GUIDELINES

Effluent Treatment System in Shrimp Farms

AQUACULTURE AUTHORITY
Government of India
Chennai - 600 006, India

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Contents

Justice G Ramanujam
Chairman
Aquaculture Authority

PREFACE

The rapid development of shrimp aquaculture in the coastal areas of the country has raised some environmental concerns, especially with regard to the impact of shrimp waste water on the ecology of the open waters systems. Shrimp aquaculture waste water comprises both living and dead plankton, feed waste, faecal matter and other excretory products of shrimp. Though all these nutrients and organic wastes are biodegradable, the soluble nutrients such as nitrogen and phosphorus, beyond a reasonable limit can result in nutrient enrichment in the open waters where the wastes are generally released.

The objectives behind the development of these guidelines are to ensure that the discharge of shrimp farm waste water does not result in long-term increase in nutrients or suspended solids in the open waters. The integration of effluent treatment system as a part of the shrimp farm will therefore assist the farmers to improve waste water quality and provide long-term strategies for sustainable shrimp farming in the country.

Guidelines, generally carry limitations due to both their general character and broad scope and the present guidelines are no exception. In view of the variety of coastal aquaculture practices and the diversity of their environmental settings in the country, it is likely that some of the issues addressed in the guidelines would need field-level alterations to meet the site-specific requirements of shrimp farmers. These guidelines are addressed to all those who are involved in shrimp farming and to those associated with the planning, development and management of shrimp aquaculture in the coastal areas of the country.

With great pleasure I record my thanks to the members of the sub-committee for their efforts in preparation of the guidelines. My special thanks are due to Dr Y S Yadava, former Fisheries Development Commissioner & Member Secretary, Aquaculture Authority and presently IGO Coordinator, Bay of Bengal Programme of the FAO, for critically going through the draft and offering valuable suggestions for improvement. My thanks are also due to the Bay of Bengal Programme, Chennai for their technical support in printing the guidelines.

G. Ramanujam

Chennai
June 2001

(G Ramanujam)

1. Background

The Hon'ble Supreme Court in it's judgement dated 11 December, 1996 in WPC No.561/94 (Shri S. Jagannathan *vs* Union of India and others) directed the Central Government to set up an Aquaculture Authority under section 3 (3) of the Environment Protection Act, 1986 and confer on the Authority all the powers necessary to protect the ecologically fragile coastal areas, sea shore, water front areas, other coastal areas and specially deal with the situation created by the shrimp culture industry in the coastal States/Union Territories. The Hon'ble Court *inter alia* also directed that any aquaculture activity including intensive and semi-intensive which has the effect of causing salinity of soil; or the drinking water of wells and/ or by the use of chemical feeds increases shrimp or prawn production with consequent increase in sedimentation which on putrefaction is a potential health hazard, apart from causing siltation/ turbidity of water courses and estuaries with detrimental implication on local fauna and flora shall not be allowed by the aforesaid authority.

The Aquaculture Authority was notified on 6th February 1997 by the Ministry of Environment and Forests and is functioning under the administrative control of the Ministry of Agriculture with Justice G Ramanujam, a retired judge of Madras High Court as Chairman of the Authority.

The main environmental concerns in the shrimp farming sector are about the increased levels of nutrients including nitrogen and phorphorus, suspended solids and particulate organic matter that are released along with the waste water. Though the nutrients and organic wastes present in the farm effluents are biodegradable, the soluble nutrients such as nitrogen and phosphorus, beyond a reasonable limit can result in nutrient enrichment or eutrophication in the open waters where the wastes are released.

To address these issues and encourage and facilitate the development of sustainable shrimp farming in the country, the Aquaculture Authority constituted a sub- committee comprising the following members for formulation of guidelines to enable farmers to set up effluent treatment systems in their shrimp farms:

1)	Prof. R C Das* Chairman (Retd.) Orissa State Pollution Control Board Bhubaneswar, Orissa	Chairman
2)	Dr M Vijayan Member Central Pollution Control Board New Delhi	Member

* Member, Aquaculture Authority

3) Mr V Venkatesan* Member Convenor
Director
Marine Products Export Development Authority
MPEDA House,
Cochin, Kerala

The terms of reference of the sub-committee are:

1) To examine the present system of waste water treatment from the shrimp culture ponds in organised sector,

2) To examine the various provisions of Environment (Protection) Act, 1986 and Central Water (Prevention and Control of Pollution) Act, 1974 regarding treatment of effluent waters,

3) To examine the design details of effluent treatment system prepared by the Marine Products Export Development Authority,

4) To suggest suitable methodology separately for small clusters of shrimp farms varying between 1.0 to 2.0 hectares and for farms up to 5.0 hectares and above,

5) To evolve design of model units for the above mentioned types of farms and to suggest ways and means of implementation.

The following chapters in the Guidelines detail the model effluent treatment system developed by the Marine Products Export Development Authority, Cochin and accepted by the sub-committee. The parameters recommended by the Ministry of Agriculture for discharge of waste water from shrimp farms into coastal marine waters, creeks and estuaries were also accepted by the sub-committee as an interim measure till the statutory standards under the Environment (Protection) Act, 1986 were developed. Keeping in view the inadequacy of data and standards on biological parameters, the sub- committee decided not to include such standards in the present guidelines.

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* Member, Aquaculture Authority

2. Introduction

The productive utilisation of coastal areas for shrimp aquaculture has received priority attention in India since early 1980s. The country has about 1.2 million hectares of brackish water area and presently about 0.14 million hectares are used for shrimp farming in the coastal States and some Union Territories. Of this, one third of the area is presently under traditional methods of farming and the rest is under improved traditional and extensive methods of aquaculture. More than 90 per cent of the shrimp farmers own less than 2.0 hectare water area and farms below 5.0 hectare occupy 65 per cent of the total area of shrimp farms in the country.

Coastal aquaculture is diverse in terms of the resources used, the scale and nature of the practices adopted and the varied environmental characteristics. Together, these varying attributes of shrimp farming make its development and promotion a challenging task. Apart from the technical and economical aspects, the orderly growth and development of shrimp aquaculture entails environmental sustainability which can be achieved by incorporating proper environmental impact assessment (EIA), environmental monitoring and waste water treatment systems in the farming activities.

The main environmental concerns in the shrimp farming sector are about the increased levels of nutrients including nitrogen and phosphorus and excess quantities of suspended solids and particulate organic matter in the waste water released from the farms. While there has been much discussion on the impact of aquaculture waste water on the environment, there is paucity of time-series data to scientifically correlate the adverse impact of shrimp farm wastes on the ecology of the open waters. In general, the nutrient levels and suspended solids in the waste water of shrimp farms practicing improved traditional and extensive methods are within the accepted norms and much less when compared with the waste water generated from the domestic sector and the fish processing units (Table 1).

Table 1. Comparison of waste water generated from shrimp farm with domestic and industrial waste water

Parameters	Shrimp farm waste water	Domestic waste water			Effluent from fish processing plant
		Untreated	Primary treatment	Biological treatment	
BOD (mg/l)	4.0 - 10.2	300	200	30	2 000 – 4 000
Total N (mg/l)	0.03 - 5.06	75	60	40	700 - 4,530
Total P (mg/l)	0.05 - 2.02	20	15	12	120 - 298
Solids (mg/l)	119 - 225	500	-	15	1 880 - 7 475

However, the waste water produced during the post-harvest cleaning operations of shrimp farms can have a much greater impact on the ecology of the open waters, although it may be for a shorter period. Similarly, the impact can be significant where large number of shrimp farms are established in areas with poor flushing capacity.

In India, overcrowding of shrimp farms in certain areas and limited carrying capacity of the creeks/ estuaries serving such farms has been a matter of concern (e.g. Kandeleru creek in Nellore District, Andhra Pradesh). Similarly, certain areas in Orissa also have concentration of shrimp farms. Presently, most of the farms lack effluent treatment system for treating the waste water before it is released into the open waters. The farms which do have such facility also do not conform to the scientific requirements. The integration of effluent treatment systems, based on best management practices in the shrimp farms will therefore assist the farmers to improve the waste water quality and make their farming practices more sustainable.

Existing Legal Provisions

Government regulations are important component of management in supporting aquaculture development, maintaining environmental quality, reducing negative environmental impacts, allocating natural resources between competing users and integration of aquaculture into coastal zone management. Presently, the following legal provisions are available to exercise appropriate control on discharge of waste water generated by the shrimp farms and other developmental activities.

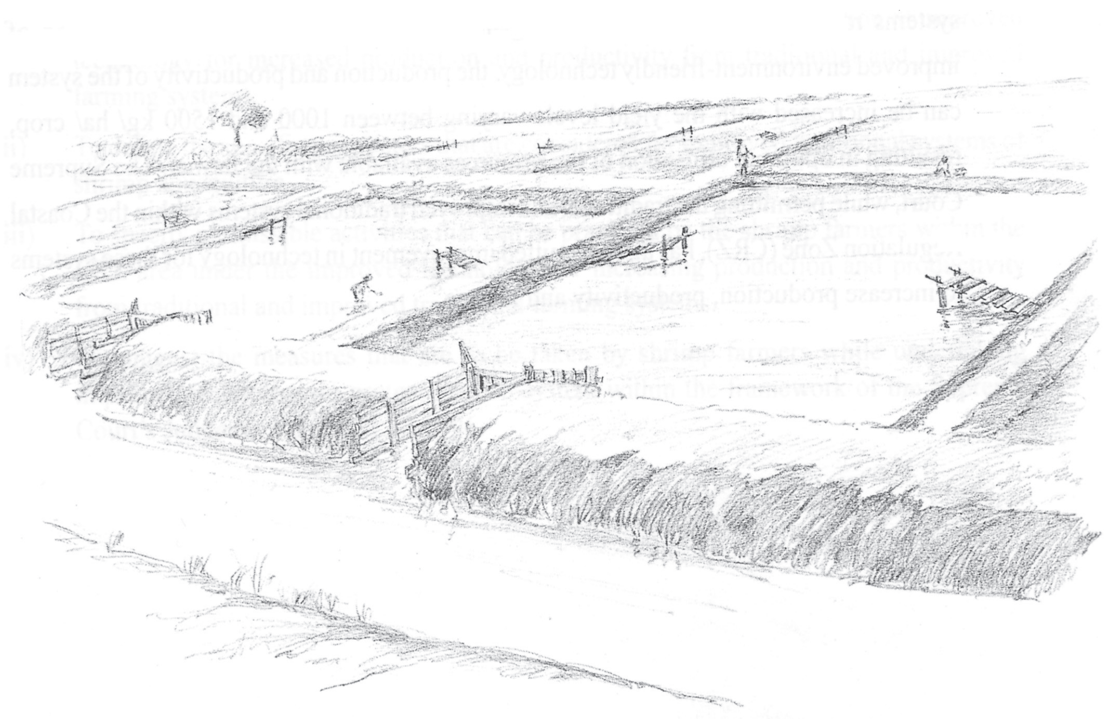
The Water (Prevention and Control of Pollution) Act, 1974 was enacted for maintaining and restoring the wholesomeness of water and to promote cleanliness of streams and wells. Under this Act, the stream includes sea or tidal waters as well and hence this Act has much relevance to the brackish water aquaculture. To keep the coastal waters clean and free from pollution, the water bodies are classified according to the use and the use may be termed as "designated best use" in that stretch. The use classes of marine coastal waters of India, based on designated best uses are:

Designated Best Use	Class
Salt pans, shell fishing, mariculture and ecologically sensitive zone	SW I
Bathing, contact water sports and commercial fishing	SW II
Industrial cooling, recreation (non contact) and aesthetics	SW III
Harbour	SW IV
Navigation and controlled waste disposal	SW V

Based on the designated best use, the primary water quality criteria was developed and notified under the Environment (Protection) Act, 1986 as standards. Any deficiency in the ambient water quality from the assigned class category in any zone would require appropriate control on the discharge reaching the zone.

The Environment (Protection) Act, 1986 is an umbrella legislation that provides for the protection of the environment by taking necessary measures for protecting and improving the quality of environment and prevention, control and abatement of environmental pollution by laying down standards for the quality of environment, emission or discharges of environmental pollutants from any sources.

The Ministry of Environment and Forests under the Environment (Protection) Act, 1986 has declared the coastal stretches as Coastal Regulation Zone (CRZ). The CRZ includes the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters, which are influenced by tidal action (in the landward side) for regulating the activities. Thus, the Water (Prevention and Control of Pollution) Act, 1974, Environment (Protection) Act, 1986 and Coastal Regulation Zone Notification 1991 as amended in 1994, 1997 and 1998 are the prevailing legislations to support the orderly development of coastal aquaculture in the country.



Small-scale shrimp farm

The Ministry of Agriculture in its Guidelines for Sustainable Development and Management of Brackish water Aquaculture has prescribed standards for the waste water discharged from the shrimp farms. A comparison of the parameters prescribed for shrimp farm waste water for release into the open waters in India and Thailand indicates that the Indian standards are fairly stringent, especially in the case of free ammonia and nutrients (Table 2).

Table 2. Guidelines/ standards for waste water from coastal aquaculture farms in India and Thailand

Sl. No.	Parameters	INDIA Final Discharge Point		THAILAND
		Coastal marine waters	Creeks/ estuaries- when the same inland water courses are used as water source and disposal point	
1.	PH	6.0-8.5	6.0 - 8.5	7.0 – 8.7
2.	Suspended Solids mg/l	100	100	100
3.	Dissolved Oxygen mg/l	Not less than 3.0	Not less than 3.0	More than 4.0
4.	Free Ammonia (as NH_3 -N) mg/l	50	0.5	1.8 – 2.9
5.	Bio-chemical Oxygen Demand (BOD) (5 days at 20ºC) mg/l	50	20	10
6.	Chemical Oxygen Demand (COD) mg/l	100	75	—
7.	Dissolved Phosphate (as P) mg/l	0.4	0.2	0.4
8.	Total Nitrogen (as N) mg/l	2.0	2.0	4.0

To achieve the waste water quality standard prescribed above, proper treatment of the farm effluents is a prime requisite. The effluent treatment system (ETS) detailed in the present guidelines will help the shrimp farms to achieve the objectives.

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3. Effluent Treatment System for Shrimp Farms

The Aquaculture Authority has made it mandatory that all shrimp farms of 5.0 hectare water spread area and above located within the CRZ and 10 hectares water spread area and above located outside CRZ should have an effluent treatment system (ETS) or effluent treatment ponds/ facility. Establishment of such a system is necessary to bring the shrimp farm waste water within the prescribed standards and mitigate any adverse impact on the ecology of the open waters.

An effluent treatment system consisting of settlement pond (SP), bio-ponds (BP) and aeration pond (AP) is proposed for the shrimp farms practicing improved traditional and extensive methods of farming. By incorporation of the ETS facility, the farm waste water is expected to be as good in quality as that of intake water. Quality-wise, the treated waste water would also be suitable and ideal for recirculation within the farm, making the farming practice conform to the ***zero discharge*** norms. However, such a system (*i.e.* recirculation system) would need the establishment of a reservoir pond of suitable size.

Effluent Treatment System– Design & Lay out

Basic considerations

The characteristic features of the shrimp farm waste water that have been taken into consideration for designing the ETS are as follows:

- Shrimp aquaculture waste water/ discharge during normal operating conditions (*i.e.* during culture period) is high in volume, but relatively dilute in nature. When ponds are aerated (farms adopting improved traditional and extensive methods of farming), discharges from the ponds usually contain adequate oxygen for aquatic life and diluted concentrations of nitrogen, phosphorous and organic matter;

- The shrimp pond water quality tends to deteriorate through the grow-out period, as feeding rate increases with shrimp size and biomass. Thus, the highest quantity and poorest quality of waste water (in terms of nutrient load, total ammonia and ionised ammonia and total suspended solid) are found just before harvest time, when shrimp biomass is at the maximum;

- Waste water discharge during harvest (especially the last 5 cms drainage) is usually the most important contributor to overall waste water loading, comprising over 75% of the total load;

- Stocking densities and management practices largely influence the quality of the discharge.

In areas where the intake water quality is below the desired standards, a recirculation system can be resorted to using a storage reservoir in combination with the ETS. This would help in maintaining the water quality and animal health standards.

Lay-out Plan

The lay-out plan of the ETS is depicted in Figure 1. As per norms, 10 per cent of the cultivable area should be assigned for the ETS. For example, for a farm of 5.0 hectare water spread area, 0.77 hectare land area or approximately 0.50 hectare water spread area (actual operational area) will be required for construction of the ETS. For farms more than 5.0 hectares, the area under ETS will also proportionately increase (e.g. for a 6.0 ha. farm area, 0.6 hectare under ETS; for a10 hectare farm area 1.0 hectare under ETS and so on). The size of the settlement pond, bio-pond and aeration pond has also been suggested taking into consideration the optimum production level of 2.0 tonnes/ hectare/ culture and specific water management practices. Water exchange schedule to be followed for operating the system is shown in Table 3. The schedule is based on the availability of a reservoir of suitable size for storage and treatment of water for initial filling of the ponds, topping up of water level during the first two months of rearing and limited water exchange during the third and fourth months of rearing.

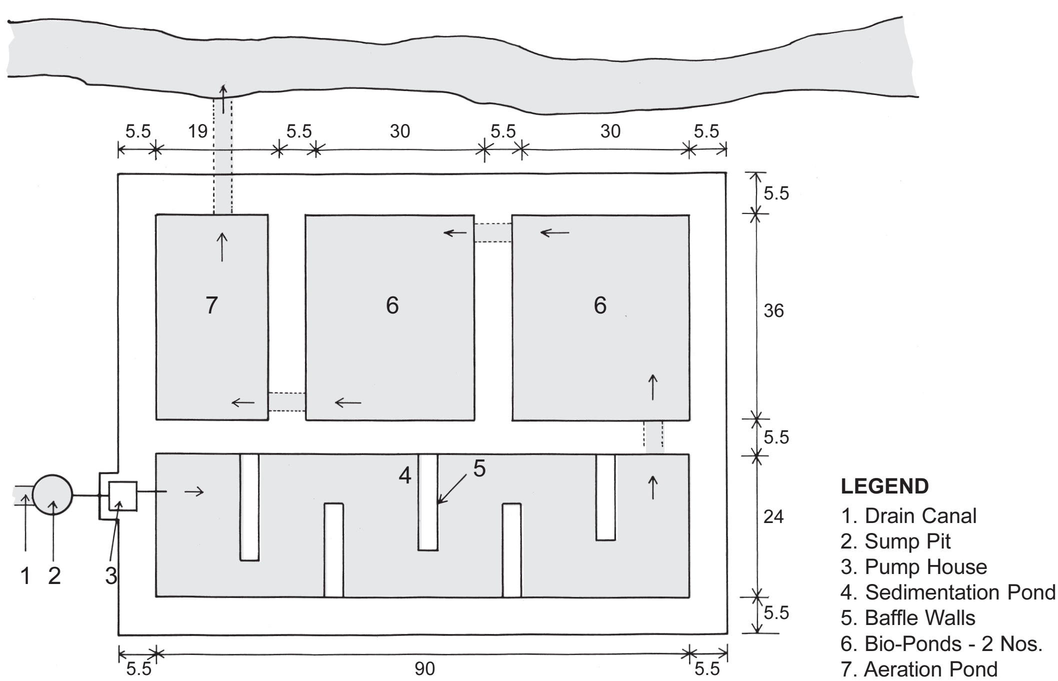


Figure 1. Layout plan of effluent treatment system for a 5.0 hectare shrimp farm

Even though, a modular design of ETS is shown, the design and lay-out may be suitably altered taking into consideration the location and shape of the land available for such purpose.

Water Exchange Schedule

Water exchange schedule for the farms practicing recirculation of water is given in Table 3.

Table 3. Water exchange schedule

Month	1	Nil
Month	2	Nil
Month	3	20% in 15 days
Month	4	20% in 10 days

A retention period of not less than one day will be available in all components of ETS during the water exchange as shown below:

A) Month – 3

Volume of water exchange (once in 15 days) = 10 000 cu.m

Volume of water / day = 10 000 /15 = 670 cu.m/ day

Retention time available

a) Sedimentation pond = 2 142 cu.m / 670 = 3.20 day

b) Bio-ponds = 1 620 cu.m / 670 = 2.40 day

c) Aeration pond = 1 153 cu.m / 670 = 1.74 day

B) Month – 4

Volume of water (once in 10 days) = 10 000 cu.m

Volume of water/day = 10 000/ 10 = 1 000 cu.m/ day

Retention time available

a) Sedimentation pond = 2 142 cu.m /1000 = 2.14 day

b) Bio-ponds = 1 620 cu.m /1000 =1.62 day

c) Aeration pond = 1 163 cu.m /1000 =1.16 day

C) Harvest

The supernatent water from the culture ponds up to a depth of 30 cm is drained starting from 10 days prior to the day of harvest.

Volume of water/ day = 50 000x0.7/ 10 =3 500 cu.m/ day

Although this supernatent water will carry practically little sediment load, a retention period of 15 hours, 11 hours and 8 hours will be required in the sedimentation, bio and aeration ponds respectively.

Description of Various Ponds and their Use

Settlement Pond/ Sedimentation Pond

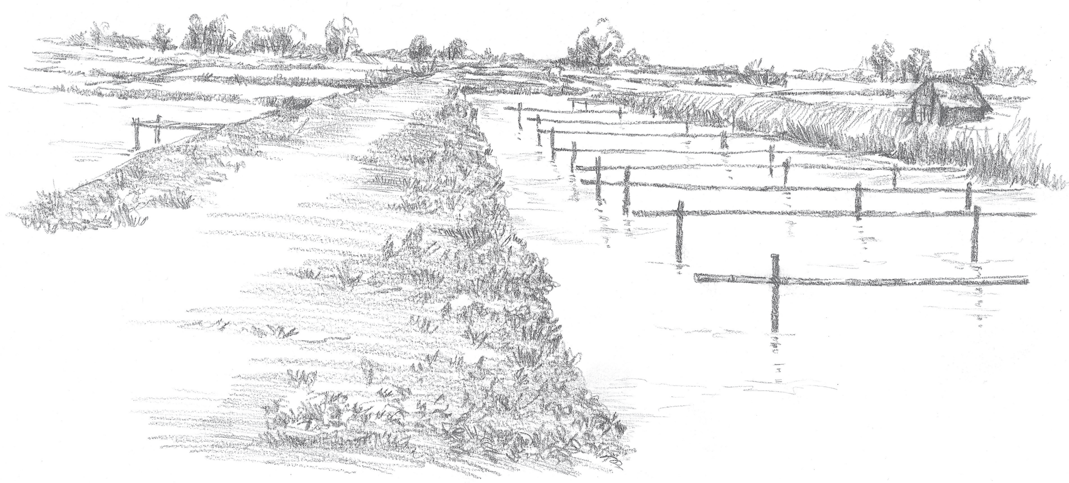
A settlement/ sedimentation pond is basically used to remove suspended solids from the waste water flow. Shrimp farm suspended solid wastes under normal operating conditions (during culture as opposed to harvest) are primarily composed of living plankton cells, feed material and other organic material, which do not easily settle down. Sedimentation tank can trap only 5 to 10 percent of such suspended solids. A retention time of one hour is sufficient to trap the material, which can settle down. Thus settlement pond is less effective in trapping the solid contents of the waste water discharge during the course of culture. However, settlement tanks are effective in trapping suspended solids during the harvest, when solid loads are far higher and particulate matter is more dense. Studies have shown that 90% of the solids in the harvest discharge settle in sedimentation ponds. Thus the sedimentation ponds prevent the release of most polluting organic matter that is discharged at the time of harvest (last 5 to 10 cm water) to the environment.

Bio-Ponds or Biological Treatment Ponds

Biological treatment aims at using plants and animals to reduce nutrient load and particulate matter in the shrimp farm discharge. Farm discharge after the treatment in settlement and bio-ponds can be readily used for recirculation to ponds for farming operation.

Various options available for biological treatment of farm discharge are as follows:

- *sea weeds/ water weeds to reduce nutrient (N and P) level,*
- *molluscs to reduce suspended particulate matter and*
- *fish to transform the phytoplankton into organic matter*



Bio-remediation methods to utilise nutrients from shrimp aquaculture waste water (sketch shows use of filter-feeding bivalves)

Biological treatment can only be used to treat operational farm waste water *i.e.* during culture period as the waste water during harvest time is biologically unsuitable in its direct form, unless diluted. However, the harvest waste water if allowed to remain in the settlement pond for requisite duration can be treated in the bio-pond.

Various species of weeds and animals available for biological treatment (bio-remediation), their usefulness and the constraints in using them are given in Table 4.

Table 4. Plant and animal species useful for bio-remediation

Group	Species	Usefulness	Constraints
Sea weeds	*Ulva latuca*	Reduces nutrient load	Survive and grow in water having salinity 25 ppt and above
	Enteromorpha sp.	- do -	- do -
	Gracilaria	- do -	26 - 32 ppt
	Photomedgetone	- do -	15 - 20 ppt
	Other weeds if found suitable and economically viable	- do -	—
Mollusc	*Crassistrea* spp.	Removes particulate matter and control of algal growth	Grow in salinity ranging from 15-25 ppt
	Geloria sp.	- do -	10 - 35 ppt
	Perna viridis	- do -	20 - 25 ppt
	Perna indica	- do -	20 - 35 ppt
	Villoria	- do -	2 - 15 ppt
	Paphia sp.	- do -	2 - 15 ppt
	Anadora granosa	- do -	Above 20 ppt
	Meritrix sp.	- do -	Above 20 ppt

(Table continued)

Fish	*Mugil cephalus*	Reduction of phytoplankton and control of algal biomass	20 - 35 ppt
	Liza spp.	- do -	20 - 35 ppt
	Chanos chanos	- do -	2 - 35 ppt

Based on the type of culture (*i.e*. production/ ha) and other features of the site, the optimum number/ quantity of weeds/ molluscs/ fishes required to treat the waste water effectively is to be arrived at.

Aeration Pond

Aeration helps to increase the dissolved oxygen levels of water before it is pumped for recirculation. Besides, it also helps to oxidise any left over ammonia and organic matter in the water that comes out of the bio-pond.

Construction of ETS

Dimensions of a model unit

Dimensions of a model unit of ETS for a farm of 5.0 hectare water spread area are provided in Table 5.

Table 5. Dimensions of different ponds of waste water treatment system for shrimp farm (for 5.0 ha water spread area)

1.	**Sedimentation Pond**		
	Size	:	90m x 24m – 375 sq.m (for baffle walls = 1 785 sq m)
	Water Depth	:	1.2 m (average)
	Volume	:	2 142 cu.m
2.	**Bio-pond**		
	Size	:	30m x 36m
	Water Depth	:	1.5m (average)
	Volume	:	1 620 cu.m
3.	**Aeration Pond / Reservoir**		
	Size	:	19m x 36m
	Water depth	:	1.7 m (average)
	Volume	:	1 163 cu.m

Construction

Aquaculture Authority does not permit construction of shrimp farms in sandy soil as water from such farms will seep out. However, when an ETS is planned, soil permeability of the ETS site has to be checked and if percolation of water is suspected either the site is abandoned or a clay lining (or core of clay) should be provided to prevent seepage of effluent. As an illustration, out of 7 750 sq.m. of land area, the ETS ponds with the following dimensions are suggested.

Sedimentation/ Settlement Pond

One pond of 90 x 24 m x 1.2 m holding a volume of 2 142 cu.m water is necessary for the system. Earthern ponds will hold good. The pond should have at least five baffle walls to allow the waste water to move slowly for a longer distance (circuitous), enabling the settlement of solid waste material.

Bio-ponds

Two numbers of bio-ponds, each of 30m x 36m x 1.5m to hold a volume of 1 620 cu.m water are necessary. The first pond is meant for stocking weeds and molluscs and the second for stocking fishes.

Aeration Pond

An aeration pond of 19m x 36 m x 1.7 m for holding a volume of 1 163 cu.m water is required. A minimum of two aerators of 3 HP each will be necessary to aerate the water.

Bed level of ponds

The bed level of the ETS ponds should be kept in such a way that the discharge from the pond flows by gravitational force *i.e.*, from drainage canals to sedimentation pond, to bio-ponds, to aeration pond and then to the open waters. Wherever such arrangements are not possible, pumping may be required.

Operation of ETS

It must be remembered that smooth functioning of the modular ETS is dependant on the adoption of the proposed water exchange schedule (Table 3) successfully. As no water exchange is proposed during the first two months of culture operation, water required for necessary topping up should come from the reservoir.

Similarly, water for the proposed exchange of 20 per cent in 15 days during the third month of grow-out operation should also come from the reservoir. During the fourth month of culture, 20 per cent of exchange in 10 days is proposed. For this purpose also water from the reservoir is preferable. If water stored in the reservoir is not sufficient, water from natural source may be pumped into the reservoir, disinfected and used for exchange. Such a water exchange schedule will ensure prevention of spread of disease through the natural water source.

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4. Cost Estimate

The cost estimate for construction of a 0.5 ha ETS is shown in Table 6.

Table 6. Cost estimate for construction of a 0.5 hectare effluent treatment system

Sl. No.	Particulars	Quantity	Unit rate (Rs.)	Amount (Rs.)
1.	Earth work excavation and laying in embankments for dykes and baffle walls as per design, with compaction, dressing, etc.	4700 cu.m	60/-	228 200/-
2.	Sluice gate - Main - Secondary	1 No 3 Nos	30 000/- 15 000/-	30 000/- 45 000/-
3.	Sump pit	L.S.		35 000/-
4.	Supplying and installing M.F. pump – 10 HP with accessories complete	1 No.	60 000/-	60 000/-
5.	Supplying and installing paddle wheel aerators including cables, etc	2 Nos.	30 000/-	60 000/-
6.	Pump shed and electrical works	L.S.	—	50 000/-
7.	Miscellaneous	L.S.	—	40 000/-
	Total			***548 200/- or say 550 000/-***

Land and operational costs are not included. The costs are indicative and may vary from location to location.

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5. Implementation

The treatment system described above is a three tier system with minimum discharge (or with zero discharge) of waste water. The sludge accumulated in the settlement pond is composed of excessive organic matter and nutrients and can be used as a fertilizer for plants. The maintenance of the gradient would mainly depend on the location, otherwise pumping will be essential, which would entail an additional expenditure.

ETS for Shrimp Farms of 5.0 Hectares and Above

The ETS described above is most suitable for the treatment of waste water from farms having a water spread area of 5.0 hectare and above.

ETS for Small Cluster of Shrimp Farms Varying Between 1.0 to 2.0 Hectares and Less than 5.0 Hectares

For small farms having less than 5.0 hectare water spread area, setting up of a common ETS depending on the total water spread area (10% of the total water spread area) is suggested. In this case the construction, operation and maintenance cost will be shared depending on the quantity of the waste water generated or on the basis of the farming area owned by the individual owner. While sharing the common ETS facility, care should be taken to prevent the spread of disease/infection while recirculating the treated waste water.

If adequate space is not available for setting up of the treatment facilities, the Government may take steps to bring in the small farms (*i.e.* less than 5.0 hectare water spread area) located in a particular area under an umbrella organisation/ co-operative society/group of farmers and assist in procurement of land required for setting up of the ETS.

Monitoring of Water and Sediment Parameters

Waste water and sediment quality parameters are generally not monitored by the farmers. To keep a record of the water and sediment quality, it is necessary to monitor before and after the treatment and also at regular intervals. This would also assist the farmer in standardising his practices.

For this purpose the farmer can take the help of State Pollution Control Board or laboratories recognised under the Environment (Protection) Act, 1986 to get the samples analysed. The larger farms can also set up their own laboratories for conducting routine analysis.

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6. Conculsion

The present guidelines for adoption of effluent treatment system are general and suitable modifications may have to be made by the farmers while adopting them. By introducing relatively simple mitigating measures like waste water treatment ponds or stabilisation ponds at the farm level by the individual farmer and by the farmers' associations/ groups in an area where the farm are clustered together, will help to a large extent in development of sustainable shrimp farming, without causing adverse impact to the environment and the ecosystem.

Use of mangrove plantation to improve shrimp aquaculture waste water quality

FARM DATA

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