
REVIEW OF LITERATURE

2.01 Introduction

Fisheries and aquaculture play a very important role in Indian economy in terms of food security, employment generation, and foreign exchange earnings and poverty alleviation programmes of the country (Malhotra and Sinha, 2007). With development of fishing industry, stakeholders started to face several problems. Some studies have been related to these issues have been conducted. In this chapter, an attempt has been made to review theoretical and empirical work on the industry. The chapter is bifurcated into three sections. Section I deals with economic theories. Section II deals with empirical studies carried out on the fishing industry. Section III deals with conclusions.

Section I

THEORETICAL APPROACH

2.02 Economists' Views

As per the Industrial classification system, fisheries is classified in the agricultural sector. However, processing of fish takes place in the industry sector. In view of this, theories related to fisheries have to be viewed separately. There are no well-built theories on the fishing industry by Adam Smith, Alfred Marshall, Thomas Malthus, Irving Fisher, A.C. Pigou, Karl Marks, Jacob Viner, J.M. Keynes or others. However, some of their observations are worth quoting.

From the ancient times, fishing was believed as form of wealth (Marshall, A., 1974). "Fisheries requires both a fixed and a circulating capital to cultivate them; and their produce replaces with a profit, not only those capitals, but all the others in the society" (Smith, A., 1937). Furthermore, sea resources compared to

agricultural resources are renewable and replenishable year after year. Even if certain quantity of fish from the total stock in seas is exploited, it is still self-renewing which means the same amount of fish can be harvested every year without depleting the stock. Fishing is also the most important source of employment for the society. It was the chief source of food for subsistence as explained by Thomas Malthus in his book 'An Essay on Principle of Population' (Malthus, T., 1938). In the past, fishing was a means of food rather than employment and foreign exchange.

All benefits depend on fish production. However, Future production is solely a matter of nature (Fisher, I., 1930). As Smith mentions, "The success of a particular day's fishing may be a very uncertain matter, yet, the local situation of the country being supposed, the general efficacy of industry in bringing a certain quantity of fish to market taking the course of a year or of several years together; it may perhaps be thought, is certain enough; and it, no doubt, is so. As it depends more, however, upon the local situation of the country, than upon the state of its wealth and industry; as upon this account it may in different countries be the same in very different periods of improvement, and very different in the same period; its connection with the state of improvement is uncertain" (Smith, A., 1937). Karl Marx also mentioned that, "the continuity of reproduction may be more or less interrupted in those branches of production which are dependent on the seasons, either on account of natural causes, such as agriculture, fishing, etc., or on account of conventional circumstance such as the so-called season-work" (Marx, K. 1906).

Regulation and conservation of fish resources are urgent need for sustainable fish production. Ralph Turvey of the London School of Economics wrote in 1964 on non-optimum situation arising due to lack of marine fisheries regulations (Ralph, T., 1964). Chanakya had first framed laws for regulating fishing and conservation as early as the 3rd century BC (Government of India, 2006). Fishing operations are conducted during the fish breeding season which is the main reason for depleting fish stock (Pigou, A., 1932). According to Jacob Viner when no rent is charged for the use of valuable natural opportunities, they

tend therefore to be overexploited (Viner, J., 1937). However, Keynes emphasized on more fishing by modernization. (Keynes, J., 2006).

2.03 Economic Theories on the Fishing Industry

2.3.1 Biological Theory of Fisheries Management states that as population increases, so fishing effort increases. It increases pressure on the original stock of fish. Maintaining effort is therefore necessary where fish stock has been depleting. The theory has been formulated by Milner B. Schaefer, an American biologist, in 1954. The Schaefer model had identified the relationship between sustainable yield and population and fishing effort. He assumed that fish stock increases at various rates, depending on its initial weight, recruitment, individual growth and mortality rates. Catch responds to changes in population and fishing effort (Korakandy, R., 1996).

2.3.2 The theory of Fisheries Management under Common Property System by Francis T. Christy Jr. and A.D. Scott (1985) analyzes the working conditions of the common property system in marine fisheries where there was no restriction on entry. This would lead to reduced profit and fall in sustainable yield and also to rising cost, falling revenue and reduced sustainable yield, with the possibility of loss and even extinction of the industry.

Christy and Scott believed that restrictions are essential for efficient utilization of resources. However, R. Korakandy (1996) opines that these restrictions will be socially unacceptable and fishermen may object to the conversion of common property resources into private property rights. Christy and Scott also considered limiting entry by licensing or restriction on quota system, which are considered to have a negative effect on employment and earnings.

2.3.3 The Economics of Subsidies: The application of this theory will facilitate a better understanding of two questions: (i) why governments use subsidies and, (ii) its impact on international trade. An efficient subsidy would correct a market failure, bringing social and private costs and benefits into alignment. Consumers in the foreign country benefit from lower world prices. Foreign producers,

however, are net losers since they now have to compete with lower prices. Uncompetitive producers will be forced to exit the industry. However, the country is better off on the whole since the increased benefit to consumers offset the loss to the producers (WTO, 2006).

2.3.4 The Effect of Free Trade on Fisheries: The present theory explains the impact of international trade on importing countries, exporting countries, on consumers, producers, on fish stock and on society as a whole. It also explicates how price is determined in the market, and how it affects the income of all stake holders. Additionally, it also appraises how countries can benefit from international trade. It has established the importance of efficient distribution to seafood prices, and how a transparent marketing system, with strong infrastructure facilitates trade (Gudmundsson, E.; Asche, F. & Nielsen, M., 2006).

2.3.5 Responsible Fish Trade and Food Security: FAO (2006) has carried out a special study in eleven countries on 'Responsible fish trade and food security'. The fish trade has been a debatable issue. One opinion holds that fish trade increases food security, whereas others hold that fish trade decreases food security.

The main contention of the argument is that international trade in fishery products will have a positive effect on food security in the developing countries participating in such trade. On the other hand, international trade in food products generally has a negative impact on fish resources. Clearly, there is an urgent need for more effective and sustainable resource-management practices, without which, there can be no sustainable international trade (FAO. 2006).

Above theories explain the effects of free trade on various stake holders of fishing industry as well as impact of fish trade on food security. In addition they also explain why government use subsidies and what would be the impact of growing population on fishing. These theories further explain how economic return can be increased under common property system. The applications of such theories are definitely essential for bountiful future of fishing industry.

Section II

EMPIRICAL STUDIES

The empirical studies are divided in to following three sub-sections i.e. (i) Fisheries studies (ii) Aquaculture studies and (iii) Fish processing and international trade studies

2.04 Fisheries Studies

Fisheries studies include both marine fisheries and inland fisheries studies and range from the study of the problems faced by the fishermen to the future of the fishing industry.

Bizzarri, G., (2009) analyzed the correlation between fisheries and economic development. He felt that fisheries could ensure a bountiful future. Fisheries supply a highly nutritious animal protein for human consumption, and provide employment and income generation in remote coastal areas. Globally, some seventeen percent of the animal protein supply is derived from fisheries. As many as 200 million people rely on fisheries for their livelihood, making rural communities economically viable. The indirect multiplier effects on economic development through intrasectoral interactions (e.g. between capture fisheries and ancillary activities such as net-making, or between capture fisheries and aquaculture through the supply of fishmeal), as well as intersectoral interactions (e.g. between forestry and fisheries through the supply of timber for boat-building, or between agriculture and aquaculture through the supply of feed). The infrastructure developed for fisheries (feeder roads, landing sites and coastal havens, water-retaining ponds) trigger other economic developments in sectors such as tourism or agriculture. He suggested that fisheries adopt a responsible attitude for sustainable development.

FAO (2006) made attempt to analyse 'Contribution of fisheries to food security'. "Food is a fundamental human right" according to Committee on World Food Security. Fisheries and Aquaculture contribute to food security by increasing fish supply for human.

The most relevant change in this context is the decline in per capita supplies in Africa, south of the Sahara as a consequence of stagnating supplies from capture fisheries and aquaculture. The FAO-Japan Conference on the Sustainable Contribution of Fisheries to Food Security and the World Food Summit recommended a series of actions which countries should take in order to achieve a growing contribution towards food security from fisheries and aquaculture. This will be achieved, inter alia, by strengthening and establishing appropriate regional and sub-regional fisheries management organizations or arrangements, by minimizing waste in fisheries, reducing excess fishing capacity and applying the precautionary approach in accordance with the UN Fish Stocks Agreement and the Code of Conduct for Responsible Fisheries; by establishing and strengthening integrated marine and coastal area management; by conserving and sustainably using marine and freshwater biodiversity; and by studying the effectiveness of multispecies management in the context of relevant provisions of the 1982 Law of the Sea Convention and Agenda 21.

Biswas, K. (2006) observes that fish and fisheries play an important role in the national economy and in particular a coastal state's economy. He addresses issues of profitability in fish production, marketing of fish and fishery products, demand and utilization pattern, and fishery policies. Crucial issues such as management of finance, insurance, social problems of fishermen and impact of co-operatives are also addressed. He strongly recommends that overfishing should be stopped, otherwise it will be harmful for the country.

Giriappa, S. (1994), edited book on 'Role of Fisheries in Rural Development'. This book is an attempt to evaluate the impact of fisheries sector on the development process of country. The contribution of marine and inland fisheries in regions like Kerala, Karnataka, Pondicherry, Uttar Pradesh and West Bengal. He pointed out that a major reason for decline in fish productivity has been overcrowding of mechanized crafts and absence of extension of exploitable zone. Effective inland water fisheries through aquaculture and pisciculture could supplement the marine catch but the total catch would be far less than demand. For rural development, he suggested that fisheries management has to be

improved by developing and adhering to the eco-system conservation principle called unit management wherein all associated species, relevant habitats and spread-outs and necessitated areas are jointly managed. Regulation of catch, entry of vessels, developing endogenous technology for management and provision of marketing and other infrastructures to both capture and artisanal fishermen would improve sustainability and pollution control of coastal areas. Losses in catch, storage and transport have to be minimized. Improving aquaculture technology would sustain fisheries so as to supplement agriculture and bio-diversity.

The Government of Gujarat (2001) conducted a 'Techno-Socio-Economic survey for fishermen community in Gujarat'. The objective of the study was to assess and determine the condition of fishery villages and fishermen households. Here, conditions of villages and households of fisher folk were studied under various parameters viz. household conditions, infrastructure facilities, demographic characteristics, participation in fishing activities, economic activities, technology application, marketing and awareness to government schemes and policies. The recommendations were made for the same.

Prabakaran, J. (1978), studied 'Economics of Fishing and Living Condition of Marine Fishermen in Tirunelveli District of Tamil Nadu'. The study placed the owners of the mechanized boats at higher level of socio-economic condition and the fishermen of traditional crafts at lower level. Hence, the mechanized programmes have to be speeded up. It could be done by evolving a modified catamaran or vallam design which could be fitted with economical light weight and efficient in board diesel engine. Fishermen exploit by master fishermen. So, the study also warrants steps to eliminate middlemen from fishing industry by encouraging institutional credit and co-operative.

Joshi, M. (1994), studied the issues relating to mechanization and examines the organizational problems in four cities of Gujarat. Joshi has found that mechanization has a favourable impact on fish collection, especially high value fish, employment, investment, capital formulation, and export earnings, but over-mechanization and over fishing are harmful. There are problems of fuel finance, maintenance and repair and high costs due to mechanization. Many fishermen are

loosing their employment and income due to mechanization. While fishermen may borrow from commercial banks, fish merchants, money lenders, relatives and friends. Co-operatives have failed in providing credit to them. Hence finance is a major obstacle in fishery development. He recommends policy measures for organizing fishermen into co-operatives on the AMUL pattern.

Datta, S. (2001), edited a volume 'Fisheries Sector Development in Gujarat' on the basis of workshop organized in Ahmadabad. How to achieve sustainability of small and artisan fishermen as well as the agribusiness units in fisheries was the main thrust of the workshop. Sustainability was interpreted to mean not only commercial viability but also social compatibility and environmental harmony.

Korakandy's study (1988) attempted to unravel the process of growth and decline in the primary marine fishing industry of Kerala since 1951. He observed that growth in output of the industry was associated with major technological changes, high price varieties of fish, and increase in the output of the mechanized sector. The fall in the output of non-mechanized sector was primarily due to the limited growth strategy followed by the administration and poor market linkages. Restoration of growth demands major and continuous technological changes in the catching, processing and marketing branches of the industry.

Rao and Raju (1998) found that mechanization and modernization coupled with trade liberalization policies have made fishing communities vulnerable.

Durai, D. (1978), studied 'Relative Costs and Returns of Various types of Fishing Methods in Marine Fisheries in Thanjavur district (Tamil Nadu)'. Analysis was carried out to examine the comparative economics of four types of fishing method. The results indicated that larger fishermen possessed larger capital and received higher net return than their smaller counterparts.

Tietze, U. et al (2005), analysed 'Economic performance and fishing efficiency of marine capture fisheries'. It included 94 most important fishing fleets operating in 94 countries that generally experienced positive gross cash flows and fully recovered their operating costs.

In the 1990s, FAO's Fisheries Department studied the viability of the world's fishing fleets. The findings indicate that capture fisheries are still an economically and financially viable undertaking. In most cases, they generate sufficient revenue to cover the cost of depreciation and the opportunity cost of capital, thus generating funds for reinvestment. (FAO, 2000).

Rao, P. (1983) points out that during the last two decades Indian Fisheries have grown from a subsistence way of living into an industry, which is still in its infancy and is beset with many imbalances. Government protection and promotion is essential to develop the industry on sound commercial lines.

Korkandy (1996) seeks to provide an integrated theory of fisheries management, applicable to developed and developing fisheries. He concludes that the global theory of fisheries management floated by the FAO has made it virtually impossible for developing countries to expand their fisheries and warns the third world against the same.

Seijo, J. et al (2001) has looked at the assumptions underlying the optimal allocation of renewable natural resources. He expounds basic elements of decision-making theory and criteria that reflect different attitudes to risk aversion in fisheries management.

Rao, S. (1986), had conducted 'Economics of Fisheries: A case study of Andhra Pradesh'. The main objective of the present study was to review and examine critically the process and progress of fisheries development in the state during the planned era and to highlight some of the problems encountered by the fishing industry. In order to overcome difficulties inherent in the fisheries economy as well as in the plan implementation, the state must intervene and accept the responsibility for including changes through positive programmes, as he suggested.

Tictze, U. (1985), made an attempt to study 'Artisanal Marine Fisher folk of Orissa'. The study aims at throwing more light on fishing technology, fishing economy, social organization, perceptions, views and caste background of the sea fishing communities of Orissa, which reflect in miniature, the life style and culture of the fisher folk of the entire east coast of India.

Kumar, A. et al (2003) in 'A Profile of People, Technologies and Policies in Fisheries Sector in India', points out that enhancement of marine fish production requires diversification of fishing activities not only in the off-shore oceanic regime but also in deep sea fishing which is capital intensive and risk prone. For the development of fishery and aquaculture, such constraints as well as social, legal and political implications have to be taken into account and innovative strategies and policies have to be initiated for a balanced and sustainable growth.

In their book 'Indian Fisheries and Aquaculture in A Globalizing Economy', Malhotra and Sinha review the significant growth of India's fishery and aquaculture during the last 50 years. The book is comprehensive, but weak in discussing problems and solutions (Malhotra and Sinha, 2007).

Loayza and Sprague (2006) studied 'A Strategy for Fisheries Development'. This paper proposes a strategy for fisheries development, aimed primarily at the World Bank Group but it is also believed to have relevance to all development institutions concerned with fisheries development. The paper was developed from an extensive review and analysis of the current trends and worldwide status of fishery sector and its relationship with other economic and social sectors, giving ample consideration to the lessons learned from past experience.

Kizhakudan and Kizhakudan (2005) have presented a case study on 'Role of fishermen in conservation and management of marine fishery resources in Gujarat'. They look at the approach of fishermen towards the sustenance of the fishery resources which they exploit. They see conservation of fish resources as a very urgent need for the survival of the fishing industry.

Munro, G. et al (2004), have studied legal and economic aspects of the conservation and management of shared fish stocks. The effective management of shared fish stocks stands as one of the great challenges towards achieving long-term sustainable fisheries. The paper warns that achieving effective cooperative management of discrete high seas stocks, which have hitherto received little

attention is likely to prove to be exceptionally challenging. If the challenge is not met, these resources will unquestionably remain vulnerable to over-exploitation.

FAO (2006) had carried out a special study on 'Low-value fish (trash fish) from marine fisheries in the Asia-Pacific region'. The objective of the study was to understand how low value fish can be utilized better. This study is important for the following reasons: (1) the production of low-value fish across the region, which includes India amounting to 25% of total marine catch, in some cases greater than 50%. (2) Low-value fish production disturbs the ecology of the ocean and future fish production. (3) High-value fishes are harvested at small size so it becomes trash or low value fish. This is not economically affordable. (4) 50% to 60% fish becomes low-value fish due to poor storage according to some reports. (5) A fish discard rate of as high as 80% exists in Bangladesh. Since fish is a rich source of protein, this waste is not affordable in malnourished countries. Therefore, FAO recommended (1) Reduction in trawl fishing and introduction of improved selectivity of fishing gear. (2) Improvement in post-harvest fish handling and developing new fish products through processing. (3) Changing from direct feeding to pellet feeding.

FAO (2009) has also attempted to study how post-harvest losses could be reduced, as these constitute an unacceptable waste of scarce natural resources. Physical loss is caused by, for example, poor handling and preservation or the discarding of bycatch. Economic losses occur when spoilage of wet fish results in a value-decrease or when there is a need to reprocess cured fish, raising the cost of the finished product. In addition, inadequate handling and processing methods can reduce nutrients, leading to nutritional loss.

Recycling of fish catches as feeds for poultry or pigs results in a net loss. They are often considered a "loss" from a food security perspective.

Reducing post-harvest losses requires wiser use of resources; numerous actions to reduce waste already exist. The need to decrease all forms of waste and to optimize the use of fisheries resources for human food security is embedded in the FAO Code of Conduct for Responsible Fisheries, as well as in the UN Fish Stock Agreement.

Guðmundsson, E. et al (2006), have analysed 'Revenue distribution through the seafood value chain'. The objective of this study was to demonstrate how the revenues from seafood trade are distributed over the entire seafood value chain. The value chains were shown to have similar characteristics to value chains for agricultural products where the primary sectors receive a relatively lower share of the retail value of highly processed products and a higher share in less processed and fresh products. The study also revealed that the developing countries seemed to control a relatively lower share of the overall value chain than developed countries. An example is the Iceland case where Icelandic owned companies control as much as 70 percent of the entire value-chain while Tanzanian and Moroccan companies controlled less than 50 percent. In this paper it has been shown that good fisheries management is a necessity in order to allow fishermen to reap the benefits from higher export prices. Without proper management in place, increased prices can lead to increased fishing pressures and hence threaten the sustainability of the resource and profitability of the fishing companies.

Mruthyunjaya (2004) attempted to study that how poor households could be benefited by fishing industry. The study has shown that technology and trade reinforce each other, bringing in wealth but raising sustainability concerns. Since these technologies and trade interventions were skill-based and capital intensive they have not had the intended impact on the socio-economic conditions of poor fishermen. Institutional and policy failures have also been observed. Strategies for accelerated fishery development that provide for poverty alleviation among poor fishermen are as follows. (1) Follow people centred approach and not commodity centred approach (2) Prioritize technology for the poor at national, regional and micro level (3) Upgrade the skills of the poor fishers (4) Enhance the investment and reorient policies to facilitate percolation of benefits from trade to all sections of the society, particularly the poor and the women.

Sathiadhas, R. (1997) deals comprehensively with complex management issues like production trends in traditional and mechanized fisheries, capital intensity of several technological options, cost and earnings of different fishing

techniques, comparative economic efficiency of various fishing methods, price behaviours of marine fish and marketing efficiency in the distribution process and policy implications.

Gupta, V. et al (1984), studied 'Marine Fish Marketing in India.' The present study is divided in six volumes. The interdependence of production and marketing and its effects on the development of the whole fisheries sectors is obvious, This report's main thrust, therefore, has been on the study of marine fish marketing system and its economics with a view to evaluate opportunities for the future investment, especially in the light of already committed investments in production and marketing sectors. They recommended for the sustained growth of the marine fisheries sector that increase the inland fish production and exploitation of deep sea fishing. There is an urgent need for changing the boats and gears mix through the promotion of other types of fishing than trawling to avoid competition in the same depth range and to increase the supplies for domestic consumption. This study has stressed on formation of the National Fisheries Development Board.

Derek and Maarten (2005) have analysed 'Social Justice and Fisheries Governance: The View from India'. They have presented a comparative analysis of Gujarat and Tamil Nadu. A key question for Indian fisheries governance is to arrive at a new understanding of the relationship between production, distribution, allocation, and social justice. They have stated that over-fishing is serious problem for both states. The trawler sector is harmful to the traditional sector. Redistribution of resources by government interventions is needed to increase social welfare.

Pascoe, S. et al (2003), have analysed 'Measuring and assessing capacity in fisheries: Issues and methods'. Over-capacity is now recognized as a major and global problem for maintaining socially and economically viable fisheries (FAO, 1999). In the absence of appropriate restrictions on harvesting activities, fishing fleets could easily deplete valuable fishery resources and generate considerable economic waste. This technical paper provides guidance for measuring and

assessing fishing capacity. It discusses concepts and issues necessary for understanding capacity and capacity-utilization in fisheries.

Bartley and Leber (2004) studied marine ranching. With coastal fisheries in decline around the world, there is mounting concern about how long current sources of seafood can supply world needs. This volume presents case studies that represent various scenarios and situations in using sea ranching and marine hatchery enhancement to generate income, re-establish fisheries and conserve aquatic biodiversity. The studies demonstrate that stocking can clearly work in some cases to increase fishery landings, but that economic success will depend on many factors such as the management system, survival, culture costs and how the resource is valued.

FAO (1995) has studied the future demand for fish, which depends on three factors: population, income and price, the latter incorporating a number of factors such as consumer preferences. Population normally accounts for about two-thirds of the change in total demand. Using the 1993 estimated world level of per capita fish consumption of 13 kg/year, the increase in world population, forecasted this to reach 7032 million by the year 2010. This would require a total fish supply of 91 million tonnes, which at present consumption levels means an additional 19 million tonnes of food fish. The significance of increased aquaculture production in satisfying this projected demand will depend on consumer acceptance of farmed products.

FAO (2004) has also identified some threats which will be faced by fishermen in the near and distant future, as well as some golden opportunities. These are as follows. (1) Demand for fish will expand as population and income grow. (2) There will be a global shortage of fish in the future so that price of fish will rise. (3) Developing countries will increase their net export of fish and fishery products and increase production. (4) Developed countries will reduce net imports of fish and fishery products because of fish price. (5) Fishermen will leave this business because of uneconomic fishing operation; and employment in will decrease in capture fisheries and production and employment will increase in culture fisheries.

In their study 'Gujarat Fisheries 2010: Opportunities and Challenges', Trivedi and Upadhyay (2001) have predicted fish production, fish export, as well as the finance requirement to achieve it. According to the authors, the fishing industry will provide vast opportunities for employment and will make a very significant contribution to the state domestic products.

2.05 Aquaculture Studies

Aquaculture is a recently developed branch of the fishing industry, especially for Gujarat. Aquaculture means growing aquatic organisms like fish and shellfish under controlled conditions. Worldwide, growing importance is being given to aquaculture for the development of fish processing and exporting as it provides high value raw-material.

The important aquaculture studies are as under.

Andrew, P. (1999), has undertaken a case study of 'Economics of Brackish water Shrimp Culture' in reference to Krishna district of Andhra Pradesh. The study details several aspects of shrimp culture and analyzes the advantages of brackish water shrimp culture, while pointing out the negative effects of unregulated shrimp culture activity on environment. The returns in aquaculture are higher than those from traditional agriculture. Productivity is also higher compared to major agricultural crops like cereals.

Gnaneswar, G. (2007), has studied the 'Economics of Freshwater Fish Farming' with reference to West Godavari district of Andhra Pradesh. Freshwater farming provides fishermen with a livelihood. According to him, freshwater farming has emerged as a major occupation for farmers and a secondary occupation for professionals such as lawyers, lecturers, doctors, and business personnel in the district.

Hishamunda, N. and Subasinghe, R. (2003), have analyzed 'Aquaculture development in China: the role of public sector policies' and aim at making the Chinese experience available to the rest of the world, especially developing countries as they strive to develop this sector as a part of their efforts to achieve food security and economic growth.

Singh, R. K. P. (2003), has studied the 'Economics of Aquaculture' in the villages of Bihar. He suggests increasing pond lease period, which leads to increased investment, establish hatcheries to bridge gap between demand and supply of fish seeds and adopt modern technology to improve fish production and income.

Gill, T. (2000), studied 'Waste from processing aquatic animals and animal products: implications on aquatic animal pathogen transfer'. Many commercial companies find it profitable to invest in aquaculture because of the many advantages including control of brood stock, ability to harvest any given size at any given time and the ability to grow fish in close proximity to processing facilities. In addition, total quality management is possible throughout the entire process from the hatchery to the dinner plate. In developing countries, aquaculture provides nutrition for the domestic market and generates foreign capital from the export market as well as employment for workers on fish farms and processing plants. However aquaculture is not without its difficulties. There are communicable diseases including fungi, bacteria, viruses and parasites which are a threat to aquaculture species due to the high stocking densities common in the industry. In addition, as the industry grows, disposal and/or utilization of processing waste are a growing problem or perhaps an opportunity which is yet to be exploited. The present document deals with potential pathways of major pathogen transfer to wild and cultured aquatic species through the waste from processing facilities.

FAO (2006) report entitled 'Aquaculture may also fail to meet global fish demand' estimated that an additional 40 million tonnes of aquatic food would be required by 2030 just to maintain current level of consumption. One serious bottleneck according to FAO, is the lack of investment capital for producers, and there is a shortage of land and freshwater for aquaculture. Rising energy costs also pose a problem, and environmental impacts and questions of product safety continue to require attention, the report said.

2.06 Fish Processing and International Trade Studies

The studies related to fish processing and international trade have been carried out on several aspects.

FAO (2007) has attempted to identify the relation between international trade and food security. With the increase of trade in fish and fishery products, the issue of fish trade and food security has become important. The dilemma of developing countries exporting fish and fishery products while having large segments of the population undernourished has been highlighted. It is obvious that fish trade is necessary for food security for many landlocked countries; otherwise these would not have access to marine fish. There is no firm evidence to show that fish exports are detrimental to food security in the export country as the products exported are generally different from those consumed locally. Also, there is no substantial evidence that fish export revenues substantially alleviate poverty problems in the exporting country.

The export of high value species from developing countries highlights the need for more research into the development of new products to satisfy low-income markets. Most experts agree that a reduction in use of fish for non-food purposes and a reduction in discards could be beneficial for food security.

Venkatesh Salagrama (2004) has undertaken a study entitled 'Policy research: Implications of Liberalisation of Fish Trade for Developing Countries: A Case Study for India'. According to him, understanding the key issues concerning international trade in order to (i) develop cohesive responses to deal with the adverse impacts and to maximise the benefits and (ii) participate in the international decision-making bodies and ensure that the particular needs of developing countries are properly addressed and incorporated into the trade agreements. He added, build institutional capacity – through inter alia, training, workshops, manuals and exposure visits – in building skills in negotiation processes, technical areas, and identifying trade opportunities in order to safeguard the interests of the poorer stakeholders. Exploring options for diversifying the export basket to include more commodities and reorient the production systems to focus on species other than shrimp. Exploring options for

diversifying the markets from the 'Big Three' – Japan, the EU and the US – to a larger number of developing countries.

Melchior, A. (2006), studied 'Tariffs in world seafood trade' included 169 countries. He found that Seafood tariffs are higher than tariffs for industrial goods. Average applied tariffs for seafood in each country are mostly spread out between 0 and 30 percent, with a median at 14 percent.

Ababouch L. Et. al. (2005) analysed the causes of detentions and rejections in international fish trade'. This paper is based on a study that identifies the major causes of detentions and rejections of fishery products in international trade, includes safety risk, quality defect or economic fraud. Key issues coming from this paper have included a need to harmonize the procedures and methods used to govern imports, to base the actions taken on risk assessment where consumer safety is in question, and importantly to communicate the actions taken to all interested parties in a manner that is unambiguous, transparent and easily obtainable.

Dixituli, J.V.H. (2007), has focused 'On promotion of export market for Indian Carps'. Small quantities of major carps are exported to a few countries with migrant or settled Indian population that prefer these fishes. But in countries like USA and those in Europe, carps are considered as fishes of inferior quality. The shortcomings of the domestic fish marketing system coupled with the absence of an export market for major carps have pushed the major carp farming sector of the country into a disadvantageous position. Establishment of a market for Indian major and other carps in Central Europe may well prove to be a major step towards helping our fish farmers in upgrading their earnings and their economic status.

Diei-Ouadi, Y. and Mensah, M.E. (2005), have undertaken a study on 'Improving Livelihoods through Exporting Artisanally Processed Fish', conducted in Côte d'Ivoire and Ghana. Certain weaknesses have been identified by the study such as limited knowledge of sanitary regulations, misuse of registration numbers, police harassments, low awareness among authorities of the importance of the trade, and lack of organization within the sub-sector. They confirmed the need for

an in-depth study of the small-scale export sub-sector and for inclusion of the sub-sector in assistance programmes on the basis of a justification consistent with its importance for livelihoods in artisanal fisheries.

The Ministry of Food Processing Industry (2006) has identified reasons for investing in the Indian Food Processing Sector. They are: (1) It is the seventh largest country with extensive administrative structure and independent judiciary, a sound financial and infrastructural network and above all, a stable and thriving democracy. (2) Due to its diverse agro-climatic conditions, it has a wide-ranging and large raw material base suitable for food processing industries. A very small percentage of these are being processed into value added products. (3) It is one of the biggest emerging markets with strong middle class. (4) Rapid urbanisation, increased literacy and rising per capita income have all caused rapid growth and changes in demand patterns, leading to tremendous new opportunities for exploiting the large latent market. (5) Demand for processed/convenience food is constantly on the rise. (6) India's comparatively cheaper workforce can be effectively utilised to setup large low cost production base for domestic and export markets. (7) Liberalised overall policy regime, with specific incentives for high priority food processing sector; provides a very conducive environment for investments and exports in the sector. (8) Very good investment opportunities exist in many areas of food processing industries, the important ones being fruit and vegetable processing, meat, fish and poultry processing, packaged, convenience food and drinks, and milk products. (Government of India, 2006).

Cato, J. (1998), has tried to analyze 'Economics of Hazard Analysis Critical Control Point (HACCP)'. According to him, marginal benefit-cost analysis (or similar analytical techniques) should be performed for each Critical Control Point. This will allow the determination of the most economically effective way to achieve a specified standard of risk reduction, and will allow HACCP to be used as a business management tool at the processing plant level.

The Pacific Northwest Pollution Prevention Research Centre (PPRC) brought out report (1993) on 'Pollution Prevention Opportunities in the Fish Processing Industry'. The discussion focused primarily on Alaskan fisheries and

included technological improvements affecting waste reduction, economic impediments, communication needs, recycling efforts, and markets for waste products.

Srivastava, U. et al (1980), analyzed 'Management of Marine Fisheries'. He suggested that to facilitate planning and implementation of development of this sector, it is necessary to understand various inter-relationships between variables in this entire system of management of marine fisheries.

Boopendranath, M. et al. (2003), edited the book on 'Sustainable Fisheries Development: Focus on Gujarat', based on a seminar organized in Veraval. In recent years, the fishing fleet has increased significantly. This has brought about increasing pressure on fishery resources, reduction in catch per fishing unit, reduction in percentage of high value fishes in the landings, insufficient availability of raw material for fish processing sector, and is taking the fisheries development in the state to a crossroads. If the fishing industry in the state is to survive in the long term, more responsible practices and approaches need to be adopted. The development of inland fisheries and aquaculture in the state has been rather slow. With the emergence of aquaculture as the major source of raw material to the export oriented shrimp processing industry, Gujarat is losing its position of pre-eminence in the field of fisheries, which should be a matter of concern and requires the state Government's serious attention.

A seminar was organized to analyse 'fish processing industry in India' by AFST and CFTRI at Mysore in 1975. The prime objective of the seminar was to make suggestions for improving efficiency in the processing industry in the years to come. It was discussed that the aspects related to the fish production, export, preservation, marketing of processed fish and the quality aspects be emphasised.

Audun, L. et al (2004), studied 'Fish marketing and credit in Vietnam'. According to them, state-owned financial institutions play a major role in financing capital expenditure while working capital requirements are mainly met by informal sources of credit. However, future investment requirements and credit needs are greater than currently available.

Bostock, T. et al (1992), studied 'The Processing and Marketing of Anchovy in Kanyakumari District of South India: Scope for Development'. It was shown that losses in potential earnings as a result of poor fish landing, spoilage and low product quality were very significant. This was due primarily to the local practice of drying the fish directly on the beach sand. These have shown that dried Anchovy is a highly desirable product amongst a wide range of socio-economic groups in many countries, ranging from West Asia through South Asia to Southeast Asia. Given quality and presentational improvements, a quality premium is payable which can mean a fivefold increase in the product's wholesale price.

Tietze, U. (1998), has based his 'Report of the Workshop on Financing Value-added Production and Marketing of Fishery Products in Asia and the Pacific' on a workshop held in Kuala Lumpur, Malaysia in 1997. In addition to exchanging and discussing experiences in financing the production and marketing of value-added fishery products, the report also documents specific proposals for enhancing credit facilities for the production and the marketing of value-added fishery products with particular reference to the small and medium-scale sectors.

K. Rama Mohan Rao and D. Vijaya Prakash (2000), in their book 'Export Marketing of Marine Products' have attempted to examine the organization and development of marine products in the country. MPEDA is the organization promoted by government of India to look after the export of marine products from this country. An analysis of programmes and policies of MPEDA has been presented, with suggested strategies.

Kumar, A. (2004) analysed the Export Performance of Indian Fisheries: Strengths and Challenges Ahead. His study shows that fish export performance has been good and that liberalization has increased the growth of fish export from India. Export will grow as sanitary and phyto-sanitary measures are taken up. Since the growth of fish export may be limited by the strict quality standards of foreign countries, processing units should follow HACCP principles. A threat to food security was found in certain groups of people due to the fish trade. These groups can be protected by developing incentives and support services.

MPEDA's vision is to make India one of the top seafood exporting countries in the world in terms of value and quantity as well as to achieve a high export turnover. To achieve this objective, MPEDA has identified Tuna exploitation, diversification of aquaculture species and promotion of value added products as the focus areas. (MPEDA, 2006).

Section III

2.07 Reviews at a Glance

As is clear that the relevant literature is limited so far as the fish processing industry is concerned. Most of the studies deal mainly with biological and technological aspects, and very few related to economic aspects. "The lacunae of studies from this perspective and valid statistical and economic data have not only made planning unrealistic in these areas but also rendered appraisal of the performance of fishery development projects quite difficult" (Biswas, K., 2006). Therefore, the present study is imperative.

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