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Goa Government's Dilemma

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Abstract: *The global population is expected to touch 8 billion by the year 2025 and cause an increase in food shortages, the world over. Aquaculture produce, is a source of cheap proteinous food, is employment generating and a good foreign exchange earner through exports, in addition to having a large domestic market. Goa has the ideal land topography, tidal amplitude and climate for aquaculture, however, only scientific aquaculture practices can avoid outbreak of diseases and environment damage, due to soil and water pollution. The objective of this study is to develop a suitable policy for estuarine aquaculture farms operating in Goa State.Data for this study has been collected from both primary and secondary sources.The potential contribution of aquaculture towards national and household food security, poverty alleviation and income generation (both local and foreign exchange) in many parts of the world has been well recognized. However, there is a considerable lack of knowledge, understanding and focus on the importance of managing health in rural, small-scale, resource-poor, subsistence- type aquaculture. Potential interventions by the authorities are needed to assist farmers to prevent and control disease outbreaks through better health management. There is an urgent need for development and implementation of appropriate national policies and regulatory frameworks that can significantly contribute to reducing the risks to poorer households involved in rural aquaculture. .*
Aquaculture has an impact on the environment right from the moment development of land is taken up for pond construction, its impact continues throughout the conduct of farm operations and even after aquaculture operations are discontinued. The SWOT analysis studies the benefits against the social and environmental costs of aquaculture. National Environment Engineering Research Institute, Nagpur (NEERI) scientists observed that organic contamination of Goan rivers was high and farms showed saline intrusion. They also observed that the coastal regulation zone (CRZ) was being violated by most aquaculture farms in Goa. The Apex Court has ordered that all prawn farms within the CRZ should be closed down. However, the Goa Government is not in agreement with this order of the Supreme Court, as about 1/3rd of Goan farms lie in CRZ designated areas.The NEERI report and Supreme Court directives on CRZ's seek to ensure that taking up aquaculture activities does not adversely impact the surrounding areas and society at large.
Index Terms: Aquaculture, estuarine regions, prawns

Background:

Since ancient times, man has been getting his resources both from the land and the seas. Fishing, the capturing of natural livestock from aquatic environments, has been going on long before the beginning of recorded history. Besides fishing, ancient man also depended on aquaculture as a source of food. Ancient cultures in China, Japan and to the Far East have practiced traditional aquaculture since 500 B.C. Aquaculture activities and facilities are documented in ancient Far Eastern works of art and literature. "Aqua", in Latin, means water. Aquaculture is the science and art of cultivating aquatic organisms and also their processing and marketing.[1]

Status of Aquaculture – The World Scenario:

The world population is increasing at an alarming rate and is expected to touch 8.20 billions by the year 2025. Due to this population, increase in food shortages, particularly of cheap, high quality proteins are being experienced increasingly in many parts of the world. The army of unemployed populace is also increasing everyday. Besides, the demand for things that create a better life or a higher standard of living are increasing as the per capita income rises. Therefore, more and more countries, especially, in Asia are now turning to aquaculture as a source of proteinous foods, jobs and foreign exchange.[1]

The governments of these countries, in a bid to attract more investments in the aquaculture industry, have been leasing large tracts of agricultural land and estuarine regions to entrepreneurs for aquaculture. Coastal farmlands and mangrove-forests are being converted into extensive aquaculture ponds. Policies favouring these entrepreneurs are being formulated and subsidies given.[2]

At an international level, intensive procedures were introduced into aquaculture farms only in the 1970's. Traditional intensive aquaculture promised a yield of over 10,000 kgs. per hectare of land, even 50,000

kilograms per hectare could be expected, from South East Asian countries, who quickly adopted these methods.

This is an increase of between 3564 to 7042 percent over the traditional methods of cultivation, which yielded only around 140 kg of prawns per hectare of land. This has resulted in quick financial returns and large profits through export of prawns to countries like Japan, USA and Europe, where both, the market for prawns, as well as the purchasing capabilities exist. Due to the numerous incentives given by the Governments in developing countries for aquaculture, many multinationals have entered the field and today cultured prawn-farming has become a multi -billion dollar industry.[2]

With the short sighted approach towards becoming rich fast, the adverse effects of intensive aquaculture were ignored, which in turn has become counterproductive to the aquaculture business.

The Indian Scenario:

India is a developing country engulfed by numerous problems. A rapidly growing population, a large chunk of which is below the poverty line, a swelling army of unemployed youth, increasing internal and foreign debt etc. Therefore, any means of obtaining quick and huge amounts of foreign exchange with little investment is seen as a golden opportunity for any Government in the developing world, including India. Besides, India has 6000 kms. of coastline and 1.20 million hectares of brackish water area. Therefore, India has projected itself to develop aquaculture into a major export oriented industry.

The Indian government is determined to usher India in from the list of third world countries to first world countries. After the green revolution and white revolution they hope to bring in a "blue" revolution. In traditional aquaculture, the yield is low and as aquaculture is highly profitable, aquaculturists encouraged by the Government have switched from the traditional production methods to semi-intensive methods. Modern aquaculture farming entered India in the 1980's with coastal states like Tamil Nadu, Maharashtra and Gujarat leasing large tracts of agricultural and estuarine regions to private entrepreneurs for establishing aquaculture farms. Due to the introduction of these modern methods, India has become one of the leading producers of cultured prawns.[1]

Marine Products Exports from India

Year	Quantity (tons)	Value Crores (Rs)	Value Millions (US $)	Growth (percent)
2008 – 09	602,835	8607.94	1908.63	0.50
2009 - 10	678,436	10048.53	2132.84	12.54
2010 - 11	813,091	12901.47	2856.92	19.85
2011 - 12	862,021	16579.23	3508.45	22.81

Source: MPEDA Annual Report

Table 1.1: Marine Products Exports from India

Indian marine exports in 2011 – 12 stood at a healthy 3.50 billion dollars and frozen shrimps accounted for 49.63 percent of marine exports value at 1.74 billion dollars, the major markets being Japan, West Europe, USA and South East Asia. Based on the steady growth of exports in marine products MPEDA has projected an export target of 6 billion dollars for 2017. This industry is also expected to provide employment to 4 million people.

The optimistic projections for production and exports of marine products have encouraged several large corporate houses to invest in aquaculture. For smaller entrepreneurs, pissiculture and cultured prawn- farming means large profits in a short time. On the whole, scientific aquaculture seems to fit well with India's current focus of liberalization and market economy.[3]

Aquaculture in Goa:

Goa is a tiny paradise on the west coast of India with a 104 kilometres long coastline and having 250 kilometres of inland water ways and a large number of tanks and fish ponds.

As the aquaculture fever was catching on in India, Goa too came under its influence in 1991-92 with the setting up of Hindustan Prawns at Marna Village, in Bardez Taluka, the Brackish Water Farmers Development Agency (BFDA) and Marine Products Export Development Agency (MPEDA).[4]

In Goa, there are about 1,200 hectares of khazan lands and 3,500 hectares of marshy areas, which are sought to be converted into aquaculture farms. According to BFDA, the topography of Goa is ideally suited for prawn farming, as the seawater is regulated only on the basis of high and low tides and the flooding of water is almost negligible. The BFDA also claims that Goa has good tidal amplitude as well as spring-tides which facilitate natural flushing. Moreover, there are no turbulences or fast currents.

According toofficial statistics available in Goa, a shrimp farmer can obtain two crops a year with an average yield of 800 to 1,000 kgs. per hectare per crop. A kilo of prawns fetches about Rs.250 to Rs.300, hence, it can be assumed that in Goa prawn farming yields between Rs.2 to 3 lakhs per hectare. The growth cycle of thespecies used in Goa,Penaeus monodon (tigerprawn) lasts for about 120 days. Thus, a prawn farmer may obtain a produce of between 1.80 to 3.20 tonnes of prawn crop per year. Most of the produce is exported by a number of marine export firms.[4]

Most of the shrimp farms in Goa have been constructed on land which was declared as unsuitable for agriculture, though encroachment of fertile agriculture lands have been reported. Natural salt-pans lying unused were also converted into aquaculture farms. Aquaculture farms have mushroomed as a result of destruction of mangroves at Divar, Chorao and along the Mandovi-Zuari basin and along the Sal and Chapora rivers. The organic effluents from these shrimp-farms lead to eutrophication of water pools in the surrounding areas. The blue-green algal blooms developed instead of diatoms, thus resulting in the release of toxins as well as choking the gills and killing of fishes in the estuarine ecosystem, where prawn farming was carried out.

Objective of the study:

In light of the previously stated facts, the main objective of the case is:

1. To develop a suitable policy for estuarine aquaculturefarms operating in Goa State.

Methods of data collection:

Data for this study will be collected from both primary and secondary sources.

Primary data will be collected by personally interviewing aquaculture practicing farmers from all over Goa and administering a formatted questionnaire. Also knowledgeable persons from this industry, like scientists, environmentalists and other stake holders will be interviewed.

Secondary data will be collected from government publications, Directorate of Fisheries, MPEDA, BFDA, research papers, reports, journals and newspaper articles.

Findings of the Study:

Modern aquaculture is quite harmful to the environment in various ways. It begins to have an impact on the environment right from the time of development of the land for the purpose of pond construction and this impact continues right through all the aquaculture operations that are subsequently conducted. Several aquaculture farms occupy considerably large areas of land and in some cases they could encompass several hundred hectares. Development of these lands for aquaculture includes activities such as leveling, clearing, filling, excavation and construction of other structures for storage of inputs.[5]

Large scale development of estuarine land can adversely affect the following aspects of surrounding environment.

1. Destruction of coastal mangrove vegetation, which leads to displacement or destruction of wildlife, from their natural habitats and soil erosion. Shrimp farming is directly linked to the loss of mangroves in the tropical world. About 2000 square kilometres of mangroves in Thailand, 12000 square kilometres in Ecuador, 670 square kilometres in Vietnam. 350 square kilometers in India and 90 square kilometres in Bangladesh have been lost to shrimp farming (anon, 1998). The result is eroding coastal land and dwindling shelter and habitat for fish and other marine life. Loss of mangroves in these countries is directly proportionate to production and export of shrimp and prawn. Mangroves are thus important for the shrimp farming business to proper.

2. Change in the pattern of land usage, resulting from conversion of grazing and agricultural lands.
3. Indiscriminate and large scale usage of ground water leading to depletion of water resources.
4. Loss of soil cover, due to soil erosion at excavation sites, leveling of hillocks and construction of bunds.
5. Clustering of several farms in a particular locality, resulting in environmental pollution and resource

strain.

6. Resettlement and rehabilitation of populace in occupied lands.

Undertaking aquaculture operations entails the utilization of huge quantities of water, which may be directly drawn from rivers, creeks, ponds, estuaries or the sea. Aquaculture farm and hatchery operations also involve the addition of considerable amounts of feed, manure, chemicals and pesticides into the aquaculture ponds. The pond water, in course of water exchange is discharged into the same water source, from where it was drawn, this leads to pollution of the water source itself.

Processing of aquaculture produce also generates effluents as a result of the use of chemicals and disinfectants, for washing and cleaning purposes. Appreciable quantities of organic wastes are generated due the processing operations, which involve beheading, peeling and deveining of shrimps. The impact of these operations on the environment is directly dependent on the level of technology utilised and infrastructure created.[5]

The negative impacts of undertaking aquaculture operations may be summarized as follows:

1. Discharge of untreated waste water from aquaculture ponds and processing plants causes pollution as it contains decomposing, unused feed and other residual chemicals used in farm operations. The water discharged could also act as a medium for disease transmission, from one pond to the other, leading to a disease outbreak in the farm or to other nearby located farms.

2. Production of large amounts of sludge due to accumulation of unconsumed feed, seed excreta, shrimp exoskeleton (that are shed during molting), organic and inorganic chemicals. Some quantities of the sludge generated would be discharged along with the waste water and the remaining accumulates at the pond bottom.

3. Air and noise pollution due to the use of pumps and diesel gensets.

Phosphates and nitrates are the nutrients found in the wastes from aquaculture ponds. They are the main pollutants that interfere and cause serious problems in the natural primary production cycle that stimulate the growth of phyto-planktons, due to the unnatural change in ingested nutrients. Excessive use of fertilizers causes the accumulated decaying organic matter to consume oxygen from the water, which in turn accelerates the process of eutrophication of water bodies. The decaying matter shelters disease causing micro-organisms that settle down on the wet sub soil and cause health hazards. Discharge of untreated sewage can cause these micro-organisms to get carried over considerable distances and even find its way into the sea.[5]

Waste water that is disposed off from aquaculture ponds contain large amounts of suspended matter, faecal matter, unconsumed feed and will be high in Ph values. The oxygen content of such waste water is low and ammonia levels are high. The high ammonia levels are the result of seeds being fed on high protein diets, the seeds in turn excrete most of the ingested nitrogen as ammonia or urea, which is harmful to other living organisms. The water disposed off from intensive culture ponds must be treated before being discharged into the natural water bodies, as it has a very high intensity of waste and will adversely affect the water body.

The processing plants are another major source of waste linked to aquaculture operations. This waste, which constitutes organic matter, needs to be disposed off in a systematic manner, to avoid pollution and its nuisance value caused by its decomposition.

The clustering of a large number of aquaculture ponds in a particular area or locality causes the quantum of waste disposed off to be very high. This high quantum of waste when discharged into the environment will upset the natural ecological balance and in turn impact the availability of high-quality water for domestic as well as for culture purposes. The overall impact of these ecological imbalances is dependant to a considerable extent on the source of the pollution.[5]

The pollution tends to be highest around the inshore and estuarine regions. Such effects are further compounded by shrimp farmers who practice shrimp culture without having the required licenses, since such farmers are then not accounted for and tend to conduct their operations with scant regard for the environment. The Government also has a problem in accounting for the pollution caused by such unauthorized shrimp farms and in stopping this illegal activity. Furthermore, such unauthorized farmers may perform their aquaculture operations in prohibited areas or ecologically sensitive areas and cause severe problems for the local community in the area, as well as for themselves.

Most of the shrimp farms in Goa have been constructed on land, which was declared as unsuitable for agriculture though encroachment of fertile agriculture land has been reported. Natural salt pans lying unused were also converted into shrimp farms. Shrimp farms have mushroomed as a result of destruction of mangroves

at Divar, Chorao and along the Mandovi- Zuari basin and along the Sal and Chapora rivers. The saline effluents from these shrimp farms lead to eutrophication of water pools in the surroundings. The blue green algal blooms developed instead of diatoms, thus resulting in the release of toxins as well choking the gills and killing of fish in the estuarine ecosystem, where shrimp farming was carried out. Scientists have observed that organic contamination of Goan rivers was high and farms showed saline intrusion. It was also observed that the coastal regulation zone (CRZ) was being violated by most aquaculture farms in Goa, the apex court has ordered that all shrimp farms within the CRZ should be closed down.[6]

Ecosystem Depletion due to Mangroves Destruction

Mangroves (salt-tolerant forests) are a very important component of Goa's bio-regions. Mangroves in Goa are fairly extensive and cover about 0.5 percent of the states geographical area and are found mainly in the estuarine areas.

The state of Goa is drained by seven major rivers, out of which the Zuari and the Mandovi, along with the Cumbarjua canal forms one of the largest estuarine complex. A study by the National Institute of Oceanography (NIO) estimates that the total area covered by these very unique tree species is approximately 2000 hectares, of which 700 hectares are located along the Mandovi, 900 hectares along the Zuari and 200 hectares alongside the Cumbarjua canal, with the remainder along the other five rivers.[5]

Mangroves are a specialized marine ecosystem which consists of a group of plants that grow in loose, muddy and wet soils in the tropical and subtropical areas, which comprise of shallow coastal waters, estuaries, deltas or lagoons. Mangroves are ecologically important for trapping and accreting sediment material for reducing the possibility of soil erosion. The mangrove ecosystem plays a very significant role in Aquaculture as a direct relationship exists between the volume of shrimp production and the area of the mangrove forests in the vicinity. The fishery potential of mangrove areas being tremendous provides livelihood to a majority of the coastal rural population. The fishes breed by laying their eggs in the safety net provided by the tangled roots of mangrove trees and after the eggs hatch the larvae grow with needed nutrients readily available around them.[7]
Mangroves are indispensable for a khazan or estuarine ecosystem to survive and flourish. Various fish, prawns, crabs, and other organisms survive due to the protection offered by mangroves. Mangroves stabilize the coastal environment by preventing soil erosion and sea encroachment. Prior to 1980, mangrove forests were considered to be 'wastelands', of little value, however, of late their importance as a major renewable resource has been recognized and a host of measures have been undertaken for their protection and conservation.[5]

They also help prevent water logging and saline banks. They also play a major role in enriching the coastal waters by transporting through their ecosystems dissolved organic matter and other nutrients and this supports the benthic populations. Mangrove ecosystems and their neighbouring water masses accept inputs from two fundamental sources i.e. inorganic matter from the surface runoffs and organic matter from the mangrove vegetation itself as mangrove litter. In India it is estimated that mangroves on an average export annually approximately 12 tons of litter per hectare.[3] "No mangrove, no prawn" is a well known saying, which is one hundred percent true.[5]

The importance of mangrove ecosystem in fisheries operations has been widely accepted, as a majority of coastal populace depends on the fishery wealth of mangrove estuaries, for earning their livelihood. Hence, it becomes obvious that any kind of destruction or damage to mangroves affects the potential of capture or culture fishery resources.[7]

Valuable fishes like mullets, milkfish and marine shrimp, an important source of high quality protein, utilize mangrove estuaries as a nursery, breeding ground and as a source of food. Mangroves are thus a haven for various aquatic life forms.
Mangroves grow in soils which have very low pH (below 3.5) and other acid sulphate soils.[5]

Some ignorant or even unscrupulous shrimp farmers, in order to increase the size of their pond cut the mangroves and put the shrimp seed there. However, the juvenile shrimps eventually die due to the extremely low levels of pH in that area that is caused due to the acid sulphate soils that make the surrounding environment acidic.

In trying to increase the final output, such shrimp farmers commit a grave mistake by chopping off the mangroves. Not only do their shrimp seeds die but this mangrove destruction hurts the entire ecosystem of the area and has large scale repercussions, especially on the local fishing community in the area. Due to the loss of the mangrove the fish and other organisms that formerly inhabited that area can no longer take refuge there.

Hence the fish populations diminish. Consequently, the local fishermen who depend on their small catch for a living have to go too far off places to catch the same amount of fish, if not less.

Today, prawn culture is practiced throughout the world, however, the potential risk of indiscriminately expanding the area for prawn culture has been very clearly seen in other countries like Indonesia, Philippines and Malaysia, where large mangrove areas were transformed into prawn culture farms, this has resulted in reduction of their capture fishery resources. The present situation in India is that in a mangroves are in a degraded condition due to increased population pressure, haphazard modern developments and industrialization. Mangrove areas have shrunk due to reclamation, deforestation and pollution; these developments in turn have adversely affected the potential of coastal and estuarine fisheries.[7]

The loss of the mangroves leads to erosion of the land and water logging. It ultimately affects the shrimp farmers whose pond gets exposed to the direct force of the river and other vagaries of nature. Of the several shrimp farmers interviewed many had lost lakhs of rupees building embankments and other fortifications, to strengthen their pond boundaries. This was due to the loss of the mangroves, which previously served as natural barriers against tidal river line currents.[5]

However, their significance and importance was not realized until they were destroyed and the shrimp farmer began regretting his actions. In the absence of the mangroves some shrimp farmers even expressed fears about their ponds being devastated by the river through gradual degradation of the artificial embankments and bunds.

If destruction of the mangroves continues, the shrimp farmers will be sabotaging the future of their business and will also spell ruin for the entire village community. Dr. Jagtap and Dr. Untawale in their study on mangroves highlighted the socio – economic importance of Goan mangroves, which could be put to various uses including fisheries, pissiculture, agriculture, salt pans, fodder, timber, manure, firewood, medicine and more. They concluded that a large number of people are dependent on mangroves as their only means making a livelihood and that these people would become destitute, if the ecology of mangroves are destabilized.[5]

Intensive and semi-intensive aquaculture operations utilize dense stocking rates, which induce problems, such as stress and increased susceptibility to diseases. Overcrowding of shrimp seeds bring about decline in the water quality due to decreased levels of oxygen, high levels of accumulated metabolic products and excrement, rapid growth and transmission of noxious microorganisms, pathogens and parasites, leading to accumulation of phosphates and nitrates in the aquaculture environment, leading to pollution, not only in the aquaculture pond, but also in all the surrounding water bodies. This fact has been confirmed by research studies carried out by Reddy et al (1996) and Sreenivas et al (1996). The effluent from shrimp ponds is more polluted as it is low in dissolved oxygen and high in BOD. An aquaculture farm does maximum harm to the environment due to release of untreated effluents into water bodies in its immediate vicinity. These effluents are in the form of loose sludge which contains inorganic matter, residual feed, faeces, antibiotics, etc. This increased oxygen demand leads to eutrophication, algal blooms and enrichment of adjacent water bodies making them unfit for use.[8]

Rajakumar et al (1996), from their studies on the pollution load in water bodies concluded that algae act as biological indicators of pollution.[9]The nutrient enriched aquaculture system supports a higher microbial population than the open estuarine system. Potential shrimp pathogens like Vibrio's are found in greater numbers in these farms.[10] This, coupled to increased levels of BOD, COD ammonia and hydrogen sulphide leads to the seeds being placed under stress conditions, this in turn lowers their resistance and leads to various types of diseases. A shrimp is considered healthy if it flicks its tail strongly and the tail extends fully, when grasped. During night time, on using a flash light, a healthy shrimp will reflect bright red eyes and they tend to swim away, whereas a diseased shrimp reflects a pale eye colour and swims slowly. The fecal matter in the check trays is of dark brown colour in case of healthy shrimps, whereas red, yellow or transparent in case of sick shrimps.[9]

Dr. Jagtap and Dr. Untawale in their study on mangroves concluded, "Mangrove degradation is a part of environmental degradation and is found in all aspects of the Goan environment". Prior to Goa's liberation in 1961, people living around the mangroves lived in harmony with them and utilized the same for their own needs without causing them any harm. However, the past decades has caused mangroves to undergo drastic changes, due to over exploitation for commercial purposes, which is well beyond their sustainable potential.

Dr. Jagtap and Dr. Untawale could not conclusively prove that environmental degradation of mangrove forests had taken place due to aquaculture operations, but rather, the main cause was pollution. They found that

pollution due to oil spillage, industrial pollutants and petroleum products were major causes of the chronic effects on mangrove vegetation and suggested preventive measures to avoid the same. They suggested that ships and trawlers should be warned against spilling oil and washing their tanks in the estuarine region, also, industrialists need to be warned about release of untreated effluents into estuaries. According to them, a proper management plan for utilization of mangroves needed to be put in place, along with a monitoring mechanism to avoid activities like indiscriminate cutting, reclamation and over grazing that have severely degraded the mangroves along the Goan coast.[9]

Dr. Jagtap and Dr. Untawale warned that if the current rate of degradation continued for another decade, then, there would be no coastal mangroves remaining in Goa and mangrove-related fisheries would be adversely affected. They suggested that the Goa government take up protective measures to protect mangroves from further destruction.

The suggestions involved the following:

1. Stoppage of deforestation
2. Taking up of mangrove cultivation
3. Stoppage of mangrove reclamation

The mangrove forests that are an important part of the Goan environment can still be saved, if firm and decisive measures are taken. Strict regulations against oil dumping by ships and effluent treatment plants for all factories discharging wastes into Goan rivers should be made mandatory. These measures would ensure that the future generations too, get the benefit of the rich Goan environmental legacy.[9]

A total of 96 aquaculture farm owners spread all over Goa were interviewed personally for the purpose of collecting primary data using a formatted questionnaire, through a census survey. The findings of the survey have been put in the form of a SWOT analysis as follows:

SWOT ANALYSIS

SWOT analysis is used as an information tool for assessing the potential of aquaculture. It gives an analytical picture of the potential strengths(S), weaknesses(W), opportunities(O) and threats(T) of a business opportunity. SWOT analysis aids in problem identification, decision making, planning, choosing an appropriate technology, project implementation, site identification, etc.

Strengths

1. Goa has the ideal topography required for aquaculture operations.
2. Goa has a good tidal amplitude as well as spring tides, which extend up to 40 kilometres inland.
3. Ready availability of natural and man-made water sources in rural areas with high potential for achieving good productivity, multiple cropping, risk reduction, economical operations and low rate of environmental degradation.
4. Availability of unutilized or under-utilized human resources, agricultural wastes and other required inputs.
5. Ready availability of region specific and resource specific technologies economically.
6. Continuous accumulation of organic matter from the village catchment areas and domestic drainage that enrich water resources with required nutrients for economical aquaculture operations.
7. Possibility of involving common interest groups with equal or joint responsibility, thus facilitating better farm operations.[11]

Weaknesses

1. Poor organizing ability of rural farmers due to lack of knowledge, capable community leaders and existing personal disputes.
2. Rural farmers do not own ponds, required infrastructure, material inputs, finance etc. for undertaking aquaculture business.
3. New farmers are hesitant to participate in such schemes due to inequalities in multi-ownership of jointly owned or community ponds.

4. Absence of or weak research-extension linkages, poor cooperation in conducting operations, low technical/technological awareness among the community members and lack of commitment among participants.
5. Short lease period, dual leasing policy, high lease rates, multi-water usage rights for irrigation and other domestic purposes of community ponds.
6. Vandalism among the fisher folks and social stigma, inadequate training facilities at village/taluka level, discrimination towards the involvement of women in aquaculture and poor marketing infrastructure in the region.
7. Destruction of mangroves to increase size of ponds
8. Eutrophication of water bodies and fields existing in the vicinity of aquaculture farms.
9. Release of toxins in the ecosystem due to excessive use of chemicals, fertilizers and antibiotics.
10. High organic contamination of Goan rivers due to release of sewage and untreated effluents.
11. Violation of Coastal Regulatory Zone rules.[11]

Opportunities

1. Possibility for achieving high aquatic productivity and contribution towards economic efficiency, social equity and ecological sustainability.
2. High possibility for achieving equities in income, employment opportunities, poverty reduction, food security and at the same time securing participation and empowering rural farmers and rural women.
3. Optimum utilization of nutrient-rich village water bodies, labour resources and waste materials for multi-community production at one location.
4. Easy implementation of production, rearing, value addition, processing and marketing technologies through community approach.
5. Resource poor and landless farmers have the chance to undertake aqua farming in leased ponds.
6. Rural farmers get equal opportunity in planning, decision making, operating, harvesting, marketing and profit sharing.
7. Participatory learning by farmers irrespective of age, experience, sex and possibility of empowerment of the rural poor.
8. Reduction in the rate of migration of farmers to other parts of state and country as wageworkers.[11]

Threats

1. Unutilized or under-utilized village water bodies will be infested with aquatic weeds which provide breeding grounds for mosquitoes and other health hazards in the village.
2. Water deterioration due to entry of polluted water from agricultural surface-runoff, domestic drainage and industrial effluents can be a major threat to the survival of aquatic organisms and affect the sediment quality of community ponds.
3. Use of illegal methods and species for rearing.
4. Poor water quality and disease outbreak in the water bodies.
5. Possibility of natural disasters such as floods, cyclones and droughts.
6. Decline in per capita crop produce and erratic income generation.
7. Unemployment and labor migration in search of job opportunities.
8. Reluctance to invest due to risk factor involved.
9. Social conflict among farmers due to differential incomes from aquaculture.[11]

National Environment Engineering Research Institute, Nagpur (NEERI) scientists observed that organic contamination of Goan rivers was high and farms showed saline intrusion. NEERI scientists also observed that the coastal regulation zone (CRZ) was being violated by most aquaculture farms in Goa.[12]The Apex Court has ordered that all prawn farms within the CRZ should be closed down. However, the Goa Government is not in agreement with this order of the Supreme Court. This disagreement gives an indication that the Goa Government lacks interest in the welfare of our people and protection of our fragile ecology. A review petition, praying that Goa be excluded from the ban has been filed.[5]

Conclusions

The literature reviewed brings out various issues which are vital for the well beingof scientific and sustainable aquaculture. Aquaculture can be integrated with other forms of agriculture to reduce the adverse social impacts inherent to aquaculture. The Department of Fisheries, MPEDA, BFDA and CAA are working towards creating the right environment to encourage entrepreneurs to take up aquaculture related activities by developing infrastructure, conducting training programs and offering assistance/incentives. The potential contribution of aquaculture towards national and household food security, poverty alleviation and income generation (both local and foreign exchange) in many parts of the world has been well recognized. Similarly, the importance of prevention and control of diseases as a measure to reduce production losses in commercial and semi-commercial aquaculture systems has also been long realized. However, there is a considerable lack of knowledge, understanding and focus on the importance of managing health in rural, small-scale, resource-poor, subsistence- type aquaculture. Potential interventions by the authorities are needed to assist rural, small-scale, resource-poor farmers to prevent and control disease outbreaks through better health management. There is an urgent need for development and implementation of appropriate national policies and regulatory frameworks that can significantly contribute to reducing the risks to poorer households involved in rural aquaculture. The various uses of the coastal land, mangroves, water bodies, rivers, seas and oceans which are all basic to human welfare can become unsustainable if they are not properly planned and managed aquaculture farms

Aquaculture has an impact on the environment right from the moment development of land is taken up for pond construction, its impact continues throughout the conduct of farm operations and even after aquaculture operations are discontinued. The importance of mangroves in fisheries operations is widely accepted as they are a haven aquatic life forms and their destruction has large scale repercussions in the area. The SWOT analysis studies the benefits against the social and environmental costs of aquaculture. The NEERI report and Supreme Court directives on CRZ's seek to ensure that taking up aquaculture activities does not adversely impact the surrounding areas and society at large.

Questions for Discussion:

1.Is the Goa governments stand against closure of aquaculture farms in CRZ regions ethical?

2. What kind of policy should the government adopt so that the interests of all stake holders are taken care of satisfactorily?

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