1.1 General Introduction

The increasing world population and awareness on the nutritional advantages of consumption of fish are the causes for the ever increasing demand for fish. Fisheries play a vital role in supplementing the protein food requirements at an affordable cost in addition to providing a lot of employment opportunities. The marine fisheries sector of the country is witnessing an era of declining production. However, the growth rate in the inland fish production which includes aquaculture was showing a high increase in volume. Even though the heavy responsibility of filling up the gap from capture fishery put on aquaculture resulted in a rapid increase in aquaculture production, it did not last long. Environmental and social conflicts along with disease outbreaks resulted in a sudden decline and almost stagnant situation in marine shrimp farming. *Penaeus monodon* is the most predominant cultured species in India which is mainly exported to highly sophisticated, quality and safety conscious world markets. There were instances of rejections and detentions due to various safety and quality problems like presence of antibiotic residues, pesticides and undesired chemicals and muddy and moldy smell in cultured shrimp in certain regions. It is well understood that the traditional methods of quality control and end point inspection cannot guarantee the safety of cultured seafood products and so in order to ensure the superior quality of our cultured shrimp products and to sustain the world
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markets, it is essential to identify the potential food safety hazards at the primary production stage of the food chain itself and control them to the safety level to eliminate the chances of detecting a hazard at later stages of the food chain. The need for aquaculture to improve its public image in the face of mounting criticism has also become urgent. The impact of aquaculture on the environment as well as the environmental conditions on aquaculture, both factors have to be taken into account. The sporadic incidences of disease outbreaks and some isolated incidents of social conflicts also have reasserted the need for adoption of better management measures for conducting shrimp culture in an environmentally, socially and economically sustainable manner. The application of a Science-based approach, based on the principles of HACCP was recommended by many experts as a remedy for overcoming such problems.

The rapid development of shrimp farming in our country was due to the setting up of a large number of modern shrimp hatcheries and assured supply of quality seed. Wild-caught broodstock, one fourth of which are reported to be White Spot Syndrome Virus (WSSV) positive is the only source of shrimp seed even today. Over the past few years, the safety and quality of hatchery produced seeds have been deteriorating and disease outbreaks have become very common in hatcheries despite the presence and use of standards and code of practices such as Good Management Practices (GMP), specifications for seeds and requirements for the facility etc.formulated by the regulatory authorities. Successful grow out operations and hence the future of the shrimp farming industry depends upon abundant supplies of high quality seed which in turn depends upon the quality of nauplii and the hatchery management practices followed. Considering the major contribution of *Penaeus monodon* to the total shrimp production and the economic losses encountered due to disease outbreaks, it is essential that better management measures, Science based preventive approaches like HACCP and PRP be implemented in our shrimp hatcheries and shrimp farms. Researchers and regulatory agencies alike have advocated the extension of HACCP concept from processing and exporting to the shrimp farming and hatchery sectors.
Several studies have assessed the possibility of application of hazard analysis and risk management procedures into aquaculture production. These studies looked into food safety issues associated with products from aquaculture and found that there were considerable need for information and the knowledge gaps hinder the process of risk assessment and the application of risk management strategies with respect to food safety assurance for products from aquaculture. Such studies recognized the difficulties in applying HACCP to small scale farming systems and found that food safety hazards associated with aquaculture vary by regions, habitat and environmental conditions as well as methods of production and management, identified the farm level risk factors and evolved practical management practices that can be used to reduce risks of shrimp disease outbreaks and improve farm production.

The worldwide evaluation and reorganization of food inspection and control systems geared towards improving efficiencies, rationalizing human resources and introducing risk analysis-based approaches resulted in the convergence towards the necessity to implement a preventative approach based on the HACCP principles and away from the traditional approach that relied heavily on end-product sampling and inspection and that is HACCP. Several researchers have pointed out that formal PRP are needed to support the implementation of HACCP. Even though a good amount of literature is available projecting the role of HACCP as a food safety assurance system and PRP as a support system for HACCP, reports indicating the importance of an integrated approach to food safety and quality are not many. Few studies have pointed out that there exists a big confusion between PRP and HACCP plan, their relations and how they should be managed mainly because of negative guideline factors and lack of understanding. In the present study, a review of the food safety literature and discussions with the shrimp farmers, hatchery operators and HACCP practitioners regarding hazard analysis, also identified similar situations which urged the need for a model which could guide the beneficiaries through the HACCP process. Realizing the inefficiency of HACCP as a stand alone system, a multidisciplinary approach to food safety and quality by combining the concepts of HACCP and PRP and managing both HACCP and PRP within a quality management system
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has been tried out in this study. A model has been designed, by consolidating various concepts from similar models which can be adopted as a generic model for safety and quality management in shrimp farming and hatchery operations.

There have been no studies examining the possibility of implementing PRP and HACCP as well as the extent to which the safety programmes are implemented in shrimp farming and hatchery operations in Kerala. The very limited research in this area forced me to take up this study. It is anticipated that the present work may give useful information to the shrimp farmers, hatchery operators and other stakeholders. This study becomes significant in the present context of repeated grow out failures, deteriorating quality of hatchery produced seeds and continuing threat of safety problems on our cultured shrimp.

1.2 Objectives

The objective of this study is to determine the extent of adherence of the shrimp farmers and shrimp hatchery operators to the principles of HACCP and PRP. The study aims at improving the methods practiced so as to ensure product safety, economic efficiency and fair trade practices. This study explores the current shrimp farming and hatchery practices, evaluates adherence to HACCP and PRP principles, identifies the various steps and factors involved in shrimp aquaculture production and hatchery production of *P. monodon* postlarvae, differentiate the control points (CPs) and critical control points (CCPs), segregate the HACCP and PRP aspects and identifies the barriers which are obstructing the implementation of HACCP and PRP in shrimp farming and hatchery operations. The purpose of this research is to evaluate current shrimp farming and hatchery management practices, assess farmer’s and hatchery manager’s knowledge and attitudes about shrimp farming and hatchery operations and to design a safety and quality management system model for implementation in shrimp farming and shrimp hatchery operations respectively.
This study is conducted with the following objectives:

- To study the status of the existing quality and safety control systems in the shrimp farming and hatchery industries in Kerala.
- To study the information needs of the shrimp farming and hatchery sectors.
- To study the quality, safety and other issues pertaining to the farming and hatchery operations.
- To study the impact of farming conditions and practices on the quality and safety of shrimp cultured.
- To identify the barriers and assess the possibilities of introducing PRP and HACCP in shrimp farming and hatchery operations.
- To develop models of safety and quality management system for implementation in shrimp farming and shrimp hatchery industries.