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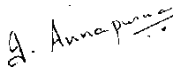
EDITORIAL

On behalf of the editorial team, I am presenting to you the peer-reviewed issue of Journal "STC Scholars Vision" III Volume. This issue is based on the papers presented at the National Conference on "Recent Trends in aquaculture for Sustainable Environment" held in November 2013 by department of Zoology, Ch.S.D. St. Theresa's College for Women, Eluru sponsored by Ministry of Earth Sciences, Government of India. Out 110 papers twenty two papers were chosen through a formal review process, to be included in this issue, after suggested modifications by the authors.

Importance of Aquaculture: Fats, proteins, carbohydrates and minerals are the chief ingredients of human nutrition. As the population of the nation increasing in arithmetical proportions the natural sources of food availability becoming insufficient, so we have to develop cultivated methods of food substances. Aquaculture is one of the major suppliers of protein supplements to the World population, and there is a special importance to the fish. As the fish meat and fat can reduce the cholesterol in the blood vessels i.e it can reduce cardiac problems and also supplement many vitamins and amino acids. It is a prime food substitute for human consumption. The unscrupulous and irregular catching of sea fish reduced the fish population in high seas that is why it became essential to produce fish through systematic cultivated methods. In this respect West Godavari District in Andhra Pradesh got the best soil, environment and naturally trained people at par with international standards for the cultivation of aquaculture. The human resource of aquaculture, the farmers and technicians are to be trained to cultivate using Eco-friendly methods.



Dr. Mrs. I. Annapurna
Editor – in - Chief

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Status of Coral reefs – The Nature's Natural Sanctuaries of Biological Diversity and Their Role in Fish Augmentation

Dr. Ch. Satyanarayana

Abstract

It is the need of the hour to protect coral **reefs, generally for the invaluable goods** and services they provide, fisheries in particular. Occupying just 2% earth surface Coral reefs provide 25% world fishery production on which majority of world population is dependent on. These highly productive ecosystems and safe niches for fish augmentation in the coastal zone are under severe threat due to man induced and natural forces and are predicted to vanish in less than a century. Global warming and over-exploitation are considered the potential threats. The importance of corals and coral reefs, their role in fish augmentation, different destructive fishing methods tried in coral reef areas, the lethal effects of global warming, present status of our reefs and the strategies to reverse the damage caused to do justice to the deprived and economically poor reef dependent populations are discussed in detail in this paper.

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Introduction

Coastal zone is the next frontier and ultimate resort for the human kind due to exhausting resources on land. Oceans always have an edge over land. Among the Oceans, the warm water belt is highly productive and diverse than the cold. In the Oceans the coastal waters are many times richer than the open sea part and are susceptible to changes because of their presence in the contiguous land domain. Coastal zone has become popular not only due to its susceptibility to dynamic natural and physical forces like storms, erosion, accretion, sea level rise etc. and also because of the presence of highly productive ecosystems like Mangroves, Coral Reefs and Sea grass beds. Among them coral reefs are considered the most valuable and richest. Coral reefs are compared with tropical rain forests in terms of biodiversity (Connel, 1978) and are nicknamed as Nature's natural sanctuaries of biological diversity because of the high diversity of animals they support (Satyanarayana, 2005).

Corals are least known and over exploited resources in our country". They are invertebrate animals belonging to the Phylum Cnidaria which form a hard external skeleton covering of calcium compounds of other materials. Coral polyps are mostly few millimeters in size and solitary or colonial in growth. Their organization is very simple, with a hollow cylindrical body with a small opening at the top used both for ingestion and egression of materials. The opening is encircled by whorls of tentacles used for catching the prey.

Most of the corals are hermaphrodites. Reproduction is both asexual (budding) and sexual (formation of sexual gametes). Most of the corals spawn at one favourable time facilitating the survival and dispersal of the zygotes. resultant larvae spend a brief planktonic life and settle down on a suitable substratum and grow into colonies by multiplication or division called budding. They secrete compounds of calcium or other horny materials to form skeleton to support their soft body. Corals in association with other calcium secreting animals and plants slowly build huge limestone structures called coral reefs.

Literally Coral reefs are defined as "limestone structures in relatively shallow water those results from the complex association of many calcium secreting plants and animals". Corals provide the matrix for coral reefs and develop one of the complex ecosystems in the world oceans which are the highly productive ecosystem in the marine environment. Because of their benthic nature corals depend on minute plants called zooxanthellae for their food. Zooxanthellae are minute plants which live in the body tissue of corals and some other plants. They produce carbohydrates with the energy derived from sunlight and supply about 80% of the food complement for coral growth.

Because of this symbiotic dependence on zooxanthellae, reef forming corals are restricted to 35°N and 32°S latitude. The reef growth is optimum at a depth of 15m where sufficient sunlight is available for growth. Reefs are at their best upto 65ft (20m). Because of the benthic nature, animals and plants of the reefs require good water circulation for continuous supply of food and they prefer stable physio-chemical parameters in the medium in which they live. The temperature should never go below 18°C and should ideally fall between 25°-30°C. The ideal salinity range is 27-38ppt. Under all these favourable conditions corals grow on an average of about 1 inch per year only.

The corals which form coral reefs are called as *hermatypic* corals and there are some corals found in deeper parts of the ocean which never form reefs and are called as *ahermatypic* corals.

Corals are divided into three groups' viz., Stony corals, Horny corals and Soft corals based on their skeletal formation. The other reef builders next to corals are Sponges, Molluscs, Calcareous algae etc. The value and beauty of coral reefs are enhanced by the association of other animals like fishes, crustaceans, echinoderms, reptiles, mammals etc., with the reefs.

Coral reefs- the geological structures formed by the calcium secreting plants and animals are the highly productive ecosystems in the coastal zone. Because of the symbiotic

association of the major reef builders (corals) with the microscopic algae (zooxanthellae) and their narrow tolerance limits to temperature and salinity, coral reefs are restricted to shallow depths in the marine environment along the equator. Their occurrence in the tropic belt makes them more productive and attractive. The resourcefulness of coral reefs is enormous. The following are some of the goods and services provided by coral reefs.

Goods

- Sea food products
- Raw materials such as seaweed.
- Cultivated food and material production.
- Medicinal treatments and products
- Live specimens for aquaria
- Non-renewable or very slowly renewable building materials

Services

- Shoreline Maintenance
- Flood and storm protection
- Sand production
- Nutrient cycling
- Waste assimilation and remediation
- Water quality maintenance
- Habitat
- Maintenance of biodiversity
- Maintenance of biological resilience
- Mixing and transport of organic production to food webs
- Development and transport of larvae and young
- Recreation
- Inspiration and support of cultural, aesthetic, and spiritual values

Among all those listed above. Fisheries provided by coral reefs stand on top since they provide 25% of the world fish catch and cater the protein needs of a large chunk of the world population inspite of their occurrence on 2% on this planet earth. The pristinely nature of the waters with the shelter and food they offer made them the **nursery and breeding** grounds for many fin and shell fishes. According to a WWF report one kilometre of well managed coral reef can yield an average of 15 tonnes offish and other seafood every year (UNISDR/UNDP (2012). Worldwide nearly 500 million people depend – directly and indirectly – on coral reefs for their livelihoods, food and other resources (Wilkinson, 2004). Further, it is estimated that nearly 30 million of the poorest human people in the world depend entirely on coral reefs for their food (Wilkinson, 2004).

Unfortunately, the support coral reefs extending to us made them the targets of overexploitation all over the world and are under severe threat primarily due to fisheries they provide. The various kinds of destructive fisheries methods practiced in coral reef areas include

- Shore seine
- Blast fishing
- Cyanide fishing
- Trawl fishing etc.,

All the biological components (Hard corals, Gorgonids, Shrimps, Lobsters, Chanks, Pearl oysters, Clams, Cephalopods, Sea stars, Sea urchins, Holothurions, Fishes, Turtles, Dugongs and even seaweeds etc.,) available in the coral reef areas are **over exploited**. **Habitats are altered and destroyed** due to indiscriminate fishing. **Pollution** and **sedimentation** in the reef areas increased beyond tolerable limits due to industrialization, urbanization and uncontrolled tourism. **Coral reefs on an average grow only at the rate of 1½ cm per year**. Inspite of this they are dynamited within few minutes and used as building material. Many reefs were lost both in India and abroad due to this irresponsible barbarous activity. Some species have dwindled drastically in numbers due to their unsustainable use as drugs. This list of wretchedness goes on and on.

Other anthropogenic impacts on coral reefs which are site specific in nature are:

1. Oil pollution,
2. Heavy metals and pesticides,
3. Engineering activities,
4. Destructive fishing,
5. Coral mining,
6. Physical damage from boat anchors and
7. Uncontrolled tourism.

In a nut shell undoubtedly **much reef damage has been caused by human impacts**. In addition to the above mentioned human interferences. Coral reefs are threatened by natural threats like predators, cyclones, tsunami etc. A beautiful starfish commonly called as **Crown-of-Thorns** (*Acanthaster planci)*is a voracious predator of corals in the Indo-pacific region. The most recent and deadly among natural threats is **Coral Bleaching**. This phenomenon takes places due to the expulsion of zooxanthellate algae from the coral tissues

due to the creation of unfavourable conditions like increase in the temperature in the surrounding medium due to global warming. Corals appear white like bleached material afterlosing their food providing partners and die slowly if the unfavourable situation continues. **Many reefs in the world including the well-managed Great Barrier Reef are affected due to 1998 bleaching event**. 16 percent of the world's coral reefs and 50 percent of those in the Indian Ocean were destroyed (Wilkinson, 2004).

A recent scientific report depicts irreparable damage to almost all the reefs in the world in another 40 years. In the recent years the frequency of natural calamities is increasing many fold. The devastating effect of recent **Tsunami** in Indian Ocean region is unexpected and the damage caused is unpredictable (Satyanarayana 2005).

Regrettably all this shameful degradation is happening in spite of well organised protection provided by our government.

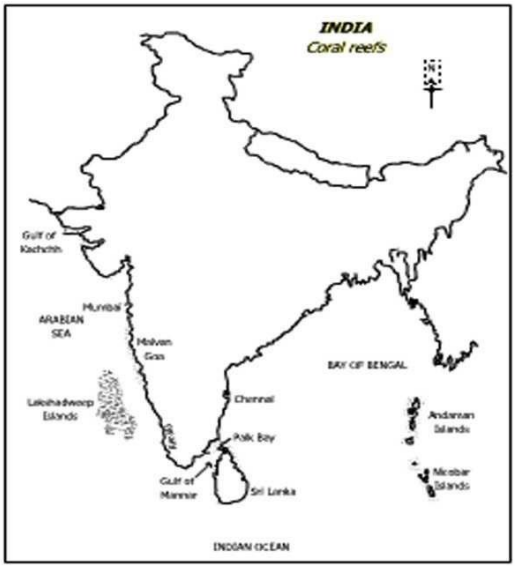
In India The Indian Forest Act 1927, Water (Prevention and Control of Pollution) Act 1974, Wild life (Protection) Act 1972, Maritime Zones Act, 1976, Forest (Conservation) Act 1980, Environmental (Protection) Act 1986, National Forest Policy 1988, Coastal Zone Regulation Act 1991 and Coastal Zone Management Plans of State Govts, Maritime and Port Policy and the Port Act of states provided protection to corals and coral associates at different levels.

Major initiative to conserve these valuable reefs dates back to 1969 when the first International Coral Reef Symposium was held at Mandapam on the banks of Gulf of Mannar, Tamilnadu. In the recent past, Ministry of Environment Forests which has been mandated for the impact assessment of all the developmental projects and their link to the protection of habits and ecosystems has taken the following initiatives benefiting the coral reefs as well as its associated mangrove ecosystems:

- Declared Coral reefs and mangroves as ecologically sensitive areas.
- Banned mining of corals and coral sands.
- Banned all exploitation and developmental activities in mangrove and coral reef areas.
- Prohibited disposal of wastes from adjoining industries and carrying of wastes by pipelines through mangrove areas.
- Carried out many capacity building activities through ICRMN (Indian Coral Reef Monitoring Net Work)/ZSI (Zoological Survey of India).

- Amended Wild life Protection Act 1972 to give legal protection to many reef builders and coral associates.

India is bestowed with extensive reef area and stands 10th in the world. There are four major reef regions in India and many patch reefs on all sides of the 7516.5 km. long Indian coastline. Gulf of Kutch, Gujarat on the west coast (42 islands), Lakshadweep close to Kerala on the west coast (about 20 reefs), Gulf of Mannar and Palk Bay reefs on the South east coast of India (21 islands) and Andaman & Nicobar islands (more than 530 islands) on the east coast of India are the **four major reef regions in India**. The occurrence of coral patches have been recorded in the intertidal regions of Ratnagiri, Malva and Rede, south of Bombay (Qasim and Wafer, 1979). Coral patches were also reported from Gaveshini bank about 100 km west of Malpe (Mangalore) (Nair and Qasim, 1978). Few stray recordings of corals were also reported off Visakhapatnam and Orissa coasts. More than 100 countries in the world are with coral reefs. **India possess a total reef area of 5,790 km^2 .**



Extent of Reef Area under Protection in the Reef Regions of India

Andaman and Nicobar islands (UT): This is the largest reef region in India with a reef flat area of 795.7 km^2. Much of the reef regions in Andaman & Nicobar are less explored. A major survey carried out by UNDP/GEF/ZSI in 2001 exposed the health of this region as the best in the whole of Indian Ocean region and the capability of these reefs to act as the seeding grounds to the affected reefs in the Indian Ocean during 1998 bleaching event. 6 Marine National Parks, 9 Marine Sanctuaries and 1 Biosphere Reserve declared from this Union Territory cover only a meager part of reefs. Another 90 islands covering much of the

island area are declared as protected areas. Large area of reefs under the water is outside the MPAs.

An area of 885 km^2 in the southernmost part of Andaman & Nicobar Archipelago is declared as Great Nicobar Biosphere reserve on 06.01.1989. It is the first out of the two Biosphere Reserves declared in the Coral Reef areas and covers terrestrial and marine ecosystems. Campbell Bay (429 km^2) and Galathea (110 km^2) protected areas are covered under this Biosphere reserve.

Lakshadweep islands (UT): Second largest reef area in India with a reef flat area of 136.5 km^2. These islands are the worst affected in the 1998 bleaching event when compared to other reefs. Reef Tourism in this region is very well organized. None of the coral reefs in this region has legal protection, only one small island called Pitti is declared as a sanctuary for birds.

Gulf of Kutch, Gujarat: It stands third in the reef area with a reef flat area of 148.4 km^2. It is the worst affected area in India primarily due to Industrialization. A sanctuary and a Marine National park are declared in this reef region. Gulf of Kutch Marine National Park is the first Marine National Park in India. The tidal amplitude is about 6 meters in this region. Even though most of the reef region exposed during low tides is covered under MPA, reefs in the sub tidal regions and water are outside MPA. All the 42 islands (34 with reefs) in this region are part of the Marine Protected Area.

South East Coast Reefs (Gulf of Mannar and Palk Bay), Tamilnadu: This is the fourth largest reef area in India with a reef flat area of 64.9 km^2. It contains about 21 coral islands in the Gulf of Mannar region. Its reefs are affected due to anthropogenic interference. One island totally disappeared and another was reduced to few square meters due to coral mining. 1 Marine National Park and 1 Marine Biosphere Reserve are declared in this region. 15 coral islands are part of the MPA, whereas other coral reef areas in the Gulf of Mannar and Palk bay under permanent water are beyond the boundary of the MPA (Singh 2002).

An area of 10500 km^2 in the Indian part of Gulf between India and Srilanka is declared as Gulf of Mannar Biosphere reserve on 18.02.1989. It is the second out of the two Biosphere Reserves declared in the Coral Reef areas and extends from the Pamban Island to Kanyakumari along the mainland coast. Gulf of Mannar marine National Park (6.23 km^2) with 21 coral islands is covered under this Biosphere reserve.

Malvan Marine Sanctuary (Sindudurg), Maharashtra: An area of 29.12 km^2 on the west coast of Maharashtra close to a fortified island called Sindudurg is declared as a Marine Sanctuary. These coral formations are between Mumbai and Goa off Malvan Coast.

The strategies for the protection of coral reefs should be dependent on their features and site specificity. The following is a brief description of the status of Indian reef regions.

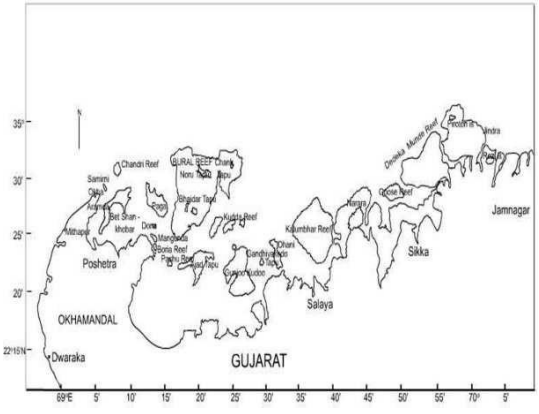
West Coast of India

Gulf of Kutch (Kachchh) Coral Formations:

Gulf of Kutch coral formations are the northern most reefs of India and are located in the Gujarat state situated on the west coast of India between Lat. 22° 15'N - 23° 40' N and Long. 68° 20' - 70° 40' E. Gulf of Kutch is 170 km long and 7350 km^2 in area and consists of 42 islands in its southern part among which only 2 are inhabited. Northern shores are almost devoid of corals and out of the 42 islands 34 islands have coral reefs. This is the fourth important major reef region in India in terms of the live reef area and coral diversity. Coral reefs of Kutch are as important as other reefs. Because of their accessibility during low tides they can be nicknamed as non-diver's paradises and nature's outdoor laboratory due to the scope it provides for study and capacity building. Because of their elevated nature they can also act as seeding grounds during devastating calamities in the low lying environment.

The reefs are mostly fringing with patch, platform and coral pinnacles in some places. Gulf of Kutch has got characteristic arid climate, large semi-diurnal tidal amplitudes and negative water balance and is tectonically unstable. The corals in the Gulf of Kutch survive through extreme environmental conditions such as high temperature, salinity changes and high-suspended particulate loads.

The mean spring tidal influx extends from the mouth to the closed end of the Gulf and it has a range of 2.1 m to 6.2 m. A notable correlation exists between the tidal range and the tidal current speed. The Gulf of Kutch is elongated in the east west direction and has an average depth of 30 m.



Coral and coral associated fauna: Very less diversity of corals are recorded from this area. The recorded hard coral diversity is the poorest when compared to other reef regions in India, with only 49 species of stony corals belonging to 27 genera which includes some dead specimens (Satyanarayana & Ramakrishna 2009). Staghorn corals belonging to genus *Acropora* which are the major contributors in almost all the reef areas in the world have disappeared totally at present due to reasons which are not exactly known.

12 species of soft corals, 76 species of sponges, 27 species of prawns, 30 species of crabs, 246 species of Molluscs, Sipunculids, the rare Echiurid *Bonelia* sp., 200 species of fishes, 3 species of turtles, 3 species of mammals and 86 species of water birds in salt works are the reported associated fauna. Additional 80 species of birds on the land are also reported from this area. The record of fewer coral associates may be attributable to the less number of explorations carried out in this reef area. 120 species of algae are also reported from this area.

Extensive Mangroves are its associated ecosystems. Gujarat State with 1650 km long coastline is well known for its rich fisheries. Veraval, Okha, Dwaraka and Mongrol are major fishing harbours. The fishery production in this region is predicted to be due to the nursery and breeding grounds provided by the Gulf of Kutch reef formations and its associated mangrove ecosystems.

Protected Area: An area of 295.03 km^2 located between Okha (22°30N', 69°00'E) and Khijadia 22°30'N-70°05'E and in the Kutch area is declared as the Sanctuary on 12.08.80. Later on 20.7.1982 an area of 162.89 sq. km. located on the southern shores of Gulf of Kutch were designated into Marine National Park owing to its importance in possessing the highly productive ecosystems in the marine environment the coral reefs and mangroves. The Marine National Park covers an area composed of 37 islands. It is the first Marine National park in India. The sanctuary area covers five islands and intertidal zone from Naiviakhi to Okha.

Reef dependent local population: Even though there are about 53 coastal villages with a population of 1,67,636 (population density: 526/km^2), the pressure on the marine resources from the coastal population is comparatively less since a section of the population is with vegetarian food habits.

Threats: Sedimentation, growing industrialization, subsequent urbanization and resultant Eutrophication leading to the exponential growth of weeds is a growing concern for biodiversity. Owing to its proximity to Gulf countries the demand for space to establish oil,

petrochemical and allied industries around Kutch is always on the rise. Kutch is tectonically unstable and a minor spill of oil in Kutch results in Black Death of Kutch and its biota. An earthquake occurred on 26th January 2001 took more than 50,000 human lives send warning signals against such activity in Kutch. Kutch has already lost flourishing pearl and windowpane oyster fisheries long back due to anthropogenic interference. Proliferation of Coral borers can be considered as a major natural threat.

Conservation measures already taken and to be taken:

Measures already taken:

1. Coral mining banned.
2. Mangrove cutting banned.

Recent Measures:

3. Mangrove afforestation programmes undertaken.

Measures which require attention:

1. Strict decision about further industrial development.
2. Strict regulation of dredging activities.
3. Control over exploitation of living resources.
4. Development of oil spill management plans and their legislation.

Malvan Coral Formations:

In 1978 Nair and Qasim reported submerged banks with isolated coral formations on the west coast of India between Bombay and Goa. In 1979 Qasim and Wafer recorded coral patches in the intertidal regions of Ratnagairi, Malvan and Rede, south of Bombay. Later, in 1987 an area of 29.12 km^2 on the west coast of Maharashtra close to a fortified island called Sindudurg is declared as the Malvan Marine Sanctuary owing to its rich faunal diversity. About 208 species of macroscopic invertebrates are recorded from this area.

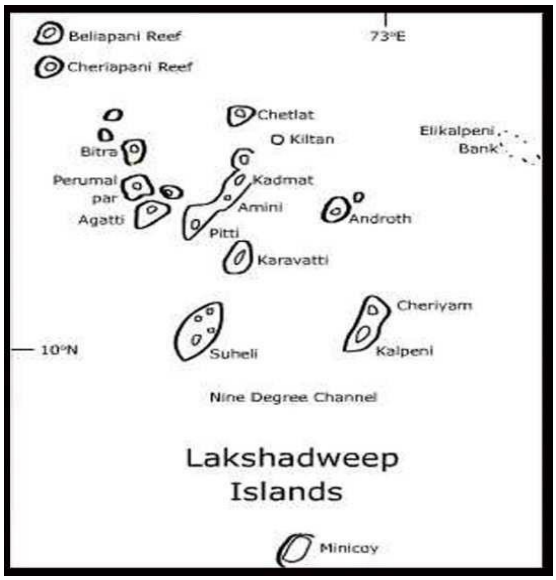
Coral and coral associated fauna: *Porites, Coscinaraea, Turbinaria, Favia* and *Pseudosiderastrea* are some of the genera reported from this region. The coral reefs get exposed during minus tides. Branching corals are not present in this region owing to the high siltation and high salinity fluctuations during monsoon.

Gaveshani Bank Coral formation: It is located 100 km west to Mangalore. During the 18th cruise of RV Gaveshani in April 1977, which was devoted for geological work, a submerged bank with living corals was discovered at Malpe, Mangalore. The bank is about 300 m wide and located about 100 km away from the shore and the depth is around 35 m. As per satellite pictures, location of this bank is at Latitude 13° 24’ N and Longitude 73° 45’ E.

The coral species collected from this area are *Euphyllia fimbriata, Leptoseris papyracea, Stylocoeniella armata, Porites lichens* and *Cyphastrea serialia.* (Nair and Qasim, 1978).

Coral Reef formations of Kerala Coast:

Pillai and Jasmine (1995) reported patchy coral formations along the coast of Quilon to Enayam, southwest coast of India. A total of 29 species of hard corals belonging to 17 genera are reported from this region. Out of which, 13 species belonging to 6 genera are hermatypic dominated by genus *Pocillopora* and remaining 16 species belonging to 11 genera are ahermatypic. The coral fauna in structure and composition is believed to have affinity with Gulf of Mannar fauna than Lakshadweep.



Lakshadweep Coral Reef formations:

The Lakshadweep reef formations are Oceanic reefs located in the Arabian Sea between 8°-12°N and 12° 3' N Latitude and 71° E – 74° E Longitude, at about 225 – 450 km from Kerala coast. These are the second best reef formations in India after Andaman & Nicobar reefs. There are six tiny islands, 12 atolls, 3 reefs and 5 submerged banks, covering an area of 32 km^2 with lagoons occupying about 4200 km^2. 11 of the 36 islands are inhabited. Androth is the largest island with an area of 5 km^2 and it is the only island without an atoll. Bitra is the smallest island with an area of 0.10 km^2 and with a glorious Kavaratti is the capital and Minicoy is separated from nine degree channel from the rest of the islands. Androth alone lies east to west when other islands are oriented in north-south direction. The distance between the islands varies from 11 to 378 km. The islands are coral formations grown on the 1500 m to 4000 m high Laccadive-Chagos submarine ridge. This ridge may be a continuation of the Arravali Mountains and the islands are understood to be remnants of the submerged mountain cliffs. Lakshadweep islands along with the Maldives and the Chagos Archipelagos form an interrupted chain of coral atolls and reefs on a continuous submarine bank covering a distance of over 2000 km.

<u>Coral and coral associated fauna:</u>

Coral fauna of Lakshadweep is not totally explored. Pillai (1996) has reported 114 species of scleractinian (hard) corals belonging to 46 genera from this reef region, exploration of deeper regions of Lakshadweep regions may yield many more species. Lagoon and reef flat are dominated by species belonging to *Acropora, Pocillopora, and Poritesand Favia*. There is a clear cut faunal variation in the corals belonging to northern group of islands and Minicoy, which is located in the southern half. Minicoy fauna is very similar to Maldivian fauna due to its proximity to Maldives. Species belonging to *Psammocora, Montipora* and *Echinopora* are common in Northern group of islands with Blue coral *Heliopora coerulea* and Fire corals dominating the lagoon. In Minicoy *Lobophyllia* and *Diploastrea* are common which are rarely found in the northern islands. Similarly, *Montipora* and *Echinopora* which are common in the northern group of atolls are not recorded from Minicoy.

About 86 species of macrophytes, 10 species of Anomuran crabs, 81 species of Brachyuran crabs, 155 species of Gastropods, 24 species of Bivalves, 13 species of Asteroids, 6 species of Ophioroids, 23 species of Holothurions, 15 species of Echinoids, 603 species of fishes and 4 species of Turtles are recorded from Lakshadweep.

Protected Area:

Only a small island called Pitti with an area of 0.01 km^2 is declared as a wild life sanctuary providing protection to sea birds, crabs and other marine fauna.

Reef dependent local population:

The Lakshadweep are the most densely populated islands in India with more than 50,000 people living on 32 km^2 of land (Elliot 1976). The recent population density is worked out as 1,894 individuals per kilometre.

Threats: Coral mining and Dredging are major anthropogenic threats and Bleaching is the major anthropogenic threat which devastated the reefs beyond imagination during 1998 bleaching event.

Conservation measures already taken and to be taken:

Measures already taken:

1. Permit to enter the islands.

Recent Measures:

2. Community based development.
3. Regulations in dredging navigation channels.

Measures which require attention:

1. Strict implementation of laws.

East Coast of India

South East Coast Reef Formations: Gulf of Mannar and Palk Bay reefs are located in Tamilnadu state on the south east coast of India. They are separated from each other at the isthmus of Mandapam peninsula and Rameswaram Island.

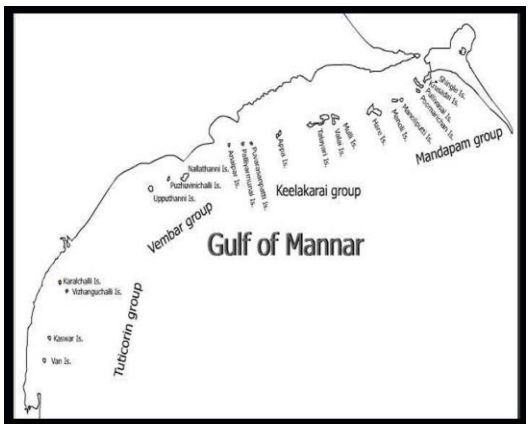
Palk Bay:

Palk Bay reef is a fringing reef located between Longitude 9°17' N and 79° 8'E and 79° 17'E Longitude and runs in east to west direction. It is running parallel to the shore for a distance of 25-30 km from Pamban channel to Pamban end of bridge to Rameswaram Island. In general, it is 200 meters wide with a maximum depth of 6m. The reef flat is relatively broad from Pamban channel to the southern end near Ramnad and narrow from Pamban to south of Rameswaram. The width of the lagoon is 200 to 600 meters. It is divided into eastern and western halfs. The eastern half which extends upto Pamban pass is called as Kathuvallimunai Reef and the western half extended upto Thedai is called Vellaperthumunai Reef. Palk Bay is one of the five major sediment sinks of India and it is influenced by Northeast monsoon. Chandramohan *et al* (2001) have calculated the total annual sediment load for this sink as 58.8000x 10^6 x m^3. Palk Bay is practically calm except during the northeast monsoon when turbulent conditions prevail.

<u>Coral and coral associated fauna</u>:

About 43 species of corals are reported from this region. Dominant stony corals on the seaward side of the reef include the families Acroporidae, Poritidae and Faviidae, the genera *Montipora* and *Acropora* representing 40% of the species (Pillai 1969, 1971). Gopinadha Pillai (1971) has classified the reefs of the Palk Bay into 5 zones viz., shore, lagoon, shoreward slope, reef crest and seaward slope. 11 species of Chaetognaths, 76 species of Sponges, 20 species of Brachyurans, 24 species of Prawns, 4 Lobsters, 51 species of Molluscs, 37 species of Echinoderms and about 130 species of Fishes are recorded. A total of 61 species of macro algae are also recorded from this region.

<u>Gulf of Mannar:</u>



Gulf of Mannar reefs are situated between Longitudes 8°47' N-9°15' N and Latitudes 78°12'-79°14'E. Coral reefs are formed around a chain of 21 islands that lie along the 140 km stretch between Mandapam and Tuticorin. These islands are formed by a 1.5 m uplift that occurred 5000 years ago, resulting in the emergence of contemporary reefs and islands (Pillai 1977). Reefs are predominantly fringing type, other reef forms such as shore, platform and patch type are also present. The islands lie at an average distance of 8 km from the main land. Reef flat is extensive in almost all the reefs. Visibility is poor probably due to monsoons, coral mining and high sedimentation load. The reefs of Gulf of Mannar are more luxuriant and richer than the reefs of Palk Bay.

Coral and coral associated fauna:

96 species of scleractinian corals belonging to 38 genera are recorded from this region. The dominant genera of corals are *Acropora*, *Montipora* and *Porites*. Extensive sea grass beds and mangroves are its associated ecosystems. Rare endangered marine mammal *dugong dugong* and turtles depend on the sea grass beds.Nearly 3,600 biological species have been recorded from this area. 109 species of sponges, 44 species of soft corals, 143 species of crustaceans, 183 species of Molluscs, 113 species of Echinoderms, 704 species of fishes, 105 species of marine birds, 15 species of marine reptiles, 27 species of reptiles are reported. It has become significant because of the presence of unique coral reefs and associated tropical fish, sponges, gorgonids, holothurions, pearl pars, chank beds, rare balanoglossus, sea horse, endangered turtles and the unique endangered herbivorous marine mammal, the *Dugong dugong*. All the unique fauna mentioned above are commercially threatened due to unabated anthropogenic activity.

Protected Area:

1 Marine National Park covering an area of 6.23 km^2 and 1 Marine Biosphere Reserve covering an area of 10,500 km^2 are declared as protected areas in this reef region.

Reef dependent local population:

47 fishing villages are located on the 140 km long reserve coastline. Most of the 50,000 people inhabiting these villages depend on the biological wealth of the reserve through fishing, seaweed collection or other related activities. More than 650 mechanised vessels and nearly 2500 non-mechanised vessels are being operated from the 47 fishing villages. Trawl nets, gillnets,

long lines, traps, shore seines and *Parikudus* (Specially designed cages) are being used to plunder the biological wealth. Annually, on an average 45,000 tons of demersals and 33,000 pelagics are fished out from the national park area. Destructive methods like dynamite fishing, coral mining are also employed to overexploit the natural resources causing irreparable damage to the ecosystem and its associated fauna. The rich biodiversity is being severely threatened.

Threats:

Over exploitation of reef resources, Sedimentation and Middlemen menace are the major anthropogenic threats. Bleaching is a major natural threat.

Conservation measures already taken and to be taken:

Measures already taken:

1. Coral mining banned.
2. Restrictions imposed on reef exploitation.

Recent Measures:

3. Community based development.
4. Steps to curb Middlemen menace.
5. Steps to provide alternative employment.

Measures which require attention:

1. Strengthening of the protective force.
2. Strict implementation of laws.

Andaman and Nicobar Islands:

The Andaman & Nicobar Islands are the continental reefs which are graded as the best in the whole of Indian Ocean and are least explored. They are a congregation of more than 530 islands and associated islets and rocky outcrops, located southeast of Bay of Bengal between latitudes 6°- 14° N and 91°- 94° E longitudes. These islands are elevated mountain ranges (Submarine extensions of the Ara rocks), basically sedimentary in nature with fringing reefs on the eastern side and barrier reefs, with a lagoon upto 40m deep on the western side (Bakus *et.al*. 2000). Only 38 islands out of 530 islands are inhabited. The Andaman and Nicobar island groups which are oriented in north-south direction are separated from each other by a deep oceanic ridge located at 10^{o} N Latitude.

Coral and coral associated fauna:

These reefs are the most pristine in India and harbour rich biodiversity which is less explored. So far 300 species of stony corals belonging to 71 genera are reported from this

region and many more are expected. The Nicobar Islands are richer in coral growth than the Andaman Islands (Pillai 1983). Majority of the reef associates are recorded from Andaman & Nicobar Islands (36 species of sponges, 81 species of soft corals, 412 crustacean species, 1393 species of molluscs, 380 species of echinoderms, 518 species of fishes, 31 marine birds and 14 marine reptiles are some) and many more are to be explored.

Protected Area:

There are more than 105 protected areas in Andaman & Nicobar islands out of which *6 Marine National Parks* (1.Mahatma Gandhi MNP, Wandoor, South Andaman (281.5 km^2); 2.Rani Jhansi MNP, Richies Archipelago, Andaman (256.14 km^2); 3.North Button NP, Middle Andaman, (0.44 km^2); 4.Middle Button NP, Middle Andaman (0.64 km^2); 5.South Button NP, Middle Andaman (0.03 km^2) and 6.Galathea NP, Great Nicobar (110 km^2), *9 Marine Sanctuaries* (1.North Reef Island Sanctuary, North Andaman (3.48 km^2); 2.South Reef Island Sanctuary, Middle Andaman (1.17 km^2); 3.Cuthbert Bay Sanctuary, Middle Andaman (5.82 km^2); 4.Cinque Sanctuary, South Andaman (9.51 km^2); 5.Parkinson Island Sanctuary, Middle Andaman (0.34 km^2); 6.Mangroves Island Sanctuary, Middle Andaman (0.39 km^2); 7.Blister Island Sanctuary, North Andaman (0.26 km^2); 8.Sandy Island Sanctuary, South Andaman (1.58 km^2) and 9.Lohabarrack (Saltwater Crocodile) Sanctuary, South Andaman (100 km^2).and *1Biosphere Reserve* (Great Nicobar BR, Great Nicobar (885 km^2)) cover some part of reef areas.

Reef dependent local population:

The total population of Andaman & Nicobar islands is 3,56,265 (including tribes), exposing this area as the least populated reef area at the rate of 43 individuals per km^2 when compared to other reef regions.

Threats:

Coastal developmental activities and poaching are the major anthropogenic threats. Crown of Thorns Starfish proliferation and Tsunami are the major Natural threats.

Conservation measures already taken and to be taken:

Measures already taken:

1. Strict implementation of laws.

Recent Measures:

2. Controlled tourism.

Measures which require attention:

3. Strengthening of the protective force to curb poaching.

conservation strategy suggested by the present author (Satyanarayana 2007) is as follows:

All steps and initiatives for the protection of Coral reefs were meticulously taken. Programmes for creating awareness undertaken. Alternative employment plans drawn and carried out. Steps for community based development undertaken. Almost all legal aspects related to ecosystem protection covered and laws notified. Much of the reef areas are declared as Marine Protected Areas. Lot of Scientific projects sanctioned, Symposia organized, research carried out and results published. Capacity building is done and baseline information for all the reef areas almost created through regular monitoring.

Inspite of all the above mentioned concrete steps taken and implemented, the degradation in the reef areas has slowed down negligibly.

The blame is simply listed as:

1. Lack of Awareness,
2. Poverty,
3. Greediness and
4. Loopholes in legal frame work and law enforcement.

A closer look at the problem exposes the following actual lacunae. Coming to the **Awareness creation,** each and every individual dependent on the reef areas is aware of what is happening to the reef because of his dependence on the reefs. In fact proper awareness is required for the people who are not dependent on reefs including the law enforcing personnel and members belonging to the reef management. There are instances where the major reef builders were not taken as the target species for protection and dead coral shingle is considered as mere inorganic material without proper knowledge about its importance in the development of a live coral reef. Much of the reefs are getting eroded due to exploitation of dead shingle and sand from the reef areas. Awareness have to be created to other stake holders who are not directly reef dependent.

None of the **alternative employment** activities were successful in discouraging the local population from their dependence on reef exploitation. In many instances they were considered as additional employment avenues for their economic growth.

Community based development was mostly unsuccessful since there is lack of belief among the involved parties and it is rather treated as a work to be carried out than as personal commitment.

Laws and protection related to ecosystems and associated fauna and flora always become weak when, the law breaker is poor and illiterate and his existence itself is in

question. Non-coordination among different agencies related to coral reef areas due to conflicting mandates also is one of the reasons for poor law enforcement.

There is clear cut non-coordination among the **reef research**ers leading to duplication or repetition of work. There is no agency to check the authenticity of the work carried out, leading to publication of contradictory and confusing results. When one publication boosts the number of publications related to reef research as more than 2000 within a short span of time. Another publication projects that 'the scientists who have worked on coral reefs have tended to focus their attention on exploitation studies or taxonomic listings (Arthur, 1999).

Although baseline information related to **reef monitoring** is created for all the reef regions in India, the data collected is not standardized due to lack of proper training and understanding.

Capacity Building efforts are partially successful due to discontinued presence of the personnel or researchers trained, in the reef areas due to transfers and new employment opportunities.

In a nut shell, Lack of People's participation, Conflicting and confusing laws, Poverty and Illiteracy of Grass-root level stakeholders, Conflicting mandates of departments operating in the reef areas, Lack of awareness among non-reef dependent stake holders, Lack of proper baseline information and Lack of permanent capacity are responsible for the failure of our efforts to stall degradation.

Preventive conservation strategy:

Much of the efforts taken so far are aimed at cure rather than prevention. A concrete preventive strategy is the need of the hour to save our valuable reefs.

Either cure or prevention is not possible in the reef areas without the participation of local people even though some frustrated economists put it as a futile effort. The direct reef dependent stakeholders have to be communicated properly and it must be for the community by the community approach.

Sense of belongingness must be created among the local community. Local Media, Audio-visual projections, Small mementos like T-shirts, Awards for protecting reefs provide opportunities for involving local community with enthusiasm. **Children of the local community must be attracted, to catch them young**. Competitions and awards among students create awareness and ultimately a sense of belongingness as they grow. Visits by popular personalities like cinema artists and politicians bring remarkable changes in the attitude of the local community. *There is no epic Ramayana if the hunter was not turned into poet 'Valmiki'.* There must be regular visits to get feed backs to sustain the involvement of

the local community.

Community based management is doing wonders in many countries. Local people must be guided to empower themselves to manage the reefs in a sustainable way. Development of Reef Tourism with local community ownership creates alternative employment to many. Skilled fishermen have to be turned into reef boat operators and skilled reef trainers and guides. Initial infrastructure and technical know how about sustainable technologies like creating environmental friendly energies must be provided to them.

Local motivating groups composed of local people have to be developed. Local people have to be trained to monitor their own reefs scientifically. They must be encouraged by providing employment in reef related positions like reef watchers etc. Awareness creation to non-reef dependent stake holders must be done through the trained and talented people from the local community.

The net annual benefit to Indonesia through reefs is 1,647 million US dollars. Sustainable fisheries contribute 1,221, through Coastal protection 314, Tourism and Recreation yield 103 and Aesthetic activities another 9 (Burke *et. al* 2002). If properly handled and trained, especially because of the change in their life style, the local communities along the reef areas become the best protectors of the reefs. In Indonesia artificial reefs are developed by coastal communities to attract tourists to the resorts they have built along the coast.

Institutional co-ordination and development:

To streamline the reef related activities and to sustainably provide a direction to the conservation measures being taken, Institutional co-ordination is very very important and it must be a full-time duty of a separate Institution. Since almost all the marine ecosystems are interdependent and exchange faunal and floral components, a. Multi-disciplinary Institution with the name of **Marine Protected Area Authority** can be developed.

Divisions for Reef Research and Monitoring, Reef fisheries, Reef Tourism, Reef Information, Reef Surveillance, Reef law, Reef Capacity building and Reef community communication have to be developed.

Monitoring and maintaining the Health and water quality of the reefs is to be made as the prime objective of the Reef Research and Monitoring Division. Duplication of research is to be curbed through this division.

Identification and protection of breeding and nursery grounds of fin and shell fishes, establishing zones, Regulating reef fisheries and Aquarium trade will be the prime objectives

of Reef fisheries division.

Coral Reef Preventive Protective Shield Strategy Diagram

Formulating reef friendly tourism, like installing buoys to avoid anchor damage, Creation of movies and communication media to inculcate reef friendly activities among tourists and to regulate reef tourism with the local people participation should be the main mottos of the Reef Tourism division.

Creation of databases (related to fisheries, ecology, reef health, socio-economic etc.,) GIS maps, Atlases, pamphlets, websites for easy accessibility of information about reefs should be the prime objective of Reef Information Division. Reef Surveillance division must deal with the co-ordination and improvement of protection forces like Forest Department, Coast Guard and Police in the reef areas and ensure effective patrolling.

Since the threats are site specific. Specific laws are to be formulated depending upon the problem faced. Laws are also to be formulated depending upon the population and exploitation status of the reef biota. Conflicts arising due to fishing etc., also should be the mandate of the Reef law division.

Reef capacity building division has to train local people especially facilitators and motivators, formulate and implement different training courses depending upon the target group like policy makers, reef managers, judges, advocates, school children, laymen etc.

Reef Community Management division is the crucial and most important division at least in the initial stages of community based management and has to formulate innovative means and methods for empowering the local community to manage coral reefs in a sustainable way and also look into matters like alternative income generation and community related problems like middle men menace etc.

The most important aspect is to involve and employ the reef dependent population in every division and event and there must be always co-ordination and networking among different divisions and the regulating agency, the Marine Protected Area Authority (MPAA).

Until the development of an Institution like MPAA atleast a networking must be established among all already existing institutions/departments to visualize the outcome of such a networking.

A global estimate made on the value of coral reefs of the world in goods and services was US $ 375 billion. The investment in research, monitoring and management is probably less than US $ 100 million per year i.e., less than 0.05 % of the value (Wilkinson 2002). In our country the investment is much less and sure to improve our country's economy and ultimately in the conservation and management of our unique paradises underwater.

Effective strategies for enhancement of fisheries in affected reef regions in particular include

- Declaration of more number of Marine Protected Areas with delineation of zones for conservation, tourism and exploitation and their effective management.
- Development of Artificial reefs and
- Deployment of Fish Aggregating Devices (FADs) and
- Reef restoration.

Among these MPAs are considered to be best since Artificial reefs made of waste materials cause pollution and Fish Aggregating devices only helpful in aggregating fishes rather than increasing natural reef habitats. Reef restoration is also considered only as a temporary alternative since the corals can come back to normalcy only when the deterrents are removed.

In a nut shell any conservative effort is successful only when the trouble caused to the reefs is rectified and it is truly possible only when the local population wishes whole heartedly to participate in the conservation of the coral reefs. It is high time that all the stake holders of coral reefs participate whole heartedly not only to save the livelihood of the poor populations dependent on the reefs but also to save our saviours, corals and their associates.

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Aquaculture is a risky business. You don't go into aquaculture for the money. You do it because you love it.

Michael Matthews

Trends in Aquaculture and Environmental Implications

Dr. D. E. Babu

Introduction

Aquaculture is defined as rearing or propagating aquatic organisms and plants of economic importance under controlled environmental conditions until they attain the marketable size and quality. Aquaculture is primarily divided into two major sectors, the i. Inland Aquaculture and ii. Coastal Aquaculture; the former deals with freshwater aquaculture wherever suitable land and river water are available where as the later deals with brackish water and mariculture. The state of Andhra Pradesh has pioneered in Aquaculture production and marketing both in Inland culture as well as Coastal aquaculture and the state has dominated all other states in overall production.

Aquaculture is one of the priority areas of Blue Revolution of India as means of augmenting the food production of aquatic origin. Finfish and Shellfish are important sources of protein and protein is necessary component for the growth and development of any animal.

Protein deficiency leads to deficiency diseases like anemia, stunted growth, immune disorders etc. Nutrition is one of the vital needs of a human being along with pure oxygen and water. Nutritional deficiencies are observed more in economically backward classes, both in towns and villages; more predominant in underdeveloped and developing countries like India.

Fish can supplement the necessary proteins and such of the deficiency diseases can be averted. Similarly, vitamin deficiency diseases can also be averted by consuming fish because fish and shellfish muscle contains fat soluble and water soluble vitamins, poly unsaturated fatty acids etc. Fish, prawns, crabs, lobsters and the squids are considered highly nutritious food material because of their content of protein. The fish and shellfish meat contains high portions of amino acids; especially the ten essential amino acids such as lysine, methionine, arginine, tryptophan, threonine, which are essential for human health to avoid malnutrition; the above components are scarce in major cereal crops and other plant proteins. High lysine content of fish protein makes it an ideal complementary food with other

protein/carbohydrate from vegetable sources. In addition to the essential amino acids, the fish and shell fish are good resources for vitamins like A, B1, B2, B12, D, E and K.

As per the survey reports of FAO, there is an ever increased demand for fish throughout the world and it was estimated that the world requirement of fish by 2015 is 180 million tons from the existing quantity of 154 million tons. Increasing population and liking palatability of fish are the reasons for greater demand. It is very much evident that Aquaculture is the only means of increasing the production to meet the demand. It is also important to mention here that the average fish consumption of India is only 9-10.5 kg while the global average is 17-18 kg, this reflects on production and the availability to common man; the deficiency in supply of fish is especially observed in the central and north-eastern parts of India.

50 years ago the Indian fish production was 600,000 tons while the current production is 7.5- 9.0 million tons. Freshwater fish production is 1.8 million tons while there is a demand for 4.5 million tons. Out of 2.2 million hectares of suitable land only 800,000 hectares is under culture in freshwater sector.

Products of demand

- Fresh fish
- Fish fillets
- Fishery products like Shark fins, Air bladders, fish skin, chitin& chitosan, fish collagen, fish liver and body oils, fish meal, head meal etc.
- Frozen shrimps, live crabs, live lobsters, crab meat, canned fish, soft crab.
- Spirulina, Chaetoceros, Duneliella and seaweeds etc.

The major problem of Aquaculture is on the environment especially with reference to its effect on Biodiversity.

Environmental affects observed due to Aquaculture practicing:

One important landscape level damage was caused by the Aquaculture is on agriculture land conversion and mangrove degradation, both are very important land areas and some of the useful agricultural fields are being used for aquaculture practicing, this resulted in decrease in food grain production, which is also essential for every human being. Mangroves are wetland forests of special category, situated near the coast and these are highly productive water bodies when compared to any other aquatic body. In addition to the main role of mangroves in preventing coastal soil erosion, protection during natural calamities of Tsunamis, cyclonic storms, floods etc, these support fish diversity to a great extent. Considerable are of mangroves were removed for construction of Aquaculture ponds.

Some of these areas adjoining the fishermen villages became barren and there is no real protection from the south-east in case of cyclonic storms or tsunamis, as also is observed near Antarvedi of East and West Godavari districts, Andhra Pradesh. .

Feed and Organic wastes:

Waste organic material produced during aquaculture due to leftover feeds, dead and decaying aquatic organisms and excretory material is a major concern of aquatic pollution. This organic waste is removed regularly from the ponds either by siphoning out into the adjacent creek or by removing through water exchange. This really is causing increased organic loads in the estuarine creeks and the organic waste also becoming a substrate for the development of pathogenic bacteria. The BOD (Biological Oxygen Demand) and the COD levels were found increasing in the areas of organic waste accumulation. During low tide times low levels of dissolved oxygen (< 2.8 mg/l) was found associated with this phenomenon, indirectly throwing threats on other aquatic life.

Usage of chemicals:

In shrimp and crab culture ponds, usage of chemicals such as lime (mixture of CaO, Ca (OH)2 and Ca CO3) is a regular phenomenon and other chemicals such as inorganic fertilizers, urea and super phosphate are also used to certain extent. Lime is especially important in the maintenance of water pH during the entire culture period and an alkaline condition always is maintained (> 7.5pH up to 8.5 pH). The entire water body is let down into the adjacent brackish water creek during times of forced or normal harvest, resulting in a sudden increase in the pH of the creek water from its normal value; usually, release of water from the pond invariably is associated with low tide. The harmful changes brought about by this is '**Eutrophication'** leading to the possibility of developing harmful algal species or killing off of the sensitive larval forms of migratory species.

Usage of antibiotics and probiotics:

The usage of antibiotics in recent past is reduced to a great extent but it is not totally stopped, antibiotics such as Oxytetracyclin, Sulphonamides, Furazo -lidine, Flumiquine, Sulfadiazine, Trime -thoprim etc are being used in times of bacterial infections of shrimps The antibiotic affect on the environment will be nullified after three weeks of usage time but sometimes, the water containing the antibiotic is released in less than 15 days time, resulting in accumulation in other aquatic organisms living in the creeks.

Pesticides:

Usage of pesticides is occasional, when mortality of shrimps were observed in the ponds due to infection, before 40 days of culture and when the shrimps were in the weight range of 1-6g. The usual practice of the aqua farmers observed was that they apply pesticides such as Nuvacran, Endrin etc in the ponds, when all the shrimps go to the bottom and such of these shrimps along with the dead and decaying shrimps and pesticides are immediately let out into the adjoining creeks during low tides, causing great damage to the aquatic life. It is important to understand that the pesticides are very much harmful to the fish and other aquatic vertebrates where the blood contains hemoglobin (invertebrates such as the prawns, crabs, lobsters etc contain haemocyanin).

Algal blooms:

Algal blooms were predominantly seen in the estuarine creeks adjoining the aquaculture ponds. Microscopic examination of the water samples have resulted in the identification of both phyto and zooplankton species in the vicinity. Rotifer population dominated in certain of the relatively stagnant creeks. Phytoplankton species were dominated by mixed species of *Skeletonema, Cerathium, Coscinodiscus, Trichodesmium* and *Chaetoceros,* harmful species like Noctiluca was occasionally seen but not a dominant species.

Effects on fish and shellfish faunal diversity:

The dominant fish fauna observed near the effluent sites was that of mud skippers like *Periophthalamus, Boleo-phthalamus, Oreochromismosambicu* mangrove crabs, *Sesarma plicatum, Sesarma bidens, Thalamita crenata, Uca annulepis* and to a less extent *Scylla serrata* and other invertebrate fauna like nematodes, polychaetes, molluscan species like *Cerethium* dominated. The common estuarine fish such as juvenile *Liza parsia, Mugil cephalus, Chanos chanos, Etroplus suratensis,* and *Elops machanta* were of very rare occurrence but these were found in the inlet (water pumping canal) systems.

Impact of Aquaculture on juveniles of shrimp and shellfish:

Harvesting of shrimp juveniles was stopped in the recent past to a large extent. However this process of harvesting the shrimp juveniles from the estuarine creeks and the intertidal zones was occasionally seen in certain places where shrimp farmers culturing the tiger prawn *Penaeus monodon* on very small scale with limited extent of land. What was observed in this process of seed collection, for every ten numbers of shrimp seed collected, about 24-46 larval forms of crabs and fish were killed when they were thrown on to the land. The second important point is about the long term effects of seed collection, resulting in the

depletion of natural shrimp stocks as observed in 1994 and 1995 when there was 70-80% depletion in the depletion of shrimp stocks from the sea when natural seed was the major source of seed for aquaculture during 1991-1994.

Exotic and Invasive species:

Invasive or alien species introduction causes economic or environmental harm to a great extent. Studies conducted has resulted in the identification of two fish species, *Oreochromis mosambica* and *Oreochromis variabilis*, both species are exotic species and have really invaded various estuarine and freshwater bodies**.** Both species were found voracious feeders, feeding on the juveniles of crabs, shrimps, native fish species and mangrove crabs etc. These fish of low commercial and economic value were also found to be prolific breeders and their population dominated the native fish species population. The harmful affects were observed on the depletion of the native fish stocks. It is most likely that this may also result in loss of biodiversity especially, the endangered species of the native estuaries. One more shrimp species introduced in recent times is *Litopenaeus vannamei* in the aquaculture ponds, this species originally belong to South America, to the existing knowledge, this particular species has so far not invaded the estuarine creeks, but it is likely that this species also invades the nearby estuaries. A proper management plan should be developed for sustainable aquaculture.

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Advances in Aquatic Animal Health Management

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The Food and Agricultural Organization (FAO) has estimated that the annual demand of seafood will outstrip the capacity of wild fisheries by 55 million tonnes by the year 2025. This presents a major challenge to the aquaculture industry. Diseases have become a primary constraint to aquaculture growth and are responsible for the severe impact on both the economic and socio-economic development in many countries of the world and have been recognized as one of the major constraints to global aquaculture production. Many factors have contributed to increased losses due to disease, including greater globalization, further intensification, introduction of new species, interaction between wild and farmed populations, lack of bio security, emerging diseases, misperception and mis-use of pathogen free stocks, climate change and other anthropogenic activities. In addition to the above said factors, the irresponsible use of chemical disinfectants and antibiotics is recognized as having potential environmental impacts. In addition, intensive culture practices with poorly controlled feed use and waste production have adversely affected local environments.

Managing the health of aquatic organisms has proven to be one of the greatest challenges and opportunities for expansion of sustainable aquaculture. Effective disease control is paramount within aquatic farming systems to stop the spread of infectious pathogens. Implementation of an effective health management programme consisting of well organized management and husbandry practices, efficient biosecurity and hygiene measures, and improved resistance to disease through vaccination can all help to reduce and control disease at farm sites (Gudding *et al.,* 1999;Thompson and Adams, 2004; Adams, 2009).

Disease is now a primary constraint to the culture of many aquatic species, impeding both economic and social development in many countries (Subashinge et al., 2001). Any successful health management programme should monitor the health status of fish, identify and manage risks to fish health, reduce exposure to or spread of pathogens and manage the use of antibiotics/chemicals. The success of any farm operation depends on health management systems. For this, proper disease diagnosis, prophylactic measures and control measures should be provided. Therefore, an increasing use of risk analysis for disease prevention and the development of precautionary management

measures in aquaculture is of utmost importance. The researchers have developed numerous technologies and advanced management techniques focusing diagnosis and exclusion of the diseases. The rapid detection of pathogens in infected fish, both clinically and sub-clinically, is desirable for effective health management in aquaculture (Adams and Thompson, 2006).

FAO/NACA (2000) has recommended the use of three levels of diagnostics based on the scale of expertise and infrastructure i.e., training, facilities and resources required for disease diagnostics:

(a) Level I: field observation of the animal and the environment, clinical examination;

(b) Level II: laboratory observations using parasitology, bacteriology, mycology and histopathology;

(c) Level III: laboratory observations using virology, electron microscopy, molecular biology and immunology.

The three levels have broad-scale application to disease detection and diagnostics (Bondad *et al*., 2001 a, b). Traditional bacteriology, virology, parasitology and mycology are appropriate for the detection of common, easily cultured pathogens; however, for many pathogens these methods can be expensive, time-consuming and might not lead to a definitive diagnosis being made, even when complemented with histological evidence (Adams *et al.*, 1995). Of the three levels of diagnostics, the level III is considered more advanced and majorly relied upon. This article will highlight the major advancements in immunodiagnostics. According to Wirth and Coste, 2010 technological developments for molecular testing have focused on target amplification step and optical detection based on fluorescent labeling.

The methods available for the diagnosticians for disease diagnosis and pathogen detection include, analysis of the history of disease at the facility or region including the source of seed, type of feed used environmental conditions etc.; gross and clinical signs; direct microscopy which includes bright-field, phase contrast or dark-field microscopic examination of stained or unstained tissue smears, whole-mounts, wet-mounts, etc. of diseased or abnormal specimens; histopathology which includes the routine histological or histochemical analysis of tissue sections with special stains; electron microscopy which possess ultra structural examination of tissue sections, negatively stained virus preparations, or sample surfaces; culture and biochemical techniques which in clued the routine culture and isolation of bacterial isolates on artificial media and identification using biochemical reactions on unique substrates; enhancement which involves the rearing of samples of the appropriate life stages of aquatic animal under controlled, stressful conditions to ‘enhance’

expression of latent or low grade infections; bioassay involving the exposure of susceptible, indicator aquatic animals to presumed carriers of a pathogenic agent. The other techniques include serological methods, hematology and clinical toxicology analysis, techniques involving the use of DNA or RNA probes for detection of unique portions of a pathogen's nucleic acid using a labeled DNA/RNA probes, PCR and tissue culture (Lightner and Redman, 1998). Walker and Subasinghe (2000) reported the findings of an expert consultation on ''Research needs for the standardization and validation of the detection of aquatic animal pathogens and diseases'' that recognized that the molecular based techniques (Level III) provide quick results, with high sensitivity and specificity, and are particularly valuable for infections that are difficult to detect using standard histology and tissue-culture techniques.

In addition to the above mentioned diagnostic techniques which forms the basis for the detection of aquatic animal diseases, Real Time PCR, Loop-mediated isothermal amplification (LAMP), Lateral flow, LAMP with lateral flow, are more advanced among the molecular techniques. Development of Egg yolk antibodies (IgY) against particular disease agents which can form the basis for developing immunodiagnostic kits or use in passive immunotherapy and Surface display technique of vaccine production in Yeast are emerging in the field of fisheries.

Advances in micro technologies over the last 20 years have led to the development of new miniaturized supports for the analysis of nucleic acids and proteins (Loy and Bodrossy, 2006; Mac, 2002). Chips or microarrays offer the advantage of being able to detect in parallel multiple targets permitting a conceptually new approach for pathogen diagnostics. Nanotechnologies can reach the single-cell or molecular scale and consequently overcome several current technological obstacles. They offer new technological tools for improving sample preparation but also for avoiding target amplification and the current fluorescent labeling. The combination of nano-objects and nano-systems in current technologies offers new possibilities for potential applications in the detection of infectious agents (Wirth and Coste, 2010). Among the micro/nanotechnologies one of the most promising techniques is the bio-barcode assay which ensures the ultrasensitive amplification and detection of nucleic acids and proteins (Nam *et al.,* 2002; Nam *et al.,* 2003; Nam *et al.,* 2004). The article explains the above mentioned emerging techniques in the field of fish health management and diagnosis.

Loop Mediated Isothermal Amplification (LAMP)

LAMP amplifies DNA with high specificity, efficiency and rapidity under isothermal conditions. The method employs a *Bst* polymerase and a set of four specially designed primers that recognize a total of six distinct sequences on the target DNA. the final products are stem-loop DNAs with several inverted repeats of the targets and cauliflower like structures with multiple loops formed by annealing between alternatively inverted repeats of the target in the same strand. Lamp can amplify a few copies of DNA to 10^9 in less than an hour under isothermal conditions and with greater specificity *i.e.*, LAMP is able to detect DNA as few as six copies in the reaction mixture. It is less prone to presence of irrelevant DNA and is also applicable to RNA upon use of reverse transcriptase together with DNA polymerase (Notomi et al., 2000).

LAMP and modified-LAMP, such as reverse transcription-loop-mediated isothermal amplification (RT-LAMP) have been developed for the detection of a wide range of virus, bacteria and parasites infecting humans. Also LAMP has applications in detection of mycoplasma, tumor detection, detection of GMOs, embryo sexing etc. and the LAMP-mediated diagnosis of Nocardiosis (Itano *et al*., 2005) Edwardsiellosis, WSSV, RSIV (Caipang *et al*., 2004) IHNV and KHV clearly demonstrates the usefulness of the method as an efficient diagnostic tool . The diagnosis can be based onspecific DNA markers as target region for the bacteria. LAMP can also be used for the detection of bacterial resistance to antibiotics by targeting antimicrobial resistance genes. Using LAMP less time is required for detection, allowing more time to use management practices to minimize the spread of disease (Savan *et al*., 2005). The detection limits (DL) using the LAMP method was up to 1 fg, when compared to 10 fg by nested polymerase chain reaction (PCR) (Kono *et al*., 2004). Using LAMP the specificity could be enhanced as the primers hybridize to six distinct sequences (El and Soliman, 2005). LAMP-LFD (LAMP- Lateral Flow Dipstick) is one of the modifications of the LAMP technique which involves the combination of LAMP and FITC nucleic-acid detection lateral flow dipstick. This technique has been proven to be efficient in detection of 10copies of WSSV/µl.

Vaccines

Fish health management with good hygiene and limited stress are key factors in the prophylaxis of infectious diseases and are a necessity for the optimal effect of vaccines (Press and Lillehaug, 1995). Vaccination is the action in which a host organism is exposed to organic (biological) molecules that allow the host to mount a specific immune reaction

through which it has a better capability to fight subsequent infections of a specific pathogen compared with genetically similar non vaccinated hosts.

Disease prevention by means of optimal husbandry, the use of biological control methods such as vaccination and the use of Immunostimulant should, however be developed because concerns regarding the pollution associated with chemical treatments, and the emergence of multiple resistance to antibiotics, make the control of infections increasingly difficult (Thompson and Adams, 2004). It has also been shown to be cost-effective and has led to the reduction in use of antibiotics. A wide range of commercial vaccines is available against bacterial and viral pathogens and many new vaccines are under development.

Most target salmon and trout, and there are expanding opportunities for marine fish. Traditionally, the organic molecules used for vaccination are directly derived from the pathogen in question. The most straight forward approach is to culture the pathogen after it has been inactivated and presented to the host. So far, vaccines containing more than ten bacterial pathogens and five viral pathogens have been produced based on such inactivated antigens. As molecular-based vaccine production procedures rely heavily on biotechnological tools, vaccines are produced mainly in developed country

Majority of the vaccines available are inactivated or killed disease agents and live attenuated vaccines were developed against viruses but with this the risk of back-mutation and reversion to virulent state remains. The other types include recombinant vaccines, which include DNA vaccine as well as subunit vaccine which are developed against IPNV and IHNV respectively (Adams and Thompson, 2006).

Surface display technique

Vaccination induces specific immunity to assist in the elimination of microbes, neutralization of microbial toxins and prevention of further microbial invasion. During late 1990s the expression of proteins in recombinant systems has become a widely used technique for vaccine production in mammals. Researchers are widely using recombinant DNA technology to develop protein vaccines for the aquaculture industry as it provides a means to produce sufficient quantities of immune protective vaccine inexpensively. These vaccines have enormous potential in the aquaculture industry as they are safe and efficient compared with live or attenuated vaccines. They also provide an alternative approach to traditional formalin-killed whole cell (WC) vaccines that are not always effective. Microbial cell surface displays are used in vaccine and antibody development, library screening, bioconversion, and biosorption (Lee *et al*., 2003; Lofblom, 2011).

One of the best approaches for production of live vaccine is to display virulence factors from pathogens on cell surface of hosts like *Saccharomyces cerevisiae, Yarrowia lipolytica, Pischia pastoris* due to its GRAS (generally regarded as safe) status, easy cultivation, cheap production and distribution, clear genetic background, available surface displaying system, regeneration and adjuvant function. In yeast cell surface displays, functional proteins, such as cellulases or lipases, are genetically fused to an anchor protein and expressed on the cell surface. Saccharomyces cerevisiae is the most commonly used yeast for cell surface display (Tanaka *et al.,* 2012). The use of yeast surface display technique for engineering enzymes and their substrates will be an interesting direction for the future. The surface display of haemolysin from *Vibrio harveyi* on the yeast cells and their potential applications as live vaccine in marine fish has already been demonstrated. Hence, development of live vaccines by using surface display technology will be a promising tool for combating bacterial and viral diseases of fish.

Egg yolk antibodies (IgY)

IgY immunotherapy is a latest concept in health management which works on the basic principle of passive immunization. Specific antibodies produced in chickens offer several important advantages over the antibodies produced in other mammals, viz, the productivity of antibodies from yolk is nearly 18 times greater than that from rabbits, based on the weight of antibody produced per animal. IgY production is less invasive, requires only the daily collection of eggs compared to blood collection in mammals. Much less antigen is required to produce an efficient immune response in chicken and the chicken antibodies recognize different epitopes than mammalian antibodies, resulting in a different antibody repertoire. In contrast to mammalian serum, egg yolk contains only a single class of antibody (IgY), which can easily be isolated from the yolk by precipitation techniques. These Ig Y antibodies could be used for either developing immunodiagnostic kits or in passive immunotherapy against disea

Eels challenged with *E. tarda* followed by administration of anti–*E. tarda* IgY survived without any symptoms of infection, in contrast to control eels that died within 15 days (Gutierrez *et al*., 1993, Hatta *et al.*,1994). Feeding anti–*Y. ruckeri* IgY before or after bacterial challenge resulted in lower mortality and reduced infection rates in rainbow trout (Lee *et al.*, 2000). IgY against *Vibrio anguillarum* protected rainbow trout against vibriosis for at least 14 days when given by intraperitoneal injection, oral intubation, or feeding (Arasteh *et al.* 2004). White spot syndrome virus (WSSV) causes high mortality in cultured shrimp. IgY produced against WSSV was shown to passively protect shrimp (Lu et al. 2008)

and crayfish (Lu *et al.* 2009) from WSSV infection when used as an immersion solution or incorporated into feed (Kumaran *et al*. 2010, Lu e*t al.* 2009).Chicken antibodies have been developed and found efficient in diagnosis and prevention of viral infection like White spot syndrome in shrimp and cray fish, and fish pathogens like *E.tarda, Y.ruckeri, Vibrio spp.*

Fish cell lines

Fish cell lines have an important role in the expanding aquaculture industry of the world. The main impetus for the development of many of the continuous fish cell lines was to provide the means for isolating and identifying viruses that are the causative agents of epizootics of commercially important species. Cell lines are indispensable for development of precise diagnostics and prophylactics of the viral pathogens. Besides diagnosis, cell lines are important in the much required national and international quarantine and certification programme for producing virus free fish stock.

Fish cell lines have also found widespread application in cytogenetics, transgenics, toxicology, as in vitro models for studying cellular physiological processes and also in comparative immunology (Sobhana, 2009). Fish cell cultures are good models for *in vitro* studies of the propagation of pathogenic fish viruses. They also play important role in toxicological and functional genomics studies in fish. However, presently very few fish cell lines are available for research in tropical species. Most of the primary cultures reported from fish in India were comprised of fibroblastic cells. A predominance of fibroblastic cells over epithelioid cells in cell cultures from fish has been reported by several workers. Among the cell lines listed, more than 60% were established from species from Asia, which contributes more than 80% of total fish production. This includes 59 cell lines from 19 freshwater, 54 from 22 marine and 11 from 3 brackish water fishes. Presently, about 283 cell lines have been established from finfish around the world.

An appropriate cell line is the most important laboratory tool to grow, isolate, characterize, and identify pathogenic fish viruses. However, cell lines currently do not exist for most of the farmed marine food fish and ornamental fish. The lack of appropriate cell culture systems hinders the development of preventive strategies for viral diseases and the inspection of batches of juvenile fish for health certification. (Sobhana , 2009)

Biobarcode assay

Bio-barcode assay is a recently developed technique for the detection of nucleic acid and protein targets. Biobarcode assay, an ultrasensitive method for detecting protein analytes, relies on magnetic microparticle probes with antibodies that specifically bind a target of interest and nanoparticle probes that are encoded with DNA that is unique to the protein

target of interest and antibodies (Nam *et al*., 2004). It uses two types of particles to perform purification, amplification and detection steps (Cheng *et al.,* 2006). DNA barcode acts as a reporter of the targeted molecule which corresponds to signal amplification. It is therefore possible to directly detect the DNA with zeptomolar sensitivity (10^{-21} M or 10 copies of DNA in a sample of 30 ml) making it as sensitive as PCR but avoiding the need for enzymes (Nam *et al.,* 2004).

With regards to proteins, this test reaches attomolar sensitivity (10^{-18} M), corresponding to a sensitivity one million times higher than that of classic ELISA tests (Nam *et al.,* 2003; Cheng *et al.,* 2006). The barcode strands can be identified on a microarray via scanometric detection or in situ if the barcodes carry with them a detectable marker, and also can be detected and quantified using PCR and Real Time PCR. The assay is found to be extraordinarily sensitive and reported to be 10^6 times efficient than ELISA. The nano-particle based biobarcode assay has been found efficient in early detection of certain human diseases and animal virus like Blue Tongue Virus and also in detection of Ricin toxin in the aquatic environment.

The concept of the bio-barcode assay is particularly original and represents a potential alternative to the conventional PCR and ELISA based technologies (Wirth *et al*., 2010). So this technique can become a promising early disease detection and diagnostic tool in the context of aquaculture.

Lateral flow kits

Lateral flow kits provide a very rapid and sensitive system for the detection of pathogens based on the principle of immunochromatography. The simplicity and the specificity in tests make it useful as a pond side test. The commercially available ISAV kit is sensitively equivalent to one step PCR (Adams and Thompson, 2008). This technology is advantageous over traditional immune assays; it is simple to use, less time consuming (<10 mins), cheap and does not require any skilled personnel or expensive equipment (Adams and Thompson, 2011).

Bluspot technology

The bluspot technology involves the assay in which the sample flows through a membrane that has been coated with a specific MAb against the pathogen of interest by vertical filtration. This concentrates the pathogen on the membrane to improve sensitivity of the reaction. Antigen- antibody complexes are then detected by a secondary antibody labeled with an enzyme. The enzyme reaction with the substrate gives a colour in case of positive reaction (Adams and Thompson, 2011). The test is highly rapid; results are obtained in 5 min.

Conclusion

With the ever increasing pathogens and diseases, there is always a requirement of more sensitive and rapid tests for disease diagnosis. Perhaps due to this reason, constant research is necessary for rapid and accurate diagnostics for better fish health management.

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Recent trends in Fisheries Technology Development in Andhra Pradesh of India

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Abstract:

India is endowed with a rich array of natural resources of marine and inland aquatic resources. The last few decades have witnessed the great advances in the productivity of the fisheries sector in India. Recent advances in Fishing Technologies through research have been grown rapidly over the years with intensification of effort and diversification in the fishing practices. Destructive fishing in the seas and estuaries without any consideration to conserve juvenile fish stocks have taken a heavy toll on natural recruitment of standing stocks of many commercially important fish species. There is an urgent need to conserve the resources of this coast. There are many management tools to achieve this. The method used to reduce the under sized fishes in this study is by following mesh size regulations, using square mesh cod-ends in the regular demersal trawls, Turtle Excluder Devices and other Bycatch reduction Devices. Deployment of Fish Aggregating Devices, By catch reduction devices, protection on biodiversity, environmental safety and energy conservation will help for Long term sustainability of fishery resources. There is a need to promote the use of such eco friendly and low energy fishing techniques, keeping in view the need to reduce the carbon foot print and energy requirement for sustainable Fisheries.

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Introduction

Andhra Pradesh is endowed with a rich array of marine and inland aquatic resources. The state has a coast line of 974km with continental shelf of 33,227 km^2 with rich pelagic and Demersal fishery resources. Andhra Pradesh contributes 7.5% of the total fish production in India. Andhra Pradesh producing 1.50 lakh tones to 2.33 lakh tons with an average annual production of 1.85 lakh tons of fish from marine sector (Syda rao et al,2008)

Destructive fishing in the seas and estuaries without any consideration to conserve juvenile fish stock have taken a heavy toll on natural recruitment of standing stock of many commercially important fish species. Mechanized fishing industry is completely based on the shrimp fishing due to its better economic returns, drastic reduction of mesh sizes of trawls operated resulted in the destruction of juveniles. Implementation of by catch reduction devices, protection on biodiversity, environmental safety and energy conservation will help for Long term sustainability of fishery resources.

A diverse spectrum of fish harvesting systems is in vogue in the captured fisheries sector of India. They range from simple fishing gear such as gillnets to advanced mechanized

systems operating trawl, purse seine and long line. During the last four decades rapid advances have taken place in fish detection techniques, fishing gear material and design, fabrication and operation of fishing gear. The fishing crafts used in Andhra Pradesh range from the traditional catamarans, stitched boat, canoes and navas to mechanized trawlers. The good returns from the fishery have encouraged the mechanized sector to diversify trawlers to Long line to venture into oceanic tuna fishing. Motorized and non motorized wooden catamaran crafts and fiber catamarans, small, medium and large trawlers contributes significantly to tuna fishery along the East Coast waters. There are 4960 Non motorized, 2480 Motorized crafts, 596 trawlers are operating from this coast (CMFRI 2010).

Choice of fishing gear and its design primarily depends on biological, behavioral and distribution characteristics of the target species. There is no universal fishing system suitable for all resources. Fishing gear has to be selected based on several attributes suitable for the particular fishing condition.

Design of fishing gear is influenced by body size and shape, feeding habit and swimming speed, behavior in the vicinity of fishing gear, spatial and aggregation behavior of the target species. Due to poor selectivity of commercial trawls large quantities of fish were discarded into the Sea. The discards consist of juveniles of commercially important species, which may reduce the yields of commercial fisheries.

Gill nets

It is a popular passive gear extensively used in the traditional sector in Andhra Pradesh. They are vertical walls of netting kept erect in the water column using floats and sinkers. Polyamide monofilament and multifilament gill nets are widely used HDPE gill nets of thicker twine are used in deeper waters to exploit bigger fish like sea bass and serranids (Rao et al., 2002).These nets are operated in surface, mid water and bottom layers in Coastal areas. Body size and shape determine the mesh size required to enmesh and hold the fish in gill nets. Body size is also related to the tensile strength requirements for the netting twines in gill nets. Mesh size and hanging coefficient for gill nets for harvesting of commercial important fishes were optimized. Mesh sizes of stake nets and trammel nets are optimized for juvenile conservation (Rao et al.,1991).

Trawl nets

It is basically a large bag made of netting, which is drawn along the sea to scoop up fish on or near bottom. It has a wide mouth, leading to tapered end. The last part of the trawl is called cod end where the fish are collected. The vertical opening of the net is provided by

floats on upper edge i.e head rope and sinkers on lower edge i.e foot rope. The horizontal spread of the net is provided by Otter boards.

Development of sustainable trawls

Responsible fishing regime, which is promoted in India and around the world, requires selectivity of gear has to be improved and its negative environmental impacts has to be reduced. In order to protect biodiversity and environment and to ensure long term sustainability of the fishery resources, CIFT has developed and standardized the designs of Rope trawls, fuel saving light weight trawls and High opening eco friendly Semi pelagic trawls. Designed and developed mid water trawls for midwater fish exploitation and semi pelagic trawl for off bottom fish exploitation. A new design of multi seam trawl yielded a high catch rate (Satyanarayana & Narayanappa, 1976;Satyanarayana *et al* 1972; Rao & Narayanappa, 1994),Rajeswari *et al.*,2012

By catch reduction devices (BRD)

Square mesh codend:

Mesh size regulations for trawl gears aim to reduce fishing mortality by allowing small fish to escape from the nets. Gear selectivity is an important tool for fisheries managers for regulating the minimum mesh sizes of a fishing fleet; determine the minimum mesh sizes of target fish species**.** Codend selectivity studies were conducted with 30mm, 35mm, 40mm and 50mm square mesh codends attached with 20mm mesh cover. The length frequency data pertaining to the fishes which escaped and those retained in the codend were measured. The selectivity data was analyzed for determination of selection range, selection factor and selection ratio for commercial fish available in this coast. (Raghu Prakash *et al* 2008 & Rajeswari *et al* 2010)

Turtle Excluder Device (TED)

Marine turtles belong to Reptile group inhabiting every Ocean basin. They are widely distributed in tropical and temperate seas. They play an important role in ocean and beach ecology. The seven species of sea turtles are the only living members found in the world. Five species are found in Indian coastal waters. All the seven species of sea turtles are included in the IUCN Red list of threatened list of animals. A major threat to day is the incidental catches of turtles in gill nets and trawl fishing operations. Sea turtles are endangered species, which are protected under Schedule I of the Indian Wildlife Protection Act 1972 and its amendment in 1991. They are also protected under the international conventions such as Convention on International Trade on Endangered Species of Wild Flora

and Fauna (CITES 1973) and Bonn Convention on Migratory species. (CMS 1979). The United Nations Convention on the Law of the Sea (UNCLOS 1982) provides obligations of coastal states with regard to scientific conservation and management of migratory marine species.

Shrimp is the major foreign exchange earner in the 1100 million USD (INR 46300 millions) export market for marine products from India, contributing to about 72% of the marine product export earnings. The US law Section 609 of Public law 101-162 restricts exports of shrimp harvested with trawl nets which are not equipped with TED that result in incidental mortality of sea turtles. The Code of conduct for responsible fishing (FAO 1995), which gives guide lines for sustainable development of fisheries, prescribes the need for protecting endangered species.

An indigenous design of TED was developed at Central Institute of Fisheries Technology with focus on reducing catch losses. CIFT-TED is a simple single grid, hard TED design with top opening. It consists of an oval frame measuring 1000x800mm and is constructed with 10 mm steel rod. Five vertical grid bars of 8mm steel rods are welded to the inside of the frame. The spacing between the deflector bars is 142 mm. The frame was fixed in the TED extension at 45^0 angles. Experiments were conducted on departmental vessels in both East and West coasts. An exit hole codend was provided additionally to collect escaped turtles. All the turtles that have entered the trawls were found to have been excluded 100 %exclusion rate for turtles. The loss of fish catch and shrimp catch due to TED installation was not statistically significant. (Dawson and Boopendranath 2002& 2003)

Fish Aggregating Devices (FAD) for Resource Enhancement

Fish are known to gather near coral reef areas. These serve as natural breeding grounds of fishes and provide habitat for a variety of marine fauna and flora. Destructive fishing practices and pollution are two main factors leading to destruction of coral reefs and other fish habitats. The Fish Aggregating Devices (FAD) are man-made structures which facilitate the attraction and aggregation of fish, FAD's are deployed to enhance biological productivity in coastal waters, rehabilitate and conserve the depleting stocks ,reduce the scouting time during harvesting operations and to enhance income and standard of living of the fishermen (Aprieto, 1991, Caddy & Majkowski, 1996
and Rajeswari et al 2005). In Andhra Pradesh, Visakhapatnam Research Centre of CIFT installed Pyramidal structures made of scrap tyres weighed with concrete rings at 15-20m depth. Hook and lines and gill nets were employed to exploit FAD fishery. The quantum of fish increased 20% more than the pre FAD's period. Large scale installation of FAD's

covering about 1-2 km area is expected to enhance the socio-economic condition of fishermen of surround villages. The deployment of benthic FAD does protect the fishing ground from mechanized trawling, keeping the area accessible to fishermen. As most inshore fishery resources are heavily exploited, FAD's if appropriately and judiciously used could help in prevention of shallow water trawling and enhance fishery resources. Other options to increase production are by exploitation of deep Sea resources by using large mesh mid water trawlers and High speed demersal trawls. Deployment of Fish Aggregating Devices, By catch reduction devices, protection on biodiversity, environmental safety and energy conservation will help for Long term sustainability of fishery resources

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Ornamental fish culture, an alternate source of livelihood – A review

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Abstract

Aquarium fish keeping has become a popular hobby and aquarium fish selling is recently gaining popularity as a trade in India. The Indian market is dominated by a vast variety of exotic ornamental fish. However, the indigenous ornamental fish can be collected from wild resources and can be easily cultured and reared for keeping in the aquariums. India with its rich and unique biodiversity is potential resource yet to be recognized. The earning potential of this sector had hardly been understood and the same is not been exploited in a technology driven manner. Ornamental fishery provides not only aesthetic requirement and sustainability of the environment but also a source of generating income and livelihood. With right policy initiatives India can tremendously contribute livelihood security of the rural poor and augment national income in a more socially equitable way.

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Key words: indigenous, exotic, ornamental fishery, biodiversity, livelihood, colouration,

Introduction:

The increasing demand for aquarium fishes gradually paved the avenue towards global trade of ornamental fishes. World trade of ornamental fish is estimated to be about Rs.2, 000 crores, but India's share is only Rs.15 crores, which is very insignificant. Our country has rich and unique biodiversity with a variety of indigenous ornamental fishes. About 80% of the ornamental fish are from fresh waters and the rest from brackish and marine waters. But this resource has not been properly exploited. The Western Ghats of India is a gold mine of tropical ornamental fishes and is one of the 25 hot spot areas of the world. It exhibits exceptional mega biodiversity and high degree of endemism with respect to fishes (Fisheries Network Information). Most of the fish species of North Eastern region of India posses high value for their attractive colouration pattern, graceful behavior, peculiar body morphology and endemic.

The major shares of country's ornamental fish export are captive collection from North East states comprising about 85% of total aquarium fish trade of India. Aquarium fish keeping has become a popular hobby and aquarium fish selling is recently gaining popularity as a trade in India. The trade is mostly confined to import of exotic ornamental fishes. The indigenous ornamental fish which are available in the rivers of the country are being neglected due to lack of awareness. Most of these fishes are caught before their first maturity

and sold in the market as food fishes. The indigenous ornamental fishes can be easily collected from the wild resources and can be cultured and reared for keeping in the aquarium. (Sagar.C.Mandal et al.,). Generally the exotic fish dominate the Indian market with more than 250 varieties. More than 200 species of these freshwater fish are bred in different parts of India by the ornamental fish breeders and aquarium hobbyists (Shabir Ahmed Dar et al.,).

Important ornamental fishes of India:

The egg layers lay adhesive or non-adhesive eggs. In contrast live bearers are easy to breed. Some of the common exotic live bearers are guppies, mollies, sword tails and platys. Egg layers like gold fish, koi carp, tiger barb, betta, tetra, silver shark, angel, red tailed black shark etc dominate the market. The native ornamental fish include honey gourami, rosy barb, zebra fish, glass fish, loach etc. (Shabir Ahmed Dar et al.,).

Global scenario:

The trade with a turnover of 5billion dollars and annual growth rate of 8% offers a lot of scope for development. The top exporting country is Singapore, followed by Hong Kong, Malaysia, Thailand, Philippines, Sri Lanka, Taiwan, Indonesia and India. The largest importer is USA followed by Europe and Japan. The emerging markets are China and South Africa. According to Alexander Ploeg, ornamental fish industry should be encouraged as worldwide trade association representing all sectors of ornamental aquatic industry at international level.

Indian scenario:

India's share in ornamental fish trade is Rs. 158.23 lakhs which is only 0.008% of global trade. The major part of export trade is based on wild collection. There is very good domestic market too which is mainly based on domestically bred exotic species. The overall domestic trade crosses 10 crore and is growing at the rate of 20 % annually.

The earning potential of this sector had hardly been understood and the same is not exploited in a technology driven manner. Ornamental fishes form an important commercial component of aquaculture, providing for aesthetic requirement and sustainability of the environment. Recently it has become an interesting activity for many in the process of generating income for unemployed youth, women and farmers. The concept of entrepreneurship development through ornamental fish farming is gaining popularity day by day. Hence many people are entering into this lucrative business of culturing and breeding these fish through farming. Along with this many aquarium plants and other accessories are coming up as pet shops in cities as well as small towns. One of the basic requirements is a clear understanding of habits and biological requirements of the fish. The hobbyists gain

knowledge of the behavior and biology of the fish during aquarium maintenance which is useful to breed several varieties of fish.

Why breeding?

95% of our ornamental fish export is based on wild collection. Majority of the indigenous ornamental fish trade in India is from North Eastern states and rest is from Southern states which are the hot spots of fish biodiversity in India. The capture based export is not sustainably and is a matter of concern for the industry. In order to sustain the growth it is necessary to shift the focus from capture to culture based development. Moreover most of the fish species grown for their ornamental importance can be bred in India successfully. Organized trade in ornamental fish depends on assured and adequate supply of demand which is possible only by mass breeding.

According to Ingochouba Lukram, (online paper) many of the ornamental fish are easy to breed, some of them rare, difficult to breed and expensive. Most of the exotic species can be bred and reared easily since the technology involved is simple and well developed. It is advisable to start with common, attractive, easily bred, less expensive species before attempting more challenging ones. An ornamental fish project can be rearing only, breeding only, breeding and rearing depending upon the space available.

The technology involves activities like:

1. **Culture or rearing** taken up in cement tanks using ground water, yielding 8-10 crops per annum.
2. **Feeding:** Juveniles or fry fed with live feed like *Infusoria, Artemia, Daphnia, Tubifex,* mosquito larvae etc. and for rearing formulated artificial or prepared food. At present no indigenous prepared feed for aquarium fish is available**.**
3. **Breeding:** The success depends on compatibility of pairs fed with good live feed and reared separately to avoid inbreeding.
4. **Health care:** Maintaining water quality parameters is of utmost importance for the health of the fish in addition to using various chemicals like methylene blue, potassium permanganate, copper sulphate for prevention and treatment of diseases.
5. **Market:** At present the market is mainly domestic which is increasing.

Basic requirements for ornamental fish project:

The following investments are required for starting ornamental fish project.

- **Tanks:** The tanks can be of RCC or brick masonry work or fiber glass or plastic having flat bottoms wit inlet and outlet pipes. Rearing should be done in large tanks.
- **Aquariums:** Glass tanks of varying size are required for breeding.

- **Overhead tank:** For storing water.
- **Water supply:** Well water would be the best source. Municipal water can also be used. Recycling of water through bio filters can be done. A small motor and network of pipes are needed to feed the culture tanks.
- **Work shed:** For the tanks to get filtered sunlight and protection from falling debris, bird droppings etc.
- **Aeration equipment:** A blower pump with network of tubes for aeration is a must Continuous power supply should also be ensured through generator or UPS or inverter.
- **Potential of ornamental fish culture in India:** Ornamental fisheries in India have a good potential due to enormous geographical spread, extensive species diversity and intensive research and developmental efforts that are put in by several institutions like R & D Centers in India like CIFA, Bhubaneswar, CMFRI, Kochi. COF, Panangad, Annamalai University, Parangipettai have standardized technologies for breeding and culture of many ornamental fish.

Chennai, Kolkata, Mumbai and Kochi are established business sites of ornamental fish trade. Of late Goa is also emerging as important center in this business. In Tamilnadu, Kolathur village near Chennai is famous for ornamental fish production as cottage industry. A proposal is set up for two techno parks of ornamental fisheries one in Ernakulam and Kollam districts of Kerala re in pipe line. In Kolkata ornamental fish farms are located in North and South of 24 paraganas, Nadia, Hooghly and Howrah districts where women folk are taking up as common backyard activity. Kerala with its highly conducive climatic conditions provides scope for development of ornamental fisheries. The state has 44 rivers of which 21 were surveyed in 2005, 142 species reported, out of which 51% are considered as possible ornamentals. Among these fish few like *Puntius denisonii* are very valuable in the international market (Anna Mercy, 2012).

Suggestions and Conclusion:

1. Central and State governments should initiate new developmental schemes for ornamental fish culture.
2. Establishment of zone wise model ornamental fish farms will help in gaining popularity.
3. Involvement of rural women and Self Help Groups should be encouraged.
4. Setting up of more public aquaria in cities and towns will help in bringing awareness to the public.
5. Ornamental fish farming can be taken up as extension of culture of food fishes.

6. Aqua farmers of shrimp production may take up ornamental fish farming during off season period.
7. Promotion of ornamental fish culture can be done through aqua clinics.
8. Private –Public partnerships to be encouraged.
9. Educational institutions should initiate training programmes in ornamental fish culture for developing entrepreneurship skills among students.

India is considered as the "sleeping giant" in ornamental fish culture. With right policy initiatives ornamental fish culture in India can tremendously contribute livelihood security of the rural poor and augment national income in a more socially equitable way.

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"Whether a fish lives in a clear stream or a wet ditch, So long as it continues swimming forward, It will grow beautifully" – Korosensei

The Immunostimulatory effect of Immunex Ds and H-Treat on total lipid content of gill, intestine, brain and thymus in Labeo rohita (Hamilton) during Aeromoniasis.

***Indira. R**

****Viveka Vardhani. V**

Abstract:

Antibiotics and chemotherapeutics are extensively used in Aqua ponds to control infectious diseases, but they create problems with drug resisting bacteria toxicity and accumulation both in fish and environment on the contrary, natural or herbal Immunostimulant have various beneficial effects like anti stress, antimicrobial and eco-friendly. Moreover, they are safer and cheaper, non toxic & improve resistance and health of the fish. In the present investigation, an attempt has been made to determine the immunostimulatory role of Immunex Ds (IDs) and H-treat on the total lipids in *L. rohita* during aeromoniasis. There was marked changes were observed in all treated fish (IDS/H-treat) compared to controls and fish which received only infection.

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Keywords: Immunostimulant, Immunex Ds, Aeromonas liquefaciens, Labeo rohita.

Introduction

Employment of chemotherapeutics for the control of disease, in aquaculture has been discouraged because of the accumulation in tissues of fish as residues, development of drug resistance in pathogens, suppressing the disease mechanisms in fish and causing pollution in aquatic environment (Rajkers et. al, 1980; Van muiswinket et. al, 1985; Ellis, 1988). Fish can be protected against diseases and/or them growth may be enhanced with the use of immunostimulants (Siwiki and Korwin, 1988; Anderson, 1992; Raa, 1996; Sakai, 1999; Sahoo and Mukherjee, 2001, 2002 and 2003; Kumari et. al, 2003). In order to promote sustainable culture of Indian major carps, there is a need to develop eco-friendly disease friendly disease preventive measures which have no or little side effects during the treatment of immunostimulants; India is equipped richly with traditional herbal medicines to treat human and animal diseases. Recent approach of use of immunostimunts in fish feed will be of immense help to formers to combat aflatoxin – induced immune suppression and other stressful situation in fish culture operations to enhance production. An attempt was made in the present investigation to evaluate the effect of H-treat (herbal immunizer) on the total lipid content in *L. rohita* during aeromoniasis. Significant increase of total lipid in fish fed with H-treat along with normal feed, compared to controls and fish infected with *A. liquefaciens*.

Material and Methods:

Experimental Fish;

Experiments were performed on the common fresh water carp, *Labeo rohita* (Indian Major carp) which is extensively cultured in India and is valued as an important food fish.

Procurement and Maintenance of fish:

Healthy fish with an average weight of 50-60 gm. were obtained from Jalipudi fish farm, Jalipudi Mandal, West Godavari District, Andhra Pradesh and kept in the laboratory for acclimatization for about 4-5 days before they were used for experimentation. Dechlorinated ground water was used during acclimation and experimental period. The water in acclimation tanks were frequently oxygenated with electrical aerators.

Bacterial strain and cultivation:

Aeromonas liquefaciens strain, MTCC 2654 (virulent strain) was obtained from MTCC, Chandigarh, India. From this parent culture, sub cultures of *A. liquefaciens* were prepared and doses were made under aseptic condition.

Antigen dose:

Various doses like 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}, 10^{-8} and 10^{-9} CFU/fish were injected to the fish to include aeromoniasis and determined 10^{-4} dose as LD_{50}. So 10^{-5} CFU/fish was selected for experimentation as optimum dose.

Route of infection:

A. liquefaciens bacterial suspension was injected to the fish, *L. rohita* intramuscularly near the anal region.

Immunostimulants:

Immunex Ds and H-Treat were used in the present investigations (manufactured from PVS laboratories Ltd., Vijayawada, Krishna District, A.P, India). Test does of H-Treat was selected as per the recommended dosage given by PVS lab i.e. 5g.per kg. of pellets).

Culture method of *Aeromones liquefaciens*:

Culture of *A. liquefaciens* was done following the method of pelczar et. al (1993). Healthy fishes were divided into six groups and maintained in separate tanks each with twenty fish as derailed below.

- Group A (fed with Immunex Ds @ 40mg/100g. of feed)
- Group B (infected with *A. liquefaciens* @ 10^{-5} CFU/fish)
- Group C (Untreated and uninfected controls)
- Group a(fed with H-Treat @ 40mg/100g. of feed)
- Group b (infected with A liquefaciens @ 10^{-5} CFU/fish)
- Group c(untreated and uninfected controls)

The fish from experimental and control groups were necropsied in day 1,2,3,4 and 5 studied for total lipid of gill, intestine, brain and thymus.

Result

Result showing in Tables 1,2 and figures 1,2 .

Table 1:- Total lipid content of gill, intestine, brain, thymus of control (Group C, untreated and uninfected), Treated (Group A, treated with Immunex Ds @ 40mg/100g. of feed) and infected (Group B, infected with *A. liquefaciens* @ 10^{-5} CFU/fish) Fish, *L. rohita* at different days of experiment. values are expressed in mean derived from five observations.

Figure 1:- (same as table 1.)

Table 2: Total lipid content of gill, intestine, brain and thymus if control (Group C, untreated and uninfected), treated (Group a, treated with H-Treat @ 40mg/100g. of feed) and infected (Group b, infected with *A. liquefaciens* @ 10^{-5} CFU/fish) fish, *L. rohita* at different days of experiment. Values are expressed in mean derived from five observations.

Figure 2: -same-

Discussion:

The dietary administration of immunostimulants/ herbal immunizers in aquaculture became popular to enhance the non specific mechanism and increase disease resistance (Raa, 1996). In the present study, the infected fish (groups Band b) showed a significant decrease of total lipid content in gill, intestine, brain and thymus. This shows that the infections bacteria caused the decreased in the content of lipid, as the gill and intestine are the organs of exposure to pathogens, brain is the sensitive organ and thymus is the primary lymphoid organ. So, these organs are considered as important in detecting the pathogenic effect of any infection. Fish treated with Immunex Ds and H-Treat showed marked increase of total lipid content in all the found organs compared to control. This shows that the Immunex Ds and H-Treat supplemented diet improved the content of total lipid in the test organs like gill, intestine, brain and thymus.

Several innate and specific immune responses of the *Labeo rohita* (Gupta et.al, 2008) and *cyprinus carpio* (soltani, 2010) were examined with diets supplemented with microbial levan Zagaria multiflora. IDs and H-Treat supplementation in rohu had

Days of Necropsy		Experimental groups								Control group			
		Treated with Immunex Ds (group A)				Infected with *A. liquefaciens* 10^{-5} CFU/fish (group B)				Uninfected and untreated (group C)			
		Gill	Intestine	Brain	Thymus	Gill	Intestine	Brain	Thymus	Gill	Intestine	Brain	Thymus

marked effect on the organs of respiration (gill) digestion (intestine), CNS (brain) and lymphoid organ (thymus) in relation to total lipid content.

Table – 1: Total lipid content (%) in the gill, intestine, brain and thymus of control (group C, untreated and uninfected), treated (group A treated with Immunex DS @ 40mg/100gm of feed) and infected (group B, infected with *A. liquefaciens* @ 10^{-5} CFU/fish) fish, *L. rohita* at different days of experiment. Values are expressed in mean derived from five observations.

	Lipids												
1	**:**	**0.140**	**0.090**	**0.265**	**0.190**	**0.050**	**0.050**	**0.150**	**0.060**	**0.060**	**0.070**	**0.150**	**0.170**
2		**0.185**	**0.175**	**0.290**	**0.260**	**0.030**	**0.040**	**0.140**	**0.060**	**0.070**	**0.070**	**0.140**	**0.160**
3		**0.200**	**0.231**	**0.299**	**0.251**	**0.020**	**0.030**	**0.120**	**0.050**	**0.060**	**0.070**	**0.150**	**0.160**
4		**0.220**	**0.280**	**0.310**	**0.269**	**0.010**	**0.030**	**0.120**	**0.050**	**0.060**	**0.070**	**0.150**	**0.160**
5		**0.320**	**0.405**	**0.326**	**0.299**	**0.010**	**0.020**	**0.090**	**0.030**	**0.060**	**0.070**	**0.150**	**0.170**

Table – 2: Total lipid content (%) in the gill, intestine, brain and thymus of control (group c, untreated and uninfected), treated (group a, treated with H-Treat @ 40mg/100gm of feed) and infected (group b, infected with *A. liquefaciens* @ 10^{-5} CFU/fish) fish, *L. rohita* at different days of experiment. Values are expressed in mean derived from five observations.

Days of Necropsy		**Experimental groups**								**Control group**			
		Treated with H-Treat (group a)				**Infected with *A. liquefaciens* 10^{-5} CFU/fish (group b)**				**Uninfected and untreated (group c)**			
		Gill	**Intestine**	**Brain**	**Thymus**	**Gill**	**Intestine**	**Brain**	**Thymus**	**Gill**	**Intestine**	**Brain**	**Thymus**
	Lipids:												
1		**0.160**	**0.080**	**0.285**	**0.195**	**0.030**	**0.060**	**0.450**	**0.050**	**0.060**	**0.070**	**0.150**	**0.160**
2		**0.175**	**0.195**	**0.320**	**0.270**	**0.030**	**0.040**	**0.140**	**0.060**	**0.070**	**0.070**	**0.140**	**0.160**
3		**0.220**	**0.255**	**0.350**	**0.260**	**0.020**	**0.040**	**0.130**	**0.050**	**0.060**	**0.080**	**0.150**	**0.170**
4		**0.250**	**0.320**	**0.360**	**0.280**	**0.020**	**0.030**	**0.120**	**0.050**	**0.070**	**0.070**	**0.150**	**0.160**
5		**0.360**	**0.450**	**0.385**	**0.355**	**0.010**	**0.030**	**0.080**	**0.010**	**0.060**	**0.070**	**0.140**	**0.170**

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Aquaculture, in conjunction with wild-harvest fisheries, will help to meet the growing demand for seafood and provide alternatives to increasing fishing pressure on fragile wild fish stocks. Aquaculture can generate prosperity in new ways while conserving and enhancing the Nation's natural resources and providing a safe, sufficient, and nutritious supply of seafood for the country and for export markets.

Aquaculture - Kolleru Lake Ecosystem

P. Paul Divakar

Keywords: indigenous, migrating, encroachments, beneficiaries, pisciculture, depletion.

Introduction

The Kolleru Lake is considered to be one of the fresh water bodies in India. The flora and fauna of the Kolleru Lake are unique. It is located in between Krishna and Godavari delta. The lake serves as a natural flood-balancing reservoir for these two rivers. The lake is fed directly by water from the seasonal Budameru and Tammileru drains also connected to the Krishna and Godavari systems by over 68 inflowing drains. The important activities in the lake area are agriculture and aquaculture and it is a bird sanctuary for indigenous and migrating birds.

Aquaculture Boom

The fishermen, who were dependent on traditional fish capture, were encouraged by the government to go in for aquaculture by forming cooperatives in 1970s. Some rich enterprising farmers, taking advantage of the government policy, captured the cooperatives. The lands have remained in the name of poor beneficiaries, while the real fisher-folk work on meager wages and started illegal encroachments, reaped rich harvests through the scheme. Their success and prosperity in the 1990s encouraged the outsiders to invest in fish tanks leading to an aquaculture boom and over exploitation of the lake. At present aquaculture is carried out in over 80,000 ha producing more than seven lakh tones of products with an annual turnover of Rs 4,000 crore. However, reports say that the area under aquaculture is much higher than official estimates since there is much illegal activity happening on this front.

Situation of Ecosystem

Unscientific and illegal aquaculture coupled with agricultural runoff from the area that also contains chemical residue, untreated water from neighbouring industries and domestic sewage flow into the lake and contribute to its pollution and also ecological degradation of the lake was set in due to extensive use of pesticides by farmers of Upper catchment and delta regions, bunding for pisciculture.The problem is, it needs saline water to flourish and bore-wells have been sunk in the lake bed to pump out saline water for the aqua ponds; the lake bed level has sunk, the tides bring in more and more saline water into the lake since the banks have also sunk. Prawn seed is cultivated for one month in small ponds and then transferred to larger ponds with saline water. Both fish and prawn cultivation require use of chemical fertilizers, gobar manure, chicken waste, etc. Once the harvest is over this water

stagnates and pollutes the surrounding water.The consequences of this pollution are there for all to see. There are frequent fish kills, scarcity of safe drinking water in dozens of island villages and contamination of groundwater around the lake in Krishna and West Godavari districts. This once glorious and picturesque fresh water body is now doomed to become a dead lake. It has undergone several chemical and biological changes that have contributed to its depletion and pollution. The water has turned saline, fish are contaminated with pesticides and polycyclic aromatic hydrocarbons and heavy metals have entered the lake which means that fish and prawns are unfit for human consumption. In this way the Kolleru is now clinically dead.

It has been found that,

(a) The government does not supply drinking water to the island villages and no investments have been undertaken to rectify this situation in spite of the fact that every year this region contributes considerable wealth, for example in the form of tourism.

(b) Fifteen years ago the villagers used to drink only lake water and now they walk three to six km to get water for domestic use.

(c) Many buy sachets of water – a thriving local industry – but there are no quality checks; there is no expiry date on the packets and no treatment of water before packaging. But the illiterate villagers have no idea about the risk they incur and suffer from various water-related diseases like diarrhea, typhoid, amoebiasis, Jaundice etc.

(d) During the last two years the prawn and fish have been disease prone and some farms have been abandoned. These lands are useless for agriculture as well since the soil and water have been contaminated.

Conclusion

The situation calls for a public dialogue that can bring about practicable and workable solutions. Water networks can play a useful role in mediating and connecting local groups with similar outfits that are willing to participate in mutual exchange of ideas that can take the process forward and to block further damage to the lake and restore its ecological health and make it sustainable again.

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The Importance and Impact of Aquatic Culture On - Ecosystems, Socio - Economic Environment and People.

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Abstract

Aquaculture development is an innovative food production technology to cope up with the current and future aqua food demands of the society. Fish and fish products have become important trade and livelihood opportunities in the coastal areas of India. In addition, it provides good export revenue to the country. However, the aquaculture industry is facing with number of socio-economic issues which are to be addressed immediately to balance the economic disparities in the aqua industry. Major socio-economic issues in the aquaculture industry is some type of fish stocks are fully exploited, over exploited or depleted which has become a great risk of extinction. Major categories of threats are habitat degradation, water pollution, flow modification, species invasion, overexploitation, and climate change. Serious environmental problems are cropping up due to aquaculture production, such as increased salinity, water pollution and destruction of fertile paddy and agricultural lands in the Coastal Areas. Potential Socio-economic implications are becoming high due to increased market concentration of aqua production in the vicinity of the human habitat.

Other major socio-economic threats are fresh water exploitation, oversight of government bodies on the aqua production guidelines, improper waste management, not maintaining the quality of seafood, all these effects the local hydrodynamics. There is a substantial risk for the anticipated socio-economic benefits from aquaculture expansion if it is produced and maintained in improper non-regulatory guidelines. Major socio-economic failures are due to a lack of stakeholder participation and/or understanding of social influences on ecosystems and of ecosystems on humans and society. Diseases and electricity (shortage of electric supply) were the first and second ranked problems to the farmers. The increased incidence of diseases (White spot and EUS) in Andhra Pradesh fish farms according to Mohan and Bhatta (2002) was due to intensification in culture practices. Price fluctuations, inundation due to floods, lack of financial assistance, lack of seed quality, lack of technical expertise and poaching of fish are the major obstacles to sustain economically in this aquaculture industry. Supreme Court of India recently gave an order to prohibit new aquaculture in three Indian states. As per the conducted Survey in India, aquaculture is causing more harm than good to the society. Social and environmental costs are outweighed the economic benefits by a ratio of four to one. Government Policies on Aquaculture are to be reviewed and stringent regulations and quality standards are to be developed and implemented to revive the aquaculture industry. Protective legislation, insurance, finance, public health, good market, quality fish seed supply, authorized regulatory bodies, good training, implementation of Social Control Mechanisms, understanding the cost-benefit analysis are the vital aspects to look into while making the aqua business more viable in socio-economic grounds. Better working frameworks, alternative strategies, regulatory and methodologies are to be developed to reduce the negative impact on aquaculture industry.

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1. Introduction

Andhra Pradesh ranks first in coastal aquaculture and fresh water aquaculture. It ranks second in fresh water fish production and overall value of fish/prawn production. Andhra Pradesh contributes nearly 40 per cent of the total marine exports of the country. Inland resources comprise 102 reservoirs of which 7 are large, 26 are medium and 69 are small reservoirs. There are two lakes - Kolleru Lake, a freshwater lake and Pulicat lake - a brackish water lake. 74,000 perennial, seasonal and long seasonal tanks, fishponds and freshwater prawn ponds for aquaculture are also present in Andhra Pradesh. Brackish water resources comprise 0.78 lakh hectares for shrimp culture, a coastline of 974 kms and 508 fishing villages.The aquatic organisms of economic importance to man are fishes, prawns, crabs, lobsters, mussels, oysters, squids, sea weeds etc. These organisms are exploited either for food or for other commercial products. The concept of blue revolution (capturing or capturing of aquatic organisms) is gaining importance. Govt of India and Govt. of Andhra Pradesh have been providing infrastructural, financial and technical support to encourage aquaculture in India in general and Andhra Pradesh in particular. The available aquatic resources are rivers, canals, reservoirs, lakes, brackish waters (estuaries) and marine waters. The freshwater habitats include lotic (running water) and lentic (stagnant water) habitats.

Traditionally, small scale coastal aquaculture is a sustainable practice in many countries. This varies according to the species cultured, location of aquaculture and different farming methods. Recently this trend has increased and it is spread over a large area, but is individually small and poorly managed. The aquaculture has become only a profit centered business than subsistence farming. Rapid expansion in inland aquaculture in some coastal regions is causing ecological impacts. Lack of adequate coastal planning, management and consideration of the environmental compatibility of particular regions is causing environmental issues and ecological changes. This is very much alarming and it is irreversible or recovery from this impact is rather very slow. Existing aquaculture in Andhra Pradesh is seriously affected by pollution caused by land based and coastal developments.

Aquaculture is competing for economic, social, physical and ecological resources, and it is resulting in environmental degradation. Its development may therefore generate negative impacts on other industries and people’s livelihoods (e.g. fisheries, agriculture, and tourism). Decisions about aquaculture development are often based on incomplete information, particularly in relation to the socioeconomic dimensions. As a consequence, inadequate accounts for how trade-offs associated with different development options are made.

Examples include aquaculture expansion in certain areas directly affecting resource systems that may already be under large pressure from other human activities. There is therefore a risk that anticipated and much needed socio-economic benefits from aquaculture expansion, may come at the expense of increased and possible unsustainable pressure on ecosystem goods and services (Naylor et al. 2000), ultimately jeopardizing people's food security and livelihoods. Unsustainable use, alteration and transformation of ecosystem services can undermine the productive resource base and divert resources away from other uses and users, bringing aquaculture in conflict with other stake-holders. A number of human pressures related to catchment disturbance, encroachment of rivers, exploitation of fresh waters, pollution, water resource development and direct biotic factors, such as invasive species, fishing and aquaculture, poses threats to the integrity of running waters (Allan, 2004; Paul and Meyer, 2001; Vörösmarty et al., 2010). Some of these problems may be overcome by taking proper steps, improvement in technology and by proper on site management.

2. Review of Literature

Aquaculture is one of the fastest growing food industries. However, the rapid growth of aquaculture worldwide has resulted in growing concerns about its impact on important ecosystems. Aquaculture is mainly referring to the farming of fish and shrimp. It forms a major enterprise primarily in the inland, fresh water and brackish water areas of India. It represents around 25% of food fishery supply and is expected to contribute more to meet the world's future food needs. In India, brackish water aquaculture is widespread in the East coast states like West Bengal, Orissa, Andhra Pradesh and Tamil Nadu. Along the west coast, Kerala had a dominant traditional system of paddy-cum-shrimp culture, followed by Karnataka and Goa. Aquaculture has turned out to be a very profitable business compared to agriculture and animal husbandry these days (Kumar, 1997). Out of a total 1.456 million hectares of brackish water area available in India, 0.902 million hectares are being utilized principally for shrimp farms. It earns foreign exchange as well as generates employment for a large coastal contiguous population (Mishra, 1998). According to Food and Agriculture Organization (FAO), total aquaculture production of aquatic animals (excluding aquatic plants) in India increased from 6.7 million tons in 1984 to 42.3 million tons in 2003 and India's share to World aquaculture production was 6.2%. Aquaculture has become a commercial farming of high profit sector in the early nineties and the area increased from 60,235 ha. In 1989-1990 to 221250 ha., in 2003-2004 (MPEDA, 2004). The rapid expansion of this industry is leading to a growing concern about its impact on the environment and in socio-economic point of view. Conversion of fertile agricultural lands, lakes, mangroves to

aquaculture farms is having a serious impact on socio-economic issues. Large scale removal of valuable coastal wetlands, salinization of ground water and agricultural lands leads to subsequent loss of goods and services generated by natural resources systems (chua, 1992).

Practices that are environmentally safe, technically appropriate, economically viable and socially acceptable should, therefore, be promoted through integrated planning and management within the framework of sustainable coastal zone management (Chua, 1992; Spalding et al., 1997). Analysis of Landsat satellite data across Asia from 1975 to 2005 revealed that aquaculture played a vital role in the destruction of 12% of total mangrove cover (Giri et al., 2008). A survey done by the aquaculture sector found that about 5% of the shrimp farms in India has been constructed in mangrove areas (ADB/NACA, 1998). Continuous monitoring and inventory of aquaculture farms is necessary for decision making on aquaculture development, including regulatory laws, environmental protection and revenue collection. Latest technologies like Remote sensing, mapping, Global information system, Global positioning systems are to be used to cover the large areas at reasonably high positional accuracy, with suitable spatial and temporal resolution (Ehlers et al., 1991).

A number of studies have been published in world over as well as in India pertaining to the application of RS and GIS in aquaculture mapping and monitoring (Kapetsky et al., 1988; Nath et al., 2000; Dahdouh-Guebas et al., 2002; Salam et al., 2003; Tong et al., 2004; Dwivedi and Kandrika, 2004; Jayanthi et al., 2006; Seto and Fragkias, 2007). The current study was undertaken to understand the impact of aquaculture on one of the largest lake Kolleru in the West Godavari District and socio-economic issues related to in land areas of aquaculture in the East Godavari District areas of Andhra Pradesh in India.

3. Discussion & Developments

Employment and income earning are the basic requirements through any industry. Aquaculture gives both of them comparatively on higher percentage. However, some questions pertaining to social site selection criteria, community impacts, right of access, ownership, taxation, liabilities of the negative repercussions from the environmental effects on society, ethical issues etc., remained largely un-tackled in a comprehensive integrated manner. Practitioners should note that sustainable aquaculture not only gives benefits, but also minimize accumulation of detriments, negative impacts on natural and social environment. A wide range of data and tools have been gathered and examined to achieve required objectives to influence management decisions.

The type and scale of any ecological change associated with coastal aquaculture development will depend on the method of aquaculture, the level of production and the

physical, chemical, and biological characteristics of the coastal area. Ecological change has een associated with the large-scale production of bivalves and seaweeds and the release of dissolved and particulate waste from fish, shrimp, and bivalve culture. Destruction of productive wetland habitats has resulted in the disturbance of wildlife and uncontrolled introductions and transfers have altered or impoverished the biodiversity of the receiving ecosystem. Some ecological change, such as the impact of organic waste on the seabed ecosystem, can limit production. The indiscriminate use of bioactive compounds, including pesticides and antibiotics, has caused concern about their release into the aquatic environment. The health implications of the use of chemicals and the consumption of seafood grown in contaminated waters are problems of growing concern, especially in relation to intoxication by phycotoxins and infectious diseases such as typhoid fever, cholera, and hepatitis.

Some of the ecological and socio-economic problems encountered are due to the market failure to reflect the true cost of resource depletion and environmental change. The solution to this problem requires policy intervention at national and local level, particularly in regard to the issues of common property rights and economic incentives and deterrents needed to minimize environmental change. Reducing the resource use conflicts, minimizing the health risks to human consumers, reducing the adverse ecological impacts, application of environmental impact assessment to aquaculture proposals, determination of the carrying capacity of ecosystems, regulation of farm discharge, monitoring ecological changes are the improvement developments to be adopted to alleviate the socio-economic impact due to aquaculture in this region.

4. Findings and alternatives

Consequences of mismanaged aquaculture in coastal belt of Andhra Pradesh is leading to many geographical issues, human health issues, fish production issues, ground water issues, diseases due to pathogens or toxins (Shuval, 1986) , threat to wild life, salinization of ground water, reduction in Kolleru lake area, reduction in natural habitat etc., are the few socio-economic and environmental problems.

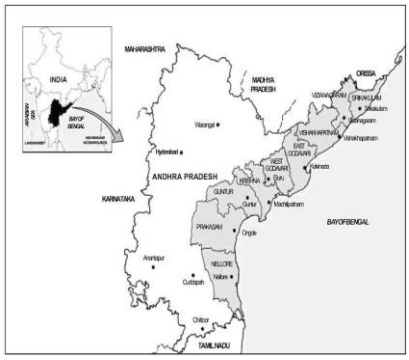

Figure – 01 Andhra Pradesh Coastal belt

The full socio-economic benefits of coastal aquaculture development can only be achieved by adopting the principle of sustainable development, which is defined by FAO (1988) as:

"Sustainable development is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable". Lack of proper management and improper practices in aquaculture is the main reason to all the impediments. The assessment of wider environmental impacts (socio-economic and ecological) is necessary in an evaluation of the social benefits. Thus, the impacts have to be identified, measured and where possible, a monetary value placed on them so that they can be included in a formal analysis (Dixon et al., 1988). However, quantitative evaluation of the impacts of aquaculture on the environment has only recently been seriously attempted, and most of the biophysical relationships involved have yet to be firmly established. Coastal aquaculture activity must be regulated and monitored to ensure that impacts remain within pre-determined limits and to signal when contingency and other plans need to be brought into effect to reverse any trends leading towards unacceptable environmental consequences.

Systematic training in aquaculture development and management plan at local level and state level is essential as the first step towards achieving the above objectives.Selecting and developing model sites of forms of coastal aquaculture practice and its evaluation with the international norms and eco friendly systems which will be technically and financially viable and becomes model to the rest of the aqua farmers.

EIA is a process whereby the potential impacts of a proposal on the social, biological, chemical and physical environment are assessed and justified, and the means sought to minimize or eliminate negative effects. Misuse of bioactive compounds, including antibiotics

and pesticides should be prevented. Proper code of practice for the use of inhibitory compounds in the aquaculture is to be framed and followed.

The accumulating effects of discharges on the coastal environment could be greatly reduced by the enforcement of site and contaminant specific effluent standards (e.g. for suspended solids, nutrients, and BOD). Levels to be adopted should be within the assimilative capacity of receiving ecosystems (GESAMP, 1986).

Ensure to maintain proper sanitary standard for waters in areas supporting aquaculture. Depuration and appropriate storage and preservation facilities need to be established and maintained to ensure the adequate quality of products.

Increase public awareness on the need for good seawater quality in the production of marine aquaculture products. Risk assessment, processing control, knowledge on consuming seafood and food borne organisms etc., is necessary to develop an eco-friendly aquaculture environment. Declaring incentives such as tariff exemption on feeds and equipment, energy subsidies and depreciation allowances on facilities and deterrents, tax exemptions, loan waivers etc., will boost the aquaculture farming and discipline will be maintained to have a socio economic and environment pro aquaculture in the future.

5. Conclusions

The coastal belt of Andhra Pradesh state is highly developed and mostly literate. Measures are to be taken to reduce the vulnerability and improve adaptive capacity of the small scale farmers. Hence it is important to train the farmers on optimum feeding schedules, fuel use, technical viability, implementation of waste management procedures, using protein sources and campaigning to have better services and information. It is important to address both women and men to bring awareness on the aquaculture impacts. Lack of financial support from the nationalized banks, poaching of fish, seed quality, bad infrastructure, shortage of electricity, more fuel cost, lack of technical support, low literacy rate, high interest rates from private financiers, is hugely affecting the aquaculture in this coastal belt of Andhra Pradesh.

The importance of aquaculture to the national and rural economy, poverty alleviation and food security has been demonstrated in many countries and regions. There is no doubt that the fish farmers' commitment and aqua culture will further develop in the coming years. However, a strong commitment from Government organizations and research institutions as well as more intensive and comprehensive co-operation, training and technology extension are urgently needed.

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Nanotechnology: A Novel Tool for Aquaculture and Fisheries Development

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Abstract:

Aquaculture appears to have strongest potential to meet the increasing demands for aquatic products in most regions of the world. The world population is on the increase, as is the demand for aquatic food products. Production from capture fisheries at a global level is levelling off. Potential contributions from aquaculture to local food security, livelihoods and nutrition can be highly significant, especially in many remote and resource-poor rural areas. One of the major constraints to aquaculture production is the losses due to diseases.

This paper presents the nanotechnology and its applications in aquaculture and fisheries.

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Keywords: Nanotechnology, Nano material, DNA nanovaccine, Aquaculture, revolutionized, eliciting,

Introduction

Nanotechnology has a tremendous potential to revolutionize agriculture and allied fields including aquaculture and fisheries. It can provide new tools for aquaculture, fish bio-technology, fish genetics, fish reproduction and aquatic health etc. Nanotechnology tools like nanomaterials, DNA nanovaccines, Gene delivery and smart drug delivery etc. have the potential to solve many puzzles related to animal health, production, reproduction, prevention and treatment of diseases. It is sensible to presume that in the upcoming years nanotechnology research will reform the science and technology and will help boost livestock production. Nanotechnology applications in the fish processing industry can be utilized to detect bacteria in packaging, produce stronger flavors, colour quality, and safety by increasing the barrier properties.

Aquaculture has become the worlds' fastest growing food-producing sector, with an annual growth rate of 10% since 1984. Asia contributes about 91% of the worlds' total aqua-culture production with China, India, Japan, the Republic of Korea, the Philippines, Indonesia and Thailand as top producers.

Fishing and aquaculture in India has a long history. Kautilya's Arthashastra (321–300 B.C.) and King Someswara's Manasottara (1127 A.D.) each refer to fish culture[1]. Fishing in India is a major industry in its coastal states, employing over 14 million people. Fish production in India has increased more than tenfold since its independence in 1947. According to the Food and Agriculture Organization (FAO) of the United Nations, fish output in India doubled between 1990 and 2010[2] . India is the fourth largest producer of fish in the world and is second in inland fish production. The states of West Bengal and Andhra Pradesh occupy the first and second positions, respectively in fish production[3].

Nanotechnology is a highly promising technology that spans many areas of science and

technological applications. Rapid advancements in nano sciences and nanotechnologies in recent years have opened up new horizons for many industrial and consumer sectors that have been regarded as the hotbed of a new industrial revolution including agriculture and allied sectors. Among the recent advancements in science, nanotechnology is fast emerging as the new science and technology platform for the next generation of development and transformation of agri-food systems[4] as well as for improving the conditions of the poor people.

Nanotechnology in Aquaculture and Fisheries

The fisheries and aquaculture industry can be revolutionized by using nanotechnology with new tools like rapid disease detection, enhancing the ability of fish to absorb drugs like hormones, vaccines and nutrients etc. rapidly. As per National Science Foundation (USA), current prediction estimates the emergence of value of the global nanotechnology industry at USD one trillion by 2015.

The areas related to aquaculture and fisheries where nanotechnology can be applied are:

1. DNA nano-vaccines

Outbreak of disease is one of the major stumbling blocks in the development and sustainability of aquaculture. A number of approaches have been made in attempts to solve disease problem in aquaculture, one among these is vaccination. The use of nanoparticle carriers like chitosan and poly-lactide-co-glycolide acid (PLGA) [5] of vaccine antigens together with mild inflammatory inducers may give a high level of protection to fishes and shellfishes not only against bacterial diseases, but also from certain viral diseases with vaccine-induced side effect. Further, the mass vaccination of fish can be done using nanocapsules containing nano-particles. These will be resistant to digestion and degradation. These nanocapsules contain short strand DNA which when applied to water containing fishes are absorbed into fish cells. The ultrasound mechanism is used to break the capsules which in turn release the DNA thus elicting an immune response to fish due to the vaccination.

Similarly, oral administration of these vaccines and site-specific release of the active agent for vaccination will reduce the cost and effort of disease management, application of drug and vaccine delivery etc., at the same cost of feeding leading to sustainable aquaculture.

2. Gene delivery

The development of new carrier systems for gene delivery represents an enabling technology for treating many genetic disorders. However, a critical barrier to successful gene therapy remains the formulation of an efficient and safe delivery vehicle. Non-viral delivery systems have been increasingly proposed as alternatives to viral vectors owing to their safety,

stability and ability to be produced in large quantities[6] .

3. Smart Drug Delivery

Nanoscale devices may have the capability to detect and treat infection and health problems. With the help of smart delivery system that poses multifunctional characteristics such as pre-programmed, time controlled, monitoring the effect of the delivery of probiotics, hormones, chemicals and vaccines is possible[7]

4. Nanoparticles for Enhancement of Fish Growth

Scientists from the Russian Academy of Sciences have reported that young carp and sturgeon exhibited a faster rate of growth (30% and 24% respectively) when they were fed nanoparticles of iron[8] . Research had demonstrated that different Selenium Sources (nano-Se and selenomethionine) supplemented in basal diet could improve the final weight, relativegain rate, antioxidant status as well as Glutathione Peroxidase(GSH-Px) activities and muscleSe concentration of crucian carp (*Carassius auratus gibelio*) [9].

5. Nanodelivery of Nutraceuticals

Use of nutraceuticals for health management, value addition and stress mitigation in fish and shellfish is an emerging area of aquaculture research. In spite of their low requirement, incorporation of nutraceuticals involves higher cost. Thus, it needs to be used in such a way that wastage will be minimised for efficient utilisation and to make the final product economically viable. Development of nano delivery system for these kinds of molecules may address the problems of their application in aquaculture practices at commercial level. There is an immense opportunity to use the nano particles to deliver nutraceuticals in fish feed and neutrogenomics studies. Hence various nano formulations of feed help to maintain better consistency and taste of feed[10] .

6. Water filtration and Remediation

Nano–enabled technologies are available today for the removal of contaminants from water. Nano-materials in the form of activated materials like carbon or alumina, with additives like zeolite and iron containing compounds, can be used in aquaculture applications for holding aerobic and anaerobic biofilm for the removal of ammonia, nitrites and nitrate contaminants. Ultrafine nanoscale powder made from iron can be used as an effective tool for cleaning up contaminants such as trichloroethane, carbon tetrachloride, dioxins and polychlorinated biphenyls to simpler carbon compounds which are less toxic, thus paving the way for nano-aquaculture.

7. Nanotechnology devices for Aquatic Environment Management

Nevada-based Altair Nanotechnologies makes a water-cleaning product for

swimming pools and fishponds called Nanotech. It uses 40 nm particles of a lanthanum-based compound which absorbs phosphates from the water and prevents growth of algae. The nanoscale delivery of weedicides and soil-wetting agents may be very useful for aquatic weed control in large water bodies, and mitigation of stress due to climate change and aquatic pollution[11].

5. Conclusion

Nanotechnology undoubtedly presents a major opportunity for the economy and sustainable development of aquatic resources in many countries. Although the application of nanotechnology is still at a very early stage in aquaculture, it may have the potential to solve most of the problems in aquaculture and fisheries with better technical innovation at differentlevels. At present, Central Institute of Fisheries Education (India) has initiated research on theapplication of nanotechnology in aquaculture and fisheries.

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Aquatic toxicology for a better world

Dr.C.A.Jyothirmayee,

Abstract

Aquatic toxicology is the study of the effects of manufactured chemicals & other anthropogenic and natural materials and activities on aquatic organisms at various levels of organization, from sub cellular through individual organisms to communities and ecosystems. Aquatic toxicology is a multidisciplinary field which integrates toxicology, aquatic ecology and aquatic chemistry.

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Keywords: toxicants, anthropogenic, ecosystems, aquatic ecology and aquatic chemistry[1].

Introduction:

This field of **Aquatic toxicology** includes freshwater, marine water and sediment environments. Common tests include standardized acute and chronic toxicity tests lasting 24–96 hours (acute test) to 7 days or more (chronic tests). These tests measure endpoints such as survival, growth, reproduction, that are measured at each concentration in a gradient, along with a control test.[2] Typically using selected organisms with ecologically relevant sensitivity to toxicants and a well-established literature background. These organisms can be easily acquired or cultured in lab and are easy to handle.[3]

Aquatic toxicity tests

Aquatic toxicology tests (bioassays): toxicity tests are used to provide qualitative and quantitative data on adverse (deleterious) effects on organisms from a toxicant. Toxicity tests can be used to assess the potential for damage to an aquatic environment and provide a database that can be used to assess the risk associated with in a situation for a specific toxicant.

Exposure systems

Exposure systems are four general techniques the controls and test organisms are exposed to the dealing with treated and diluted water or the test solutions.

- Static- a static test exposes the organism in still water. The toxicant is added to the water in order to obtain the correct concentrations to be tested. The control and test organisms are placed in the test solutions and the water is not changed for the entirety of the test.
- Recirculation- a recirculation test exposes the organism to the toxicant in a similar manner as the static test, except that the test solutions are pumped through an apparatus (i.e. filter) to maintain water quality, but not reduce the concentration of the toxicant in the water. The water is circulated through the test chamber continuously, similar to an aerated fish tank. This type of test is expensive and it is unclear whether or not the filter or aerator has an effect on the toxicant.

- Renewal- a renewal test also exposes the organism to the toxicant in a similar manner as the static test because it is in still water. However, in a renewal test the test solution is renewed periodically (constant intervals) by transferring the organism to a fresh test chamber with the same concentration of toxicant.
- Flow-through- a flow through test exposes the organism to the toxicant with a flow into the test chambers and then out of the test chambers. The once-through flow can either be intermittent or continuous. A stock solution of the correct concentrations of contaminant must be previously prepared. Metering pumps or diluters will control the flow and the volume of the test solution, and the proper proportions of water and contaminant will be mixed.[1]

Types of tests

Acute tests are short-term exposure tests (hours or days) and generally use lethality as an endpoint**.** Chronic tests are long-term tests (weeks, months years), relative to the test organism's life span (>10% of life span), and generally use sub-lethal endpoints

Early life stage tests are considered as sub chronic exposures that are less than a complete reproductive life cycle and include exposure during early, sensitive life stages of an organism. Short-term sub lethal tests are used to evaluate the toxicity of effluents to aquatic organisms

Bioaccumulation tests are toxicity tests that can be used for hydrophobic chemicals that may accumulate in the fatty tissue of aquatic organisms. Freshwater tests and saltwater tests have different standard methods, especially as set by the regulatory agencies

Effluent toxicity tests are tests conducted under the Clean Water Act, National Pollutant Discharge Elimination System (NPDES) permit program and are used by dischargers of contaminated effluent to monitor the quality of effluent into receiving waters

Toxicological effects

Toxicity can be broken down into two broad categories of direct and indirect toxicity. Direct toxicity results from a toxicant acting at the site of action in or on the organism. Indirect toxicity occurs with a change in the physical, chemical, or biological environment.

There are a number of effects that occur when an organism is simultaneous exposed to two or more toxicants. These effects include additive effects, synergistic effects, potentiating effects, and antagonistic effects. An additive effect occurs when combined effect is equal to a combination or sum of the individual effects. A synergistic effect occurs when the combination of effects is much greater than the two individual effects added together. Potentiating is an effect that occurs when an individual chemical has no effect is added to a

toxicant and the combination has a greater effect than just the toxicant alone. Finally, an antagonistic effect occurs when a combination of chemicals has less of an effect than the sum of their individual effects.[1]

Significance to regulatory world

In the United States aquatic toxicology plays an important role in the NPDES wastewater permit program. In addition to analytical testing for known pollutants, aquatic, whole effluent toxicity tests have been standardized and are performed routinely as a tool for evaluating the potential harmful effects of effluents and dust particles discharged into surface waters [4]. For the Clean Water Act under United States Environmental Protection Agency there are water quality criteria and water quality standards derived from aquatic toxicity tests [5].

Control of pollution

The UK water industry has invested an enormous amount in pollution control technologies and good practice over the past 30 years. The concept of effective river basin management is now accepted as standard practice and, whilst there are still many challenges to face in controlling pollution from many sources, the quality of the water environment is now better than at any time since the start of the industrial revolution in the late 18th century

In addition to legislative instruments, the adoption of 'good practice' guidelines is common in agriculture, industry and in the home, offering advice and guidance to those using potentially-polluting substances, such as fertilizers and pesticides, in order to safeguard the water environment.

The principles shall be to prevent rather than to rectify and to eliminate environmental damage at source. The approach shall be to minimize the risk of harm to human health and the ecosystem, to minimize the risk of impairment to the beneficial uses, to prevent pollution at source and to apply the most suitable technical solutions to prevent and rectify pollution problems

Conclusion:

Water resource management is the activity of planning, developing, distributing and managing the optimum use of water resources. It is a sub-set of water cycle management. In an ideal world, water resource management planning has regard to all the competing demands for water and seeks to allocate water on an equitable basis to satisfy all uses and demands. This is rarely possible in practice.

The field of water resources management will have to continue to adapt to the current and future issues facing the allocation of water. With the growing uncertainties of global climate

change and the long term impacts of management actions, the decision-making will be even more difficult. It is likely that ongoing climate change will lead to situations that have not been encountered. As a result new management strategies will have to be implemented in order to avoid setbacks in the allocation of water resources.

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Physical devices in aquaculture

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Keywords: rugged, resistant, salinity, calibration, deionizer, flexible, reagent.

Introduction:

This Paper deals with various physical devices used in Aquaculture such as Digital Refractometer, Multiparameter photometer, Resistant Temperature Detectors (RTDs) and Thermistors etc .

Digital Refractometer for natural or Artificial Seawater Analysis:

Digital Refractometer is a rugged, portable, water resistant device that utilizes the measurement of the refractive index to determine the salinity of natural and artificial seawater, ocean water or brackish intermediates. This digital refractometer eliminates the uncertainty associated **with** mechanical refractometers and is durable and compact enough to be used at home, in the lab and out in the field.

The digital refractometer is an optical device that is quick and easy to use. After a simple user calibration with distilled or deionizer water, a seawater sample can be introduced into the sample well. Within seconds, the refractive index and temperature are measured and converted into one of 3 popular measurement units: Practical Salinity Units (PSU), salinity in parts per thousand or specific gravity (S.G. (20/20))

Multiparameter photometer:

With the ever increasing depletion of fish stocks in the open seas, aquaculture has gained prominence and can prove essential to our future dietary needs. Monitoring and controlling parameters such as the oxygen level as well as pH and nitrate content in water is vital in ensuring profitable fish production.

The optical system of the multi photometer is based on special subminiature tungsten lamps and narrow-band interference filters to guarantee both high performance and reliable results.

Resistant Temperature Detectors (RTDs) and Thermistors

Resistant temperature detectors and thermistors work on the principle of change of resistance with a change in temperature. This resistance can be measured and calibrated to a temperature scale which can be electronically displayed. Although the principle of operation is completely different, RTDs and thermocouples are very similar from user's point of view. Thermocouples usually are more flexible in application and have a better long-term stability.

However, RTDs and thermistors have much higher temperature sensitivity than thermocouples, thus requiring less sophisticated electronics.

Integrated Circuit (IC) Transducer:

An integrated circuit transducer is a solid-state microelectronic circuit that is contained in a transistor-like housing and has an output voltage or current proportional to its temperature when supplied with a constant current or voltage. They have the advantage of being a completely packaged temperature indicator in comparison to thermocouples and RTDs which must be connected to some electronic circuit. They do have a limited temperature range (minus 85° to 125° Celsius).By using this instrument we can measure P^H and Dissolved Oxygen.

(a) pH measurement :

The pH measurement is made either chemically or electronically. The chemical method is extremely simple. A reagent is added to a sample and the resulting color change corresponds to the pH value. The electronic method uses an electrode that is placed in the water and has an output voltage which is correlated to pH. These units are commercially available at a moderate cost and can be interfaced with control systems.

(b) Dissolved Oxygen Measurement:

Dissolved Oxygen can be measured both chemically and electronically. The electronic measurement for DO simply requires the placement of the probe in the water. The DO probe consists of a gold or platinum element that is surrounded by a reagent solution.

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Socio- Economic Issues Related to Aquaculture

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Introduction:

Fisheries and aquaculture are an important source for food and livelihoods for people along the world's seashores and waterways and influence the livelihoods for more than one billion people. Coastal lands and shallow coastal seas contain some of the most biologically diverse and productive ecosystems found on earth. These ecosystems sustain a wide variety of human activities and support a major part of the total harvest of marine organisms as well as helping to sustain numerous onshore activities such as agriculture, rural and urban development as well as tourism, recreation and leisure activities.

The world-wide decline of capture fisheries has provided an impetus for increased production from coastal lands and waters through farming of marine resources. Fish and shellfish farming, or mariculture, currently forms a significant and rapidly growing component of world aquatic production.

Most importantly, the world's waterways and oceans cover about two thirds of the surface of the planet and they are the earth's most underutilized natural resource when it comes to food production. The fact that aquaculture is the world's fastest growing food production technology indicates not only that one has started to exploit this potential. The rapid growth also indicate how powerful systematic R&D process can be together with knowledge from other sectors, primarily agriculture.

If humanity succeeds in using the oceans more efficiently, this can be the largest single contributor to less pressure on marginal land and less deforestation on land. However, as this is largely a new way of using and interacting with the environment, increased aquaculture production and it's interaction with wild fish is in many cases creating controversy and the industry's environmental sustainability is challenged.

Factors Which Affect The Field Of Aquaculture:

- The precise impacts on future aquaculture production also will depend in part on other competing uses for fishmeal and fish oils.
- Usage of other sources of protein or developments in synthetic oils for industrial applications could reduce demands on fishmeal and fish oils, thereby reducing potential impacts on aquaculture.

- Any increases in the intensity and frequency of extreme climatic events such as storms, floods, and droughts will negatively impact aquaculture production and may result in significant infrastructure damage.
- Elevated temperatures of coastal waters also could lead to increased production of aquaculture species by expanding their range. These species could be cultivated in higher latitudes as well as in existing aqua farms as a result of a longer warm season during which water temperature will be near optimal.
- A decrease in sea-ice cover could widen the geographical boundaries, allowing cultivation of commercially valuable species in areas hitherto not suitable for such developments.
- ***Specific issues*** that need to be addressed within the framework for the integrated evaluation of the ***economic, social and environmental parameters*** governing the sustainable ***development of aquaculture*** include:
- Development of more accurate information on the economic, social and environmental benefits and costs of aquaculture.
- Clearer definition of gaps in existing knowledge on factors critical to the sustainable and equitable development of aquaculture;
- Development of pro-active consideration of the coastal land and water resource requirements of aqua culture as part of strategic economic planning, spatial planning and natural resources management;
- Development of awareness among decision-makers, planners, and managers from different sectoral agencies of the contribution that aqua culture may make in promoting the sustainable use of coastal ecosystems;
- Promotion of a shift in emphasis away from controlling the end use of resources and toward a more balanced approach to coastal development where emphasis is also given to maintaining the health and productivity of coastal ecosystems and the resources they generate that sustain different forms of activity, including mariculture.

In response to the persistent and emerging social and economic issues in aquaculture in Southeast Asia, the R&D activities of the Program on 'Meeting social and economic challenges in aquaculture' (MSECAP) intend to address the four categories of problems discussed and adopted for development of action plans during the **ASEAN-SEAFDEC** Conference on Sustainable Fisheries for Food Security Towards 2020, held last June 2011.

These issues define the scope and coverage of the **MSECAP** as follows:

(i) Enhancing the role of aquaculture in addressing food, income and livelihood security through improved governance, multi-agency collaboration, and comprehensive and inter-disciplinary approaches;

(ii) Promoting sustainable aqua culture through enabling policies that support the management of natural and environmental resources;

(iii) Enabling mechanisms, institutions and infrastructure to encourage adoption of better aquaculture practices;

(iv) Understanding and improving linkages from production to marketing and trade of fishery products to support small and medium enterprise (SME) development; and

(v) Strengthening the capacity of aquaculture stakeholders by mainstreaming specific rural and semi-urban aquaculture programs, and policies in local, national and international development programs.

Aquaculture production is expected to continue its upward trend in the foreseeable future, although in many areas (such as in Thailand) there is a boom and bust pattern to aquaculture.

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Dynamics of Aqua Motion

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Introduction:

Underwater creatures have to adapt to the static and dynamic properties of the aquatic environment for their existence and locomotion - hydrostatic pressures and viscous and other forces. A fluid is one which flows. It may be a liquid or a gas. A fluid flows from one place to other due to difference of pressure between two places. The study of the fluids at rest is called hydrostatics and the study of fluids in motion is called hydrodynamics.

The Aquatic Environment:

Ideal fluids obey Bernoulli's law.

Bernoulli's law:

When a non- viscous fluid flows between two points, the sum of the pressure energy, kinetic energy and potential energy of the fluid is constant at all points in the path of the flow.

$P+1/2\ \rho v^2 +\rho gh$ = constant, Bernoulli's law

For normal [Newtonian] fluids the stress is proportional to strain

$$\text{The elastic modulus for solids, } \eta = \frac{\text{Stress}}{\text{Strain}} = \frac{F/A}{dx\,/\,dz}$$

A liquid flowing at a steady rate on a horizontal surface can be assumed of different horizontal layers. The velocity of liquid at any point on any given horizontal layer is same. But the velocity of liquid in the layers perpendicular to the direction of flow is different in different layers. The velocity of the upper layer of the liquid surface is maximum and that of the lower layer is lesser. Similarly the velocity goes on decreasing as the depth increases and finally the deepest layer in contact with the horizontal surface is at rest. So, there exists a velocity gradient perpendicular to the plane of the fluid. If a specific layer of a liquid is taken, the layer below it moving with lesser velocity tries to decrease the velocity of upper layer due to cohesive forces between the molecules of adjacent layers.

In turn the upper layer which is moving with greater velocity tries to increase the velocity of the lower layer. Thus between parallel, successive layers of a liquid in motion, opposing successive forces come into play tending to decrease the relative velocity between the layers. These forces are called viscous drag. It appears as if a tangential shearing force is

acting between the layers. To overcome these shearing forces and to maintain constant velocity between the layers, an external force must be applied. If there is no external force the velocity of flow decreases and becomes zero. This property of a fluid which opposes the relative motion between different layers is called viscosity. This is the internal resistance or friction exhibited between the layers of a fluid.

Biological fluids, like cytoplasm are non- Newtonian (flow is depended on pressure). Fluids do not produce a constant velocity gradient and the viscosity,

η = Shearing stress ⁄ Velocity gradient = F/A ⁄ dv / dz

Velocity gradient: The change in velocity per unit distance is called velocity gradient.

Aquatic creatures have to generate propulsive thrust (by swimming) to balance drag and also for massive creatures dynamic buoyancy should be maintained.

In general fluids exert pressure on the walls and the box of the containing vessel .The thrust exerted by the fluid per unit surface area is called pressure.

Thrust: Total force acting on a surface is called thrust.

Thrust = Pressure X Area

Buoyancy:

The body experiences a resultant force acting vertically upwards. This upward force is called buoyancy or buoyant force.

Pressure energy:

Fluids are able to do some work by virtue of pressure they exert. This ability of doing work is known as pressure energy.

$$\text{Pressure energy per unit mass} = \frac{\text{Work done}}{\text{Mass of the liquid}} = \frac{\rho}{p}$$

Where ρ- density of the liquid, p- static pressure

Pressure energy per unit volume is equal to static pressure

Stream line flow or steady flow:

Stream line is a line along which a particle of liquid moves and the direction of this line at any point is the direction of the velocity of the liquid at that point. If the velocity at a point does not change with time either in magnitude or direction it is called steady or stream line flow.

Turbulent flow :

When the velocity of fluid is greater than a particular value called critical velocity,

the liquid flows in a disorderly fashion growing eddies and vortices. The liquid flow is zig - zag. The velocity of fluid at a point is not constant in time.

If the velocity at a point of a fluid varies in time, it is called turbulent flow.

The minimum velocity at which a liquid flow changes from stream line to turbulent flow is called critical velocity.

Reynolds Number.Re.

Osborne Reynolds (1842 -1912) observed that turbulent flow is less likely for viscous fluid flowing at low rates. He defined a dimensionless number, whose value gives us an approximate idea whether the flow would be turbulent and this number is called Reynolds number Re; the ratio of inertial to viscous force is the Reynolds number, Re.

$$Re = \frac{\text{Inertial force}}{\text{Viscous force}} = \frac{I}{V}$$

$$Re = \underline{\rho v l} / \eta$$

Where, ρ = density, v = velocity, l = length and η = coefficient of viscosity. In laminar flow, the viscous force is proportional to velocity, as given by **Hagen – Poiseuille law:**

$(P 1 – P 2) r^2h = 8\pi \eta lv$ **Hagen – Poiseuille** equation

The inability of a body to change its state of motion by itself is called inertia of motion.

The viscous force acts tangential to the liquid layers and in a direction opposite to the direction of liquid flow. In trubulent flow, the viscous force is αv^2. The velocity above which the laminar flow becomes turbulent is the critical velocity given by the **Reynold's** equation $Vc = Re \eta / \rho r$, Reynold equation

$Re << 1$ Laminar flow,

$Re >> 1$ Turbulent flow

(i) **Low Re**: At low Re velocity of flow is laminar. For a laminar flow, the value of Reynolds number (Re) lies between 0 and 1000.Under such conditions transport of solids in a viscous medium is given by Stokes equation: $F_d = 6\pi\eta vr$, where F_d is drag force. The flow of liquid through a cylindrical tube of radius r is given by Poiseuille's equation

Flux = J = volume of flow / second = A.v

$$J = A.v = \underline{\prod r4dP} \text{ Where, } (dP / l \text{ is the pressure gradient})$$
$$8\eta l$$

Microscopic particles, such as bacteria, algae and spermatozoa swim at very low Reynolds

numbers (Re < 10^{-3}) where the viscous forces are dominant and, therefore, the ability of these organisms to glide is lost. Wriggling and whipping movements are employed to produce forward motion (flagella movements). The drag,D, is proportional to velocity v, and the velocity is dependent upon the size, shape and density of the particle; a body should have low drag coefficients.

(ii) **High-Re:** High Re (Re > 100) corresponds to low viscosity; flow is not uniformly laminar, and the drag for F_d is dependent upon velocity and the size of the solid.

$F_d \alpha v^2 \rho l$. Swimming of fish, flight of birds and aeroplanes are examples. For values of Re between 1000 and 1500, the flow is unstable and switches from laminar flow to turbulent and vice versa.

It has been observed that for all liquids the value of Reynolds number corresponding to V_c is nearly the same, Re = 2000.Thus the orderly flow or stream line flow is produced when we use narrow tubes and liquids of low density and viscosity.

In the regions of high Re, the effects due to viscous and pressure drags have to be taken into account. Rigid bodies moving in a fluid of high Reynolds numbers (Re $\geq 10^6$) will experience turbulent flow. The influence of pressure drag can be minimized by streamlining the shapes- elongated ellipsoidal body form with widest point toward back (Example: tuna fish) and creation of maximum laminar boundary layer combined with little vortex turbulence (by tails).

By optimizing the interplay of drag and propulsion effects, swimming by aquatic creature with minimum exertion is possible (Ex: eels, snakes, flagella etc.). Concepts on the movement of particles in Newtonian and non- Newtonian liquids, under laminar and turbulent flow conditions have relevance in the study of the movement of erythrocytes suspended in blood, flow of body fluids in organisms. Swimming motion also helps in preventing of the formation of a boundary layer.

Aero-flight:

Gliding and flying are the processes of locomotion by birds and other flying objects. For aero flight, combination of lift and drag components have to be optimized. A wing of birds or aeroplanes at an angle α (angle of attack) to the direction of the flow of air stream experiences drag and lift forces and for an object to fly in air the lift component should be naturally greater than the drag component.

The design of the wing should be such that the coefficient of lift is high and the coefficient of drag is minimal. Maximum lift occurs at the angle of attack $\approx 10^0$. Above this angle, the drag on the wind increases, eddy currents ensure and stalling occurs. In addition,

induced drag also comes into play at low speeds. Induced drag is least for long and narrow wings. So birds that soar high have long and narrow wings to reduce the effect of induced drag. Birds that fly by flapping should have short and wide wings. Short wings lead to greater maneuverability and feathers at the wing tips (many smaller wing tips) further reduce the induced drag.

Aerodynamic lift :

Bodies moving through fluids experience dynamic lift. Thus wings of flying aeroplane will experience aerodynamic lift.

Bernoulli's principle is used in designing fluid conduit systems, aircraft and boats. Its utility in aerodynamic and boat design studies results particularly from the quantitative way in which it predicts that fluid pressure is reduced wherever the speed of flow is increased. An aeroplane wing is designed so that air travels faster over its upper surface than over its lower surface. This difference in speed of flow causes a lower pressure on the upper surface of the wing, according to Bernoulli's principle and thus results in an upward force, or lift on the wing.

Birds possess two separate systems for locomotion – wings for flying and hind limbs for walking, running and swimming. Thus they require two different sets of muscles and a strong skeleton to support each. In many birds the flight muscles account for 30% to 40% of the total body weight. The muscles of the legs also are large and make upto 20% to 30% of the body weight in most of the birds.

In any flying apparatus, weight is critical and birds have reduced body weight as much as possible. Feathers- unique to birds- are crucial to avian flight. They provide strong, light weight flying surfaces on the wings and tail. Bird flight is powered mainly by the tips of the primary feathers which serve as propellers. The avian tail consists of two parts, the long tail flight feathers and a short fleshy tail containing the caudal vertebrae. Most birds have a moderately long tail that functions in flight direction and landing. The two main flight muscles are the pectoralis which pulls the wing down and the supracoracoidens which pulls the wing back up. Both lie on the underside of the body and are anchored to the keel of the sternum. The tendon of the supracoracoidens passes over the shoulder joint which acts like a pulley to change the downward pull of the muscle to an upward pull on the humarus. This arrangement places the muscle low on the body and contributes to flight stability.

Conclusion:

The dynamics of aquatic life are determined by hydrostatics, viscosity and other environmental parameters. At low Reynolds numbers, viscous forces are dominant and the

locomotion of organelles is by wiggling and twisting movements. Motion in fluids of high Reynolds numbers is turbulent and aquatic creatures in regions of high Reynolds numbers are conditioned to the effects of turbulence, viscous and pressure drags. Gliding and flying are the processes of locomotion by flying creatures. For aero flight, lift and drag components have to be optimized. Shapes of the wings and feathers of birds etc., are in accordance with the environmental requirements (gliding and flying motions).

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Aquaculture for Food and Nutrition Security

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Abstract:

In common, we say, "we are what we eat". What we eat is both important for our physical activity and mental health. Therefore it is important to have the best nutrition. Fish is one of the main sources of protein and fat, but it also has other qualities that make it very valuable as a nutrient. Fish have always been important to man. Man has always eaten fish. The fish consumption per capita is expanding globally, and the pattern of fish consumption is changing. In developing countries fish is still very much an essential food and a main source of protein.

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Keywords: consumption, digestible, polyunsaturated, anti-inflammatory, antioxidant.

Introduction

Fish makes a vital contribution to the survival and health of a significant portion of the World's population. Fish is especially important in the developing world. Often referred to as "rich food for poor people," fish provides essential nourishment, especially quality proteins, fats, vitamins and minerals. For those involved in fisheries, aquaculture and fish trade, fish is a source of income. India produces about 6.57 million metric tons fish every year. The inland-sector, which has a growth rate of 6 per cent, contributes around 55 per cent of it.

Extensive aquaculture has been in practice in the state for the past several years and fish provides a source of income which can be used to purchase other additional food items. Proteins are important for growth and development of the body, maintenance and repairing of worn out tissues and for production of enzymes and hormones required for many body processes. The importance of fish in providing easily digested protein of high biological value is well documented. On a fresh weight basis, fish contains a good quantity of protein, about 18-20%, & contains all the eight essential amino acids including the sulphur containing lysine, methionine and cysteine.

Fish, meat and dairy products are the main sources of proteins in the human diet. Fish is mainly eaten for its protein contents. Our body utilizes proteins from fish better than proteins from beef, pork, chicken and milk. All the proteins from fish are adequate, important and digestible. The amount of connective tissue in fish muscle is quite low and softens and dissolves more readily when heated compared to the connective tissue of land animals. The connective tissue is easily broken down by digestive enzymes making it very easy for the body to digest.

The fat content of fish varies depending on the species as well as the season but, in general, fish have less fat than red meats. The fat content ranges from 0.2% to 25%.
However, fats from fatty fish species contain the polyunsaturated fatty acids (PUFAs) namely EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) (omega 3 fatty acids) which are essential for proper growth of children and are not associated with the occurrence of cardiovascular diseases such a coronary heart diseases.

In pregnant women, the presence of PUFAs in their diets has been associated with proper brain development among unborn babies. In other studies, omega 3 fatty acids have also been associated with reduced risk of preterm delivery and low birth weight. The fat also contributes to energy supplies and assists in the proper absorption of fat soluble vitamins namely A, D, E, and K.

The fat in fish contains a larger portion of Omega 3 and other unsaturated fatty acids that are healthier than the saturated fat of red meat. A large intake of the saturated fat in red meat is one of the main causes of cardiovascular diseases, while the unsaturated fat of fish and vegetables does not have this effect. In addition, the types and proportions of dietary fats found in fish are generally more "heart healthy" than the fats found in other protein foods. This is due to its relatively high share of unsaturated fat. Fish – especially fatty fish like wild Salmon, Tuna, Sardines, and Sablefish are the only abundant food sources of the long-chain omega-3 fatty acids known as EPA and DHA. The results of countless studies indicate that these vital food factors promote optimal health.

The American Heart Association (AHA) says that the ways in which omega-3s reduce the risk of cardiovascular disease are still being studied, and that research shows that omega-3s have the following effects:

- Decrease the risk of arrhythmias, which can lead to sudden death.
- Decrease triglyceride (blood fat) levels.
- Decrease growth rate of atherosclerotic (arterial) plaque.
- Lower blood pressure modestly.
- In addition, omega-3s are shown to improve the ratio of HDL ("good") cholesterol to total cholesterol, and this ratio is the most accurate predictor of cardiovascular risks.

Fish are also the richest food sources of three other valuable food factors:

- **Vitamin D** offers uniquely strong bone-building and anti-cancer benefits. Tuna and wild salmon are the richest food sources known.
- **Astaxanthin** is the powerfully anti-inflammatory, carotenoid-class antioxidant that gives wild Salmon its characteristic red-orange color.

- **Selenium** is an essential mineral needed to make enzymes that play key roles in the body's internal antioxidant network.

The role that fish can play in improving diets is undisputed, and this can be particularly important in regard to children's diets and child nutrition. Aquaculture can contribute to improved food security and nutrition through various channels: local food supplies can be improved through the increased availability of low-cost fish; employment opportunities and incomes can be raised; and consumption of fish can be increased directly. While increasing the quantity and variety of fish and other foods consumed by the poor will reduce under-nutrition, such dietary improvements are not automatic benefits of aquaculture development.

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Scientists say breeding fish can, over the time, reduce salinity. Photo: M. Karunakaran THE HINDU, November 7th 2013

Aquatic toxicology

A.Padmavathi

Abstract:

Fisheries and aquatic resources (ponds, lakes, rivers, streams, and oceans) are exceptionally valuable natural assets enjoyed by millions of people. They provide citizens with generous long-term benefits in return for minimal care and protection. These benefits can be direct financial ones that provide employment, profit, and savings. For example, the seafood industry provides jobs for commercial fishers, wholesalers, and retailers. More indirect, but equally valuable, benefits of fish and aquatic ecosystems include recreational boating, sport fishing, swimming, relaxation, and natural beauty.

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Keywords: retailers, toxicity, persistence, dermal, inhalation, leaching,

Introduction:

Appreciation of fisheries and aquatic systems has been accompanied by increasing concern about the effects of growing human populations and human activity on aquatic life and water quality. Pesticides are one group of toxic compounds linked to human use that have a profound effect on aquatic life and water quality.

Aquatic toxicology is the study of the effects of environmental contaminants on aquatic organisms, such as the effect of pesticides on the health of fish or other aquatic organisms. A pesticide's capacity to harm fish and aquatic animals is largely a function of its (1) toxicity, (2) exposure time, (3) dose rate, and (4) persistence in the environment

Toxicity of the pesticide refers to how poisonous it is. Some pesticides are extremely toxic, whereas others are relatively nontoxic. Exposure refers to the length of time the animal is in contact with the pesticide. A brief exposure to some chemicals may have little effect on fish, whereas longer exposure may cause harm.

The dose rate refers to the quantity of pesticide to which an animal is subjected (orally, dermally, or through inhalation). A small dose of a more toxic chemical may be more damaging than a large dose of a less toxic chemical. Dosages can be measured as the weight of toxicant per unit (kilogram) of body weight (expressed as mg pesticide/kg of body weight) or as the concentration of toxicant in the water or food supply (usually expressed as parts per million, ppm or parts per billion, ppb).

Pesticides can reduce the availability of plants and insects that serve as habitat and food for fish and other aquatic animals. Insect-eating fish can lose a portion of their food supply when pesticides are applied. A sudden, inadequate supply of insects can force fish to range farther in search of food, where they may risk greater exposure to predation. Spraying

herbicides can also reduce reproductive success of fish and aquatic animals. The shallow, weedy nursery areas for many fish species provide abundant food and shelter for young fish. Spraying herbicides near weedy nurseries can reduce the amount of cover and shelter that young fish need in order to hide from predators and to feed. Most young fish depend on aquatic plants as refuge in their nursery areas.

Aquatic plants provide as much as 80% of the dissolved oxygen necessary for aquatic life in ponds and lakes. Spraying herbicides to kill all aquatic plants can result in severely low oxygen levels and the suffocation of fish. Using herbicides to completely "clean up" a pond will significantly reduce fish habitat, food supply, dissolved oxygen, and fish productivity. Aquatic toxicity can also be attributed to leaching of nitrates in to water bodies.

These aquatic toxicity when enter into infant stomach through food web because of neutral pH reduced to nitrites. These combine with hemoglobin in the blood and result in blue baby syndrome. Leaching of H2SO4 in to water through mining process of thiobacillus, thioxidans causes acid mine drainage. Increase of nutrients in aquatic ecosystem leads to Eutrofication i.e excessive growth of algae. Some algal blooms are toxic to plants and animals.

This reduces oxygen penetration .As a result fish, shrimp, and especially aquatic bottom dwellers die off. When algae die or eaten neuro and hepato toxins are released this can kill animals and may pose a threat to humans.

Some BI insecticides are less hazardous to fish and other aquatic animals. BIs include microbial and insect growth regulators. For example, the microbial, *Bacillus thuringiensis* (BT), is a bacterium that causes disease in some insects, but does not harm other animals or plants. Herbicides are the most commonly used pesticides Herbicides often are directly applied to lakes and ponds to control nuisance growths of algae (colonial, filamentous, and single cells), submersed water grasses (coontail, milfoil, naiad, pondweed), floating water plants (water lily, spatterdock, duckweed), and emergent water plants (cattails, rushes, reeds).

Dense growths of algae and rooted waterweeds can interfere with swimming, fishing, and boating. They also can discolor waters, impart unpleasant taste and odors to water supplies, and degrade property values and water quality. Herbicides generally are less toxic to fish and aquatic life than insecticides. Many are short-lived and do not accumulate in the environment. However, some are highly toxic to aquatic animals and should be avoided or used with extreme caution near water ways and aquatic environments.

Fungicides, like herbicides, generally are not as highly toxic to fish and aquatic animals as insecticides. However, some fungicides have been banned due to their adverse effects on the environment. Fungicides containing mercury were discontinued for home and agricultural use in the United States in 1976. Mercurial fungicides accumulated in the environment and concentrated up the food chain, causing fish kills. Prior to using a pesticide, one must consider the following:

1. Use a Pesticide Only When Necessary

2. Use Less Toxic Pesticides

3. Use Safe/Sensible Application Methods

Conclusion:

A pesticide label containing information on use and safety must be attached to all pesticide containers. The label includes the product name, name and amount of active ingredients, EPA registration number and establishment number, name and address of the manufacturer, and net contents.

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"By 2030, says the UN Food and Agriculture Organization, fish farming will dominate fish supplies. Given how wrong the FAO has been in the past--saying catches were going up when, in fact, they were going down--this statement is worth examining carefully. When you do, you find it to be an observation of previous trends, not a reflection of what could happen or what people might want--in the same way as Red Delicious was once far and away the most popular apple in the United States because it was basically the only apple you could get. The FAO is simply observing that fish farming is the fastest growing form of food production in the world--growing at 9 percent a year and by 12-13 percent in the United States. Nobody is asking us whether we want this. It is just happening. The continued destruction of mangrove swamps in poor countries to provide shrimp for people living in rich countries is simply the market operating in a vacuum untroubled by ethics. It is a reflection of what will go on happening if we do not find ways of exercising any choice in the matter."

— Charles Clover, *The End of the Line: How Overfishing Is Changing the World and What We Eat*

To Our Aquatic Friends – A Tribute

Dr. R. Madhavi

O Graceful, multihued, wondrous, intricately shaped,
Mysterious creatures that dive and thrive in the dark depths,
Of oceans, seas, rivers, ponds, lakes and springs,
To you, mankind since times immemorial is indebted.

Your presence in waters cool, as you frolic and dance,
Adds grace to your charm and the murky depths brightens,
Clothed in apparel so delicate, bright and unique,
That no artist dare imitate nor can artisan create.

Darlings of sparkling waters, your glorious shapes we salute,
So intricately designed, to mesmerize, stun and charm,
Gracefully you swim and cavort, rousing our awe
As we gaze at mighty whales and feisty sharks.

Frolicking fish that dart and dash on rising currents,
Moping giants that slouch and crouch on sea beds inviting,
Salmon and mackerel, shrimps and eels, dike and pike,
You add to the harmony of the merry aquatic family.

You lend to world beauty that gratifies the discerning eye,
You nurture and sustain millions of earth's beings.
You complete the circle of nature, by selfless giving,
You provide to humanity, sustenance, wealth and livelihood.

To the humble fisherman who ekes his very existence,
Harvesting the fruits of the oceans, you are a boon,
Couched in shells, nooks and crannies of the watery home,
You teach a lesson in patience, peace and harmony.

Let us pledge to safe-guard our delicate friends of the seas,
The aquatic world let us preserve from pollutants.
Let us re-think, generate and re-create meaningful strategies
That enables us to nurture, preserve and save these precious gifts of God

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Impact of Fisheries and Aqua culture in Socio-Economic Development

Dr.D.Rajani Deivasahayam

Abstract:

Large scale operators with greater access to capital and gear have emerged in the past few decades concentrating on ownership and control of resources. For example, in India, fishing practices have changed with rising investments and higher levels of mechanization and motorization have led to greater centralization of landings and competition over the catch. In the past, small scale traders were able to purchase fish from local fishermen at decentralized beach-based landings, sometimes taking the fish on credit and paying once they had sold it. But the increasing centralization of landings has led to fierce competition at landing sites, favouring those with greater access to credit and infrastructure and marginalizing traditional fish processes and petty traders.

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Keywords: marginalizing, bivalves, mollusks, degradation, urbanization, anti-retroviral drugs,

Introduction:

Fisheries and Aqua culture make significant contribution to employment, nutrition and trade in the developing world. Over 45 million people world-wide, the vast majority of whom live in developing countries, work in fish production as it is regarded as an important source of nutrients for the poor and is often the cheapest form of animal protein. It is also a commercially successful production with a third of fishery commodity production is destined for export. While data on fisheries in developing countries is often patchy, certain trends can be identified in the importance of fisheries and aqua culture especially in the areas of employment, consumption trade and health.

Employment:

Employment in fishing and aqua culture has grown rapidly over the past few decades, increasing from 13 million people in 1970 to over 45 million in 2009. Most of this development has taken place in Asia, where over 85% of the world's fisher folk live and is largely due to the expansion of aquaculture during this period. Millions of women in developing countries are employed in fisheries and aquaculture, participating at all stages in both commercial and artisanal fisheries but their presence is found mostly in fish processing and marketing. In capture fishing, women are commonly involved in making and repairing nets, baskets, pots, baiting hooks, setting traps and nets, fishing from small boats and canoes, and collecting sea wood, bivalves, mollusks and pearls. They are rarely involved in commercial offshore and deep-water fishing. In aquaculture, women feed and harvest fish,

attend to fish farms and collect fingerlings and prawn larvae. They also play a major role in fish processing in many parts of the world both using traditional preservation methods and working in commercial processing plants. But at present, with the intervention of large scale operations, the livelihood of the small scale fisher folk and traditional fish processors is in jeopardy.

Production and Consumption:

Data on fisheries in developing countries do not totally account for artisanal and subsistence production, as the magnitude of the landings of these fisheries is not generally known by the responsible fisheries administration, but it is clear that capture fisheries are currently being fished near capacity and further growth in fish production will come primarily from aqua culture.FAO (2006) estimates that marine capture fisheries production will remain between 80 and 90 million tonnes per year and fresh water fisheries may not expand significantly due to environmental degradation and draining of fresh water resources but demand for fish continues to increase in most parts of the world mainly due to urbanization and raising income of the ever increasing population worldwide. Both in developed and developing countries, demand for all varieties of fish has increased, mainly due to growth in income and urbanization, as well as a shift in preference – from red meat to fisheries products.

Trade:

Developing countries are involved in export of a large portion of fish production to the developed countries. They are now net exporters of fish to developed countries having shifted dramatically from being net importers. Over 40% of fishery commodity production in developing countries is being exported and it turned out to be an important source of foreign exchange for many small countries such as Chile, Mozambique, Senegal and Thailand. But interestingly an increasing amount of trade in fish production is between developing countries rather than from developing to developed countries. Demand for fish in developing countries continues to grow both due to population growth and increased per capita consumption, while overall demand in developed countries has stagnated since 1985.

International trade in fishery products has had a positive effect on food security in many developing countries, stimulating increased production, generating foreign exchange and enhancing the trade-based capacities of people engaged in fishing and fish processing. These trade transactions help to raise the income of the poor fisher folk and people employed in fish processing, enabling them to achieve greater food security through increased

purchasing power. This fish processing for export can also generate employment particularly among young generation which enables them to become economically independent thus improving their position in the society.

Development in Health and Nutrition:

Even when consumed in small quantities, fish often plays a nutritionally important part of many people's diet in developing countries. It is a vital source of protein and micronutrients, and it improves the quality of protein in largely vegetable and starch-based diet by providing essential amino acids. It is also rich in iron, zinc, magnesium, phosphorous, calcium, vitamin A, vitamin C and above all, marine fish is a good source of iodine. Many of these vital nutrients are found only in small amounts in staple foods such as maize, rice which make up the bulk of people's diet in developing countries. Fish are indispensable source of these nutrients for many people. Small low value fish which are largely consumed by the rural people provide more minerals than the same quantity of meat or large fish as they are consumed as whole with the bones intact. They also contain fatty acids which are essential for the development of brain and body, and are particularly crucial for the diets of babies, children, pregnant and lactating women.

The nutritional benefits of fish consumption are also particularly important for people living with HIV/AIDS. Proper nutrition is essential for the effectiveness of anti-retroviral drugs, and fish has also been shown to contain combinations of nutrients which reduce susceptibility to secondary diseases.

Throughout the developing world, the fisheries sector provides the basis for the livelihoods and nutrition of the millions of people, and constitutes a significant source of foreign exchange for many developing economies. Despite its considerable contributions to development it is often not seen as a priority sector by policy makers or donor agencies. The governments of the developing countries have to play a major role both in managing capture fisheries to prevent further stock depletion and in regulating the development of aquaculture to ensure that they are both environmentally sustainable and pro-poor. Under such conditions, fisheries and aquaculture can realize their potential as an important and growing source of social and economic development in rural areas.

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The contribution of Aquaculture to Indian Economy

Dr.P.Ratna mary

Abstract

Agriculture is the back bone of Indian economy and fisheries is one of the allied activities of this sector. Fishery is the oldest and most important livelihood option for the inhabitants of the coastal line of the country since times immemorial. This natural resource along with the marine environment has been the custodian of livelihood security of the coastal populace. The web of life of the coastal community is woven around it, be it festivals, weddings or even death, the community is intricately related to the natural marine resource. The main aim of fish culture is to obtain maximum yield of fish and to obtain palatable and highly nutritive fish flesh and to obtain by products of fishing industry.

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Keywords: diversification, potential, ingredients, insulated, refrigerated.

Introduction:

The objective of this paper is to analyze the contribution of aquaculture to Indian economy. Approximate of about 1 % of the total population depends upon fishery sector in India as a primary source of livelihood – direct employment to about 6 million fishers and to another six million people who are employed in fishery related activities. India has an estimated marine resources potential of about 3.9 million tons per year. This potential source can be bracketed under two categories i.e. oceanic fishery and coastal fishery. The important marine fish disposition in India are the Mackerel, Sardines, Bombay duck, Shark, Ray, Perch, Croaker, Carangid, Sole, Ribbonfish, Whitebait, Tuna, Silver belly, Prawn, Shrimp, Squid, Octopus, Red snapper, Lobster, Cat fish and Cuttlefish. Among the species caught, Indian oil sardine, Indian mackerel and Sciaenid are dominant ones.

Indian fisheries and aquaculture is an important sector of food production, providing nutritional security to the food basket, contributing to the agricultural exports and engaging about fourteen million people in different activities. With diverse resources ranging from deep seas to lakes in the mountains and more than 10% of the global biodiversity in terms of fish and shellfish species, the country has shown continuous and sustained increments in fish production since independence. Constituting about 4.4% of the global fish production, the sector contributes to 1.1% of the GDP and 4.7% of the agricultural GDP. The total fish production of 6.57 million metric tonnes presently has nearly 55% contribution from the inland sector and nearly the same from culture fisheries.

The country has 429 Fish Farmers Development Agencies (FFDAs) and 39 Brackish water Fish Farms Development Agencies (BFDAs) for promoting freshwater and coastal

aquaculture. The annual carp seed production is to the tune of 20 billion and that of shrimp about 8 billion, with increasing diversification in the recent past. Along with food fish culture, ornamental fish culture and high value fish farming are gaining importance in the recent past. With over 2.4 lakh fishing crafts operating in the coast, six major fishing harbours, 40 minor fishing harbours and 151 landing centre are functioning to cater to the needs of over 3.5 million fisher folk. More than 50 different types of fish and shellfish products are exported to 75 countries around the world. Indian fisheries occupy third position globally in fisheries and second position in aquaculture. The contribution of fisheries to Indian GDP is 1.07% and to agriculture GDP is 5.3% annual export earnings is 7200 crores and employment created in this sector is 14 millions.

Despite the differing location specific features some broad aspects can still be identified in almost all the sample ponds, which need to be highlighted. For instance the fishermen associated with FCS or FPG are in general rather poor, semi literate or illiterate and hardly have any other alternative job opportunity to switch over. The little amount that they could possibly save get drained away for buying medicine or for servicing of the nets which for most part of the year remain idle. For fuel and water, the two important ingredients of household maintenance, most of them have still to depend on outdoor collection. The aforesaid conditions are manifest mostly in rural areas compared to urban sector. Some of these feature like poor family income, low level of literacy, family size etc coupled with poor financial inputs have left many of the fishermen in unimproved state of economic condition. Instability in earning potential from fishing occupation has in many cases compelled the offspring of the fishermen to turn to alternative employment prospects.

This trend needs to be countered by ameliorative steps. Ensuring access of fishermen in poorer rural cooperatives to credit support from various financial institutions, National Bank for Agricultural and Rural Development (NABARD) etc on congenial terms, provision of quality seed and feed, role of non-governmental organizations (N.G.O) or local institutions in the spread of literacy, or even spread of distance education through print or electronic media, are essential prerequisite for preventing potential exodus of people from traditional fishing occupation in near future.

Conclusion:

In the given context of the present state of affair of the fishing trade and industry, it is highly improbable the distortion can be treated by simple corrective measures. The need of the hour is surgical amputation of the dysfunctional part of the trade. It is expected that the corrective action of overriding the non function players of the value chain can directly /

indirectly enhance the probability of redirecting the flow of revenue / profit back to the primary player of the trade. This in turn is expected to have its own positive externality in terms of improvement in the socio-economic standard, improvement in health and hygiene, per capita income, literacy level, decline in child mortality, etc. In the prevailing environment, external & internal, it is difficult to predict the probable repercussion of any direct intervention in the supply chain by external agency. The change has to be generated from within the community through wider co-operation between the community members and also amongst the various communities living side by side along the coast line. The factors which help increase the fish rates: Movement of larger quantities by fast trains and introduction of insulated or refrigerated rail transport on all routes connecting important landing centers, and large areas of consumption.

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Aquaculture – an economic route to Employment

K. Hymavathi

Abstract:

In most coastal areas, over the last two decades, a significant employment and income shrink was observed; this was attributed to a gradual decline of fishery activities. Hence, in an attempt to restrain this decline and to safeguard a sustainable development of the coastal areas, initiated new measures within the current (2007–2013) Common Fisheries Policy (CFP). This work attempts to assess the effectiveness of this new policy, Axis 4 of the Operational Fisheries Programme, by measuring the employment and income effects upon the whole economy. The analysis was applied in a coastal area as a case study. Results demonstrate that the employment and income generated, due to those measures, are relatively small mainly because of fund limitations and weak interactions in the local economy in a short-run timeline, though indirect benefits could occur in the long run.

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Keywords: rearing, predators, hydroponics, density, optimize, saturated.

Introduction

The definition of aquaculture is the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants. Farming implies some sort of intervention in the rearing process to enhance production, such as through regular stocking, feeding or protection from predators. Farming also implies individual or corporate ownership of the stock being cultivated. The definition does not include fisheries, which is the harvesting of organisms from the wild of which there is no ownership or intended intervention to increase production.

Hydroponics is the culture of terrestrial plants in water instead of soil and is not considered as aquaculture. Compared to agriculture which is thought to have started about 10000 years ago, the practice of aquaculture has only been around for about 2500 years.

Aquaculture is currently the fastest growing food producing sector in the world. It is highly diverse and the sector consists of many species, systems, practices, people, environments, and operation. Developing countries and Low Income .Food Deficit Countries (LIFDCs).produce the most .Asia produces over 90%.

Total aquaculture production of aquatic animals (excluding aquatic plants) for 2004 was reported to be 45.5 million tones with a farm-gate value of US$ 63.4 billion. Given the projected population growth over the next two decades, it is estimated that at least an additional 40 million tones of aquatic food will be required by 2030 to maintain the current per capita consumption.

If water is available to grow fish, aquaculture offers more choice than farming on land. This is because there is almost always a suitable species of fish that can be cultured in the available conditions. However, it is important that only species with requirements compatible

with the region's environmental conditions are cultured. For example, trying to grow a coldwater species such as trout in warm water will not work; however, tilapia or catfish would do well in warm water.

Some of the reasons why a farmer or small land owner might start fish farming:

- Fish are an important source of high-quality food
- Fish farming can help a farmer make better use of his/her land • Fish farming can provide extra money.

Types of aquaculture

The practice of aquaculture varies widely and differs in the intensity of culture, level of water exchange and structures used, with each method having its own set of benefits and problems. Aquaculture can be broadly grouped into three intensities:

Extensive –

This uses large stagnant ponds that allow only a low stocking density and rely on natural production to feed the animals (i.e. there is no supplemental feeding). Management and skills input are low.

Semi-intensive –

This is much like extensive culture; however there is a greater degree of intervention either through feeding and/or improvement of water quality through aeration and partial water exchange. This allows for an increase in the production of livestock when compared to extensive systems. Management and skills input occur at a medium level.

Intensive –

Livestock are maintained at high stocking densities and feeding comes solely from introduced feeds. The culture systems tend to be highly technical and rely on electricity to operate. The space required is relatively small and the system is designed to optimize water use and quality. Management and skills input are high.

Major issues and challenges

- Aquaculture is an income generating activity.
- Rapid sector growth has, in some instances, outstripped planning and regulatory activities.
- There are regulatory rebounds, resource use conflicts
- The role of aquaculture in food security has been a major concern of the sector for many years.
- Production has been in the increase at a reducing rate.

- May be due to declining prices for luxury and commodity products as markets are becoming saturated and competition is increasing.

Maintaining environmental sustainability

- Certain forms of aquaculture have a bad reputation.
- Arguments are:

1. use of feed and seed resources
2. disease control and chemical and veterinary drug use
3. accumulation of environmental contaminants
4. escapees and point source cont animation of wild resources
5. negative or low net energy conversion during farming of top carnivores
6. Mangrove clearance and land degradation, etc.
7. Some of the arguments are true and worthy of considering but the quantum to which the issues are highlighted is certainly bias.
8. Traditional aquaculture produce large volumes of fish feeding low in food chain which supports livelihoods of people
9. Modern-day aquaculture", mainly the production of high value carnivorous fish or shellfish destined to import markets is a different subject
10. This sector uses considerable quantity of natural resources and also produces considerable quantity of effluents and waste.
11. The sector's sustainability and environmental acceptability has been increased significantly over the past decade through research involving developing technically specialized conditions.
12. The environmental, social and economic landscape within which aquaculture has performed well up to now, is changing.
13. Consumers look for "Sustainability, Safety, Quality, and Equity" of the products.
14. Competition will increase as barriers to trade decline through the process of economic globalization.
15. Negative environmental and social impacts of aquaculture will increase public scrutiny and criticism that could well alter the policies that have so far fostered growth.
16. The trend has been to improve the environmental acceptability or sustainability of the sector through several interventions and developments such as;

    * Reduced reliance on fishmeal in fish feed

* Increased efficiency in feed formulation
* Improving food conversion ratio
* Containment and recycling of wastes
* Increased land and water use efficiency
* Improvement to health management and reduction of chemical and veterinary drug use
* Domestication and genetic improvement towards reducing negative impacts on aquatic biodiversity.

Keeping up with safety and quality

- There is a need for aqua culturists develop systems for farming aquatic animals that assures food safety;
- Risk assessment and HACCP and Good Hygienic Practice (GHP) based practices.
- New demands for trace-ability of aquaculture products
- Not easy with the large number of small-scale farmers
- Substantial institutional re-organization, legal and policy development, awareness raising and capacity building efforts will be essential

Conclusions:

The fisheries policy is obviously one of those policies that took into consideration the coastal areas since the decade of 70's. Furthermore, it is an important policy as it is formed in programmes and axis that can promote the development and management of the coastal zones. Bearing in mind the importance of the fisheries policies and specifically of the current OPF, the present study aimed to evaluate the programmer's ability to generate regional impacts and hence to promote the regions development.

As it can be seen from the results the dynamics of the fisheries sector in the regional economy are weak and along with the pessimistic perspectives of the sector lead to the necessity of supporting alternative vocational activities for the development of coastal rural areas. The only axis (4th) of the OPF that promotes such activities is proved very ineffective; the generated impacts in the regional economy are not expected to confront any developing problems or redirect significant number of people engaged in fishing to other alternative activities.

The specific authorities that are involved in the formation of the fisheries policies should take into account the peculiarities of the sector and the coastal regions, while forming the axis and their attributed funds. Alternative or related to fishing activities are necessary to

be supported and promoting.

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"Pouring chemicals down the drain is bad for fish and shellfish. Aquaculture is good for the environment."

— *C. Gross (5)*

Nutrition in Health and Disease

***Dr.Sr.Mercy.P**

****N.Dhanusha**

Abstract

A number of global trends – including growing world population, urbanization, rising incomes, and an increase in the number of people living beyond 60 years – have an impact on nutritional habits and health. These trends can improve dietary choice for some people marked by increases in the number of people adopting less nutritionally balanced diets and more lifestyles that are sedentary. These choices lead to over-nutrition and related non-communicable diseases at one extreme. At the other, under-nutrition, including micronutrient deficiencies and associated disorders, persist. Under- and over-nutrition currently affect the health, wellness and livelihoods of nearly half the world's population – irreversibly impairing the physical and mental development of infants and children, increasing illness and premature death among all age groups and decreasing personal and national productivity. In many developing countries, people effectively bear a 'double burden' of malnutrition, with under nutrition (comprising protein-energy malnutrition and micronutrient malnutrition) and over nutrition (overweight and obesity) occurring simultaneously. In general, people in lower income groups around the world are at higher risk of suffering malnutrition in any form.

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Keywords: sedentary, deficiencies, malnutrition, morbidity, catastrophic, rehabilitative, chronic.

Introduction:

Health is much more than the absence of disease. It is a positive quality, emphasizing physical, social, intellectual, emotional, and spiritual well being. Optimum nutrition, providing all nutrients in both kind and amount, is the cornerstone of good health and the cutting edge of prevention. The foods we eat, and the nutrients they should provide, are the most important continuing environmental factors influencing our growth, development, functional abilities, and health. Nutritional knowledge, with education of both the public, and particularly health professionals is critical if we are to succeed in significantly reducing the excessive premature morbidity and mortality from our leading killer diseases - heart disease, cancer, and stroke. How we structure our lifestyles, with proper nutrition, health habit discipline, and exercise programming, will have a great influence on personal health, and will help reduce our current catastrophic medical care expenditures.

A healthful diet and wise food choices are critical components of promoting health and reducing the risk of chronic disease. A substantial amount of health care resources saved by expanding health promotion and disease prevention programs that target dietary change among Americans. In addition, reduce health care costs, the emphasis and delivery of health care must promote health as well as deliver treatment and rehabilitative services to the sick.

Prevention measures, such as nutrition interventions that also encourage physical activity, can help prevent or halt progression of full-blown chronic disease and thus decrease chronic disease disability. Health promotion and disease prevention need to be integral parts of all health care, community, public health, and worksite programs across the life cycle.

Correspondingly, such programs must be culturally competent and address the specific needs of vulnerable or underserved populations. Dietetics professionals in all areas of practice should play an integral role in health promotion and disease prevention programs. Achieving this goal will require expansion of training programs and active learning by dietetics professionals that includes theory and practice in using team approaches, developing coalitions, and managing complex systems. Dietetics professionals also need to amplify their understanding of politics, administration, health care financing, and reimbursement, and expanded to include social and behavioral sciences and to address program evaluation, outcomes, and cost-benefit and cost-effectiveness in nutrition-focused health promotion and disease prevention programs. Continued training in program development, research, and evaluation will help build the body of evidence that supports ongoing inclusion of prevention in a rapidly changing health care environment.

Nutrition and medicine interface in a variety of ways and combine to serve as a dynamic force in health as well as in disease. A conceptual understanding of this interrelationship is critical to the continued and effective development of clinical nutrition in medical education. The physician may play an important role in critical-care medicine, long-term health care, research, education, and preventive medicine. While there is great potential for the physicians their impact on nutrition status in both health and disease, there is clear evidence that greater emphasis to be placed on providing adequate nutrition training for every physician.

The interaction between genes and the environment plays a major role in the human life cycle from birth to death beginning with fertilization through the stages of growth, development, and aging. The role of nutrition, which can modify the genetic base, is of crucial importance in this life cycle. Human nutrition is a science that deals with nutrients and how the body assimilates them. Life maintenance requires food as well as water and oxygen. Food provides the energy required supporting the body's life sustaining processes and the materials required to build and maintain all body cells. These materials, called nutrients, undergo extremely complex processes in the body, from breakdown to release as energy and from rebuilding cells and tissues to maintain the overall health of the individual.

The satisfaction of nutritional needs is mandatory to human life from conception through growth and development and finally to the achievement of long-term survival. Diet is a major influence during the human life cycle since food preferences, influenced by likes and dislikes, mainly determine what people eat. Other influencing factors include advertising, socioeconomic and time constraints, cultural and religious beliefs, and health related concerns. In order to achieve maximum genetic potential in the human life cycle, optimal nutritional needs must be satisfied.

The understanding of the role of nutrition in health maintenance and disease prevention has advanced rapidly in the past decade. The relationship between nutritional deficiencies and chronic diseases such as cardiovascular disease and cancer, especially breast and prostate cancer, have come under scrutiny. With increased emphasis on disease prevention and health maintenance, in 1989 the federal government issued the recommended dietary allowances for nutritional supplements1. In 1989, the National Academy of Sciences made the following recommendations.

- Reduce total fat intake to 30% or less of k calories. Reduce saturated fat intake to less than 10% of k calories, and the intake of cholesterol to less than 300 mg daily.
- Increase intake of starches and other complex carbohydrates.
- Maintain protein intake at moderate levels.
- Balance food intake and physical activity to maintain appropriate body weight.
- For those who drink alcoholic beverages, limit consumption to the equivalent of less than 1 oz of pure alcohol in a single day. Pregnant women should avoid alcoholic beverages.
- Limit total daily intake of salt (sodium chloride) to 6 g or less.
- Maintain adequate calcium intake.
- Avoid taking dietary supplements in excess of the RDA in any single day.
- Maintain an optimal intake of fluoride, particularly during the years of primary and secondary tooth formation and growth.

The U.S. Department of Agriculture and the U.S. Department of Human Services made the following recommendations.

- Eat a variety of foods.
- Maintain desirable body weight.
- Choose a diet low in fat, saturated fat, and cholesterol.
- Choose a diet with plenty of vegetables, fruit, and grain products.
- Use sugars in moderation.

- Use salt and sodium in moderation.
- If you drink alcoholic beverages, do so in moderation.

As early as 1990, the Surgeon General of the U.S. issued specific objectives for primary health in America. These objectives were updated in 1990 to define the national goals for the year 2000, healthy people 2000. The U.S. Surgeon General identified 21 specific nutrition related objectives to improve the nation's health. The following broad goals achieved by the end of year 2000 are:

- Increase the number of healthy years for Indians.
- Reduce health disparities among segments of Indians.
- Achieve equal access to preventive health services for all Indians.

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Recent Trends in Aqua Culture for Sustainable Development

Kanigalla Sruti

Abstract

Aquaculture, also known as **aqua farming**, is the farming of aquatic organisms which are mentioned such as fish, crustaceans, mollusks and aquatic plants. Aquaculture involves cultivating freshwater and saltwater populations under controlled conditions, and can be contrasted with commercial fishing, which is the harvesting of wild fish. Broadly speaking, finfish and shellfish fisheries can be conceptualized as akin to hunting and gathering while aquaculture is akin to agriculture. Mari culture refers to aquaculture practiced in marine environments and in underwater habitats. Although many aquaculture projects have been developed that have provided significant economic and social benefits with a negligible environmental impact there are several aquaculture industries, most notably the shrimp farming in certain Asian countries, that have significantly damaged the local ecosystems. These ventures have significantly damaged aquaculture's public image. For aquaculture to become widely accepted it must address this issue.

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Keywords: sustainability, devastating, shrimp, decimating, integrated, conceptualized.

Introduction

The main trend in aquaculture is towards sustainability. This issue of sustainability is likely to change, in many cases, how aquaculture is practiced and what forms are desirable. One of the important realizations of this trend is that to achieve full market potential the environment must be protected, as environmental damage results in a decrease in production and possibly the collapse of the industry. The Chinese white shrimp industry is a prime example: environmental damage in the region resulted in devastating diseases decimating theindustry. The Chinese white shrimp industry has since almost collapsed. The collapse of the Chinese white shrimp industry is the result of unsustainable practices. Fortunately, the industry is now recovering as the result of the use of more environmentally friendly harvesting techniques such as closed water systems, lower density cultivation, and the use of polyculture systems.

There are a number of issues that must be addressed for sustainability to be achieved. Among these are:

The development of an integrated infrastructure and appropriate management

This system must encourage positive development of aquaculture, administrative and legal framework, and institutional linkages, and development policies, allocation of resources, zoning, and increased public awareness among other things.

More efficient resource usage

Improved water management involving decreased usage better usage, better feeding

practices and less polluting feeds, improved health management, increased integration with agriculture and perhaps genetically improved stocks with specific pathogen resistance are important side issues of more efficient resource usage. Disease control and the development of vaccines is important to establish efficient resource usage.

Avoiding permanent damages

Negative environmental impacts that result in permanent damage must be avoided at all costs. If some environmental damage must occur it must not exceed the rate at which the environment can recover. This involves better site selection, planning, risk assessment, farm design, treatment of wastes, and the development of new more environmentally efficient technologies and techniques.

Establishing a database of aquaculture practices and effective management systems

An adequate working knowledge of the impacts of aquaculture must be developed and a means of communication so that all aquaculture farms can benefit from the information and avoid mistakes made by other farms. This site is an attempt to establish such a database. We welcome any and all input from aqua culturists around the world.

Positive environmental practices should be maximized

Some aquaculture practices such as mollusc and seaweed culture can provide a positive effect on the environment by removing pollution from the local water systems. Systems that reduce pollution and are successfully integrated into the local ecosystem must be maximized.

These and many other topics have been discussed at various aquaculture forums around the world. In response the Food and Agriculture Organization of the United Nations (FAO) unanimously adopted the Code of Conduct for Responsible Fisheries (CCRF) in 1995 that outlines what are believed to be sustainable aquaculture practices and how they might be achieved. Unfortunately, fish farmers along with government agencies do not know how effective the CCRF's suggestions will be, what it will involve and the economics of its adoption.

There are other trends within the industry, one of which being a trend from extensive or semi-extensive productions to more intensive levels of production. The impacts of such a trend on the environment can have significant implications on the environment. Intensive farming projects must be managed more carefully than extensive ones and the danger of environmental damage is greater.

This trend is the result of increasing demands on the output of aquaculture farms. Despite this trend some farms have flourished, such as salmon culture in Norway, where low-

pollution feeds along with vaccines, genetic improvement, lower stock densities, and improved resource management have resulted in increased production, efficiency, and the maintenance of an decent profit margin. Although such practices are not common, many agree that they should be the model upon for further research and development.

As a relatively new industry, many of the wrinkles in aquaculture are still being worked out, and with most industries it must go through a shakedown period in which experience shows what practices are effective and which are not. Hopefully, we have learned much of that lesson already, the task, and general direction of aquaculture in the immediate future is to develop more environmentally friendly facilities and practices and determine species and site specific sustainable yields. If this trend takes hold and continues aquaculture is poised to become a significant food source of the 21 century.

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There's a national imperative to rebuild that infrastructure ... We've got half-a-dozen critical industries down there - shipping, refining, agriculture, aquaculture - that serve the entire country. But where and how to rebuild the rest of the city, those are politically charged questions that can only be answered down the road.

~ *Bernard Weinstein*

Freshwater pearl crop in the Indian subcontinent

P.RaghavaKumari,

Abstract

Pearls one of the most ancient of gems, are esteemed around the globe because of their cool and soft emergence, pastel hue and recognition to diverse disposition as compared to the other jewels. Pearl culture is a billion dollar business and one of the world's largest aquaculture activities in terms of value. India is in the process of establishing its own 'niche market' employing indigenous mussel fauna. The Indian subcontinent is bestowed with a rich and diverse group of mussel fauna. The biological parameters that need to be checked before initiation of pearl culture include water quality, water source, water depth, substratum type, nutrient load, temperature and superior quality of recipient as well as donor mussels. Site selection has to be convenient for operational activities. Mussels collected from the wild are ideal; however pathological parameters of the indoor produced animals need attention prior to selection. Pearl culture demands various ancillary activities that require appropriate attentions viz. mussel collection, implantation, nucleus preparation, culture unit fabrication, farm management and harvesting. The product should have a steady market avenue for better remuneration.

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Introduction

Pearls one of the most ancient of gems, are esteemed around the globe because of their cool and soft emergence, pastel hue and recognition to diverse disposition as compared to the other jewels. Previously Japan, China, Australia and French Polynesia have had exclusive authority on pearl culture techniques. During the early period of the last century Japan dominated in the frontier of pearl cultivation, later joined by the Australians in 1950's and French Polynesians a decade later, both through technical exchange from Japan, which gradually lost its monopoly on technical grafting skills.

The grafting process is the crux to success in any pearl culture operation, and in the early stages of the industry the techniques were closely guarded secrets by Japanese technicians, who were often brought in to conduct the grafting work in other countries. Currently, Australian, Chinese, American and Indian technicians are engaged in the grafting process. Earlier in the marine segment three oysters fundamentally ruled the pearl world.

The Japanese and Indians employed *Pinctadafucata*for akoya pearls ranging from 4mm to 8mm. Australians employed their indigenous species *P. maxima,* the gold lipped pearl oyster, for production of 12 to 18 mm sized pearls and in French Polynesia *P. margaritifera*to produce a wide range of black, grey or greenish tinge pearls were produced of 10 to 14 mm size range. Pearl culture is a billion dollar business and one of the world's largest aquaculture activities in terms of value. Until recently, opportunities for investing in this specific area have been limited. The hatchery and indoor production of juveniles have

created an avenue for taking up this venture even in regions where pearl mussel resources are depleted, as established in Indonesia. India is in the process of establishing its own 'niche market' employing indigenous mussel fauna.

Freshwater pearl farming opportunities in India

In the early 1990s another dimension to pearl culture was added with the emergence of Chinese freshwater pearl crops. China has stood as a major contender for Japan as far as quantity of pearl product is concerned; although the value of marine pearls is generally much higher, and freshwater pearls are considerably different in character and do not necessarily occupy the same market niche.

The Indian subcontinent is bestowed with a rich and diverse group of mussel fauna the genus *Lamellidens*is represented by nine species and two sub-species while the genus *Parreysia* is represented by 35 species and six sub-species under two sub-genera.

The most popular wealth of mussels is:

I. *Lamellidensmarginalis,*
II. *L. corrianus*
III. *L.consobrinus* and
IV. *Parreysiacorrugata*.

Their worth has been elevated of late because of their role in indigenous production of freshwater pearls. Most other species also possesses nacre, but their potential for culture pearl production is yet to be realized. Every mussel has the ability to produce a pearl of some sort, however only those possessing a lustrous mother of pearl layer can form a gem quality pearl.

Hence, though two thirds of the available species possess magnificent inner nacreous deposit, their success in pearl production through surgical practice is yet to be under taken. Natural pearl formation is instigated when a foreign particle such as a piece of sand, shell piece or parasite make its way into particular region of mollusc and cannot be expelled. As a defense device, the animal secrets a calcium carbonate material known as nacre to coat the foreign body. Layer upon layer of this coating is deposited on the irritant, resulting in a shimmering and iridescent creation of a pearl.

Cultured pearls are formed essentially by the same process, except that the irritant, otherwise called a nucleus, of desired shape and size is surgically implanted into the body of bivalve mollusk where it is difficult to be expelled. The animal does the rest, creating this prized biological gem. Thus, the nature's hand has not been completely eliminated; in fact it is the animal that determines the character of the pearl produced. According to the size and

colour of pearl desired the appropriate mussel species is selected. *Lamellidensmarginalis* and

*L. corrianus*produce a maximum of 6mm sized pearl with a pinkish hue in former and silvery in latter. In *Parreysiacorrugata*3mm sized pearls can be retrieved with a golden yellow tone.

Freshwater pearl culture practices

Collection of mussels

Mussels are handpicked and collected from the wild in buckets, baskets or crates with water for short distance transportation. The collected mussels are preferably transported during the cooler early morning hours, where possible.

Pre-operative conditioning

The indigenous pearl mussel species are collected from freshwater bodies and are subjected to pre-operative conditioning for two days. They are kept in ferro-cement tanks (200 l capacity) with aged tap water at a stocking density of one mussel per litre of water. Pre-operative conditioning ensures proper relaxation of adductor muscles in preparation for surgery. This aspect is important in view of limited application of narcotizing procedures as followed in marine pearl culture operation.

Surgical implantation

Surgical implantations are of three types, made in three different regions of the mussel depending on the pearl type targeted. Individual mussels are taken up for a particular type of implantation. The mantle cavity insertion method is a simple technique. Prior to surgery, mussels of required shell length and weight are collected. They are carefully opened by means of a speculum, 0.5 cm wide, without causing injury to the adductor muscle and soft parts of the mussels.

A small area of the mantle from the anterior side is carefully detached from the upper shell valve and a nucleus of the desired size and shape (up to 1 cm in size for designed pearl) is inserted slowly into the mantle cavity and is further pushed in deep to avoid rejection. Both the valves of a single mussel can be implanted with the preferred foreign body.

In the mantle tissue method the mussels surgery are segregated into two groups before surgery, the mussels to be operated upon (the recipient mussels) and those to be sacrificed (the donor mussels). The live donor mussels are sacrificed and the pallial mantle ribbon extracted and cut into appropriate sized graft pieces and implanted alone or along with a small nucleus (2 mm diameter) into the mantle tissue of the recipient mussel. Such grafting is done on both the side of the mantle lobes.

The number of implantations can vary between 2 to 8 depending upon the size and mantle thickness of the recipient mussel. In the gonadal method of implantation once the live graft pieces are ready, the recipient mussels are carefully opened with the shell opener to about 0.5cm. A small measured incision is made by means of a special knife placed at the other end of the graft needle, under the outer membrane of the gonad. Care is to be taken not to cut deep into the gonadal tissue to avoid damage to the coils of the intestine. One implantation is made per animal.

Post-operative care

Post-operative care is an important step in freshwater pearl culture operation that is required for the implanted mussels to recover. The implanted mussels are placed at the rate of two mussels per bag in a ventral side up position for a period of 10 days. Sufficient care is taken to allow free opening and closing of the shell valves for respiration.

The units are daily examined; dead mussels and those that reject the nucleus are removed. The food requirements of most of the bivalves are still poorly understood. Most of the commercially important species of bivalves are plankton feeders. However the examination of the gut content does not give any precise idea of their feeding habit. It contains organic materials, colloidal substances, particles of organic detritus and living organic particles(bacteria, planktons, eukaryotic cells). The size of the particles plays an important role as well as their concentration on the rate of retention. *Chlorella, Chlorococcum, Kirchenirella*and & *Spirulina*are considered to be their preferred diet3.

Pond culture of implanted mussels

Ponds are generally 2.5 metres deep with a clayey soil base and slightly alkaline waters. A rectangular shaped pond with proper inlets and outlets is ideal for implanted pearl mussel rearing. Ponds without aquatic macrophytes and algal blooms such as *Microcystis*and *Euglena* are suitable for pearl culture operations. The ponds are provided with P.V.C tubing (5 cm diameter) platforms (16 x 8 m) as rafts for hanging the pearl mussel culture units. The implanted mussels are placed in nylon bags (1.0 cm mesh, 12 x 14 cm) at two mussels per bag and reared. The physico-chemical parameters and water level of the ponds are monitored throughout the culture period. The optimum temperature regime lies between 20° to 30°C.

Harvest of pearls

India being a tropical country, the culture period of pearl is narrow compared to other temperate countries. The pond culture of operated mussels varies from twelve months or more depending upon the size and number of nuclei implanted, the health of the mussels and the condition of the pond environment.

In the case of mantle tissue and gonadal implantation methods the colour of the pearls varies from silvery white to golden yellow and deep pink depending upon the mother mussel and the nature of the donor mantle grafts employed4. At the end of the culture period (12 to 14 months), harvesting is done.

The mussels are either individually sacrificed, or individually pearls are taken out from the pearl sac of the live mussels without sacrificing. Some freshwater mussels are capable of producing gem quality pearls. As the pearls are produced through a natural process they show a wide range of variation in their appearance and quality. To maintain uniformity in coloration and quality, pearls after harvest are subjected to value addition through surface cleaning or bleaching and dyeing or both cleaning and bleaching which may enhance their value.

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Financial Performance of Life Insurance Corporation of India after Privatization of Insurance Sector in India

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Abstract:

Life Insurance Corporation has been playing a very significant role in selling its products and providing a great support to government by ensuring monopoly position till the introduction of IRDA (Insurance Regulatory development Authority) after privatization of insurance sector, it started facing competition from private players in insurance sector. There is 26% foreign direct investment in the total capital of private insurance sector. The present study aims at getting an idea about the impact of privatization of life insurance industry on performance of life insurance Corporation of India. Researcher tried to analyze total income, total outgo, life insurance fund, total assets of life insurance Corporation of India after privatization of insurance sector in India.

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Introduction:

By the life insurance of India Act passed in parliament of India LIC was established in 1956 on 1st September the private insurance industry in India with the effect of nationalization 154 Indian Insurance companies, 16 non Indian companies,75 provident societies, totally 245 insurance companies were amalgamated on 19th June 1956 and LIC was forced. Since then LIC played very significant monopoly position in selling its products till privatization of insurance sector.

IRDA was established to regulate insurance business with the entry of private players in India (Insurance Regulatory and Development Authority) By this LIC monopoly came to an end and it stated facing competition from private players.

It is necessary to analyze the impact of privatization of insurance of LIC of India particularly after privatization.

As per the LIC annual report 2012-13, as on 31-3-2013 there were 8 zonal offices, 113 Divisional offices, 2048 branch offices and 1275 satellite offices(SOs)

The life fund, valuation surplus and the share of central government are going constantly every year.

Insurance is giving assurance for the recovery of loss which arises due to unforeseen events like fire accident, death critical illness etc.

When a policy is taken cover loss, certain amount will be paid to the sufferer by the insurance company on occurrence of unfavorable events.

The person confirm who takes such policy for recovery of loss is insured who gives guarantee for recovery of loss i.e. insurance company is insurer. The agreement between the

two parties is insurance contract.

When a policy is taken against the risk of death or critical illness is life insurance and for any other risk is general insurance.

When head of a family dies unexpectedly due to an accident or illness or naturally, the dependent family members suffer a lot to get their livelihood. They will be on cross roads. If the head of the family insures his/her life, family members shall not suffer because certain amount shall be paid by insurance company to the family members which will be a great financial support to them. So taking life insurance policy is very much useful and necessary to any person to safeguard his/her family members from financial troubles.

Important Terminology:

- IRDA – Insurance Regulatory And Development Authority.
- Total Outgo – Total Expenditure incurred by Insurance Company.
- Life Fund – Accumulated Surplus Of Insurance Company.

Review of the literature:

❖ **Prof Sanjay Kumar Jagannath Patil(2012)**

"A study on consumer satisfaction towards LIC of India." In this the author analyzed that 95% of customers were satisfied with the products and services of LIC of India .97% of respondents from the selected sample (88) are familiar with the products.

❖ **Dr Sonal Nena**

"Performance evaluation of LIC of India " International Journal of Advance Research in computer science and management studies. Researcher evaluated that there is consistent increase in business of LIC of India during the period of the study there is no one for change in the performance of LIC and it need to control the operating expenses and investments.

❖ **Chandrana, Harish M(2008)**

"Performance evaluation of Life insurance Corporation of India" thesis PhD, saurashtra university researcher shows that During the study period, average percentage of total outgo to total income was observed always less than 50% (average 42.43) Excess of income over outgo added to Life insurance fund was observed more than 50% (average 58.40%). Investment in infrastructure and social security was less than the amounts as per IRDA guidelines. It was suggested that to increase LIC fund management expenses are to be controlled and reduced.

❖ **Shilpa Thakur, Amity Law school Noida(2010)**

"Competition in life insurance sector of India" research paper.

As per survey experience of the researcher it is observed that LIC is a dominant

market player with more than 70% of total market. Sovereign guarantee of government to states owned LIC is giving it an unfair advantage to build trust in customers because of that the LIC is playing major role in life insurance market. The commission should be separately appointed to make fair effort to enlarge distribution network to provide a levels of playing field to all players and also discourage dominance of LIC.

- **G.A.Venkatesan& R.sundaraRaman(2013 April):**

"SWOT Analysis of LIC of India- An overview "

In this paper the researcher opines that LIC of India has strengths, weaknesses opportunities and threat which are analyzed clearly- LIC is state owned, govt. of India has 100% stake strong financial position is strength, increase in operating expenses and there by affecting margins is weakness. Competition from private sector is threat. Optimistic Indian economy is an opportunity.

- **Tanveer Ahmed Darzi(2010)**

'Financial performance of insurance industry in post liberalization era in India.": In this research it is analyzed that there is a higher claim ratio is contributing negatively to overall solvency status. Operating margin of non-life insurer's solvency Insurers in both the sectors via private and public are affected by price deregulation of Jan 2007. Investment income had been coming down during the study period. It is suggested that capital reconstruction is needed for public non life insurers.

- **Mark S.Dorfman(2002)**

In the book "Introduction to risk management and Insurance" written by him, different types of Insurance intermediaries, role of private players insurance sector were discussed and analyzed with suitable illustrations.

- **Srivasthava D.C and Srivasthavas(2001)**

In this book," Indian insurances industry- transition and prospects.":

The role played by insurance sector in Indian economy and its financial significance and contribution to Indian economy.

- **Dr Anshuja Tiwari, Babita yadav(2012 Feb)**

"A customer survey & perception towards bank assurance (with reference to life insurance industry)"

In this paper, they say that large number of respondents from the selected sample is not aware of the concept Bancossurance. Spreading awareness among the general public is needed. Majority of respondents buy LIC policies for tax benefits 34% of respondents are only moderately satisfied with various services of banks.

❖ **Neelam Gulati and CM Jain (2013)**

"A study of impact of liberalization of Indian insurance sector on the strategies of life insurance Corporation of India since 2001"

LIC of India though enjoyed monopoly position for the four decades. It got a title bit affected with the entry of private players in insurance sector in India. Private players have been working efficiently and effectively in selling their innovative insurance products and services with strong strategies. They cannot break the market share kingdom of life insurance Corporation of India and beat out its growth and development. But it is suggested that LIC of India has to still strengthen its working with more innovations and rocking strategies to hold and improve its market share in Indian insurance sector.

"Statement Of The Problem"

"Financial performance evaluation of LIC of India after privatization of insurance sector"

Objectives of the study:

- To know the importance of life insurance
- To understand the working of LIC of India
- To measure the financial performance of LIC of India after privatization.
- To understand the public trust on LIC of India.

Research Methodology:

Data collection: This study is based on secondary data only. The total required information is extracted from the LIC an annual report from 2000-01 to 2012-13 and some information is taken from various journals.

Period of study: The period of the study was from 2000-01 to 2012-13 i.e. 13 years (after privatization of insurance sector in India)

Significance of the study: Human life is risky. Life insurance is necessary to every one who cares of ones family for social security. It is very important to know about working of LIC and its various plans and how they become useful when some unfavorable incidents occur.

Sampling: Out of insurance industry in India having 23 insurance companies, LIC is selected as sample for study.

Tools and techniques used: Simple averages, trend percentage, X2 tests are used for analysis. Diagrammatic presentation was also projected to have a clear idea on the performance of LIC of India after privatization of insurance sector.

Hypothesis:

H0 = There is no significant difference in the total income, total outgo, total assets of sampled unit during the period of the study.

H1 = There is significant difference in the total income, total outgo, total assets of sampled unit during the period of the study.

Scope of the Study

Based on secondary data extracted from LIC annual reports from 2000-01 to 2012-13, total income, total outgo, LIC fund, assets evaluation and analysis of financial performance of LIC after privatization of insurance sector in India.

Limitation of the Study

1. The study is only for the period of 13 years i.e. from 2000-01 to 2012-13.
2. It focused attention on LIC of India only in the total insurance industry in India.
3. Calculations are based on data collected from LIC annual reports

Data Analysis

Analysis of Total Income

Year	Amount (Rs. in Crores)	% of Growth	Index
2000-01	**53998.76**	**-**	**100.00**
2001-02	**72769.82**	**34.76**	**134.76**
2002-03	**80938.49**	**11.23**	**149.89**
2003-04	**93088.91**	**15.01**	**172.39**
2004-05	**112392.74**	**20.74**	**208.14**
2005-06	**132146.88**	**17.58**	**244.72**
2006-07	**174424.76**	**31.99**	**323.02**
2007-08	**206362.98**	**18.31**	**382.16**
2008-09	**217274.36**	**5.29**	**402.37**
2009-10	**261773.02**	**20.48**	**484.78**
2010-11	**297180.68**	**13.53**	**550.35**
2011-12	**308399.81**	**3.78**	**571.12**
2012-13	**333715.07**	**8.21**	**618.01**

Based on %growth rate of base year i.e. 2000-01, 2001-02 % growth rate was calculated & the same process is considered for the remaining selected years .e. 2001 to 2012-13. During 2001-02(i.e. 34.76%), 2004-05(i.e. 20.74%), 2006-07(i.e. 31.99%) & 2009-10(i.e. 20.48%) are the significant growth rates where as the remaining years there is a decreasing % rate of growth with increasing rate i.e. between 2001-02(34.76%) declined rate of growth at an increasing rate during 2002-03(i.e. 11.23%)

CHI-Square Table

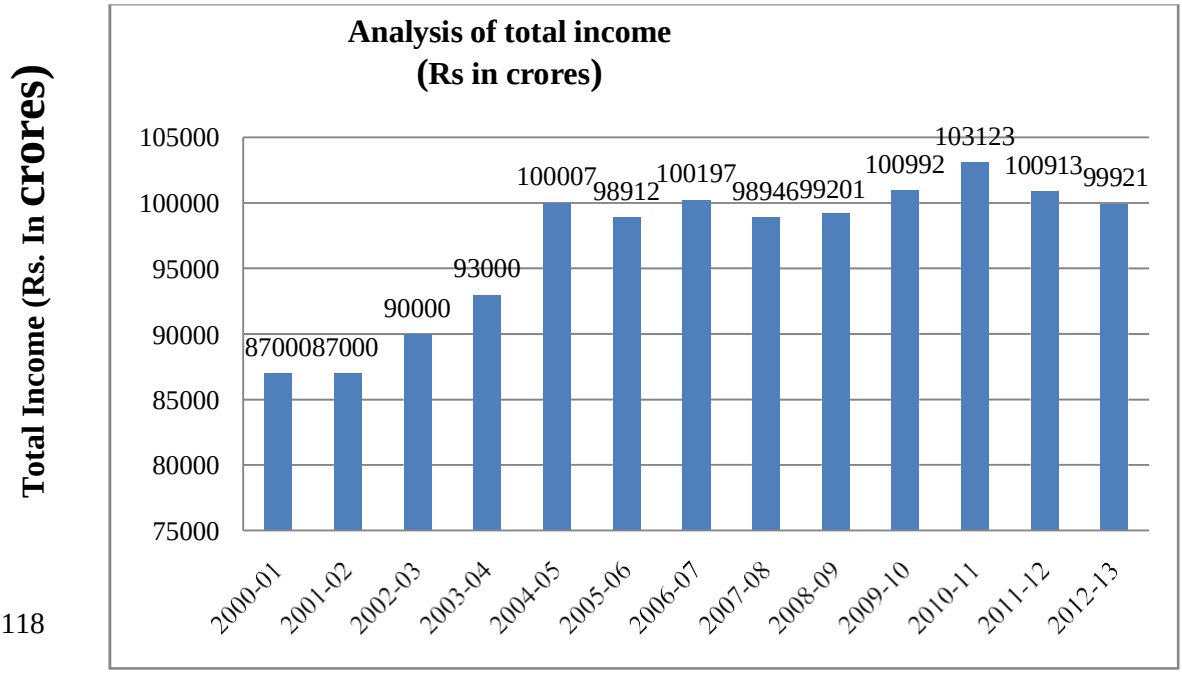
Analysis of Total Income

Year	Actual growth(O)	Expected growth(E)	$(O-E)^2$	$(O-E)^2/E$
2000-01	-	-	-	-
2001-02	34.76	15.45	372.88	24.13
2002-03	11.23	15.45	17.81	1.15
2003-04	15.01	15.45	0.19	0.01
2004-05	20.74	15.45	27.98	1.81
2005-06	17.58	15.45	4.54	0.29
2006-07	31.99	15.45	273.57	17.71
2007-08	18.31	15.45	8.18	0.53
2008-09	5.29	15.45	103.22	6.68
2009-10	20.48	15.45	25.30	1.64
2010-11	13.53	15.45	3.69	0.24
2011-12	3.78	15.45	136.19	8.81
2012-13	8.21	15.45	52.42	3.39
				66.39

$X^2 = \sum(O-E)^2/E = 66.39$ V= n-1= 13-1= 12

X^2=0.05(degree of freedom)= 21.0

The calculated value of X^2 is greater than the table value(H0) the hypothesis is rejected hence the values of actual growth during 2001-02,2006-07,2008-09,2011-12,2012-13 the calculated X^2 is very significant. Hence the amount of total income right from 2000-01 to 2012-13 under consideration is concerned.



Years

Analysis of Total outgo

Year	Actual amount (Rs.in crores)	% of growth	Index
2000-01	22055.26	-	100
2001-02	28283.50	28.24	128.24
2002-03	40886.08	44.56	185.38
2003-04	48507.20	18.64	219.93
2004-05	52251.57	7.72	236.91
2005-06	52251.57	0.00	236.91
2006-07	77938.52	49.16	353.38
2007-08	80176.14	2.87	363.52
2008-09	77849.47	-2.90	352.97
2009-10	108728.37	39.66	492.98
2010-11	147589.64	35.74	669.18
2011-12	154548.38	4.71	700.73
2012-13	177229.46	14.68	803.57

Based on % of growth rate of base year i.e 2000-01, 2001-02 % growth rate was calculated the same process is considered for the remaining selected years i.e 2001 to 2012-13. During 2001 – 02 (i.e 28.24%), 2002-03 (i.e 44.56%), 2006-07 (i.e 49.16%), 2009-10 (i.e 39.66%) and 2010-11 (i.e 35.74%) are the significant growth rates whereas the remaining years 2003-04;2004-05;2005-06;2007-08;2008-09 % growth rate is completely in decreasing trend except the 2012-13 (i.e 14.68%).

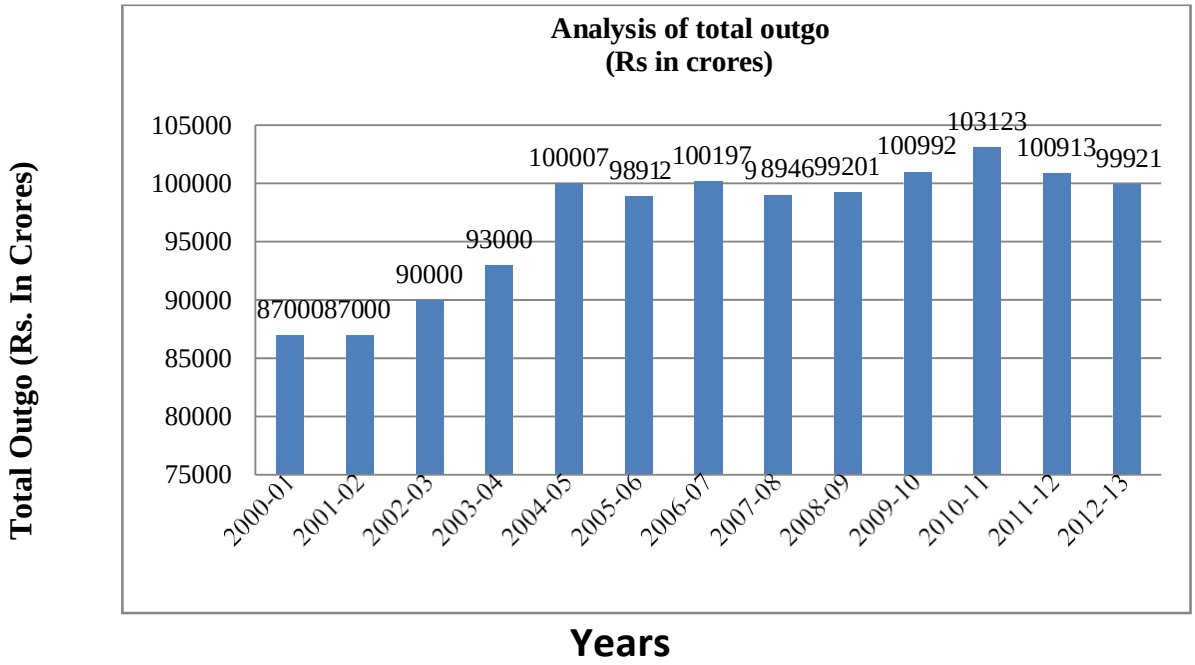
CHI-Square Table
Analysis of total outgo

Year	Actual growth(O)	Expected growth(E)	$(O-E)^2$	$(O-E)^2/E$
2000-01	-	-	-	-
2001-02	28.24	18.7	91.04	4.87
2002-03	44.56	18.7	668.82	35.77
2003-04	18.64	18.7	0	0.00
2004-05	7.72	18.7	120.53	6.45
2005-06	0	18.7	349.63	18.70
2006-07	49.16	18.7	927.91	49.62
2007-08	2.87	18.7	250.54	13.40
2008-09	-2.9	18.7	466.49	24.95
2009-10	39.66	18.7	439.39	23.50
2010-11	35.74	18.7	290.41	15.53
2011-12	4.71	18.7	195.68	10.46
2012-13	14.68	18.7	16.15	0.86

$X^2 = \sum(O-E)^2/E = 204.11$ V= n-1= 13-1= 12

X^2=0.05(degree of freedom)= 21.0

The calculated value of X^2 is greater than the table value (H0) the hypothesis is rejected. Alternative hypothesis is accepted. There is significant different in the outgo values.



Analysis of Life Insurance Fund

Year	Actual amount (Rs. In crores)	% of growth	Index
2000-01	186024.75	-	100
2001-02	232900.94	25.20	125.20
2002-03	273004.96	17.22	146.76
2003-04	321759.55	17.86	172.97
2004-05	385791.21	19.90	207.39
2005-06	463147.62	20.05	248.97
2006-07	560806.33	21.09	301.47
2007-08	686616.45	22.43	369.10
2008-09	807317.43	17.58	433.98
2009-10	999517.59	23.81	537.30
2010-11	1151200.58	15.18	618.84
2011-12	1283990.72	11.53	690.23
2012-13	1433103.14	11.61	770.38

Base year is 2000-01, basing on this % of growth rate is calculated for 2001-02 and the same process is continued for the remaining selected years i.e 2001to 2012-13. During 2001-02 (i.e 25.20%), 2004-05 (i.e 19.99%), 2005-06 (i.e 20.05%), 2006-07 (i.e 21.09%), 2007-08 (i.e 22.43%), 2009-10 (i.e 23.81%) are the significant growth rates whereas the remaining years 2002-03, 2003-04, 2004-05 decreasing percentage growth rate with a little bit increasing trend. With a small different the growth rate is observed for the last two years 2011-12, 2012-13.

CHI-Square Table

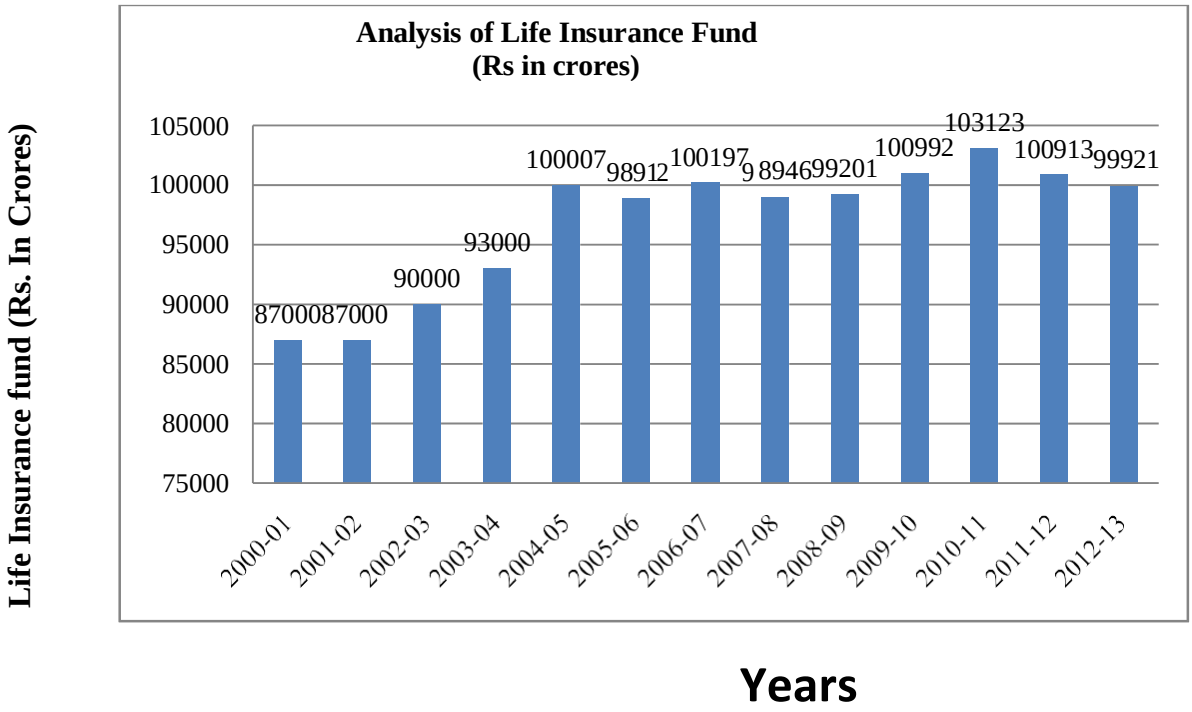
Analysis of Life Insurance Fund

Year	Actual growth(O)	Expected growth(E)	$(O-E)^2$	$(O-E)^2/E$
2000-01	-	-	-	-
2001-02	25.2	17.19	64.17	3.73
2002-03	17.22	17.19	0.00	0.00
2003-04	17.86	17.19	0.45	0.03
2004-05	19.9	17.19	7.35	0.43
2005-06	20.05	17.19	8.18	0.48
2006-07	21.09	17.19	15.22	0.89
2007-08	22.43	17.19	27.47	1.60
2008-09	17.58	17.19	0.15	0.01
2009-10	23.81	17.19	43.83	2.55
2010-11	15.18	17.19	4.04	0.24
2011-12	11.53	17.19	32.03	1.86
2012-13	11.61	17.19	31.13	1.81
				13.63

$X^2 = \sum(O-E)^2/E = 13.63$ V= n-1= 13-1= 12

X^2=0.05(degree of freedom)= 21.0

The calculated value of X^2 (13.63) is less than the table value so (H0) the null hypothesis is accepted and concluded that there is no significant difference in fluctuations of life insurance fund values. It is getting increased year after year.



Analysis of Total Assets

Year	Total assets (Rs in crores)	Growth (%)	Index
2000-01	192514.65	-	**100**
2001-02	245331.46	**27.44**	**127.44**
2002-03	290539.97	**18.43**	**150.92**
2003-04	367359.84	**26.44**	**190.82**
2004-05	438079.22	**19.25**	**227.56**
2005-06	552447.33	**26.11**	**286.96**
2006-07	651882.89	**18.00**	**338.61**
2007-08	803820.15	**23.31**	**417.54**
2008-09	873551.35	**8.67**	**453.76**
2009-10	1152057.21	**31.88**	**598.43**
2010-11	1317416.10	**14.35**	**684.32**
2011-12	1417891.79	**7.63**	**736.51**
2012-13	1560481.84	**10.06**	**810.58**

Base year is 2000-01, basing on this % of growth rate is calculated for 2001-02 and the same process is continued for the remaining selected years i.e 2001-02 to 2012-13. During 2001-02 (i.e 27.44%), 2003-04 (i.e 26.44%), 2005-06 (i.e 26.11%), 2007-08 (i.e 23.31%) are the significant growth rates. Highest growth rate for the year 2009-10 (i.e 31.88%) is observed and lowest growth rates for 2008-09 (i.e 8.67%) and 2011-12 (i.e 7.63%). For the years 2002-03 (i.e 18.43%), 2004-05 (i.e 19.25%), 2006-07 (i.e 18%) with a small difference the same growth rates are observed. But in the last year 2012-13, there is a little bit increment in growth rate (i.e 10.06%) when compare to previous year growth rate (i.e 7.63%).

CHI-Square Table

Analysis of total assets

Year	Actual growth(O)	Expected growth (E)	$(O-E)^2$	$(O-E)^2/$
2000-01	-	-	-	-
2001-02	**27.44**	**17.81**	**92.68**	**3.38**
2002-03	**18.43**	**17.81**	**0.38**	**0.02**
2003-04	**26.44**	**17.81**	**74.42**	**2.81**
2004-05	**19.25**	**17.81**	**2.06**	**0.11**
2005-06	**26.11**	**17.81**	**68.84**	**2.64**
2006-07	**18**	**17.81**	**0.03**	**0.00**
2007-08	**23.31**	**17.81**	**30.22**	**1.30**
2008-09	**8.67**	**17.81**	**83.60**	**9.64**
2009-10	**31.88**	**17.81**	**197.88**	**6.21**
2010-11	**14.35**	**17.81**	**11.99**	**0.84**

$X^2 = \sum(O-E)^2/E = 46.52$ V= n-1= 13-1= 12

X^2=0.05(degree of freedom)= 21.0

The calculated value of X^2 (i.e 46.52) is much more than table value. So (H0) null hypothesis is rejected alternative hypothesis is accepted and concluded that there is significant difference in the values of total assets during the selected period. The values are

getting increased considerably.

Research Findings:

- Life insurance Corporation of India has been playing a vital role since inception and contributing well to the government.
- Even after privatization of insurance sector in India, Life insurance corporation of India is still in unbreakable dominating position over the private insurance sector with regard to income, assets customers most trust based insurance business, claims settlement
- Being the state owned organizations, most of the customers are in opinion that it is very safe to buy the insurance products and services of LIC of India only
- Most of the customers are buying insurance products and services of LIC of India mainly for tax saving purpose not paying attention on other benefits like health insurance, death and maturity benefits and critical illness riders etc.
- LIC of India has still very good growth potential to capture with regard to no. of policies, sum assured expansion and diversification insurance products and services. Being a state owned organization much more accountability at different levels in LIC of India is not so visible.

Suggestions:

- LIC has to improve its performance particularly on framing out innovative insurance products and services and marketing strategies to sell them.
- Time span for death claims settlement should be reduced to not more than 30 days from the date of claims intimated.
- It has to follow cost reduction programs without disturbing the quality in services to reduce the increasing operating expenses burden which will result in enhancement of surplus income.
- LIC has to concentrate on strengthening marketing strategies and appropriate training programs are to be conducted periodically for the marketing personnel.
- When compared to private insurance sector it is observed that LIC of India is lagging behind in marketing unit linked insurance products. Much more attention is to be paid in this regard.

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Role of Banks in Financial Inclusion

Dr.A.Uttama Durga Devi

Introduction

Financial inclusion (FI) denotes delivery of financial services at an affordable cost to the vast sections of the disadvantaged and low income groups. The various financial services include credit, savings, insurance and payments and remittance Facilities. The objective of financial inclusion is to extend the scope of activities of the organized financial system to include within its ambit people with low incomes. Through graduated credit, the attempt must be to lift the poor from one level to another so that they come out of poverty.

Need For Financial inclusion:

The policy makers have been focusing on financial inclusion of Indian rural and semi-rural areas primarily for three most important pressing needs:

1. **Creating a platform for inculcating the habit to save money** – The lower income category has been living under the constant shadow of financial duress mainly because of the absence of savings.
2. **Providing formal credit avenues** – So far the unbanked population has been vulnerably dependent of informal channels of credit like family, friends and moneylenders. Availability of adequate and transparent credit from formal banking channels helps them for entrepreneurial development.
3. **Plug gaps and leaks in public subsidies and welfare programmers** – A considerable sum of money that is meant for the poorest of poor does not actually reach them. Government is therefore, pushing for direct cash transfers to beneficiaries through their bank accounts. All these efforts require an efficient and affordable banking system that can reach out to all. Therefore, there has been a push for financial inclusion.

Steps for increasing financial inclusion:

1. Initiatives taken by RBI for financial inclusion:

RBI set up the Khan Commission in 2004 to look into financial inclusion and the recommendations of the commission were incorporated into the mid-term review of the policy (2005–06) and urged banks to review their existing practices to align them with the objective of financial inclusion. Of the many schemes and programmers pushed forward by RBI the following need special mention.

a. **Initiation of no-frills account** –. These accounts are expected to provide a low-cost mode to access bank accounts. RBI also eased KYC (Know Your customer) norms for opening of such accounts.

b. **Banking service reaches homes through business correspondents** – The banking systems have started to adopt the business correspondent mechanism to facilitate banking services in those areas where banks are unable to open brick and mortar branches for cost considerations. Business Correspondents provide affordability and easy accessibility to this unbanked population. Armed with suitable technology, the business correspondents help in taking the banks to the doorsteps of rural households.

c. **EBT – Electronic Benefits Transfer** – To plug the leakages that are present in transfer of payments through the various levels of bureaucracy, government has begun the procedure of transferring payment directly to accounts of the beneficiaries. This "human-less" transfer of payment is expected to provide better benefits and relief to the beneficiaries while reducing government's cost of transfer and monitoring..

2. Initiation of financial Inclusions by NABARD.

The SHG-Bank Linkage Programme and other Microfinance initiatives by NABARD has contributed much towards financial inclusion process in India. The SHG-Bank Linkage Programme and Microfinance Institutions (MFI)-Bank Linkage Programme have been accepted as effective tools to inclusive growth for extending various financial services to households. The phenomenal outreach of the programme has enabled an estimated 471 lac SHGs to gain access to microfinance from the formal banking system to the extent of 8448.96 crore as on March 31, 2011 as may be seen in the Table given below.

SHG- Bank Linkage: Savings and Loans Amounts (As on March 31, 2011)

Year	Savings with Banks		Bank Loan Disbursed	
	No. of SHGs (in lakh) crore)	Amount (INR in	No. of SHGs in(lakh)	Amount (INR in crores)
2006-07	41.61	3512.71	11.06	6570.39
2007-08	50.01	3785.39	12.28	8849.26
2008-09	61.21	5545.62	16.10	12253.51
2009-10	69.53	6198.71	15.87	14453.30
2010-11	74.62	7016.30	11.96	14547.73

Source: Stated of Micro finance in India, NABARD (from 2007-08 to 2010-11)

3. Expansion of Banking Infrastructure:

As per Census 2011, 58.7% households are availing banking services in the country. To extend the reach of banking to those outside the formal banking system, Government and Reserve Bank of India (RBI) are taking various initiatives from time to time some of which are enumerated below:-

(a) Opening of Bank Branches: Government had issued detailed strategy and guidelines on Financial Inclusion in October 2011, advising banks to open branches in all habitations of 5,000 or more population in under-banked districts and 10,000 or more population in other districts. Out of 3,925 such identified villages / habitations, branches have been opened in 3,402 villages/ habitations (including 2,121 Ultra Small Branches) by end of April, 2013.

(b) Each household to have at least one bank account: Banks have been advised to ensure service area bank in rural areas and banks assigned the responsibility in specific wards in urban area to ensure that every household has at least one bank account.

(c) Business Correspondent Model: With the objective of ensuring greater financial inclusion and increasing the outreach of the banking sector, banks were permitted by RBI in 2006 to use the services of intermediaries in providing financial and banking services through the use of Business Facilitators(BFs) and Business Correspondents (BCs).

Business Correspondents are retail agents engaged by banks for providing banking services at locations other than a bank branch/ATM. BCs and the BC Agents (BCAs) represent the bank concerned and enable a bank to expand its outreach and offer limited range of banking services at low cost, particularly where setting up a brick and mortar branch is not viable. BCs as agents of the banks, thus, are an integral part of the business strategy for achieving greater financial inclusion.

Banks had been permitted to engage individuals/ entities as BC like retired bank employees, retired teachers, retired government employees, ex-servicemen, individual owners of kirana / medical / fair price shops, individual Public Call Office (PCO) operators, agents of Small Savings Schemes of Government of India/ Insurance Companies etc. Further, since September 2010, RBI had permitted banks to engage „for profit□ companies registered under the Indian Companies Act, 1956, excluding Non Banking Financial Companies (NBFCs), as BCs in addition to the individuals/entities permitted earlier. According to the data maintained by RBI, as in December, 2012, there were over 1, 52,000 BCs deployed by Banks during 2012-13, over 18.38 crore transactions valued at Rs.16533 crore had been undertaken by BCs

till December 2012.

(d) Swabhimaan Campaign: Under "Swabhimaan" - the Financial Inclusion Campaign launched in February 2011, Banks had provided banking facilities by March, 2012 to over 74,000 habitations having population in excess of 2000 using various models and technologies including branchless banking through Business Correspondents Agents (BCAs).

(e) Setting up of Ultra Small Branches (USBs): Considering the need for close supervision and mentoring of the Business Correspondent Agents (BCAs) by the respective banks and to ensure that a range of banking services are available to the residents of such villages, Ultra Small Branches (USBs) are being set up in all villages covered through BCAs under Financial Inclusion. A total of over 50,000 USBs have been set up in the country by March, 2013.

(f) Banking Facilities in Unbanked Blocks: All the 129 unbanked blocks (91 in North East States and 38 in other States) identified in the country in July 2009, had been provided with banking facilities by March 2012, either through Brick and Mortar Branch or Business Correspondents or Mobile van.

(g) USSD Based Mobile Banking: The Department through National Payments Corporation of India (NPCI) worked upon a "Common USSD Platform" for all Banks and Telco's who wish to offer the facility of Mobile Banking using Unstructured Supplementary Service Data (USSD) based Mobile Banking.

4. Steps taken by Reserve Bank of India (RBI):

To strengthen the Banking Infrastructure –

(a) RBI has permitted domestic Scheduled Commercial Banks (excluding RRBs) to open branches in Tier 2 to Tier 6 Centers (with population up to 99,999 as per census 2001) without the need to take permission from RBI in each case, subject to reporting.

(b) RBI has also permitted SCBs (excluding RRBs) to open branches in rural, semi urban and urban centers in North Eastern States and Sikkim without having the need to take permission from RBI in each case, subject to reporting.

(c) Regional Rural Banks (RRBs) are also allowed to open branches in Tier 2 to Tier 6 centers (with population up to 99,999 as per Census 2001) without the need to take permission from the Reserve Bank in each case, subject to reporting, provided they fulfill the following conditions, as per the latest inspection report:

5. Direct Benefit Transfer (DBT) –

The objective of DBT Scheme is to ensure that money under various developmental

schemes reaches beneficiaries directly and without any delay. The Government has also started the transfer of cash subsidy for domestic LPG cylinders to Aadhaar linked bank accounts of the customers with effect from 1st June 2013, in 20 pilot districts. About 75 lakh beneficiaries would be benefitted in these districts.

6. **Expansion of ATM network:**

Pursuant to Budget announcement 2013-14, Banks are required to ensure an onsite ATM in all the branches. Out of 34,668 onsite ATMs thus identified to be installed by Public Sector Banks, 1,097 ATMs have been installed by end of April, 2013.

7. **Financial literacy:**

The triad of financial literacy and consumer protection has been recognized as intertwining threads in pursuit of financial stability. Hence to give financial literacy to rural and semi-urban people the people from RBI visited these places. Financial counseling centre's were started.

8. **Technology:**

Technology plays a major role in financial inclusion, a sustainable banking them very relevant to a country like India that has a large unbanked population. If we want to move the mobile financial service sector beyond payments space and create products that reach every level of society. For example, in Uganda, Grameen Foundation's AppLab is partnering with MTN and CGAP to do this by lunching a product incubator: AppLab money.

Financial Inclusion plan of Banks:

A major initiative taken by the Reserve Bank in January 2010 was that all public and private banks were advised to submit a Board approved three-year Financial Inclusion Plans (FIPs) starting April 2010.In this direction, banks have been advised that FIPs prepared by their head offices are disaggregated at respective controlling offices and further at the branch level and the progress monitored periodically.

Financial Inclusion Initiatives

i. Banking connectivity has been extended to more than 1, 99,702 villages up to September 2012 from 67,694 villages in March 2010.4848 rural branches have been opened.
ii. Numbers of Business Correspondents have increased from 34,532 to 128,054.
iii. 83.70 million Basic Savings Accounts (NFAs) have been added.
iv. 7.35 million KCCs and about 0.98 million GCCs have been added.
v. About 37 million people/families have been credit-linked.
vi. Share of ICT based accounts have increased substantially-% of ICT accounts to NFAs has increased from 25% to 45%.

Source: RBI Bulletin January 2013

Financial inclusion plans

articulars	Year Ended Mar'10	Year Ended Mar'11	Year Ended Mar'12	Year Ended Sept'12
Total No. of Branches	**85457**	**91145**	**99242**	**101413**
No. of Rural Branches	**33433**	**34811**	**37471**	**38281**
No. of CSPs Deployed	**34532**	**60993**	**116548**	**128054**
Banking outlets-Villages>2000-Sub Total	**37791**	**66447**	**112130**	**117570**
Banking outlets-Village<2000-Sub Total	**29903**	**49761**	**69623**	**82132**
Banking outlets-All Villages-Branches	**33378**	**34811**	**37471**	**38281**
Banking outlets-All Villages-BCs	**34174**	**80802**	**141136**	**158159**
Banking outlets-All Villages-Other Modes	**142**	**595**	**3146**	**3262**
Banking outlets-All Villages-Total	**67694**	**116208**	**181753**	**199702**
Urban Locations covered through BCs	**447**	**3771**	**5891**	**10985**

Source: RBI Bulletin January 2013

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