Introduction

Shrimp aquaculture sector occupies very important role in the socio-economic development of the country and also provide proteinaceous food for the poor people. The issue of malnutrition has become important for the growing populations in India as well as world. The aqua industry has expected to account progressively for the insufficient aquatic food supply that would occur for the population increase expected until 2030, and it is the fastest growing food production sector in the world increasing with an average rate of 9.2% over the past 30 years (FAO 2005) which makes aqua industry one of the promising industry to meet future food demand.

The pacific white shrimp *Litopenaeus vannamei* has become the main crustacean species produced through culture, with production exceeding that of black tiger shrimp *Penaeus monodon* since 2003 (FAO, 2007). This is largely due to the advantage in terms of disease management and strain selection resulting from domestication of brood stock. The continued growth of shrimp culture required high number of good quality post larvae and juveniles from commercial hatcheries, especially where captive brood stock was used. As is typical for Penaeids, the larval stages of *Litopenaeus vannamei* undergo complex tropic changes during development (Jones *et al.*, 1997; Levay *et al.*, 2001). The non feeding Nauplius stages are followed by the phytoplankton feeding Zoea and the carnivorous Mysis stages, the latter being highly dependent on a constant supply of live food, which is generally provided in hatcheries as rotifers and artemia naupli.

In 1950, When the Food and Agriculture Organization, (FAO) first compiled production statistics on shrimp production solely from wild catches (FAO, 1995). In 1975, the shrimp aquaculture industry contributed 2.5% of total shrimp production. In 1990s it was gradually increased and reached around 30% of total shrimp supply. During the last decade the farmed shrimp supply has stagnated and even been reduced to 3-4% of global aquaculture
production by weight and 15% by value (FAO, 1999). Out of it almost 80 percent of cultured shrimp came from Asia with Thailand, China, Indonesia and India as the top producers. Total farmed shrimp production for 2010 is estimated at around 3.06 mmt, down from the estimated 3.22 mmt produced in 2009 (Table-1.1). By region, the main producers include South-east Asia with 1.45 mmt; China, 899,600 mt; India and Bangladesh, 204,190 mt; the Americas, 465,600 mt; Africa and the Middle East, 27,500 mt; and others, 16,000 mt. Total global production is estimated to increase from 3.30 mmt in 2011 to 3.58 mmt by 2012. Table 1.2 shows shrimp aquaculture production estimates for Asia and Latin America from 2004 to 2012. In addition to China, include Thailand with 548,800 mt; Vietnam, 357,700 mt; Indonesia, 333,860 mt; India, 94,190 mt, and Bangladesh 110,000 mt. Several of these countries had lower production compared to the previous year. Total shrimp aquaculture production by major producing regions and Asia was given in table 1.1 and 1.2

Table-1.1. Shrimp aquaculture production by major producing regions (mt)

<table>
<thead>
<tr>
<th>Region</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeast Asia</td>
<td>993,115</td>
<td>1,150,615</td>
<td>1,333,639</td>
<td>1,357,155</td>
<td>1,462,992</td>
<td>1,342,629</td>
<td>1,449,440</td>
<td>1,574,876</td>
<td>1,716,346</td>
</tr>
<tr>
<td>China</td>
<td>935,944</td>
<td>1,064,949</td>
<td>1,080,479</td>
<td>1,265,636</td>
<td>1,268,074</td>
<td>1,181,130</td>
<td>899,600</td>
<td>962,000</td>
<td>1,048,000</td>
</tr>
<tr>
<td>India /Bangladesh</td>
<td>191,064</td>
<td>206,222</td>
<td>209,047</td>
<td>171,265</td>
<td>153,797</td>
<td>181,261</td>
<td>204,190</td>
<td>222,737</td>
<td>236,103</td>
</tr>
<tr>
<td>America</td>
<td>332,052</td>
<td>376,962</td>
<td>455,249</td>
<td>451,244</td>
<td>474,344</td>
<td>478,716</td>
<td>465,644</td>
<td>499,250</td>
<td>527,750</td>
</tr>
<tr>
<td>Africa /Mideast</td>
<td>25,500</td>
<td>26,753</td>
<td>27,790</td>
<td>26,641</td>
<td>30,067</td>
<td>25,000</td>
<td>27,500</td>
<td>30,000</td>
<td>34,000</td>
</tr>
<tr>
<td>Other</td>
<td>7,585</td>
<td>9,968</td>
<td>11,751</td>
<td>9,502</td>
<td>9,725</td>
<td>15,000</td>
<td>16,000</td>
<td>16,000</td>
<td>16,000</td>
</tr>
</tbody>
</table>

Sources: FAO (2010), GOAL (2010, 2009)

(Global production Estimates Key Element of GOAL 2010 Program)
India’s seafood industry has become one of the leading suppliers of quality seafood to all the major markets of the world. India is the second largest aquaculture producer in the world, the 2nd largest producer of fish & exporter of shrimps to EU, the 4th largest exporter of shrimps to Japan and the 5th largest exporter of shrimp to US. Indian seafood exports are growing exponentially over the past 5 years. India exported US $2.857 Billion worth quality seafood in 2010-11 and is expected to achieve US $ 4 Billion in 2011-12. Sustainable fishing methods, increased shrimp aqua production particularly of *Litopenaeus vannamei* offers best opportunity to participate in this growth. The world shrimp aquaculture production given in fig: 1.1

Table: 1.2. Shrimp aquaculture production estimates in Asia (mt)

<table>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>935,944</td>
<td>1,064,949</td>
<td>1,080,479</td>
<td>1,265,636</td>
<td>1,268,074</td>
<td>1,181,130</td>
<td>899,600</td>
<td>962,000</td>
<td>1,048,000</td>
</tr>
<tr>
<td>Thailand</td>
<td>360,292</td>
<td>401,251</td>
<td>500,800</td>
<td>504,856</td>
<td>507,500</td>
<td>541,994</td>
<td>548,800</td>
<td>553,200</td>
<td>591,500</td>
</tr>
<tr>
<td>Vietnam</td>
<td>275,569</td>
<td>327,200</td>
<td>349,000</td>
<td>376,700</td>
<td>381,300</td>
<td>302,400</td>
<td>357,700</td>
<td>403,600</td>
<td>444,500</td>
</tr>
<tr>
<td>Indonesia</td>
<td>238,567</td>
<td>279,539</td>
<td>339,803</td>
<td>330,155</td>
<td>408,346</td>
<td>299,050</td>
<td>333,860</td>
<td>390,631</td>
<td>442,757</td>
</tr>
<tr>
<td>India</td>
<td>133,020</td>
<td>143,170</td>
<td>144,347</td>
<td>107,665</td>
<td>86,600</td>
<td>76,261</td>
<td>94,190</td>
<td>107,737</td>
<td>116,103</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>58,044</td>
<td>63,052</td>
<td>64,700</td>
<td>63,600</td>
<td>67,197</td>
<td>105,000</td>
<td>110,000</td>
<td>115,000</td>
<td>120,000</td>
</tr>
<tr>
<td>Asia total</td>
<td>2,001,436</td>
<td>2,279,161</td>
<td>2,479,129</td>
<td>2,648,612</td>
<td>2,719,017</td>
<td>2,505,835</td>
<td>2,344,150</td>
<td>2,532,168</td>
<td>2,762,860</td>
</tr>
</tbody>
</table>

Sources: FAO (2010), GOAL (2010, 2009)

(Global production Estimates Key Element of GOAL 2010 Program)
The MPEDA, a nodal agency under the Ministry of Commerce & Industry, Govt. of India coordinating with different Central & State Government establishments engaged in fishery production and allied activities established field offices in all the maritime states of India and the developmental schemes for export promotion/aquaculture production of marine products (Table 1.3). During 2010-11 for the first time in the history of Marine product exports, the export earnings have crossed 2.8 billion US $. This is also first time that export has crossed all previous records in quantity, rupee value and US $ terms. Exports aggregated to 8,13,091 tones valued at Rs. 12,901.47 crore and US $ 2,856.92 million (Fig1.2). Compared to the previous year,
seafood exports recorded a growth of 19.85% in quantity, 28.39% growth in US $ earnings respectively.

**Fig: 1.2 Marine products Export Growth in US$ Terms**

![Marine Products Export Growth in US$ Terms](image)

**Source: MPEDA, 2011(News letter)**

Shrimp farming is highly technical activity and sensitive to the environment. Indiscriminate and unplanned use of feed and fertilizers with subsequent effects on water quality in pond ecosystems and correspondingly increases stress on shrimp and accelerate susceptibility to pathogen. The concept of sustainability serves as a tool for evaluating the more sustainable product, a farm raised shrimp or a wild shrimp caught shrimp. Determining which product is more sustainable relies on the knowledge of how the shrimp caught or how the shrimp was raised. The technical advisory committee of the consultative Group on International Agriculture Research defines sustainability as “Successful management of natural resource base and the orientation of technological and Institutional change in such as to ensure the attainment and continued satisfaction of human needs, while maintaining or enhancing the quality of the environment and conserving natural resources” (Pullin et al., 2007).
The momentum of growth in aquaculture acquired in India during late eighties and early nineties started declining due to various bio-physical and Socio-economic factors including occurrence of White Spot Syndrome Virus (WSSV), stipulations of Supreme Court and lack of institutional credit support. It is possible to solve most of the production constraints through well developed management practices. Hence, there is a strong need to facilitate the adoption of **Better Management Practices (BMPs)** to achieve the goal of sustainable shrimp farming. International principles of shrimp farming were evolved from the consortium programme on shrimp and environment sponsored by the FAO/NACA and WWF. These principles were evolved to harmonize the various certifications stand evolved different agencies for suitable shrimp farming. It include eight basic principles starting from Farm siting, Farm designing, water use, Brood stock and post larvae, Feed management, Food safety and Social responsibility. The long-term success of shrimp farming depends upon providing a good growth, better survival and sustainable environment in ponds concerned for shrimps. Environmental conditions in shrimp production ponds are directly linked with the ecological considerations of the coastal zone. Therefore, it is in the best interest of shrimp farmers to use environmentally responsible production practices that will not have any negative impacts on the environment. BMPs can facilitate the farmers to farm shrimp in a more sustainable way taking into account also the environmental and socio-economic considerations. BMPs must meet the needs of farmers and has to be modified and adopted to their considerations to make it more appropriate and relevant in each location. Farmers need to be relied up on as learning base for enhanced capacity building and their participation is a must in the development of strategies for the adoption of BMPs. More than 90% of the shrimp farmers in the country are small, own less than 2ha of area of ponds and they are located with each other and share the same source of water. Because of this it is essential that the BMPs are adopted by all the farmers who share a creek or canal.
Marine shrimps are benthic animal spending most of their life in contact with the bottom (Dall et al., 1990) and have wide range of food habits in natural systems. They have been described as omnivorous scavengers, opportunistic omnivores, detritus feeders, carnivores and predators (Bailey-Brock and Moss, 1992). They consume detritus aggregates, including bacteria and microfauna, including protozoa, microalgae, zooplankton, macrobenthos and other items (Dall, 1968; Chong and Sasekumar, 1997; Moriarity, 1997). Shrimp in intensive culture ponds also derive significant benefits from small suspended solids in culture waters (Leber and Pruder, 1988; Moss, 1995; Burford et al., 2004). The widely diverse feeding behavior of possibilities to culture shrimp in monoculture or polyculture as either the main species or secondary species. However, research and culture practices were mainly based on extensive and semi-intensive systems.

Constant improvements through nutritional research have narrowed the dependency on live foods and some studies have reported the successful total replacement of microalgae and/or artemia at different larval stages (Kanazawa, 1990; Cuzon and Aquacop, 1998; D’Abramo et al., 2006). Complete replacement of live foods with formulated food through all the larval stages has been demonstrated (Jones et al., 1979; Kurmaly et al., 1989a, 1989b; Levay et al., 1993) but while survival can be equivalent to that of larvae rared on live foods, growth and development may be slower (Levay et al., 1993; D’Abramo et al., 2006).

Penaeid shrimp larvae showed good acceptance of inert diets in co-feeding regimes and different methods have been applied to evaluate the physical, chemical and nutritional performance of new feeds. Among the larval growth and survival rates, diverse conditions indexes and stress tests are some of the methods used to indirectly evaluate the nutritional quality of larvae and post larval diets (Gallardo et al., 2002; Robinson et al., 2005). Valuable information has also been gathered through the assessment of rates (Kurmaly et al., 1989; Rosas et al., 1995; Delima and Souza-Santos, 2007) and estimation
of diet assimilation (Sumule et al., 2003; Jimenez – yan et al., 2006). Biochemical analysis have been included the evaluation of diets for larval and adult tissue (Abdel-Rahman, 1996; Coutteau et al., 2000). Direct assessment of nutrient incorporation has advantage because they integrate not only what has been selected, ingested and digested, but also assimilated in to growing tissue.

Oceans and inland water contribute less than 1% of the world’s food requirements, with rest produced by land production- systems (FAO, 2006). The production of the world fisheries is currently stable and trend show that by 2030 aquaculture production will exceed traditional fishery capture (Tidewell and Allan, 2001). Aquaculture species production is mainly freshwater species, but because fresh water is becoming scarce to several parts of the world, mariculture or brackish water species are alternate for increasing the production of aquacultures species. In 2004, aquaculture activities were 43% of marine resources production worldwide. Shrimp was the most significant product economically, being 17% of the global value of shrimp production in international trade (FAO, 2007). The feed industry released to shrimp farming is of great economic importance as it represents 60-80% of shrimp production costs, with protein usually accounting for at least one third of compounds found in commercial diets (FAO, 2006). However, the growth of the shrimp farm industry is strongly conditioned by the availability and quality of proteins produced from aquatic organisms and effluents from shrimp farms that have been shown to produce relevant environmental impacts. Current feeding methods taken advantage of shrimp omnivorous habits by incorporating plant based ingredients to their diet as an alternative source of proteins which in addition, may contribute to the reduction in environmental impacts derived from this industry (Kanazawa, 1989).

In India, the success of aquaculture industry based on the extensive and semi-intensive culture systems. In extensive culture practice the target species is completely depend on the natural food supply from the culture medium while in semi-intensive culture practice the target species is also dependent on
supplementary feed along with natural food supply. In semi-intensive culture systems feed with fertilized ponds resulted in significantly higher growth survival and better yield than fertilization alone (Green, 1992; Diana et al., 1994). Supplementary feeds costs in aquaculture operations account for approximately 50% of total operational costs (Keenum and Waldrop, 1988; Ratafia, 1994) and is considered a major constraints for aquaculture operations.

Fish meal is utilized as a protein source not only provides lipids, essential fatty acids, minerals and vitamins to the diet but also it is too expensive. Consequently, there will be more likely a need to use a variety of feed ingredients in association with animal and plant by products to provide a better balanced nutrient profile. Utilization of various potential protein sources in shrimp feeds such as animal and plant resources have been evaluated under different rearing conditions (Lim and Dominy, 1990; Pead- Pascual et al., 1990, Sudaryono et al. 1995, Amaya et al., 2007a, 2007b; Cruz-Suarez et al., 2001, Ray et al. 2009). In order to reduce feed cost, findings alternative protein sources to replace costly protein such as commercial feed. There is considerable interest in optimizing the protein sources in shrimp feed using locally available plant and animal protein sources. This is because of their steady supply, consistent quality and low cost which could contribute to reduce feed cost. Therefore alternative protein sources used to replace costly commercial feed containing nutrient profiles that support the shrimp nutritional requirement for growth and survival. In addition to the high price the availability of protein ingredients is also a problem for feed producers (Foster et al., 2003). Besides, the use of several sources of plant proteins is limited due to many specific anti-nutritional factors (Francis et al., 2001) and imbalance in amino-acid composition (Watanabe et al., 1995). So less-expensive plant proteins with none or minimum anti-nutritional factors are seriously being considered as alternative sources. Among such alternatives Ground nut cake, heated soybean cake, Rice bran may prove to be a valuable protein sources due to its high protein content (Palmegiano et al., 2006, 2007).
The lipid levels in the commercial shrimp feed range from 6 to 8% and should not exceed 10%. According to Akiyama et al. (1992), decreased shrimp growth and increased mortalities are associated with Lipid levels exceeding 10% probably due to nutrient imbalances/deficiencies as they relate to energy and toxic products for lipid oxidation. In many studies, the lipid level judged to be best for a number of shrimp species that may be influenced by a variety of factors, including the quality and quantity of dietary protein, the Quality, Quantity and availability of other energy sources (D’Abramo, 1997). Shrimps are required dietary lipids to meet a variety of metabolic functions.

Dietary lipids are a concentrated and highly digestible source of energy supplying approximately 9Kcal/g about double of that contributed by either carbohydrate or protein (Mead et al., 1986). In addition, dietary Lipids are a source of essential fatty acids (EFA) necessary for normal growth and survival of all organisms, and source of other nutrients such as sterols and phospholipids, which are necessary for normal metabolic functions of crustaceans. Dietary lipids are also served as carriers of the fat-soluble vitamins A, D, E and K. It has reported that elevated lipid levels carcass composition of shrimp mainly due to increase in lipid deposition in hepatopancrease. Moreover, food intake may be influenced by energy content thus excess dietary lipid content may influenced in food consumption and ultimately results in nutrient deficiencies (D’Abramo,1997).

The intensification of shrimp aquaculture and globalization of the sea food trade have led to remarkable developments in the aquaculture industry. However, the economics of most modern aquaculture operations require that hydrobionts be cultured at high level stocking densities and a consequence is the increased probability of exposure of the hydrobionts to elevated stressful conditions. The diseases and deterioration of environmental conditions often occur and result in serious economic losses (Bondad - Reantasoe et al., 2005). Prevention and control of diseases have led during recent decades to a substantial increase in the use of veterinary medicines. The utility of
antimicrobial agents as preventive measures has been questioned, given extensive documentation of the evolution of antimicrobial resistance among pathogenic bacteria.

Globally, tones of antibiotics have been distributed in the biosphere during an antibiotics are of only about 60 years duration. In the United States, 18000 tones of antibiotics produced each year for medical and agricultural purposes, 12600 tones are used for the non therapeutic treatment of livestock in order to promote growth (Scan, 2003). In the European Union and Switzerland, 1600 tones of antibiotics, representing about 30% of the total use of antibiotics in farm animals, were similarly used for growth promotion purposes in 1997 (Scan, 2003). These amounts of antibiotics have exerted a very strong selection of pressure towards resistance among bacteria, which have adapted to this situation, mainly by a horizontal and promiscuous flow of resistance genes (Scan, 2003).

Indian shrimp has been evolved as a leading culture industry in the international scenario, using locally available species such as *Penaeus monodon* and *Fenneropenaeus indicus* growing in brackish water culture ponds. In the year 2002, the exotic species like *P.vennamei* stock was brought to India by BMR industries Pvt.Ltd with permission from Government of India. In the year 2009, the species *L.vannamei* has been accepted for commercial culture in India in view of the significance of the introduction of exotic species and possibility of prevalence of several endemic diseases in the culture operations of the *L.vannamei*. The main reasons for outbreak of disease likes virus, bacteria, fungal and other diseases could be possibly implied because of pond management practices particularly because of direct pumping of water from the creeks and canal without any pathogen screening and elimination methods.

Few researchers revealed that high stocking usually increases the pond sediments leading to pond deterioration (Blackburn et al., 1988; Garnier
and Barillier, 1991 and Ray and Chien, 1992) and increases the susceptibility of shrimp to pathogen (Hanson and Goodwin, 1977; Bacticados et al., 1986 and Doubrovsky et al., 1988). Further it affects the growth of the shrimp to reduce a reasonable amount (sandifier et al., 1987; Ray and Chien, 1992; Daniels et al., 1995 and palomino et al., 2002). It also increases the pressure on the availability of natural food resources (Hopkins et al., 1988 and Allan and Maguire, 1992a), reduces the food conversion efficiency (Sandifier et al., 1987 and Martin et al., 1998) and finally resulting in raising the total food costs (New, 1987).

Pacific white shrimp, *Litopenaeus vannamei*, are one of the most intensively cultivated shrimp in the world (Perez Farfante and Kensley 1997). Over 90% of shrimp culture in the Western hemisphere is represented by the white shrimp (*Penaeus vannamei*) (Wurmann et al., 2004). This species is generally cultivated in semi-intensive systems located near coasts. In Asia it has been first introduced in China, later it has spread in East, southeast and South Asian countries. Generally Pacific white shrimp *L. vannamei* will tolerate wide salinity range and high incidence of epidemic diseases. Initially the development and growth of inland shrimp farming of white shrimp happened in coastal areas (Boyd 2001; Saoud et al., 2003; Roy et al., 2007). Because of the reduced risk of catastrophic diseases and favorable environmental conditions inland shrimp farming has been expanding rapidly all over the world (Boyd 2002; Zhu et al., 2006). As a result inland shrimp farming is now present in both saline coastal wetlands and arid regions far from the sea (Roy et al., 2007).

There is little information about the growth and survival of *L. vannamei* in brackish water. Some reports have shown that it will grow from 1.2 to 20g in 120 days at a stocking density of 25 no’s shrimp/m² (Samocha et al., 2002). There were also reports of super-intensive culture (109 shrimp/m²) in earthen ponds (0.1ha) in the Sonora Desert of Arizona, with production as high as 12 tons/ha in low salinity (Davis, Samocha, & Boyd 2004). Research
has been done to identify the reasons for the differences in survival and growth among farms, and to develop strategies for producing shrimp under various conditions (Davis, Samocha, & Boyd 2004).

Stocking density significantly affects shrimp growth (Martin et al., 1998), survival (Ray and Chien, 1992) and yield, etc. (Allan and Maguire, 1992 and Daniels et al., 1995). Few researches about interactive effects of stocking density on shrimp growth performance were reported. In recent years, technologies have been developed which allow the intensification of shrimp production rates without sacrificing large average sizes or negatively impacting water quality. These technologies include adding substrate materials to the production ponds combined with increased stocking densities, (Tidwell and D'Abramo, 2000). Planktonic use of shrimp production in extensive ponds has been promising results (Van Dam et al., 2002; Hargreaves, 2006; Azim and Little, 2006) in aquaculture.

**Health as a constraint to shrimp farming** : The current trend in shrimp culture development is towards increased intensification and commercialization of aquatic production. Like other aqua farming sectors, the likelihood of major disease problems occurring increases as culture activities intensify and expand. Thus, the shrimp farming industry has been overhelmed with its share of diseases and problems caused by virus, bacteria, fungi, protozoan, crustaceans and other undiagnosed and emerging pathogens. Diseases are now a primary constraint to the culture of many aquatic species, impeding both economic and social development in many countries. This situation can be attributed to a variety of multi faced and highly interconnected factors such as the increased globalization of trade in live aquatic animals and their products; the intensification of shrimp farming through the translocation of brood stock larvae and post larvae; the enhancement of marine and coastal areas through stocking aquatic animals raised in hatcheries; the mishandling and misuse of specific pathogen free stocks, unanticipated negative interactions between cultured and wild populations (Oliver, 2002).
In India, aquaculture industry has grown at an alarming rate surprising some major hurdles (disease outbreak and pollution) with improved technologies and with the introduction of commercial formulated feeds leading to the deterioration of the surrounding environment and of pond water and sediment quality. The economic performance of Inland shrimp farming may be improved by two ways. Revenue increase and cost decrease are the two ways. Financial analyses of shrimp production technology generally indicate that economic performance is more sensitive to increasing revenues through increased production (e.g., Stocking density, survival, and growth rates) than to reducing input costs (e.g., labor, construction and feed) (Rhodes et al., 1987; Wyban et al., 1987; Wyban and Sweeney, 1989; Wang and Leiman, 2000). Some analysis also suggests that for inland shrimp farming commercially feasible production technology will develop most rapidly by intensifying production systems rather than by reducing costs, in optimizing the culture area.

Andrews et al., (1972) explained and suggested about the importance of balance between dietary energy and protein requirement for shrimp feed formulations. Rosas et al., (2001) first determined the optimal (E:P) ratio for *L. vannamei*. Later some other researchers also noticed for *L. vannamei* (Dokken, 1987; Aranyakananda, 1995; Cuzon et al., 2004). Normally feeding method has the ability to increase or decrease the feed intake. Sometimes it nullify the effect of a low protein diet through higher feed intake and substantially affects the variation in dietary E:P requirement (Kureshy and Davis, 2002). Foster and Bread, (1974) revealed that this decrease at higher density was due to crowding and stress. Haran et al., (2004) and Arnold et al., (2006) were also agreed and reported that higher densities will lead to greater dominance and hierarchy placement of large organisms over small organism in terms of feed and space. Social interactions due to higher population create inhibitory effect on growth and survival.
Various plant protein sources and their products were used successfully in aquatic animal feeds such as Ground nut, soybean, pea, cotton seed, corn gluten, wheat gluten and distiller’s grains soluble, have been reported: (Allan et al., 2000; Alvarez et al., 2007; Boonyaratpalin et al., 1998: carter and Hauler; 2000; Fountainhas-Fernandes et al., 1999; Kaushik et al., 1995; Kikuchi, 2007; Lim and Dominy, 1990; Mambrini et al., 1999; Sudaryono et al., 1995, 1999; Watanabe et al., 1993; Webster et al., 1991, 1993, 1995).

Substitution of fish meal with plant protein and other animal proteins in shrimp diets in combination with other ingredients resulted an acceptable Growth, Survival and Feed Conversion Ratio (FCR) (Amaya et al., 2007a, b; Cruz-Suarez et al., 2001; Lim and Dommy, 1990, 1992; Piedad-Pascual et al., 1990; Ray et al., 2009; Samocha et al., 2004; Smith et al., 2001; Sudaryono et al., 1995). Amaya et al., (2007a) evaluated the diets containing 0 to 9% fish meal in combination with 16% of poultry by- product meal, a plant base diet containing 1% squid meal and a commercial diet for L.vannamei reared under pond conditions. Roy et al., (2009) experimented diets with combinations of vegetable protein and 10% fish meal resulted in similar weight gain, survival and FCR of Pacific White shrimp. Partially substituted or no fish meal diets resulted no negative impact for growth and production when feeds formulated to contain well balanced of nutrients for animal (Amaya et al., 2007a,b; Davis et al., 2004; Davis and Arnold, 2000).

Dietary protein requirement for L.vannamei has been estimated under controlled or observed environmental conditions. Many results have suggested that protein requirements of juvenile L. vannamei ranges from a level of 15% (Aranyakananda, 1995), to 30% of diet (Cousin et al., 1991) approximately. Some have suggested certain greater values also. It was 36% of diet (Smith et al., 1985) and even greater than 40% of diet (Colvin and Brand, 1977). These protein requirements may vary with age, size, physiological status, growth rate and dietary characteristics such as E: P ratio (Colvin and Brand, 1977; Bhaskar and Ali, 1984; Akiyama, 1991; Guillaume, 1997; Pedrazzoli et al., 1998).
Aquatic organisms have an intimate relationship with the water they live in as their bodies, gills and other organisms are in constant contact with what is dissolved and suspended in it. Therefore, water Quality directly affects the health and growth of the cultured organisms. Water contains many organic and non-organic elements that collectively make up what is termed as water Quality. The Quality of water is not a fixed characteristic, is very dynamic, changing overtime as a result of environmental factors and biological process. Water Quality is initially related to the source of water. In the culture environment its Quality may be altered by biological process such as photosynthesis, respiration and excretion of metabolic wastes, as well as by physical processes such as temperature wind. In the shrimp culture, most important parameters determining the suitability of water for aquaculture are the alkalinity, Hardness, dissolved oxygen, temperature, pH and phytoplankton diversity. Therefore, all of these water Quality parameters should be strictly managed at their optimum level of productive environment to culture species (Boyd and Green, 2002). The different biological and physic-chemical parameters of the water were assessed to find out the optimum levels of each parameter that are required for the pond culture of this shrimp species.

The adequate management and use of the natural biota in shrimp ponds as techniques in farming have found to be cost effective methods in reducing the risk of environmental degradation (Martinez-Cordova et al., 2002, MartineZ-Cordova & Penamissina, 2005; De Schryver et al., 2008). This achieved through lesser use of supplementary feeding thereby decreasing the organic load of the effluent that is being released back to the water ways. The culture method in shrimp farming suits these criteria in which there is ideal stocking density of the shrimp and the cultured stock relies mainly on natural feed production. It has been demonstrated that semi intensive ponds, the natural food present can support up to 75% of nutritional requirements of the stock (Anderson et al., 1987; Jory, 2000).
Shrimp aquaculturist opt that to consider aquaculture has the overall technical co-operation of the farm supervision of day to day activities. Good farm management expertise is often considered as the same as practical experience in the application of shrimp in the field. Proper and firmly maintenance of shrimp farm/pond and its installation, successful methods of perfect stocking, proper feeding and disease management, proper water management, including the maintenance of water quality, protection of stock from pouching, harvesting and marketing are the major elements of the content of better management practices. Keeping in view of the importance of better management practices and application of sufficient quantity of fertilizers and quality of supplementary feed including probiotics, the present work has been designed to evaluate the survival growth performance and some immunological parameters of *L. vannamei* under different experiments in the better management practices.

Main objectives of the present study is

1. To compare with the survival and growth performance of *L. vannamei* in the different stocking densities.

2. To observe the effect of supplementary feeds from commercial, animal and plant proteins in terms of proximate composition (moisture, total protein, total fats and ash) of the shrimp and feed.

3. To study the effect of probiotics on survival and growth of *L. vannamei* including some immunological parameters.

4. To observe and record the presence of diseases during experimental period and to study the histopathological observations of Vibriosis sps effected *L. vannamei*. 
Review of Literature

The decapods are the largest and longest crustacean animals in most of water bodies particularly shrimps, prawns, and lobsters. These capture species goes to 5, 39, 000 MT in 1989 worth of US $ 3.5billions and by 1997 this had raised to 1.1 MMT comprising value of US $ 7.2billion (Kongeko 2001). The shrimp activities started in 1970’s as an identical activity developed with a gigantic increase in number of culture systems. Shrimp farming make available about 30% of the shrimp produced in the world market.

It is estimated that shrimp culture produces in 1997 was worth of US $ 6.9 M at farm gate prices in Asian region representing a sum of 9, 02, 000 MT. The value added through processing in addition is remarkable making its worth more than US$ 6.9 billion to the province (Kongeko 2001). In Asia and pacific region the production of introduced Litopenaeus (Penaeus) vannamei was 1.1MMT (FAO, 2006). In 2004, Asia alone produced more L.vannamei (52%) than the native species P.monodon was 48% (FAO, 2005). Over the years pacific white shrimp Litopenaeus vannamei production has greatly increased in South East Asia. Currently it was the leading farm raised shrimp (Davis et al., 2004). The massive expansion of commercial shrimp culture in the last decade is now facing limitations due to increased price of raw materials and higher quality demand in shrimp market (Lucien-Brun and Vidal, 2006).

Most of the researchers worked on the economic performance of shrimp farming in terms of stocking density, survival and growth rates. The following authors worked on the shrimp production increments through optimum stocking densities: Cailout et al.,(1976); Hanson and Good win (1977); Sedgwick (1979); Maguire and Leedow (1983); Lee et al., (1986); Baticados et al., (1986); Sandifer et al., (1987); Rhodes et al., (1987); Wyban et al., (1987); Doubrovsky et al., (1988); Black burn et al., (1988); Hopkins et al., (1988); Wyban and Sweeney (1989); Garnier and Bariller (1991); Ray and Chien (1992); Why-Ming and Yew Hu (1992); Allan and Maguire (1992a); Daniels et
The role and importance of natural pond biota in improvement of growth and survival rates of cultured fish and shrimp was noted by Anderson et al., (1987); Hunter et al., (1987); Leber and pruder (1988); Castille and Lawrence (1989); Bostock (1991); Teichert-coddington et al., (1991); Cam et al., (1991); Allan and Maguire (1992); Trino et al. (1992); Cruz-Suarez, Ricque and Aquacop (1992); Moss et al., (1992); Akiyama (1993); Palacios et al., (1994); Moss (1995); Trino and Sarroza (1995); Teichert-Coddington and Rodriguez (1995); Hopkins, Sandifer and Browdy (1995); Hunter (1996); Nunes et al., (1997); Lawrence and Lee (1997); Moriarity (1997); Cook and clifford (1997); Focken et al., (1998); Tacon et al., (1999, 2001b, 2002); Villamar (1999); Nunes and Parsons (2000); Velasco and Lawrence (2000a); Gautier et al., (2001); Otoshi et al., (2001); Moss et al., (2006); McLean et al., (2006); Tacon and Metian (2008) and Terrazas-Fierro et al., (2010).

The dietary nutrient requirement and feeding habits of shrimp was important in formulating of a feed for any culture organism. The following researchers have studied and formulated feed models for Protein, carbohydrate, lipid, vitamins and minerals requirement in fish and shrimp: Jones et al., (1979); Barrows et al., (1980); Bordner et al., (1983); Guillaume (1987); Kanazawa (1990,1995); Cho (1991, 1992); Akiyama (1993); Teshima et al., (1993); Kiang (1993); Coelho (1994); Lim and Cuzan (1994); Rokey and Huber (1994); Tacon (1994); Boonyaratpalin (1996); Kurmalay and Guo (1996); Chon (1996); Kanazawa (1996); Pangantohen et al., (1996); Potter et al., (1996); Bird (1997); Kontara et al., (1997); Tan and Dominy (1997); D’Abramo et al.,(1997); Riaz (1997, 2001); O’keefe (1998); Focken et al., (1998); Obaldo et al., (1998); Shiau (1998); Dveresse (1998); Nunes and

Some of the researchers studied on the nutritional requirements of *P.vannamei* during larval development. The following are Jones et al., (1979); Kurmalaya et al., (1989a, b); Lawrence and Castille (1991); Leray et al., (1993); Rosas et al., (1995); Abdel-Rahman (1996); Coutteau et al., (2000); Gallardo et al., (2002); Robinson et al., (2005); Kanazawa (1990); Cuzon and Aquacop (1998); Brito et al., (2001); Sumule et al., (2003); Calderon et al., (2004); Jimenez-Yan et al., (2006); D’Abramo et al., (2006); de lima and Souza-Satos (2007) and Gamboa-Delgado and Le Vay (2009).

The dietary requirements of juvenile *L.vannamei* were studied by Andrews et al., (1972), Smith et al., (1984); Teichert-Coddington and Rodriguez (1995); Velasco et al., (1998, 2000); Beiping et al., (2000); Davis and Arnold (2000); Kureshy and Davis (2002); Epp et al., (2002); Foster et al., (2003); Cheng and Hardy (2004); Samocha et al., (2004); Tan et al., (2005); Siccardi (2006); Cruz-Suarez et al., (2007); Ju et al., (2009); Forster et al., (2010); Terrazos-Fierro et al., (2010) and Otoshi et al., (2011).  

The Animal proteins are used in the preparation of shrimp feed as protein source by Devresse (1996); Civera et al., (1998); Tacon and Barg (1998); Vargas et al., (1998); Cruz-Suraz et al., (1998,200a); Corpron and Boonyaratpalin (1999); Tacon and Akiyama (1997); Williams et al., (1997); Shepherd (1998); Mendoza et al., (1998); IFOMA (2000); Hardy (2000);
DeBault et al., (2000); Davis (2000); Davis and Arnold (2000); Neylor et al., (2000); Dong et al., (2000); Hertrampf and Piedad-Pascual (2000); Li et al., (2000); Pearl (2000); Millamena et al., (2000); Smith et al., (2000); Anon (2000a); Tacon (2000b); Ziggers (2000, 2001); Hardy and Tacon (2001); Anon (2001c); Watanabe (2002); Cheng et al., (2002); Fox et al., (2004); Wang (2005); Cruz-suarez et al., (2007); Gatlin et al., (2007); Hernandez et al., (2008); Naylor et al., (2009); Simon (2009a); Chi et al., (2009); and Sookying and Davis (2011).

In preparation of shrimp feeds selection of suitable and digestible ingredients was most important to get better growth and FCR. Some of the scientists were concentrated on these aspects especially on specific pathogen free ingredients and binders. The following scientists were: Dominy and Lim (1991); Lim and Cuzon (1994); Jory (1995b); Kulty (1995); Philips (1995); Limsuwan (1996); Supamattaya (1996); Cuzon (1996); Intriago et al., (1996); Chamberlain (1997); Merchie et al., (1997); Cuzon and Gehin (1998); Camarena-Conchas et al., (1998); Baroows (2000); Sugiura and Hardy (2000); Fast and Menasreta (2000); Gill (2000a); Suresh and Zendeja (2000); Dominy et al., (2001); Tacon and Obaldo (2001); Fegan (2001); Prior et al., (2001); Rodriguez et al., (2001); Li et al., (2009) and Ali et al., (2010).

Feed additives were playing major role in the dietary requirement of shrimp nutrition and health management. Many researchers studied on the use and advantage of additives such as Free Amino Acids, feed enzymes, Chemo-attractants, feeding Stimulants, Probiotics, Immunostimulants, Antioxidants, Chemotherapents, certain Harmones and Pigments which are commonly used shrimp aquaculture. Some of them are: Fuller (1989); Toullec et al., (1991); Chen et al., (1992); Guzman (1993); Baldia (1994); Divakaran (1994); Swick (1994); Fox et al., (1995); Austin et al., (1995); Chen and Chou (1996); Mohanthy et al., (1996); Cuzon (1996); Koshio et al., (1996); Millamena (1996); Janssen and Peschhe-Koedt (1996); Heng and Guangyou (1996); Anon (1997); Buchanan et al., (1997); Guillaume (1997); Devresse et al., (1997); Lee and Meyers (1997); Moriaty (1997b,1998); Lopez et al., (1998); Guerin (1998); Best and Gill (1998); Divakaran et al., (1998); Montemayor et al. (1998); Kaushik (1998); Davis and Arnold (1998); Le Moullac et al. (1998); Dugger (1998); Davis et al., (1998); Intriago et al., (1998); Divakaran and Velasco (1998); Rosas et al., (1998); Samocha et al., (1998); Meyers (1998); Scholz et al., (1999); Rengpipet et al., (1998,2000); Gatesoupe (1999); Boyd

The role of the water quality parameter is more important in growth and survival of shrimp. In intensive shrimp farming some of the parameters like Temperature, Dissolve oxygen, Salinity, Hardness, pH and Nitrogen metabolites were influencing more on the shrimp nutrition. Some of the scientists worked on the effect of Dissolved oxygen, Temperature and Nitrogen metabolites on shrimp: Rahman et al., (2006); Krupesha Sharma et al., (2009); Esparza-Lee et al., (2009); Ye et al., (2009); Preetha panikar (2009) Schuler et al., (2010); Biao et al., (2010); Schuler and Boardman (2010); Schroeder et al., (2010) and Barbieri (2010).

Growth, survival and FCR of P.vannamei under different salinities was studied by Sandifer et al., (1987); Wyban et al., (1987); Reid and Arnold
Immunological studies were undertaken by many of the scientists to know the effect of certain feeds which are preferably using in different combination for shrimp growth and survival. The following scientists were worked on these immune responses in shrimp: Hernandez-Lopez et al., (1996); Lee (2002); Liu (2004); Wang and Chen (2005); Liu et al., (2006); Okumura (2007); Yeh and Chen (2008); Saravana Bhavan et al., (2008); Huai et al., (2009); Alpuche et al., (2009); Xian et al., (2009); Chen et al., (2010); Bai et al., (2010); Zhang et al., (2010) and Sun et al., (2010).

Diseases are recognized as major constraints to the sustainable development, expansion and intensification of shrimp farming. Hence most of the scientists are concentrated and studied to describe different types of diseases and the causative agents. Some of them were: Aquacop (1977); Couch (1978); Jhonson (1978); Lightner (1983,1999), Lightner et al., (1983a, 1983b, 1992, 1993, 1994, 1996a, 1996b); Lightner and Redman (1985, 1991); Bell and Lightner (1987); Anderson et al., (1987); Baticados (1986); Lim (1989); Brock (1992); Fegan et al., (1991); Flegal et al., (1992, 1995a, 1995b); Vickers et al., (1992); Boonyaratpalin et al., (1993); Brock and Main (1994); Bonami et al.,