black tiger shrimp are dominated. The farms which apply monoculture system account four fifths (80%). Of which black tiger shrimp accounts 40.5%, pacific white leg shrimp accounts 21.25% and the farms which cultivate both species account 38.25%. The farms which apply poly-culture system account 37%. Of which, shrimp cum crap system accounts a half (50%), shrimp cum rice system accounts 32% and shrimp cum fish system accounts 18%. The farms which apply both monoculture and poly-culture system account 17%.

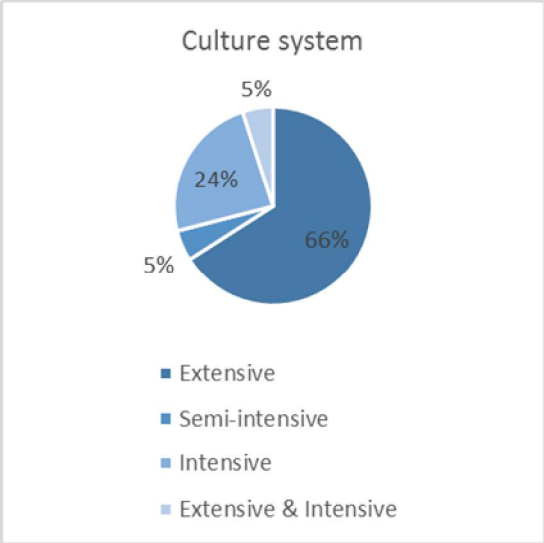



**Figure 16. Culture system**

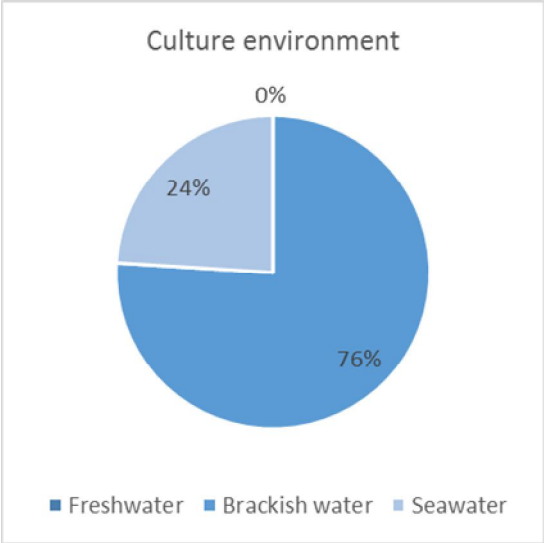



**Figure 17. Culture environment**

Two thirds of culture system are extensive (66%). 24% are intensive system. Semi-intensive culture system accounts 5%. Farms which apply both extensive and intensive system accounts 5%s. These farms cultivate black tiger shrimp in extensive system and pacific white leg shrimp in intensive system. Around three fourths of culture environment are brackish-water (76%) and one fourths (24%) are seawater. 100% shrimp is cultivated in ponds. Regarding extensive shrimp farms in Ca Mau province, they cultivate shrimp in ponds and channels within their land in mangrove forest.

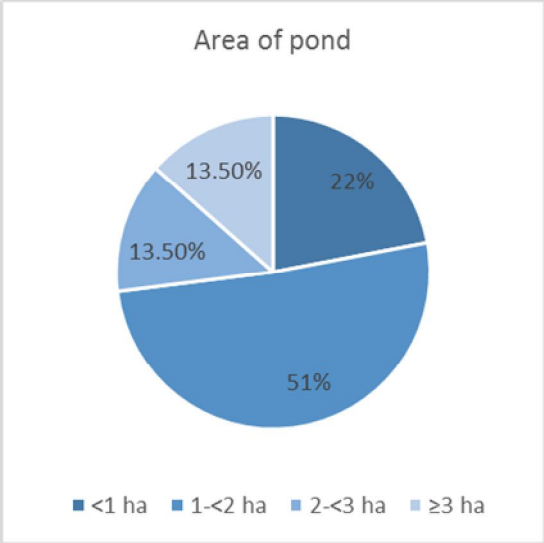



**Figure 18. Total area of pond**

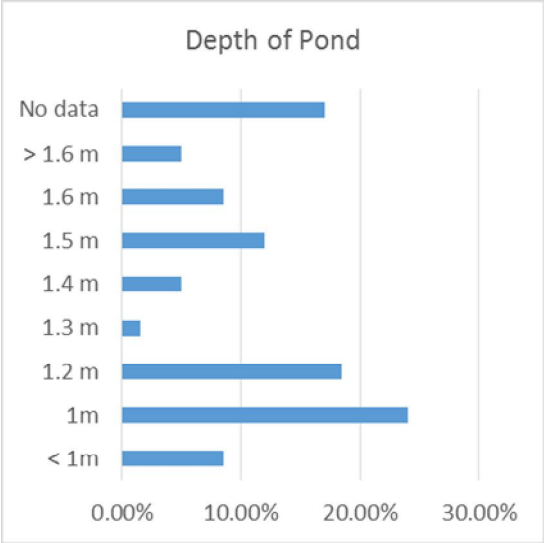



**Figure 19. Depth of pond**

Most of pond are at medium size. 51% of pond area is within 1 to 2 hectares, with an average is 1.27 hectares. 22% is below 1 hectare (average 0.52 hectare). 13.5% is from 2 to 3 hectares (average 2.3 hectares). And 13.5% is above 3 hectares (average 4.825 hectares). There is no clear definition of small scale farm in Vietnam. At the beginning, small scale shrimp farm is categorized by size, namely small scale is less than 1 hectare and large scale is larger than 1 hectare. However, recently the definition has changed which is based on scale of production, including number of employees and linkage in the value chain. Of which small scale farm is defined that the farm has one or two permanent employees, does not have linkage with processors. While large scale farm is defined that the farm has more than two permanent employees and has vertical integrated system or linkage with processors.

Regarding depth of pond, 24% of pond is 1 meter depth. 8.5% is shallower than 1m. 18.5% is 1.2 meters depth. 32% is deeper than 1.2 meters. The missing data accounts 17% because the farmers do not measure their depth of pond in extensive culture system. In intensive culture system, pond's depths are

usually varied around 1.4 meters (5%), 1.5 meters (12%) and 1.6 meters (8.5%). Depth of pond has impacts on stability of feed, and also on several parameters (e.g. oxygen, transparence of water).

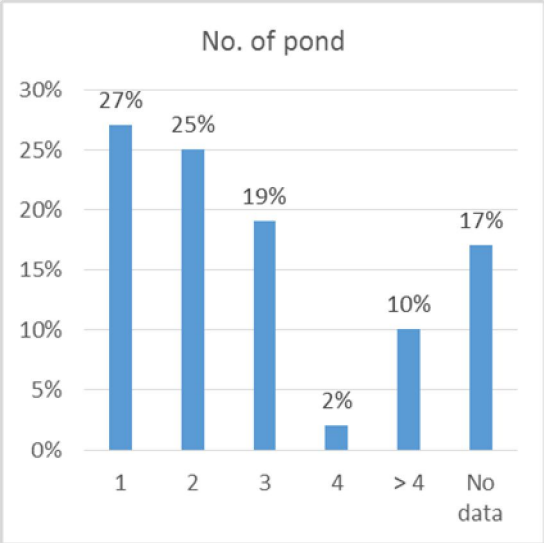



**Figure 20. Number of pond**

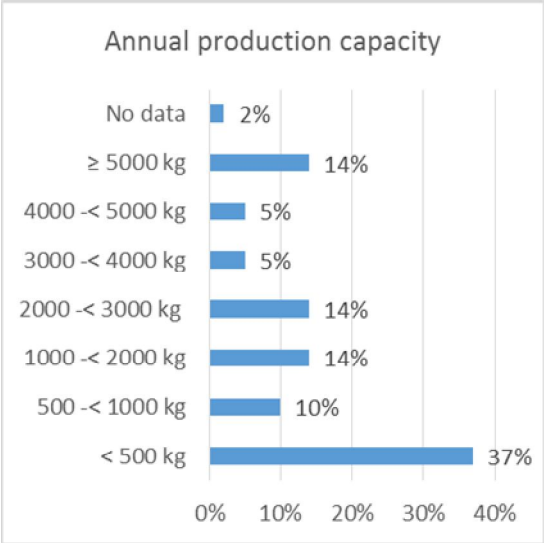



**Figure 21. Annual production capacity**

More than one fourths (27%) of farmer have only one pond and one fourths (25%) have two ponds. 19% has three ponds while 12% has more than three ponds. 17% of interviewees did not answer.

With regard to annual production capacity, more than one thirds (37%) of interviewees have annual production capacity less than 500 kg. Farms have annual production capacity from 500kg to 1000kg accounts 10%. The range from 1000kg to 2000kg and from 2000kg to 3000kg both account the same 14%. The range from 3000kg to 4000kg and from 4000kg to 5000kg account the same 5%. Farms have annual production capacity above 5000kg accounts 14%. There were interviewees could not recall his annual production capacity.

In general, for extensive culture system for black tiger shrimp, the average annual production capacity is ranged among 200kg-300kg. Farms that cultivate both black tiger shrimp and pacific white leg shrimp have annual production capacity from 500kg to 1000kg. Farms that have annual production volume above 1000kg are those cultivate shrimp in intensive system.

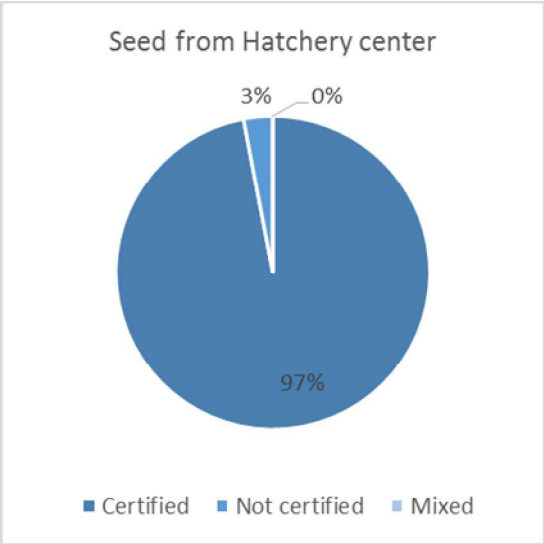



**Figure 22. Seed from hatchery center**

All of seed comes from hatchery centers, of which 97% is certified and 3% is not certified.

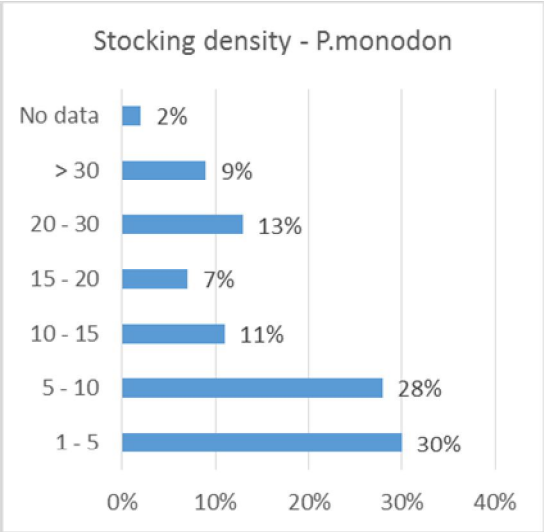



**Figure 23. Stock density for black tiger shrimp**

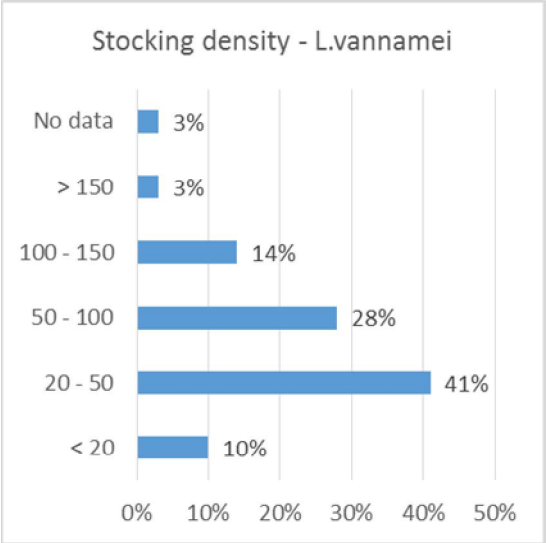



**Figure 24. Stocking density for pacific white leg shrimp**

*Regarding stocking density:*

For black tiger shrimp, stocking density from 1 to 5 Post Larvae (PL) per meter square accounts 30%. This stocking density is applied for extensive system. 28% is from 5-10 PL/m$^2$. 11% is from 10-15 PL/m$^2$. These two ranges are applied for semi-extensive system. 7% is from 15 to 20 PL/m$^2$. 13% is from 20 to 30 PL/m$^2$. Farms that stock more than 30 PL/m2 accounts 9%. In fact, farms that stock more than 15 PL/m$^2$ are usually intensive farms. There were two interviewees could not recall their stocking density. They explained they bought seeds from hatchery center and only remember the cost.

For pacific white leg shrimp, stocking density less than 20 Pl/m$^2$ accounts 10%. More than one thirds (41%) of farms stock at density from 20 to 50 PL/m$^2$. This stocking density is mostly used in semi-intensive system. Stocking density from 50 to 100 PL/m$^2$ accounts 28%. Farms stock at 100 to 150 PL/m$^2$ accounts 14%. Stocking density above 150 PL/m$^2$ accounts 3%. There was one farmers could not recall their stocking density. Intensive farms usually stock more than 50 PL/m$^2$.

Regarding cultivation facilities, 100% of interviewees cultivates shrimp in pond and only does grow out.

### *3) Feed and Feeding*

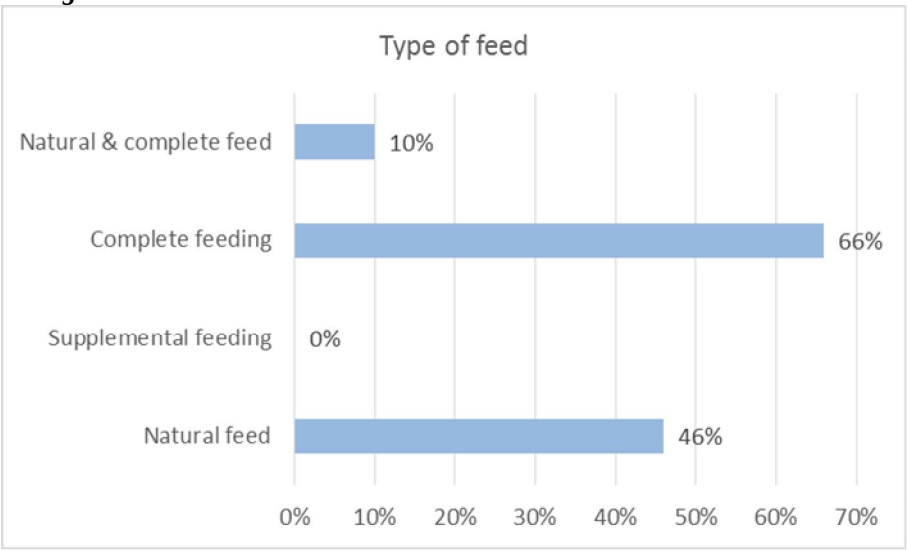



**Figure 25. Type of feed**

In general, in extensive system for black tiger shrimp, farmers only use natural feed while for intensive system for pacific white leg shrimp, they use commercial feed. Namely, 46% of the interviewees uses natural feed which includes only plankton. This type of feed is used for extensive system which located

inside mangrove forest area. Two thirds of interviewees (66%) use complete feed, of which 100% uses commercial feed. The farms which cultivate in both extensive and intensive system for black tiger shrimp and pacific white leg shrimp account 10%.

There is no on-farm feed is used, because of the fact that commercial feed has better performance than on-farm feed. And at small scale farm, farmers do not have facilities to make feed. There are only 4 farmers who use fertilizers (accounts 7% in total), of which 75% uses inorganic fertilizers and 25% uses organic fertilizers.

100% of feed is sinking feed and produced locally. Of which 100% is pelletized. Most of farmers (97%) used different type of feed (with differences on size, protein content, etc.) for several periods such as starter, grower, and finisher.

With regard to proximate composition of feed, most of farmers use feeds of companies such as C.P, UNIPRESIDENT, VIETHOA, etc. which have protein content is ranged among 36% to 42%, depending on growing periods of shrimp. And fat content is ranged among 4% to 5%.

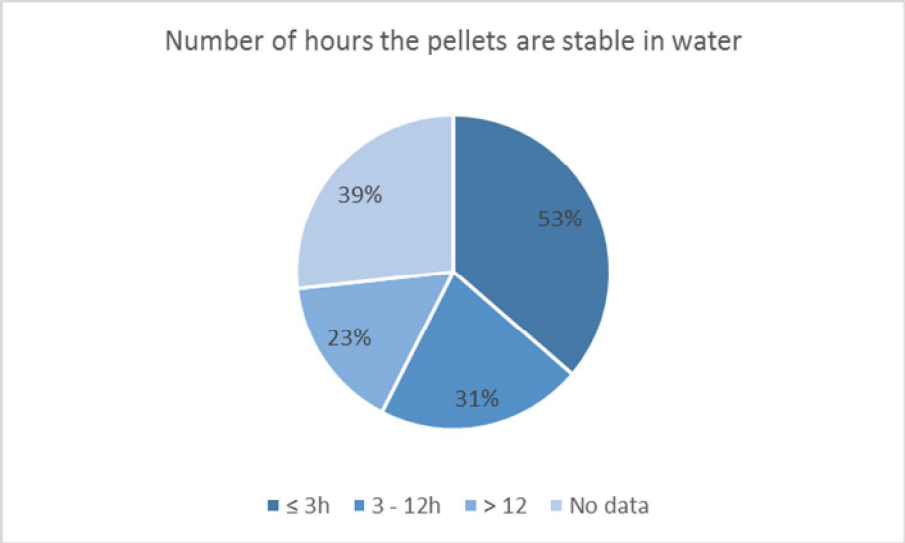



**Figure 26. Number of hours the pellets are stable in water**

Regarding number of hours the pellets are stable in water, more than a half (53%) of feed are stable shorter than three hours (average 2.57 hours). 31% are stable from three to twelve hours. And 23% is stable than 12 hours.

79% uses additives in feed. Of which, 45% uses both medicine and vitamin. 26% uses medicine, vitamin and other additives. 23% uses only vitamin while 3% only uses medicine. Bio-products and vitamin C are most used.

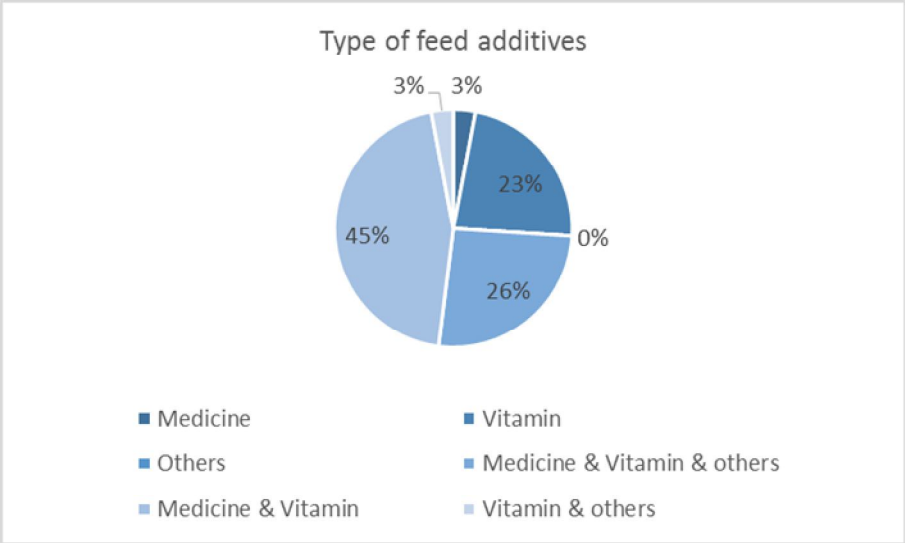



**Figure 27. Type of feed additives**

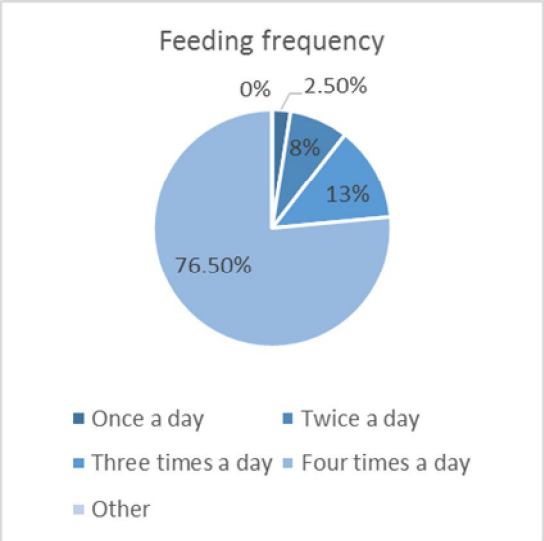



**Figure 28. Feeding frequency**

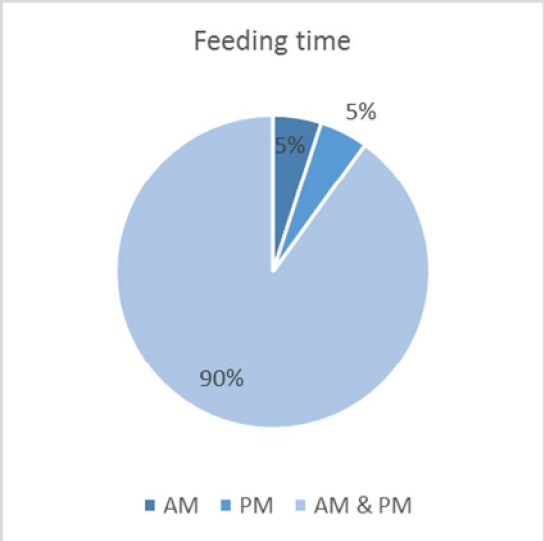



**Figure 29. Feeding time**

Most of farmers (76.5) feed four times per day. 13% feed three times per day. And 10.5% feed from one to two times per day. Regarding feeding time, most of farmers (90%) feed in AM and PM, their schedule is usually at 6:30AM & 10:30AM and 16:30PM & 21:30PM. Farmers who only feed in AM accounts 5% and farmers who only feed in PM also accounts 5%.

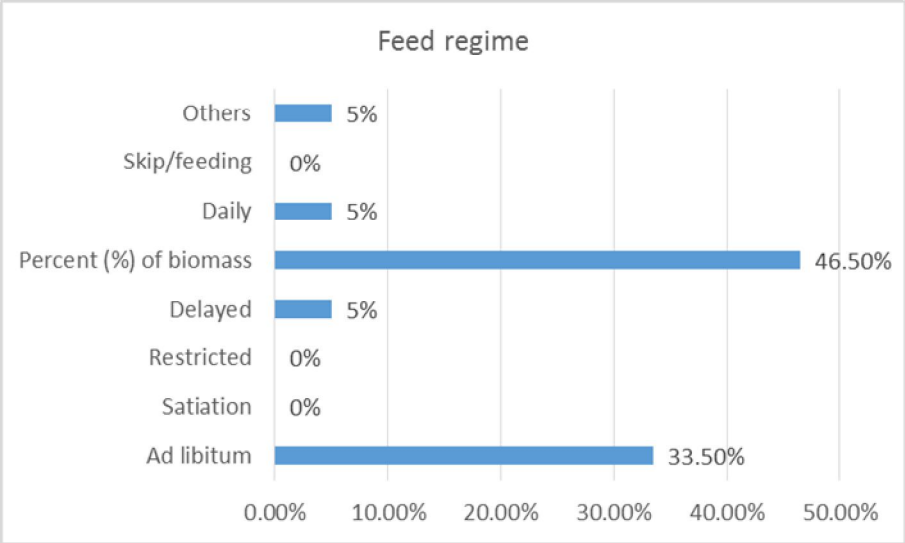



**Figure 30. Feeding regime**

With regard to feed regime, 46.5% apply feed regime based on percentage of biomass. And 33.5% apply ad libitum. Farmers apply feed regime based on satiation, delayed regime and daily regime accounts the same percentage as 5%. Restricted feeding regime and skip feeding are not applied.

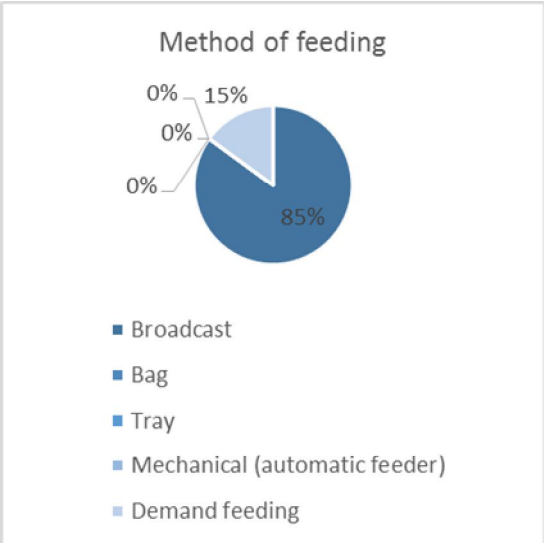



**Figure 31. Method of feeding**

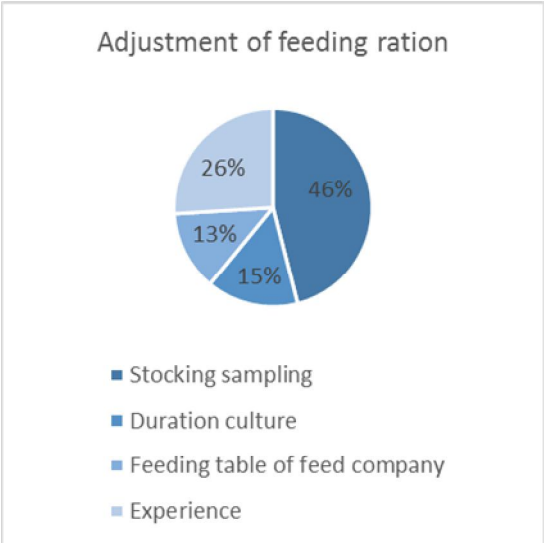



**Figure 32. Adjustment of feeding ration**

In general, most of interviewees apply broadcast feeding method (85%) while 15% apply demand feeding method. The adjustment of feeding ration is mostly based on stock sampling which accounts 46%. 15% adjusts feeding ration based on duration of culture. 13% are following feeding table of feed company and around one fourths (26%) adjusts feeding ration based on their experience.

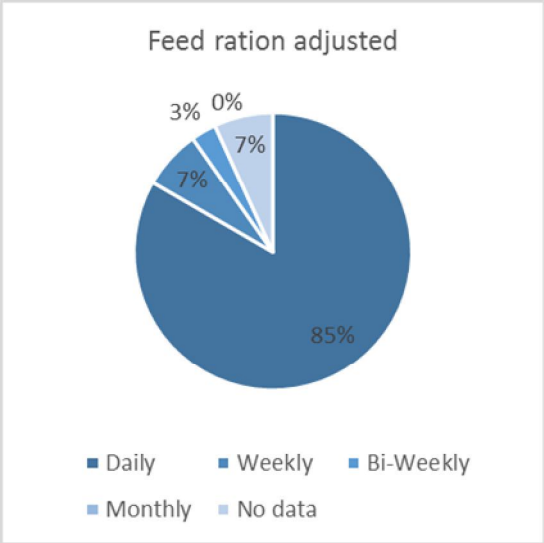



**Figure 33. Feed ration adjustment**

Feed ration is mostly adjusted daily (85%). Some farmers adjust it weekly (7%) and very few farmers (3%) adjust it bi-weekly. There were 8% could not give the answer because they are not in charge of feeding at farm.

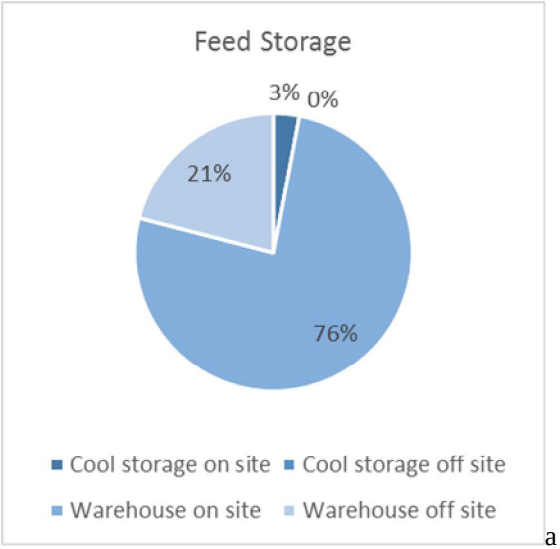



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**Figure 34. Feed storage**

Regarding feed storage, around three fourths (76%) of interviewees stores feed in warehouse onsite. And 21% stores at warehouse offsite. There is only 3% stores feed in cool storage on site. These farmers are also middlemen who supply feed for other members. So that they have better storage facilities.

Feed is normally stored within one week (74%). There is only one farmer who stores feed around a month. Nearly one fourths (23%) of farmers could not recall how long they store feed at the warehouse.

At the warehouse, there is 39% applies pest control, such as net, mesh, trap while 61% does not apply any manner of pest control.

## *4) Production parameters*

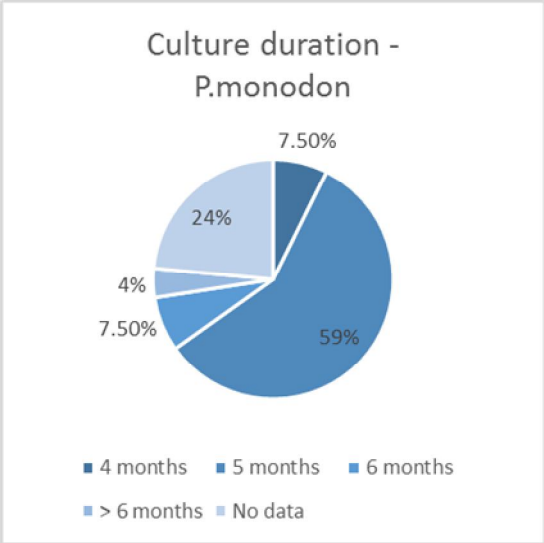


**Figure 35. Culture duration – black tiger shrimp**

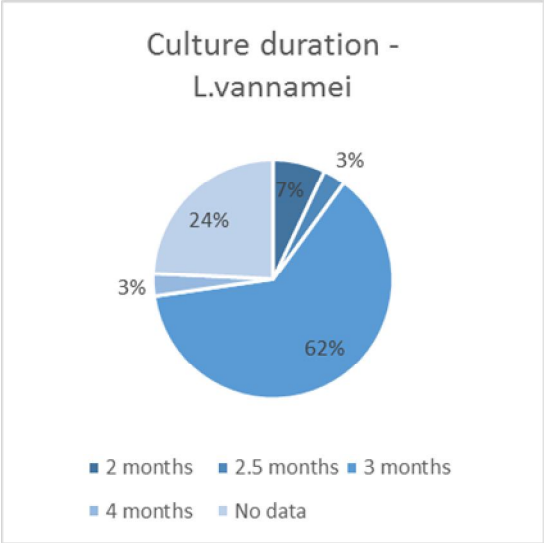


**Figure 36. Culture duration – L.vannamei**

With regard to culture duration, for black tiger shrimp, more than a half (59%) of interviewees cultivates shrimp during five months. 7.5% cultivates during four month and 7.5% does during six months. There is 4% which cultivates longer than six months. There are some farmers (24%) who cultivate black tiger shrimp in extensive scale in mangrove forest could not recall their culture duration. They answered they stock shrimp continuously every month and harvest every month. In fact, a crop of black tiger shrimp lasts from four to five months. Depending on the size of shrimp that the farmers want to get, the culture duration can be shorter or longer.

For pacific white leg shrimp, 62% cultivates shrimp during three months. 7% does in two months. 3% farms during two and a half of months, and 3% cultivates during four months. Similarly as the case of black tiger shrimp, there are some farmers who cultivate pacific white leg shrimp in semi-extensive system could not recall their culture duration.

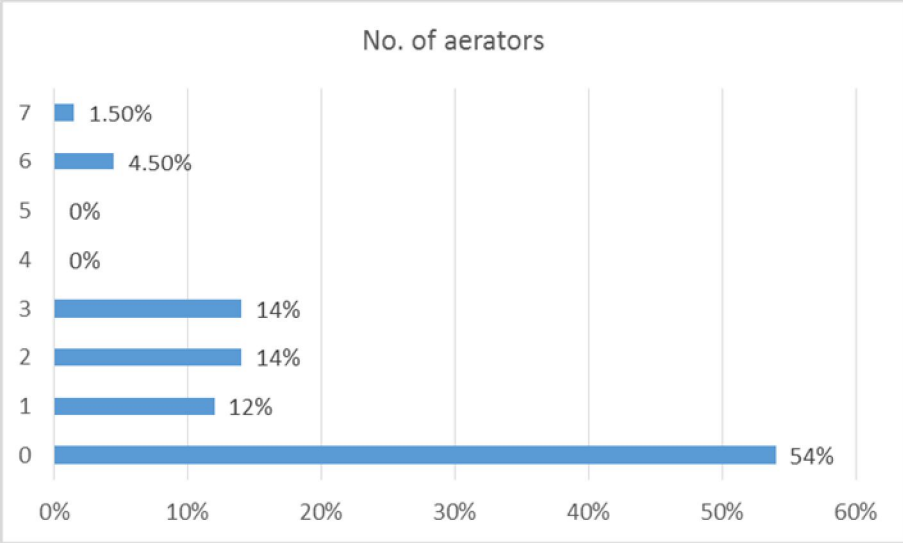


**Figure 37. No. of aerators**

In general, aerators is used in intensive shrimp pond. 54% does not use aerator because their shrimp are extensive and semi-extensive system. 12% has only one aerator. They are who only have one pond. 14% has two aerators and 14% have three aerators. There are three farm (4.5%) which have six aerators and one farm have seven aerators.

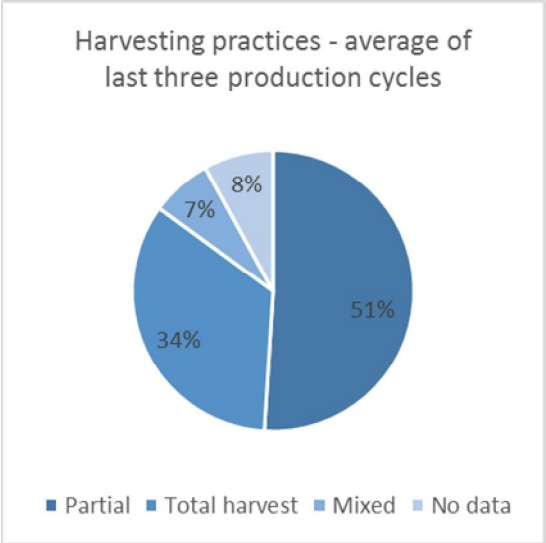


**Figure 38. Harvesting practices – Average of last three production cycles**

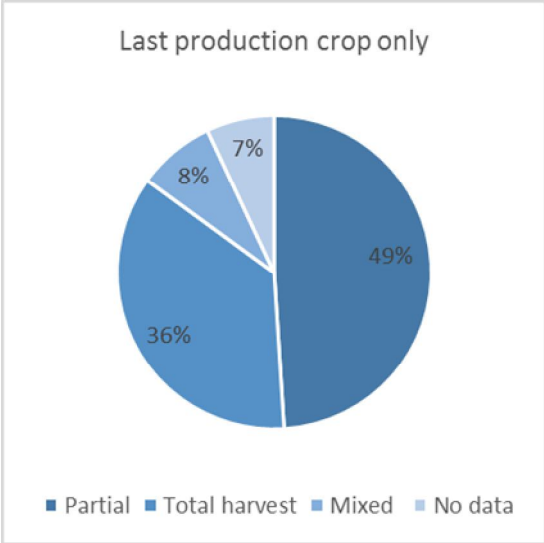


**Figure 39. Harvesting practices – Last production crop only**

At last production crop, 49% harvested partially. 36% did total harvest. 8% did both partial harvest and total harvest. For the last three production cycle, around a half of interviewees (51%) harvested partially. 34% did total harvest and 7% did mixed harvest.

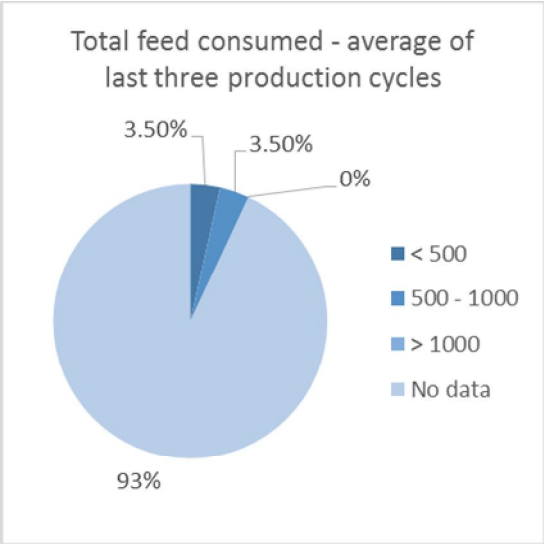


**Figure 40. Total feed consumed – average of last three production cycles**

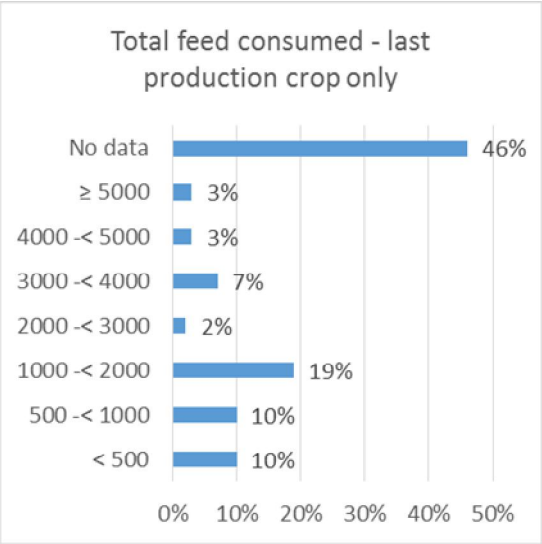


**Figure 41. Total feed consumed – last production crop only**

At last production crop, 10% used less than 500kg of feed per one crop. 10% used among 500 to 1000 kg. 19% used from 1000 to 2000kg. 15% used more than 2000kg of feed. And 46% did not use feed as they cultivate shrimp by natural food.

For last three production cycle, most of farmers (93%) could not remember the amount of feed they used because they did not record. Few farmers (3.5%) used less than 500kg and other farmers (3.5%) used from 500 to 1000kg.

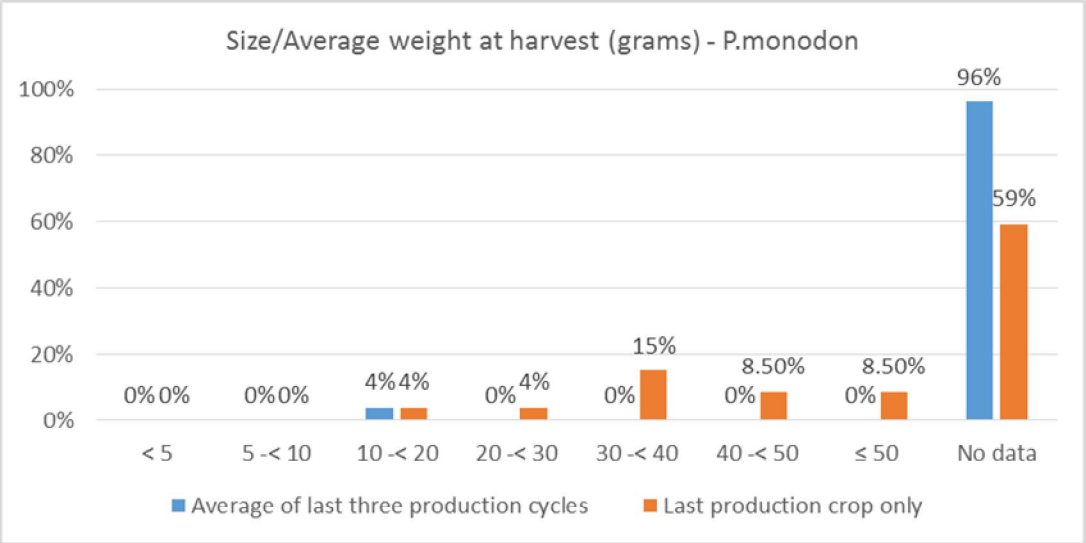


**Figure 42. Size/average weight at harvest – black tiger shrimp**

Regarding size of shrimp at harvest:

*For black tiger shrimp*

At the last production crop, 15% harvested when shrimp reached weight among 30 to 40 grams. 8.5% harvested shrimp at 40 to 50 grams and 8.5% harvested at above 50 grams. 8% harvested shrimp at less than 30 grams. 59% of interviewees only measured size of shrimp by number of shrimp per kilogram. For the last three production cycles, most of farmers (96%) could not recall size of shrimp at harvest. 4% harvested at from 10 to 20 grams.

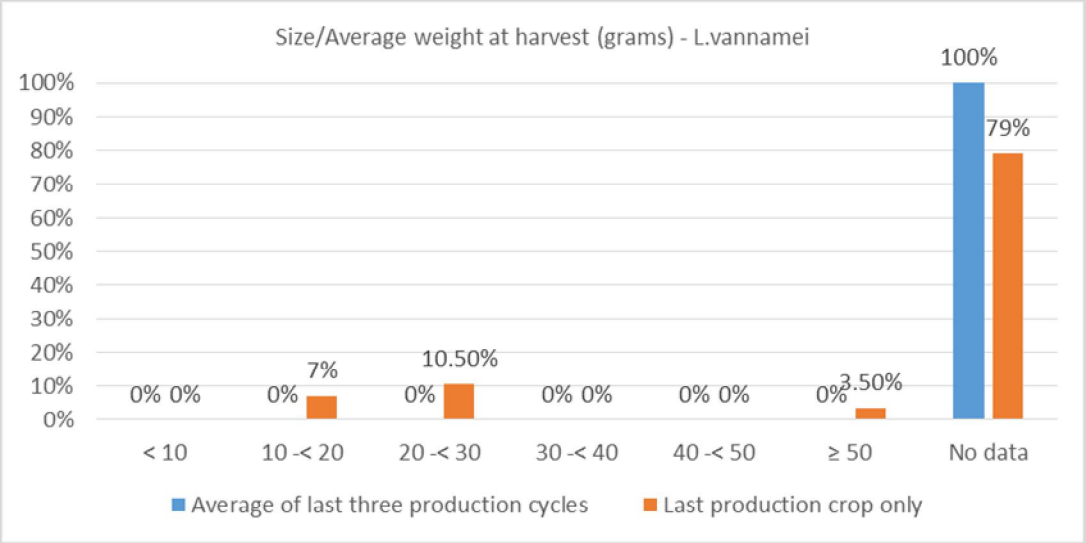


**Figure 43. Size/average weight at harvest – pacific white leg shrimp**

*For pacific white leg shrimp*

At last production crop, 10.5% harvested shrimp at weight of 20 to 30 grams. 7% harvested at from 10 to 20 grams. There is only 3% which harvested at weight above 50 grams. Similarly in the case of black tiger shrimp, farmers used to measure size of shrimp by number of shrimp, therefore 79% of interviewees was not able to answer.

*Regarding number of shrimp per kilogram:*

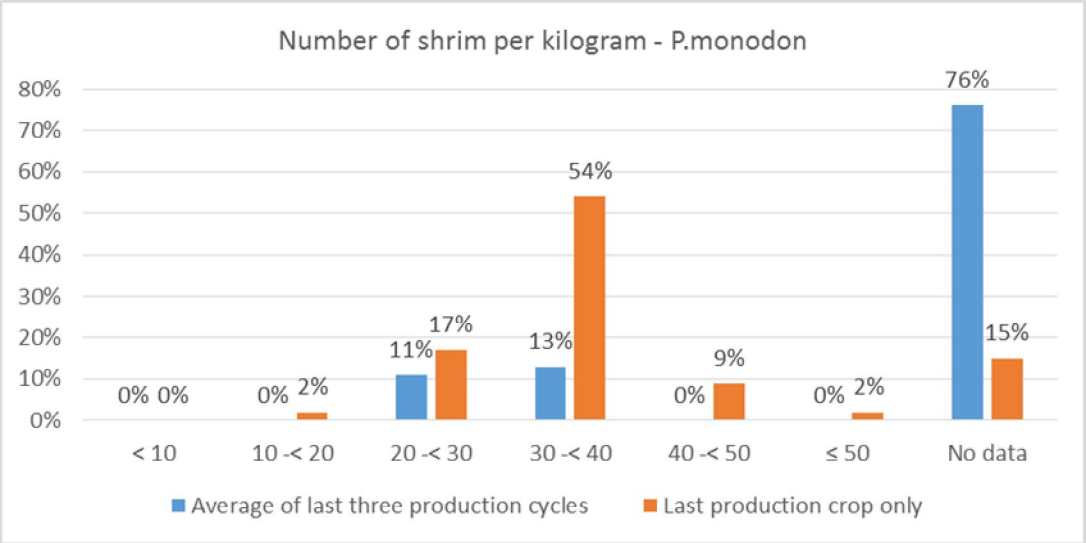


**Figure 44. Number of shrimp per kilogram – black tiger shrimp**

*For black tiger shrimp*

At the last production crop, 54% of shrimp harvested was in range of 30 to 40 shrimps per kilogram. 17% was at 20 to 30. 9% was at 40 to 50. For the last three production cycles, 13% was at 30-40 and 11% was at 20 to 30. 76% of interviewees was not able to remember the size of harvested shrimp.

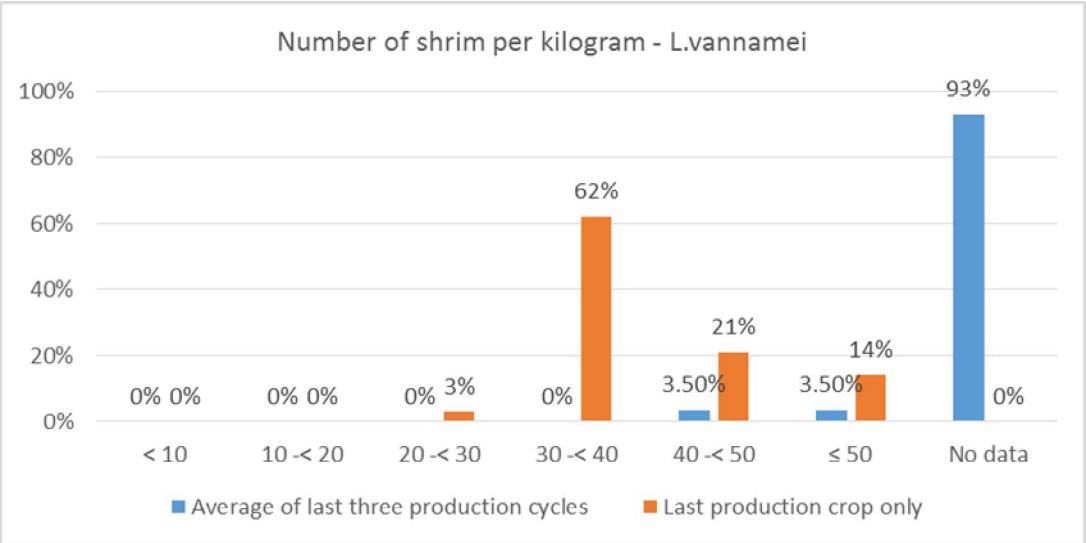


**Figure 45. Number of shrimp per kilogram – pacific white leg shrimp**

*For pacific white leg shrimp*

At the last production crop, 62% of shrimp harvested was in range of 50 to 80 shrimps per kilogram. 21% was in range of 80 to 100 and 14% was at size of over 100 shrimp per kilogram. There is 3% was in range of 30 to 50. For the last three production cycles, 93% of interviewees was not able to recall. 3.5% harvested at size of 80 to 100 shrimp per kilogram and 3.5% harvested at size or more than 100 shrimp per kilogram.

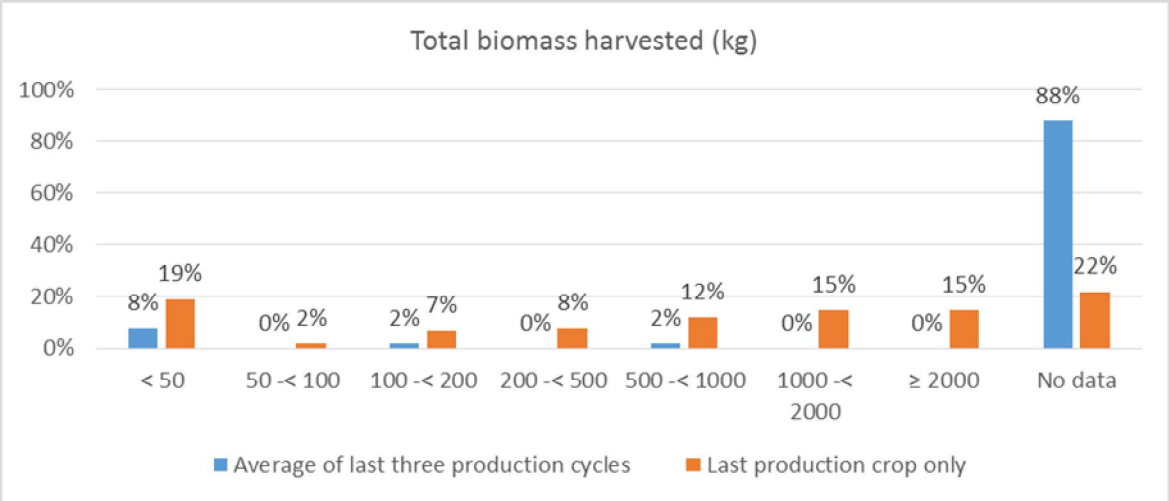


**Figure 46. Total biomass harvested**

For the last production crop, 19% of farmers harvested less than 50kg. 15% harvested from 1000 to 2000kg and 15% harvested more than 2000 kg. 12% harvested from 500 to 1000kg. 8% harvested from 200 to 500kg while 7% harvested from 100 to 200kg. There is only 2% which harvested from 50 to 100kg. 22% of interviewees was not able to recall because they only remember the amount they harvested and sold by value.

For the last three production cycles, 88% of interviewees was not able to recall. 8% harvested less than 50kg, 2% harvested in range of 100 to 200kg, and 2% harvested from 500 to 1000kg.

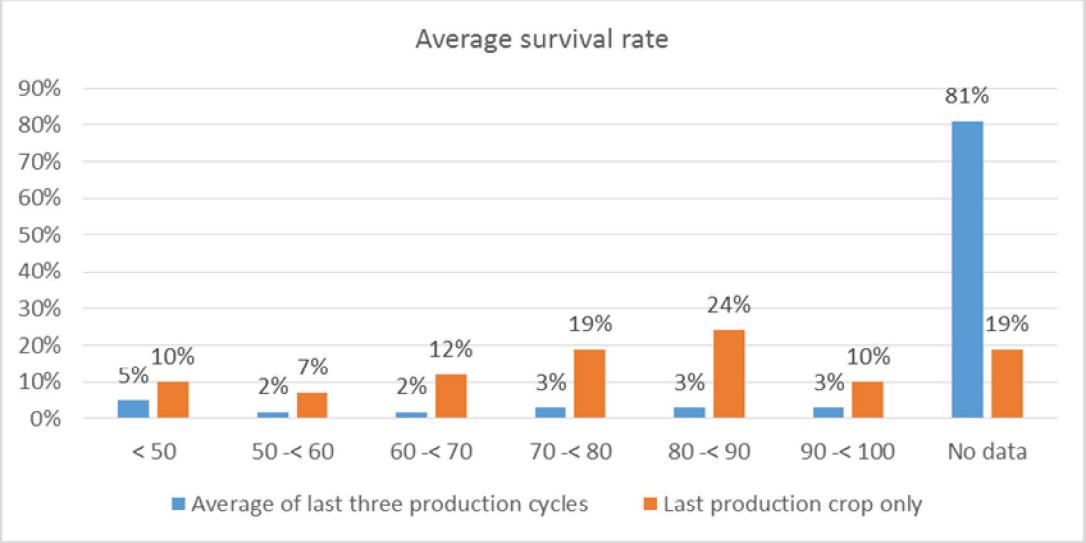


**Figure 47. Average survival rate**

For the last production crop, 24% of interviewees maintained survival rate in range of 80 to 90 percent while 10% maintained it in range of 90 to 100 percent. 19% maintained from 70 to 80% percent. 12% maintained from 60 to 70 percent. 7% maintained from 60 to 70 percent. There is 10% of interviewees had survival rate less than 50 percent. In fact, with black tiger shrimp in extensive system, maintaining survival rate higher 50 percent is considered as successful, while for pacific white leg shrimp, survival rate should be higher than 80 percent.

For the last three production crops, 81% could not recall the survival rate. 3% maintained in range of 90 to 100 percent. 3% maintained from 80 to 90 percent. Another 3% maintained from 70 to 80 percent. 9% has survival rate less than 70%.

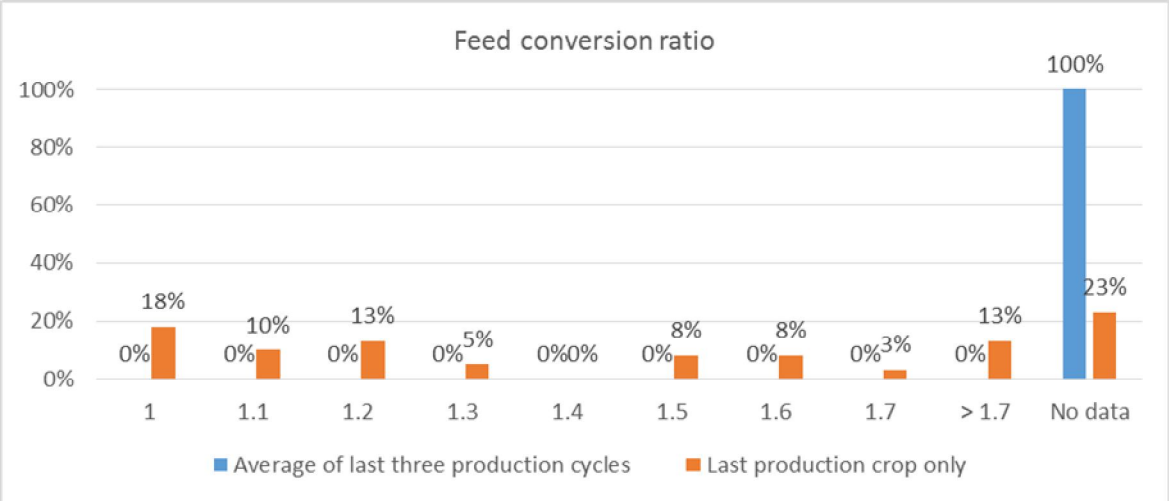


**Figure 48. Feed conversion ration**

Regarding FCR, at the last production crop, 41% maintained FCR not higher than 1.2. While 13% maintained FCR in range of 1.3 to 1.5. 11% maintained FCR in range of 1.6 to 1.7. 13% has FCR higher than 1.7. 23% was not able to recall their FCR.

For the last three production crop, 100% of interviewees was not able to recall the average FCR. Because they don't used to measure FCR as well as record data about feed consumed.

In general, for black tiger shrimp, FCR should not be higher than 1.7 and for pacific white leg shrimp, it should not be higher than 1.4. In fact, the most of interviewees have maintained good FCR.

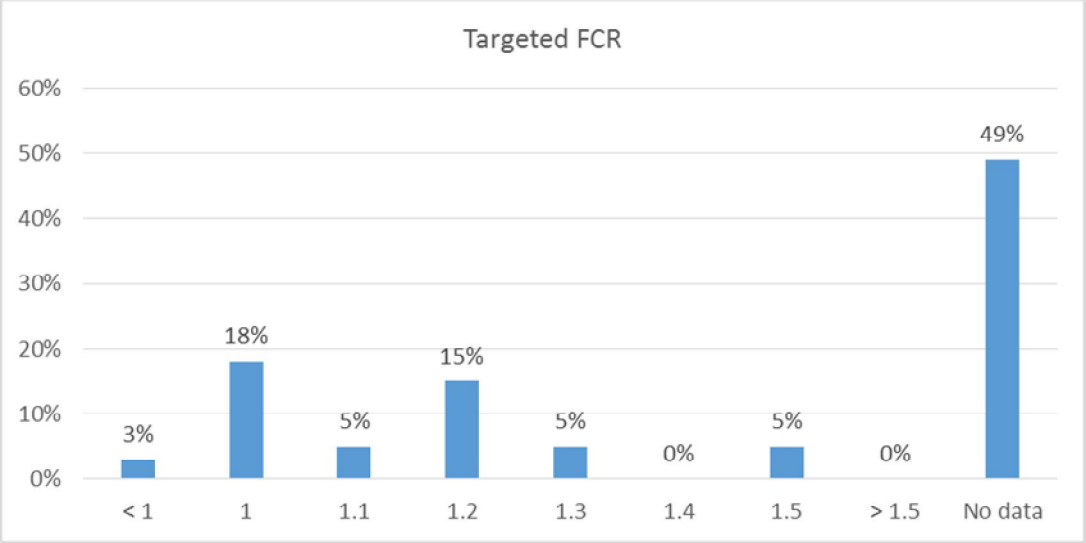


**Figure 49. Targeted FCR**

18% of interviewees targets to keep FCR at 1. While 20% wants to keep it in range of 1.1 to 1.2. 10% target to maintain FCR in range of 1.3 to 1.5. 3% wants to have FCR below 1. 49% of interviewees does have targeted FCR and was not able to give an assumption. Most of them want to maintain current FCR.

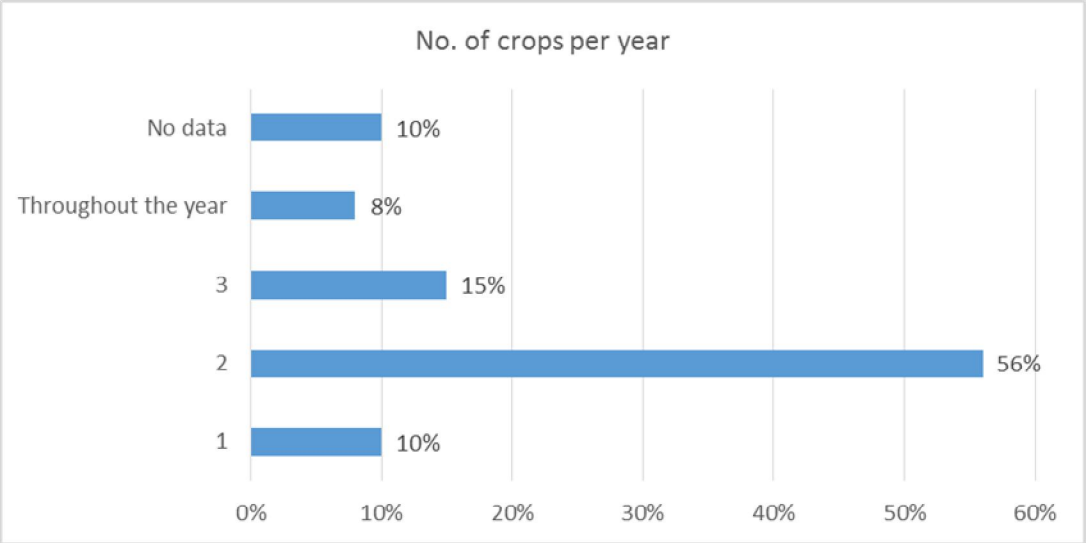


**Figure 50. No of crops per year**

Around a half of interviewees (56%) farm two crops per year. 15% does three crops and 10% does only one crop. 8% said they stock throughout the year and was not able to count how many crops were done. 10% said they do not know.

*Feed-related problem:* Most of farmers said they don't have any problem on feed, particularly on quality. Several farmers said the price of feed is raising gradually in the last previous year.

### *5) Environmental Monitoring*

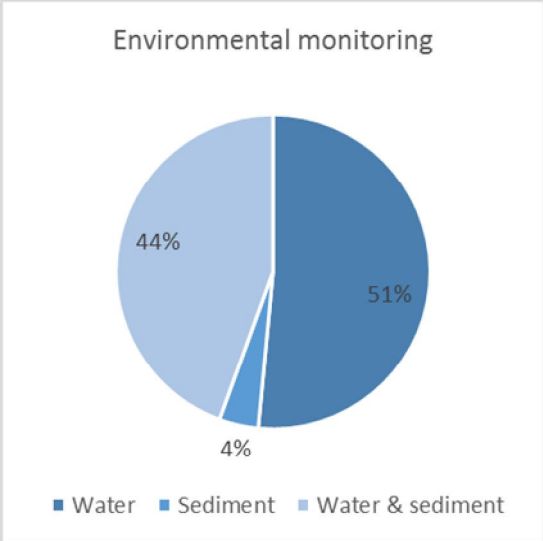


**Figure 51. Environmental Monitoring**

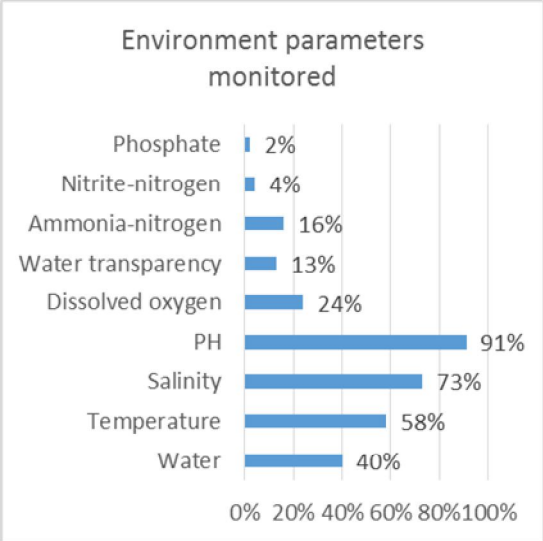


**Figure 52. Environment parameters monitored**

Most of interviewees practiced environmental monitoring of which 51% measures both water and sediment, 44% measures only water and 4% measures only sediment. Regarding environment parameters, PH is most monitored (91%) while sanity is the second most monitored parameter (73%). Besides, temperature and water are also often measured. Parameters such as phosphate, nitrogenous, and dissolved oxygen are less measured. Because most of farmers don't have equipment.

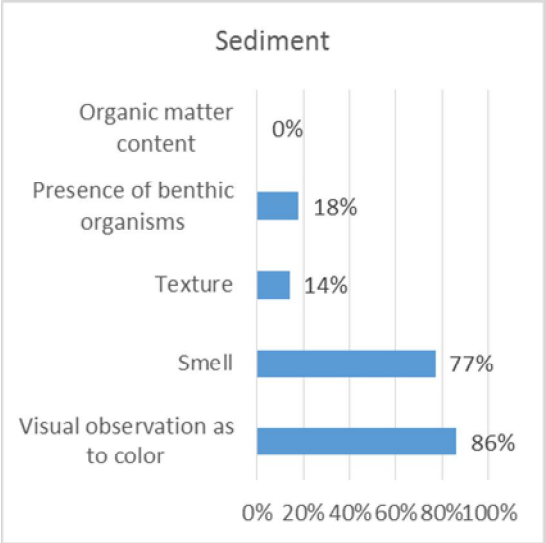


**Figure 53. Sediment**

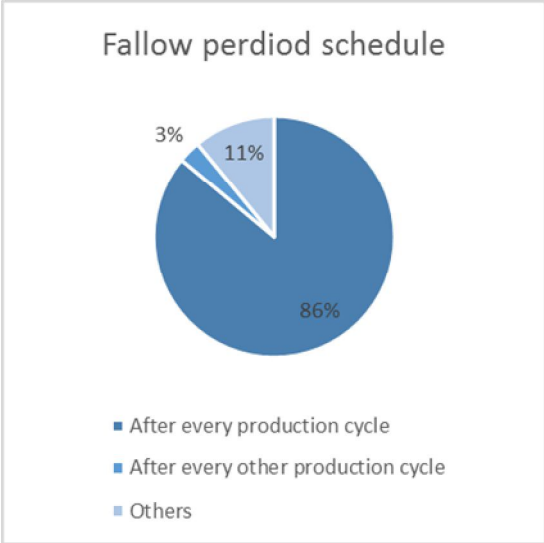


**Figure 54. Fallow period schedule**

Regarding sediment, 86% evaluates sediment through visual observation as to color while 77% evaluate it via smell. A small part of interviewees (14%) measure sediment's texture. 18% measures the presence of benthic organisms. Most of analysis are done on farm.

Nearly two thirds of interviewees (63%) apply fallow period, of which 86% apply fallow period after every production cycle, while 3% apply after every other productions cycle. 11% applies fallow period in specific time.

*Pond preparation scheme*

All of farmers apply pond preparation scheme, of which for extensive system, the scheme includes: discharge water - dredge sludge - dry sludge - take water in from sea/river. For intensive system, the scheme includes: discharge water - dredge sludge - dry pond – liming - pump water in - water treatment with chemicals and bio-products.

**Disease management practices**

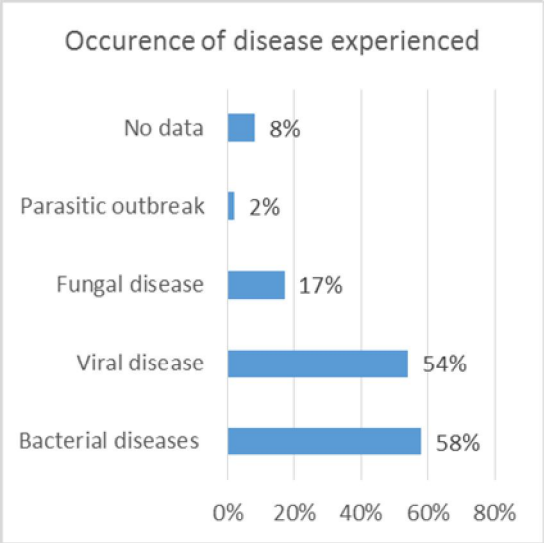


**Figure 55. Occurrence of disease experienced**

Regarding diseases which have been occurred, 58% is bacterial disease, 54% is viral disease, 17% is fungal disease and 2% is parasitic outbreaks. 8% of interviewees was not able to identify the disease have occurred in their farms. Some of them said their farms have never got any disease.

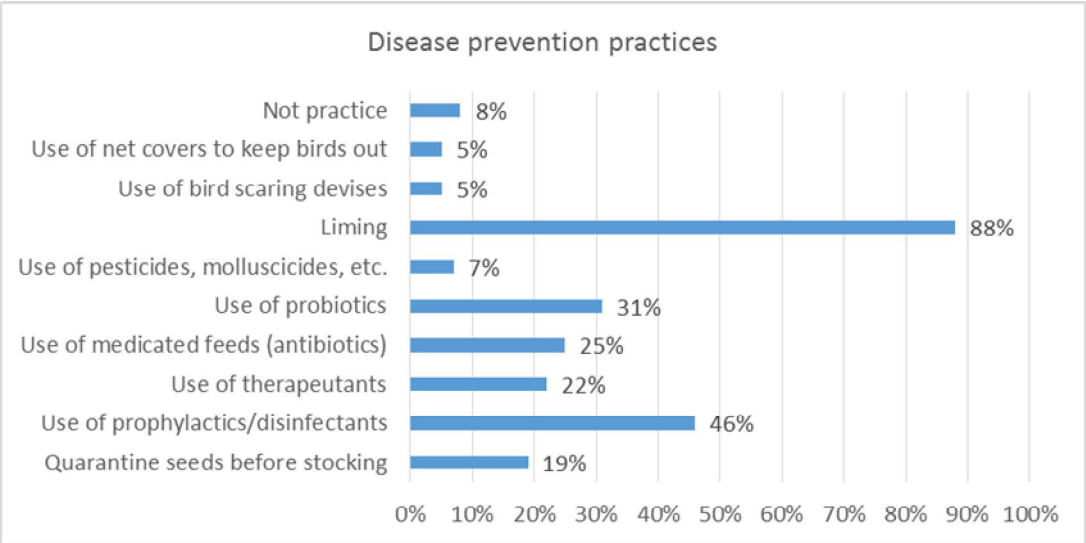


**Figure 56. Disease prevention practices**

The most often practice to prevent disease is liming which accounts 88%. Use of prophylactics and disinfectants are also often applied (46%). 31% uses probiotics. 19% apply quarantine of seeds before stocking. There are several prevention practices which are less often applied such as use of pesticides, molluscicides (7%), use of bird scaring devices (5%), and use of net covers (5%). There is 8% which do not apply any disease prevention practices.

90% of disease diagnosis are conducted on farm which basically through visual observation of abnormal behavior of shrimps as well as by experiences, rather than based on environmental parameters.

Regarding recording at farm, two thirds of interviewees (66%) do recording however 59% update frequently.

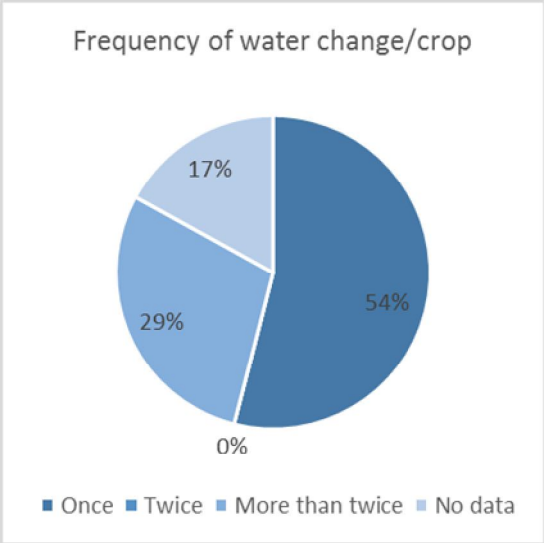


**Figure 57. Frequency of water change/crop**

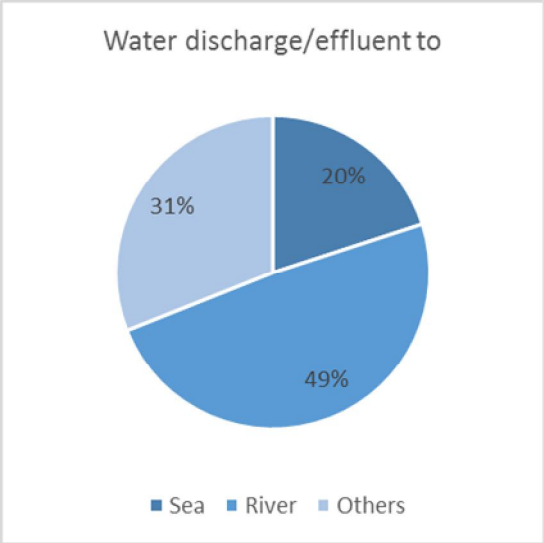


**Figure 58. Water discharge/effluent to**

59% take water from river through pumping, and 47% take water direct from the sea. 54% only change water one time, at the beginning of the stock. 29% change water more than twice per crops.

49% discharge water to the sea, and 31% discharge to river, while 20% discharge into water treatment pond before discharging to channels or rivers.

44% of shrimp farms are surrounded by mangrove forest.

## 2. Questionnaire

**Assessment of Aquaculture Feed Management Practices**
**QUESTIONAIRE**

**Personal Information**

*Please fill in the blank or mark X in one of the most appropriate answers*

1. Name: ……
2. Age: ……
3. Gender: a. Male …… b. Female ……..
4. Your Involvement in farm:
   a. Owner …….. b. Manager……. C. Owner & Manager……
   d. Technician ……. e. Caretaker……..
5. Length of involvement in operations (years): ……..
6. Number of technician(s): ……..
7. Number of caretaker(s): ……
8. If owner is also the manager or technician
   Educational background of owner:
   a. college graduate …….
   b. high school graduate …….
   c. others (specify) ……
9. Owner's experience working in aquaculture:
   a. less than 1 year ……
   b. up to 5 years ……
   c. up to 10 years ……
   d. more than 10 years ……
10. If owner is different from Technician, then Technician's educational background:
    a. college graduate ……
    b. high school graduate ……
    c. other (specify) ……
11. If owner is different from Technician, then Technician's experience in aquaculture :
    a. less than 1 year ……
    b. up to 5 years ……
    c. up to 10 years ……
    d. more than 10 years ……
12. Caretaker's experience:
    a. less than 1 year ……
    b. up to 5 years ……
    c. up to 10 years ……
    d. more than 10 years ……
13. Are you getting technical assistance? _____ Yes _____ No
    If yes, from whom? _____ Consultant
    _____ Local Fisheries/aquaculture agency
    _____ Other farmers
    _____ Other ……
14. Have you availed of formal training? _____ Yes _____ No
    If yes, indicate which training _____
15. Are you a member of an organized farmers group? _____ Yes _____ No
    If yes, indicate the name of the organization _____

**Technical Information:**

16. Species cultured (please indicate X in one or more of the appropriate answer(s):
    Monoculture
    a. Milkfish …….
    b. Tilapia …….
    c. P. monodon……..
    d. L. vannamei……..
    Polyculture: please indicate what species
    a. ……
    b. ……
    c. ……...
17. Culture system: a. extensive …….. b. semi-intensive …… c. intensive…….
18. Culture Environment: a. Freshwater …….. b. Brackishwater …… c. Seawater…….
19. Culture facilities: a. tanks …….. b. ponds…… c. pens…… d. cages …….
    e. cages in ponds ……..

20. Farm size (please indicate number or amount as appropriate):
    a. tanks:
        i. number of tanks ……..
        ii. total volume (cubic meters) ……..
        iii. annual production capacity (Kgs or ton)……..
    b. ponds:
        i. total area (hectares) ……
        ii. depth of ponds (meters) ……
        iii. number of ponds ……
        iv. annual production capacity (Kgs or ton)……
    c. cages in ponds:
        i. total pond area used (hectares) ……
        ii. number of cages/hectare ……
        iii. annual production capacity(Kgs or ton)……
    d. Pens:
        i. area of pens (sqm/hectares) ……
        ii. total number of pens ……
        iii. total area of pens (sqm) ……
        iv. annual production capacity (Kgs or ton)……
    e. cages:
        i. total number of cages …….....
        ii. size of cages (Meters) …….....
        iii. total volume (Cubic Meters) …….....
        iv. annual production capacity (Kgs or ton)…….....
21. Source of seeds (Please indicate X in the most appropriate answer):
    a. Wild ……..
    b. Hatchery - i. certified ……..… ii. not certified……..… iii. Mixed…….…….
22. Stocking density (number/sq meter):
    a. Nursery in:
        i. tanks …… ii. Ponds …… iii pens…… iv. cages…….
        v. Cages in ponds ……..…
    b. Grow-out in:
        i. tanks …… ii. Ponds …….…… iii pens…… iv. cages…….
        v. Cages in ponds ……..…
    c. Brood stock in:
        i. tanks …… ii. Ponds …….…… iii pens…… iv. cages…….
        v. Cages in ponds ……..…

**Feeds and Feeding**

23. Feeding:
    a. Natural food only (please indicate X in the most appropriate answers)
        i. Plankton only ……..
        ii. Mussel ……
        iii. Other ……..
    b. supplemental feeding (please indicate X in the most appropriate answers)
        i. Rice bran ……...
        ii. Chicken feed ……
        iii. Boiled corn ……
        iv. Others ……
    c. Complete feeding (fish or shrimp pellets only) Source of feeds (please indicate X in the most appropriate answers):
        i. Natural ……
        ii. On-farm ……
        iii. Commercial ……
        iv. Mixed ……

***For Natural Food Only***

24. Fertilizers used:
    a. Organic only (enumerate) ……
    b. Inorganic only (enumerate) ……
    c. mixed (enumerate) ……
    d. Describe fertilization scheme:
    ……
    ……
    ……

***25. For On-farm Feed*** *(Please write the answer)*

***a.*** Protein source(s): ……..

***b.*** Oil source(s): ……..

***c.*** Binder(s) used: ……..
***d.*** Additive(s): ……
***e.*** Types of feedstuffs/raw materials used:
***i.*** live (please indicate) ……
***ii.*** fresh (please indicate) ……
***iii.*** frozen (please indicate) ……
***iv.*** Source of ingredients (please indicate X in the most appropriate answers):
***1.*** Local …….
***2.*** Imported…….
***3.*** Mixed …….

***26.*** Feed preparation procedure:
Methods of feedstuff processing (please indicate X in the most appropriate answers):
a. soaking ……..
b. heating and cooking ……..
c. de-hulling ……..
d. grinding ……
e. sieving (indicate size of sieve used) …….
f. None ……

27. Methods of feed preparation:
a. weighing ……
b. mixing ……
c. pelletizing (indicate equipment used) …….....
d. steaming ……
e. air-drying …….....
f. oven-drying …….....
g. sun-drying …….....
h. pellet crumbling …….....
i. bagging …….....
j. others …….....

28. Proximate analysis of feed done: a. Yes…… b. No……
29. Other chemical analysis done (please indicate):
a. For own farm's use - yes ……..
b. For sale to others - yes …….
30. Number of hours the pellets are stable in water:
……
……
31. ***For Commercial Feeds you use:*** (please indicate X in the most appropriate answer)
a. Feed characteristics:
i. Floater …….
ii. slow-sinking …….
iii. Sinking …….
b. Source:
i. Local ……..
ii. Imported ……..
c. Form:
i. Extruded ……..
ii. Pelletized ……
d. Type:
i. Single type only …….
ii. phased feed: (starter, grower, finisher) …….
32. Proximate composition of feed: (please write the answer)
a. crude protein content (please give range) ……
b. crude fat content (please give range) ……
c. other relevant information
……
……
33. Number of hours the pellets are stable in water:
……
34. Additives coated to feeds before feeding:
a. Yes…….. b. No……..
35. If yes, what additive type? (Please write the answer)
a. Medicine ……
b. Vitamins ……
c. Others (please specify) ……
36. Feeding frequency: (please indicate X in the most appropriate answer)
a. once a day ……..

b. twice a day ……..
c. three times a day ……
d. four times day ……
e. other (specify) ……..

37. Feeding time: (Please indicate time)
a. AM …… b. PM…… c. AM & PM…….
38. Feeding regime:
a. Ad libitum ……
b. Satiation ……
c. Restricted ……
d. Delayed ……
e. Percent (%) of biomass……..
f. Daily ……
g. Skip/feeding ……
h. Others (specify; or if a combination of the above, please indicate which ones)
……
……
39. Method of feeding: (please indicate X in the most appropriate answers)
a. Broadcast ……
b. Bag ……
c. Tray ……
d. Mechanical (automatic feeder) ……
e. Demand feeding ……
40. Adjustment of feeding ration based on:(Please write the answer)
a. stock sampling (average biomass) ……
b. duration of culture ……
c. feeding table of feed company ……
d. experience ……
41. Feed ration adjusted:
a. Daily ……..
b. Weekly ……..
c. bi-weekly ……..
d. monthly ……..
42. Feed storage: (please indicate X in the most appropriate answers)
a. Cold storage on site……
b. Cold storage off site ……
c. Warehouse on site ……
d. Warehouse off site ……
43. Warehouse temperature: ……, do not know……...
44. Warehouse relative humidity: ……., do not know……
45. Before feeding, feeding ration protected from sun and rain
a. yes …… b. no ……
46. Duration of storage: a. weeks …… b. months……
47. Pest control: a. not practiced …….. b. practiced (specify) ……

**Production Parameters:**

48. Culture duration: (days or months) ……..
49. Use of mechanical aerators (example, paddle wheel):
a. yes (how many) …….. b. no …….
50. Harvesting practices:

| | Average of Last three production Cycles | Last Production Cycle only |
|---|---|---|
| (Please complete both columns) | | |
| a. Partial | …… | …… |
| b. Total harvest | …… | …… |
| c. Mixed | …… | …… |

51. Total feeds consumed/crop (kgs) …… ……
52. Size/Average weight at harvest (grams) …… ……
53. Number of fish/shrimp per kg: …… ……
54. Total biomass harvested(kgs) …… ……
55. Survival rate (%): …… ……
56. Feed conversion ratio (FCR): …… ……
57. What is your targeted FCR? ……
58. Number of crops per year: ……
59. What feed-related problem(s) have been encountered during culture/operation:
a. Current year: ……..
b. Previous years: ……..

**Environmental monitoring**

60. Environmental monitoring practiced
    a. Yes …….……. b. No……..:
61. If yes to answer 57, what areas do you practice it in (please X the appropriate answers)
    a. Water ……
    b. Sediment ……
    c. both water and sediment ……
62. Environmental parameters monitored in (please X appropriate answers):
    a. Water: ……
    b. Temperature ……
    c. salinity ……
    d. pH ……
    e. dissolved oxygen ……
    f. water transparency ……
    g. ammonia-nitrogen ……
    h. nitrite-nitrogen ……
    i. phosphate ……
63. Sediment:
    a. visual observation as to color ……
    b. smell ……
    c. texture ……
    d. presence of benthic organisms ……
    e. organic matter content ……
64. Analysis done:
    a. on-farm:…….. b. service labs …….. c. commercial labs……..
65. Fallow period:
    a. Practiced ……. b. not practiced ……
66. Fallow Period Schedule:
    a. after every production cycle ……
    b. after every other production cycle ……
    c. others (specify) ……
67. Fallow Period Duration:
    a. days (specify) ……. b. weeks (specify) …….

***Disease management practices***

68. Occurrence of diseases experienced:
    a. bacterial diseases (specify)……
    b. viral diseases (specify) ……
    c. fungal diseases (specify) ……
    d. parasitic outbreaks (specify)……
69. Disease diagnosis:
    a. on farm ……..
    b. service labs ……..
    c. commercial labs ……..
70. Disease prevention practices:
    a. quarantine seeds before stocking ……
    b. use of prophylactics/disinfectants ……
    c. use of therapeutants ……
    d. use of medicated feeds (antibiotics) ……
    e. use of probiotics ……
    f. use of pesticides, molluscicides, etc. ……
    g. liming ……
    h. use of bird scaring devises ……
    i. use of net covers to keep birds out ……

***Record keeping***

71. Farm records in place: a. Yes …….. b. No ……
72. Farm records updated (current) a. updated …….. b. not updated ……..

***Others: for ponds***

73. Pond preparation scheme (describe):
……
……
……
74. Water change: a. tidal …….. b. pumping……
75. Frequency of water change/crop: …….
76. Water sources (Please indicate): a. …… b. …… c. ……
77. Water discharge/ effluents to: ……..
78. Ponds surrounded with mangrove trees/forest: a. Yes …… b. No ……

## 3. Data tables

**Table 1. Personal information of interviewees**

| | Number per total | % |
|---|---|---|
| **Gender** | | |
| Male | 5/59 | 8 |
| Female | 54/59 | 92 |
| **Age** | | |
| <20 years old | 0/59 | 0 |
| 20-40 years old | 17/59 | 29 |
| 40-60 years old | 33/59 | 56 |
| >60 years old | 9/59 | 15 |
| **Involvement in farm** | | |
| Owner | 47/59 | 79.6 |
| Manager | 0/59 | 0 |
| Owner & Manager | 7/59 | 11.8 |
| Technician | 0/59 | 0 |
| Caretaker | 5/59 | 8.6 |
| **Length of involvement in operation** | | |
| <10 years | 15/59 | 25.4 |
| ≥10 – 15 years | 30/59 | 50.8 |
| >15 years | 14/59 | 24.8 |

**Table 2. Number of technician and caretaker at shrimp farm**

| | Number per total | % |
|---|---|---|
| **No. of technician** | | |
| 0 | 52/59 | 88 |
| 1 | 6/59 | 10 |
| >1 | 1/59 | 2 |
| **No. of caretaker** | | |
| 0 | 20/59 | 34 |
| 1 | 17/59 | 29 |
| 2 | 13/59 | 22 |
| 3 | 5/59 | 8 |
| 4 | 3/59 | 5 |
| 7 | 1/59 | 2 |

**Table 3. Educational background and working experience of owner, technician, and caretaker**

| | Number per total | % |
|---|---|---|
| **Owner's educational background** | | |
| College graduate | 1/59 | 2 |
| High school graduate | 27/59 | 45 |
| Others | 31/59 | 53 |
| **Owner's working experience in aquaculture** | | |
| < 1 year | 0/59 | 0 |
| ≤ 5 years | 10/59 | 17 |
| ≤ 10 years | 11/59 | 18.5 |
| > 10 years | 36/59 | 61 |
| No data | 2/59 | 3.5 |
| **Technician's educational background** | | |
| College graduate | 0/7 | 0 |
| High school graduate | 2/7 | 28.5 |
| Others | 2/7 | 28.5 |
| No data | 3/7 | 43 |
| **Technician's working experience in aquaculture** | | |
| < 1 year | 1/7 | 14.25 |
| ≤ 5 years | 1/7 | 14.25 |
| ≤ 10 years | 0/7 | 0 |
| > 10 years | 0/7 | 0 |
| No data | 5/7 | 71.5 |

| Caretaker's working experience in aquaculture | | |
|---|---|---|
| < 1 year | 4/39 | 10 |
| ≤ 5 years | 6/39 | 15.5 |
| ≤ 10 years | 5/39 | 13 |
| > 10 years | 22/39 | 56.5 |
| No data | 2/39 | 5 |

**Table 4. Technical assistance and participation**

| | Number per total | % |
|---|---|---|
| **Getting technical assistance** | 52/59 | 88 |
| **Availed of formal training** | 20/59 | 34% |
| **Be a member of an organized farmers group** | 57/59 | 97% |

**Table 5. Type of culture and cultivated species**

| | Number per total | % |
|---|---|---|
| **Monoculture** | 47/59 | 80 |
| Milkfish | 0/59 | 0 |
| Tilapia | 0/59 | 0 |
| P.monodon | 19/47 | 40.5 |
| L.vannamei | 10/47 | 21.25 |
| P.monodon & L.vannamei | 18/47 | 38.25 |
| **Poly-culture** | 22/59 | 37 |
| Shrimp cum crap | 11/22 | 50 |
| shrimp cum fish | 4/22 | 18 |
| Shrimp cum rice | 7/22 | 32 |
| **Monoculture & Poly-culture** | 10/59 | 17 |

**Table 6. Culture system and culture environment and facilities**

| | Number per total | % |
|---|---|---|
| **Culture system** | | |
| Extensive | 39/59 | 66 |
| Semi-intensive | 3/59 | 5 |
| Intensive | 14/59 | 24 |
| Extensive & Intensive | 3/59 | 5 |
| **Culture Environment** | | |
| Freshwater | 0/59 | 0 |
| Brackish-water | 45/59 | 76 |
| Seawater | 14/59 | 24 |
| **Culture facilities** | | |
| Tank | 0/59 | 0 |
| Pond | 59/59 | 100 |
| Pen | 0/59 | 0 |
| Cage | 0/59 | 0 |
| Cage in pond | 0/59 | 0 |

**Table 7. Total area, depth of pond, number of pond**

| | Number per total | Average (ha) | % |
|---|---|---|---|
| **Total area** | | | |
| <1 ha | 13/59 | 0.52 | 22 |
| 1-<2 ha | 30/59 | 1.27 | 51 |
| 2-<3 ha | 8/59 | 2.3 | 13.5 |
| ≥3 ha | 8/59 | 4.825 | 13.5 |
| **Depth of pond** | | | |
| < 1m | 5/59 | 0.68 | 8.5 |
| 1m | 14/59 | | 24 |
| 1.2 m | 11/59 | | 18.5 |
| 1.3 m | 1/59 | | 1.5 |
| 1.4 m | 3/59 | | 5 |
| 1.5 m | 7/59 | | 12 |
| 1.6 m | 5/59 | | 8.5 |
| > 1.6 m | 3/59 | | 5 |

| | | | |
|---|---|---|---|
| No data | 10/59 | | 17 |

**Table 8. Annual production capacity**

| Number of pond | Number per total | Average (ha) | % |
|---|---|---|---|
| 1 | 16/59 | | 27 |
| 2 | 15/59 | | 25 |
| 3 | 11/59 | | 19 |
| 4 | 1/59 | | 2 |
| > 4 | 6/59 | | 10 |
| No data | 10/59 | | 17 |
| **Annual production capacity** | | | |
| < 500 kg | 22/59 | 267 | 37 |
| 500 -< 1000 kg | 6/59 | 650 | 10 |
| 1000 -< 2000 kg | 8/59 | 1237.5 | 14 |
| 2000 -< 3000 kg | 8/59 | 2150 | 14 |
| 3000 -< 4000 kg | 3/59 | 3133 | 5 |
| 4000 -< 5000 kg | 3/59 | 4000 | 5 |
| ≥ 5000 kg | 8/59 | 6000 | 14 |
| No data | 1/59 | | 2 |

**Table 9. Source of seed**

| | Number per total | % |
|---|---|---|
| **Source of seeds** | | |
| Wild | 0/59 | 0 |
| Hatchery | 59/59 | 100 |
| + Certified | 57/59 | 97 |
| + Not certified | 2/59 | 3 |
| + Mixed | 0/59 | 0 |

**Table 10. Stocking Density**

| | Number per total | Average | % |
|---|---|---|---|
| **Stocking Density PL/m$^2$** | | | |
| **P.monodon** | 46/59 | | |
| 1 – 5 | 14/46 | 3.06 | 30 |
| 5 -< 10 | 13/46 | 6.3 | 28 |
| 10 -< 15 | 5/46 | 10.6 | 11 |
| 15 -< 20 | 3/46 | 15 | 7 |
| 20 -< 30 | 6/46 | 20.8 | 13 |
| ≥ 30 | 4/46 | 33.25 | 9 |
| No data | 1/46 | | 2 |
| **L.vannamei** | 29/59 | | |
| < 20 | 3/29 | 12.6 | 10 |
| 20 -< 50 | 12/29 | 29 | 41 |
| 50 -< 100 | 8/29 | 82.5 | 28 |
| 100 – 150 | 4/29 | 100 | 14 |
| > 150 | 1/29 | 200 | 3 |
| No data | 1/29 | | 3 |

**Table 11. Facilities**

| | | |
|---|---|---|
| **Nursery in** | 0/59 | 0 |
| Tank | 0 | 0 |
| Pond | 0 | 0 |
| Pen | 0 | 0 |
| Cage | 0 | 0 |
| Cage in pond | 0 | 0 |
| **Grow out in** | 59/59 | 100 |
| Tank | 0 | 0 |
| Pond | 59/59 | 100 |
| Pen | 0 | 0 |
| Cage | 0 | 0 |
| Cage in pond | 0 | 0 |
| **Brood stock in** | 0/59 | 0 |
| Tank | 0 | 0 |

| | | |
|---|---|---|
| Pond | 0 | 0 |
| Pen | 0 | 0 |
| Cage | 0 | 0 |
| Cage in pond | 0 | 0 |

**Table 12. Source of feed**

| | Number per total | % |
|---|---|---|
| **Natural feed only** | 27/59 | 46 |
| Plankton only | 27/27 | 100 |
| Mussel | 0 | 0 |
| Other | 0 | 0 |
| **Supplemental feeding** | 0/59 | 0 |
| Rice bran | 0 | 0 |
| Chicken feed | 0 | 0 |
| Boiled corn | 0 | 0 |
| Others | 0 | 0 |
| **Complete feeding** | 39/59 | 66 |
| Natural | 0/39 | 0 |
| On-farm | 0/39 | 0 |
| Commercial | 39/39 | 100 |
| Mixed | 0 | 0 |
| **Natural & complete feed** | 6/59 | 10 |

**Table 13. Fertilizers used**

| | Number per total | % |
|---|---|---|
| **Fertilizers used** | 4/59 | 7 |
| Organic only | 1/4 | 25 |
| Inorganic only | 3/4 | 75 |
| mixed | 0/4 | 0 |

**Table 14. Feed characteristics**

| | Number per total | % |
|---|---|---|
| **Feed characteristics** | | |
| Floater | 0 | 0 |
| Slow sinking | 0 | 0 |
| Sinking | 39/39 | 100 |
| **Source** | | |
| Local | 39/39 | 100 |
| Imported | 0/39 | 0 |
| **Form** | | |
| Extruded | 0/39 | 0 |
| Pelletized | 39/39 | 100 |
| **Type** | | |
| Single type only | 1/39 | 3 |
| Phased feed | 38/39 | 97 |

**Table 15. Number of hours the pellets are stable in water**

| | Number per total | Average | % |
|---|---|---|---|
| **Number of hours the pellets are stable in water** | 36/59 | | 61 |
| ≤ 3h | 19/36 | 2.57 | 53 |
| 3h< - ≤12h | 8/36 | 11.25 | 31 |
| > 12h | 9/36 | 24 | 23 |
| No data | 23/59 | | 39 |

**Table 16. Type of feed additive**

| | Number per total | % |
|---|---|---|
| **Additive coated to feed before feeding** | | |
| Yes | 31/39 | 79 |
| No | 7/39 | 21 |
| **Additive type** | | |
| Medicine | 1/31 | 3 |

| | | |
|---|---|---|
| Vitamin | 7/31 | 23 |
| Others | 0/31 | 0 |
| Medicine & Vitamin & others | 8/31 | 26 |
| Medicine & Vitamin | 14/31 | 45 |
| Vitamin & others | 1/31 | 3 |

**Table 17. Feeding frequency**

| | Number per total | % |
|---|---|---|
| **Feeding frequency** | | |
| Once a day | 1/39 | 2.5 |
| Twice a day | 3/39 | 8 |
| Three times a day | 5/39 | 13 |
| Four times a day | 30/39 | 76.5 |
| Other | 0/39 | 0 |
| **Feeding time** | | |
| AM | 2/39 | 5 |
| PM | 2/39 | 5 |
| AM & PM | 35/39 | 90 |

**Table 18. Feeding regime**

| | Number per total | % |
|---|---|---|
| **Feeding Regime** | | |
| Ad libitum | 13/39 | 33.5 |
| Satiation | 2/39 | 5 |
| Restricted | 0/39 | 0 |
| Delayed | 2/39 | 5 |
| Percent (%) of biomass | 18/39 | 46.5 |
| Daily | 2/39 | 5 |
| Skip/feeding | 0/39 | 0 |
| Others | 2/39 | 5 |

**Table 19. Method of feeding**

| | Number per total | % |
|---|---|---|
| **Method of feeding** | | |
| Broadcast | 33/39 | 85 |
| Bag | 0 | 0 |
| Tray | 0 | 0 |
| Mechanical (automatic feeder) | 0 | 0 |
| Demand feeding | 6/39 | 15 |
| **Adjustment of feeding ration based on** | | |
| Stock sampling | 18/39 | 46 |
| Duration of culture | 6/39 | 15 |
| Feeding table of feed company | 5/39 | 13 |
| Experience | 10/39 | 26 |
| **Feed ration adjusted** | | |
| Daily | 33/39 | 85 |
| Weekly | 2/39 | 7 |
| Bi-Weekly | 1/39 | 3 |
| Monthly | 0/39 | 0 |
| No data | 3/39 | 8 |

**Table 20. Feed storage**

| | Number per total | % |
|---|---|---|
| **Feed storage** | | |
| Cool storage on site | 1/39 | 3 |
| Cool storage off site | 0/39 | 0 |
| Warehouse on site | 30/39 | 76 |
| Warehouse off site | 8/39 | 21 |
| **Warehouse temperature** | | |
| Yes | 2/39 | 5 |
| No | 37/39 | 95 |
| **Warehouse relative humidity** | | |
| Yes | 0/39 | 0 |

| | | |
|---|---|---|
| No | 39/39 | 100 |
| **Before feeding, feeding ration protected from sun and rain** | | |
| Yes | 39/39 | 100 |
| No | 0 | 0 |

**Table 21. Duration of storage**

| Duration of storage | Number per total | Average | % |
|---|---|---|---|
| Week | 29/39 | 1 | 74 |
| Month | 1/39 | 1 | 3 |
| No data | 9/39 | 0 | 23 |

**Table 22. Feed storage**

| Pest control | Number per total | % |
|---|---|---|
| Yes | 23/59 | 39 |
| No | 36/59 | 61 |

**Table 23. Culture duration**

| Culture duration | Number per total | % |
|---|---|---|
| **P.monodon** | | |
| 4 months | 3/46 | 7.5 |
| 5 months | 27/46 | 59 |
| 6 months | 3/46 | 7.5 |
| > 6 months | 2/46 | 4 |
| No data | 11/46 | 24 |
| **L.vannamei** | | |
| 2 months | 2/29 | 7 |
| 2.5 months | 1/29 | 3 |
| 3 months | 18/29 | 62 |
| 4 months | 1/29 | 3 |
| No data | 7/29 | 24 |

**Table 24. Use of mechanical aerators**

| Use of mechanical aerators | Number per total | % |
|---|---|---|
| 0 | 32/59 | 54 |
| 1 | 7/59 | 12 |
| 2 | 8/59 | 14 |
| 3 | 8/59 | 14 |
| 4 | 0/59 | 0 |
| 5 | 0/59 | 0 |
| 6 | 3/59 | 4.5 |
| 7 | 1/59 | 1.5 |

**Table 25. Harvesting practices**

| Harvesting practices | Number per total | % |
|---|---|---|
| **Average of last three production cycles** | | |
| Partial | 30/59 | 51 |
| Total harvest | 20/59 | 34 |
| Mixed | 4/59 | 7 |
| No data | 5/59 | 8 |
| **Last production crop only** | | |
| Partial | 29/59 | 49 |
| Total harvest | 21/59 | 36 |
| Mixed | 5/59 | 8 |
| No data | 4/59 | 7 |

**Table 26. Total feed consumed/crop**

| Total feed consumed/crop (kgs) | Number per total | % |
|---|---|---|
| **Average of last three production cycles** | | |
| <500 | 2/59 | 3.5 |
| 500-<1000 | 2/59 | 3.5 |
| ≥1000 | 0/59 | 0 |

| | | |
|---|---|---|
| No data | 55/59 | 93 |
| **Last production crop only** | | |
| <500 | 6/59 | 10 |
| 500-<1000 | 6/59 | 10 |
| 1000-<2000 | 11/59 | 19 |
| 2000-<3000 | 1/59 | 2 |
| 3000-<4000 | 4/59 | 7 |
| 4000-<5000 | 2/59 | 3 |
| ≥5000 | 2/59 | 3 |
| No data | 27/59 | 46 |

**Table 27. Size/average weight at harvest (grams)**

| | Average of last three production cycles | | Last production cycle only | |
|---|---|---|---|---|
| **Size/Average weight at harvest (grams)** | **Number per total** | **%** | **Number per total** | **%** |
| **P.monodon** | | | | |
| <5 | 0/46 | 0 | 0/46 | 0 |
| 5-<10 | 0/46 | 0 | 0/46 | 0 |
| 10-<20 | 2/46 | 4 | 2/46 | 4 |
| 20-<30 | 0/46 | 0 | 2/46 | 4 |
| 30-<40 | 0/46 | 0 | 7/46 | 15 |
| 40-<50 | 0/46 | 0 | 4/46 | 8.5 |
| ≤50 | 0/46 | 0 | 4/46 | 8.5 |
| No data | 44/46 | 96 | 27/46 | 59 |
| **L.vannamei** | | | | |
| <10 | 0/29 | 0 | 0/29 | 0 |
| 10-<20 | 0/29 | 0 | 2/29 | 7 |
| 20-<30 | 0/29 | 0 | 3/29 | 10.5 |
| 30-<40 | 0/29 | 0 | 0/29 | 0 |
| 40-<50 | 0/29 | 0 | 0/29 | 0 |
| ≥50 | 0/29 | 0 | 1/29 | 3.5 |
| No data | 29/29 | 100 | 23/29 | 79 |

**Table 28. Number of shrimp per kilogram**

| | Average of last three production cycles | | Last production cycle only | |
|---|---|---|---|---|
| **Number of shrimp per kg** | **Number per total** | **%** | **Number per total** | **%** |
| **P.monodon** | | | | |
| <10 | 0/46 | 0 | 0/46 | 0 |
| 10-<20 | 0/46 | 0 | 1/46 | 2 |
| 20-<30 | 5/46 | 11 | 8/46 | 17 |
| 30-<40 | 6/46 | 13 | 25/46 | 54 |
| 40-<50 | 0/46 | 0 | 4/46 | 9 |
| ≤50 | 0/46 | 0 | 1/46 | 2 |
| No data | 35/46 | 76 | 7/46 | 15 |
| **L.vannamei** | | | | |
| <10 | 0/29 | 0 | 0/29 | 0 |
| 10-<30 | 0/29 | 0 | 0/29 | 0 |
| 30-<50 | 0/29 | 0 | 1/29 | 3 |
| 50-<80 | 0/29 | 0 | 18/29 | 62 |
| 80-<100 | 1/29 | 3.5 | 6/29 | 21 |
| ≥100 | 1/29 | 3.5 | 4/29 | 14 |
| No data | 27/29 | 93 | 0/29 | 0 |

**Table 29. Total biomass harvested**

| | Average of last three production cycles | | Last production cycle only | |
|---|---|---|---|---|
| **Total biomass harvested (kgs)** | **Number per total** | **%** | **Number per total** | **%** |
| <50 | 5/59 | 8 | 11/59 | 19 |
| 50-<100 | 0/59 | 0 | 1/59 | 2 |
| 100-<200 | 1/59 | 2 | 4/59 | 7 |
| 200-<500 | 0/59 | 0 | 5/59 | 8 |
| 500-<1000 | 1/59 | 2 | 7/59 | 12 |
| 1000-<2000 | 0/59 | 0 | 9/59 | 15 |
| ≥2000 | 0/59 | 0 | 9/59 | 15 |

| | | | | |
|---|---|---|---|---|
| No data | 52/59 | 88 | 13/59 | 22 |

**Table 30. Average survival rate**

| | Average of last three production cycles | | Last production cycle only | |
|---|---|---|---|---|
| **Average survival rate (%)** | **Number per total** | **%** | **Number per total** | **%** |
| <50 | 3/59 | 5 | 6/59 | 10 |
| 50-<60 | 1/59 | 2 | 4/59 | 7 |
| 60-<70 | 1/59 | 2 | 7/59 | 12 |
| 70-<80 | 2/59 | 3 | 11/59 | 19 |
| 80-<90 | 2/59 | 3 | 14/59 | 24 |
| 90-100 | 2/59 | 3 | 6/59 | 10 |
| No data | 48/59 | 81 | 11/59 | 19 |

**Table 31. Feed conversion ratio**

| | Average of last three production cycles | | Last production cycle only | |
|---|---|---|---|---|
| **Feed conversion ratio** | **Number per total** | **%** | **Number per total** | **%** |
| 1 | 0/39 | 0 | 7/39 | 18 |
| 1.1 | 0/39 | 0 | 4/39 | 10 |
| 1.2 | 0/39 | 0 | 5/39 | 13 |
| 1.3 | 0/39 | 0 | 2/39 | 5 |
| 1.4 | 0/39 | 0 | 0/39 | 0 |
| 1.5 | 0/39 | 0 | 3/39 | 8 |
| 1.6 | 0/39 | 0 | 3/39 | 8 |
| 1.7 | 0/39 | 0 | 1/39 | 3 |
| >1.7 | 0/39 | 0 | 5/39 | 13 |
| No data | 39/39 | 100 | 9/39 | 23 |

**Table 32. Targeted FCR**

| Targeted FCR | Number per total | % |
|---|---|---|
| <1 | 1/39 | 3 |
| 1 | 7/39 | 18 |
| 1.1 | 2/39 | 5 |
| 1.2 | 6/39 | 15 |
| 1.3 | 2/39 | 5 |
| 1.4 | 0/39 | 0 |
| 1.5 | 2/39 | 5 |
| >1.5 | 0/39 | 0 |
| No data | 19/39 | 49 |

**Table 33. Number of crops per year**

| Number of crops per year | Number per total | % |
|---|---|---|
| 1 | 6/59 | 10 |
| 2 | 33/59 | 56 |
| 3 | 9/59 | 15 |
| Throughout the year | 5/59 | 8 |
| No data | 6/59 | 10 |

**Table 34. Environmental monitoring practiced**

| Environmental monitoring practiced | Number per total | % |
|---|---|---|
| Yes | 45/59 | 76 |
| No | 14/59 | 24 |
| **If yes** | | |
| Water | 23/45 | 51 |
| Sediment | 2/45 | 4 |
| Both water and sediment | 20/45 | 44 |

**Table 35. Environmental parameters monitored**

| Environment parameters monitored | Number per total | % |
|---|---|---|
| Water | 18/45 | 40 |
| Temperature | 26/45 | 58 |
| Salinity | 33/45 | 73 |
| PH | 41/45 | 91 |

| | | |
|---|---|---|
| Dissolved oxygen | 11/45 | 24 |
| Water transparency | 6/45 | 13 |
| Ammonia-nitrogen | 7/45 | 16 |
| Nitrite-nitrogen | 2/45 | 4 |
| Phosphate | 1/45 | 2 |

**Table 36. Sediment**

| Sediment | Number per total | % |
|---|---|---|
| Visual observation as to color | 19/22 | 86 |
| Smell | 17/22 | 77 |
| Texture | 3/22 | 14 |
| Presence of benthic organisms | 4/22 | 18 |
| Organic matter content | 0/22 | 0 |

**Table 37. Analysis done**

| Analysis done | Number per total | % |
|---|---|---|
| On-farm | 41/59 | 69 |
| Service labs | 0/59 | 0 |
| Commercial labs | 0/59 | 0 |
| No data | 18/59 | 31 |

**Table 38. Fallow period**

| Fallow period | Number per total | % |
|---|---|---|
| Practiced | 37/59 | 63 |
| Not practiced | 22/59 | 37 |

**Table 39. Fallow period schedule**

| Fallow period schedule | Number per total | % |
|---|---|---|
| After every production cycle | 32/37 | 86 |
| After every other production cycle | 1/37 | 3 |
| Others | 4/37 | 11 |

**Table 40. Occurence of disease experienced**

| Occurrence of disease experienced | Number per total | % |
|---|---|---|
| Bacterial diseases | 34/59 | 58 |
| Viral disease | 32/59 | 54 |
| Fungal disease | 10/59 | 17 |
| Parasitic outbreaks | 1/59 | 2 |
| No data | 5/59 | 8 |

**Table 41. Disease diagnosis**

| Disease diagnosis | Number per total | % |
|---|---|---|
| On farm | 53/59 | 90 |
| Service labs | 0/59 | 0 |
| Commercial labs | 0/59 | 0 |
| No data | 6/59 | 10 |

**Table 42. Disease prevention practices**

| Disease prevention practices | Number per total | % |
|---|---|---|
| Quarantine seeds before stocking | 11/59 | 19 |
| Use of prophylactics/disinfectants | 27/59 | 46 |
| Use of therapeutants | 13/59 | 22 |
| Use of medicated feeds (antibiotics) | 15/59 | 25 |
| Use of probiotics | 18/59 | 31 |
| Use of pesticides, molluscicides, etc. | 4/59 | 7 |
| Liming | 52/59 | 88 |
| Use of bird scaring devises | 3/59 | 5 |
| Use of net covers to keep birds out | 3/59 | 5 |
| Not practice | 5/59 | 8 |

**Table 43. Farm record in place**

| Farm record in place | Number per total | % |
|---|---|---|
| Yes | 39/59 | 66 |

| | | |
|---|---|---|
| No | 20/59 | 34 |
| **Farm record updated (current)** | | |
| Updated | 35/59 | 59 |
| Not updated | 24/59 | 41 |

**Table 44. Water change**

| Water change | Number per total | % |
|---|---|---|
| Tidal | 28/59 | 47 |
| Pumping | 35/59 | 59 |

**Table 45. Frequency of water change/crop**

| Frequency of water change/crop | Number per total | % |
|---|---|---|
| Once | 32/59 | 54 |
| Twice | 0/59 | 0 |
| More than twice | 17/59 | 29 |
| No data | 10/59 | 17 |

**Table 46. Water sources**

| Water sources | Number per total | % |
|---|---|---|
| Sea | 16/59 | 27 |
| River | 43/59 | 73 |
| Others | 0/59 | 0 |
| No data | 0/59 | 0 |

**Table 47. Water discharge/effluent to**

| Water discharge/effluent to: | Number per total | % |
|---|---|---|
| Sea | 12/59 | 20 |
| River | 29/59 | 49 |
| Others | 18/59 | 31 |

**Table 48. Pond surrounded with mangrove trees/forest**

| Pond surrounded with mangrove trees/forest | Number per total | % |
|---|---|---|
| Yes | 26/59 | 44 |
| No | 33/59 | 56 |

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