Chapter - 9

SUMMARY, RECOMMENDATIONS AND CONCLUSION

9.1 Summary

The contents of this thesis is organized into nine chapters.

Chapter 1

The topic is introduced with in chapter one. The importance of aquaculture in the context of declining production from capture fisheries as well as increasing world population and undernourishment is discussed. The role of fish as one of the major protein sources for humans, the contribution, environmental impacts and constraints of aquaculture are analyzed. The concern about aquaculture whether it can increase global food security taking into account the inputs to aquaculture and the benefits of shrimp aquaculture in contributing to the export earnings are discussed. Chapter one closes with a brief mention on the scope and objectives of the present study.

Chapter 2

The literature review on the following aspects is presented in Chapter two. Throws light on the history of development of shrimp farming in the Asian region listing the top producers and dominant shrimp species cultured. The
development of Shrimp Farming in India, the circumstances which led to the formulation of CRZ rules and the setting up of Aquaculture Authority, BMP in aquaculture and barriers to the adoption of BMPs and regulations for aquacultural effluents are discussed. The role of Aquaculture Legislation, the international, regional and national instruments and arrangements for maintaining aquatic animal health management etc. are reviewed. The status of hatcheries and their role in contributing to sustainable aquaculture production, nutrition and broodstock management, the environmental issues, effluent management in hatcheries are discussed with stress on the need for shrimp seed certification. The norms for registration of hatcheries, hatchery facilities required and the various hatchery management aspects are discussed.

The history of food safety and origin of HACCP and the emergence of modern HACCP system are reviewed. The evolution of global food safety systems, the seven principles of HACCP and the views of different authors regarding HACCP are presented. Development of HACCP in the United States, European Union and other countries as well as in India is reviewed. Concept and application of the HACCP approach, process of implementation of the HACCP system and benefits of HACCP system over traditional quality control systems are brought out. The farm to table food safety, genesis of the PRP, need for HACCP and PRP and development of safety and quality management systems are critically analyzed.

Chapter 3

In Chapter three, the methodology used for the surveys and analyses is discussed.

Chapter 4

Chapter four presents brief review of the studies conducted in shrimp farming operations, identifying the need for studies on the application of HACCP and PRP in shrimp farming operations. The HACCP and PRP knowledge, attitudes and behavior of selected farmers were evaluated. Non availability of good quality seed, low selling price, non availability of technical
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and financial support, environmental pollution, non awareness to proper dosage of chemicals and quality norms and standards etc. were the problems identified as key issues. The study indicated that most of the shrimp farmers were not aware of the HACCP principles, those who were aware had very little understanding. However, they were found to have a significant amount of knowledge in good aquacultural practices and the PRP adherence was found satisfactory. The main constraints to HACCP implementation identified were lack of motivation, lack of technical and financial support. Popularization of management approaches like BMPs and cluster management as well as need for research work on optimum nutrition and health management in the farming sector were suggested. This chapter concludes with the finding that proper PRP were followed in most of the shrimp farms studied.

Chapter 5

In chapter five, this study investigates the impact of farming environments on the quality and safety of farmed shrimp. The physico chemical and microbiological characteristics of selected brackish water shrimp farms and chemical and microbiological characteristics of shrimp cultured in these farms in three different districts in Kerala were studied. This study indicated that during brackish water aquaculture of shrimp, better care need to be taken to avoid contamination from the environment and suggests the implementation of better management approaches like HACCP to exercise control over food safety. The present study indicated that the farmed shrimp were cultured in unpolluted waters and are safe for consumption. It was also observed that the hazardous chemicals were within the permitted limits. The continuing threat of safety problems on our cultured shrimp, despite the mandatory imposition of HACCP in the seafood processing sector, points to the need for extension of this approach to the pre harvest culture operations.

Chapter 6

In chapter six, this study surveys the leading shrimp hatcheries in Kerala, explores the current shrimp hatchery practices, evaluates their adherence to HACCP and PRP principles and identifies the barriers to implementation of
these concepts. The study becomes significant in the context of continuing deterioration of the quality of the hatchery produced seeds as well as disease outbreaks which have become very common. Though the understanding of the HACCP concept by the hatchery operators was poor, their PRP knowledge was good in most of the areas. The dependence on wild broodstocks, low selling price of the PL and non availability of technical assistance were identified as the major problems confronting this sector. Poor cleaning and sanitizing practices suggests the need for improvements in employee habits and sanitizing practices along with proper record keeping practices. There is need for ensuring the quality and safety of the hatchery seeds thereby protecting the farmers from economic fraud while ensuring a reasonable prize to the hatchery owner. The need for seed certification, fixation of uniform price and monitoring by regulatory agencies were recommended. Since the broodstock or nauplii receiving step is a CCP in a hatchery production process, the issue of non availability and high price of the spawners and nauplii could be a major hindrance to effective HACCP implementation in hatcheries. The hatchery operators had a higher level of HACCP awareness, compared to the shrimp farmers. The limited number of hatcheries, the hierarchial system prevailing in the hatcheries coupled with existence of proper guidelines for hatchery production and specifications for the seed and easy access to the hatcheries makes the verification by outside agencies easier. The present study also points to the need for strengthening the HACCP information dissemination systems available in our country since the inability of the usually conducted training programs in giving an in depth understanding of the concept or to motivate the individuals for self reading and improvement has been observed.

Chapter 7

In chapter seven, approaches to HACCP, PRP and safety and quality management by different authors have been presented. This study included PRP assessment of farm layout and facilities and separation of quality and hygiene hazards which may arise from the processing and surrounding environment. The hazard locations identified were listed on the flow chart, the
CCPs determined and developed the process control model representing the centre of activities of a shrimp farm incorporating the CCPs and CPs as well as made a comparison of similar studies conducted by other workers. Realizing that the concepts of HACCP and PRP were not clear to most of the respondents and that they fail to connect the two systems together, an attempt was made to bring the HACCP and PRP activities of shrimp farming operation under an umbrella, by coordinating all the safety and quality control activities. Accordingly, a safety and quality management model was developed for shrimp farming operations by linking the concepts of HACCP and PRP which could guide the farmers and the HACCP practitioners through the HACCP process which can be adopted as a generic model for safety and quality management in shrimp farming operations.

Chapter 8

Chapter eight is an attempt to identify the various steps and the factors involved in the hatchery production of *P. monodon* postlarvae, differentiate the CCPs and CPs, segregate the HACCP and PRP aspects to unite and arrange them on a quality management wheel for the overall management of the shrimp hatchery operations. This chapter is introduced with the PRP assessment of the hatchery facilities and layout followed by the segregation of quality and hygiene hazards to be addressed through the PRP. The hazard identification, preparation of flow chart and the determination of CCPs were elaborated. The confusion prevailing among the hatchery operators with regard to PRP and HACCP plan, their relations and how they should be managed as revealed by the HACCP and PRP surveys and discussions with the hatchery operators, provided the background for this study and urged the need for an implementation model which could guide them in understanding and applying these concepts in their daily hatchery activities and thus ensure improvements in the quality and safety of the seeds raised. The model holds the PRP at the boundary and the process control activities at the centre with the CPs under the PRP and the CCPs under HACCP. The model designed is the result of the search for a united approach to safety and quality by combining the HACCP and PRP concepts. This combination approach integrates the safety and quality management activities of the shrimp hatchery
operations and has the advantage of facilitating the HACCP and PRP verification on a concurrent basis. This model can be adopted as a generic model for safety and quality management in shrimp hatchery operations and is expected to help the hatchery operators and the regulatory authorities alike in a dual role as a process control and a regulatory tool.

Chapter 9

Summary, recommendations and conclusion are presented in Chapter nine.

9.2 Recommendations

- There is need for providing good quality, disease free PL to the shrimp farmers thereby facilitating elimination of infected and unhealthy larvae in the hatchery itself which could reduce the incidence of disease in grow out operations. Hence seed certification and regular monitoring by the regulatory authorities are important.

- Even though the implementation process of HACCP involves a sequence of steps in which the seven basic principles of HACCP are included, this study recommends the implementation of five stage HACCP in shrimp farming, using only five criteria instead of seven criteria, considering the position of our shrimp farmers that more than 90% of them are small scale farmers lacking proper HACCP knowledge and access to experts. Since the presence of pre requisite practices were identified, five stage HACCP can be implemented with appropriate source control for the CCPs identified. For this certified seed and feed are essential. However, in hatcheries, implementation of seven-stage HACCP is recommended. Instead of allowing foreign agencies for the process of certification, services of the experts from our state can be availed.

- Non availability and higher price for the broodstock were the most important problem confronting the hatchery sector which forces the hatchery operators to procure nauplii from other states. Therefore,
upgradation of one or two hatcheries in the public sector into master hatcheries with hi tech infrastructure and R&D facilities for the purpose of supplying nauplii to hatcheries in the state at cost price and for utilization of excess production in the hatcheries for supporting stock enhancement activities is recommended.

- The sustainability of the practice of harvesting wild broodstock spawners and wild PL is under threat. Hence there is need for regulation of broodstock capture fisheries and encouragement of captive breeding techniques.

- Slight variations are observed with respect to the farming practices in different regions. However, standard flow charts and work sheets prepared in this study can be introduced. Layout and premises studies showed that the arrangement of farms in certain areas causes cross contamination leading to contamination of the main intake sources. The common water intake canals were observed to be in blocked condition, so the local administration should be properly instructed to carry out the clearing jobs. Constant monitoring and surveillance of the quality and safety of coastal waters and shrimp samples by the regulatory authorities is suggested.

- Govt. support is needed for the upgradation of hiring centers for ice, krates, vehicles and other accessories for post harvest handling. The post harvest handling aids are most often found dirty and the quality of water used for ice manufacture is also not satisfactory and need to be improved. Common freezing and storage facilities should be provided at regions where marginal farmers concentrate which will also improve their bargaining power.

- Middlemen such as traders, suppliers and salesmen were found to have an important role in exchanging and disseminating information on safe and effective use of chemicals. Hence it is essential that information on safe and effective use of chemicals through training should be extended not only to hatchery and farm operators but also to these people. This study
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awareness of the hatchery operators was higher with respect to information on HACCP and PRP. Major constraints faced by the farming and hatchery sectors were identified and suitable remedial measures suggested. These surveys also revealed that there is a confusion prevailing among the respondents with respect to the concepts and relations of PRP and HACCP and how they should be applied and managed in a system. Chapters seven and eight apply these information into their specific needs, examine the possibility of application of the concepts of PRP and HACCP, identify the ways in which PRP could be a basic constituent of safety itself and an enabling key to total quality management and ventures into designing models for guiding the shrimp farmers and hatchery operators through the HACCP process. The role of PRP as a support system for HACCP has been clearly brought out in this study. The reviews available on HACCP and PRP are mostly authored by foreign publishers which makes easy reading impossible by layperson. This work critically analyses the views presented by different workers and reiterates the advantages of an integrated move involving PRP and HACCP in support of the argument that while improving the quality is important, enhancing the safety is critical. This study also points to the need for capacity building of HACCP extension personnel thereby strengthening the HACCP information dissemination systems available in our country.