WATER QUALITY MANAGEMENT FOR INLAND FISHERY IN WATER COMMONS – EXPERIENCE OF DVTF'S IN RAINFED WATER RESOURCES

S.P.Madhan Mohan[1]*
Team Leader
DHAN Vayalagam (Tank) Foundation
Madurai -625 016, Tamilnadu, INDIA
Email: dhantank@dhan.org

ABSTRACT

India is the second largest in aquaculture production in the world. The fish production during 2010-11is estimated to be 8.29 million tonnes. The marine production is become constant and the inland aquaculture production in increased state. Water commons plays a vital role in fish production in India, as having 2.35 million hectare fresh water resources and Tamilnadu in the ninth place of inland fish production, having 3.73 lakhs hectares fresh water resources includes Reserviors, Village tanks, Village ponds and Dams. The short seasonal water resources are occupying 48% of the total fresh water resources in Tamilnadu, and the average productivity per hectare is around 520 Kgs. The average fish consumption in India is around 11.5 Kgs and Tamilnadu is less than the India average consumption, consuming 9 Kgs per year.

The average fish production in scientific fish ponds are more than 4 tonnes. The major difference between Fish ponds and water commons is the Management of Pisciculture, which plays major role in fish productivity especially water quality management is one of the crucial aspect which help fishes to disease free survival, good growth and quality habitat. In scientific fish ponds, controlled environment helps to keep water quality. In village tanks and ponds, water quality management is less possible and least preferable area, because of multiple use and multiple owners.

The Physical, Chemical and Biological water quality parameters are more important for breathing, excretion of waste, feeding and reproduction in fresh water resources. Poor water quality can result in low productivity, low product quality and potential human health risks. Production is reduced when the water contain contaminants that can mess up development, growth, reproduction or even cause mortality to the fish species.

We, DHAN Vayalagam Tank Foundation, are actively involved in inland fishery development in water commons, Farm Ponds since 2006. Water quality management in common water resources is a highly challenging one. Due to multiple purpose includes domestic purpose won't allow to manure, using chemicals in water commons. Doing Pisciculture with the exiting water quality is the prime reason after that of water available duration is the reason for less productivity in Tamilnadu, even in India also. In Tamilnadu, out of 3.73 lakhs hectare of short seasonal water resources, due to bad water quality, especially high turbid is one of the major reason for low productivity or still unreached. We are recently trying to improve water quality in water commons by adding inorganic fertilizers for plankton growth, Probiotic to keep conducive environment for fishes to grow.

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[1] Conference speaker

Probiotic helps to keep water quality and also health and growth of fishes. competitive exclusion of pathogenic bacteria, source of nutrients and enzymatic contribution to digestion, direct uptake of dissolved organic material mediated by the bacteria, enhancement of the immune response against pathogenic microorganisms are the some of the benefits of probiotic. In common water resources, Dissolved oxygen is the major issue during later stage of fish rearing and we are advising and practicing partial harvest of fishes to overcome this issue in many places and the partial harvest also take place during Ban on fishing in Tamilnadu coast.

Key words: Aquaculture, water commons, inland fishery, Fish production, Water quality, Probiotic, Pisciculture

BACKGROUND

DHAN Vayalagam (Tank) Foundation- DV(T)F, Water theme of DHAN collective (www.dhan.org) is giving importance to conservation of minor rainfed water bodies such as Tanks and Ponds receive water through rain water runoff during South west and North east monsoon period, only from their free catchments area without any other supplemental source. Normally these water resources are used for irrigation, Domestic use as well as for percolation. Water holding capacity or water available duration of these tanks is three to seven months. Normally fishing of natural stock is the long-established practice in small scale water bodies and slowly that has changing in to rearing of fishes. Even though this water ecosystem has utilized for irrigation, percolation and domestic purposes, fishery activity is given least importance in these water bodies due to the uncertainty in water availability. DVTF is giving importance to develop community Inland fisheries development in these rural minor rainfed water bodies by providing “dead storage” in these water bodies.

OBJECTIVE & FOCUS OF COMMUNITY INLAND FISHERIES:

1. Making full use of available water in rural common water resources by taking up fish rearing activity.
2. Providing additional income to community organisations to sustain the Maintenance of rural water ecosystems
3. Providing protein rich food at their reach to offer additional nutrition to rural community
4. Employment generation for inland fishermen & Landless agriculture labours

PRESENT STATUS OF INDIAN FRESH WATER AQUACULTURE

Indian Fishery sector plays an important role in food production, providing nutritional security, increasing the income through export of fish and fishery products and also providing employment to inland fishermen and rural men and women. Every year Fish production in India through aquaculture has shown continuous and sustained growth. India is the second largest producer of fish through aquaculture next to China. Both inland and marine aquaculture, which has been registering an annual growth rate of over six per cent, and fisheries have become important enterprises in both coastal and inland states contributing to food vats and employment generation as well as the economy of different regions.

In recent days fish food gains more important worldwide includes in developing countries as highly nutritious. During the past decade the per capita fish consumption in developing countries are also showing significant improvement. In India, the per capita consumption of fishes had reached to 11-12 kgs/ year from 9kgs/ year. When compared to developed countries, the per capita consumption was nearly 1/3 even India ranking 3rd in Fisheries export and 2nd in Aquaculture globally.During the last decade, the marine fish production become constant and the same time fish and fisheries production from aquaculture both inland and brackish water shows tremendous increase. The following graphs, the first one will show the growth of aquaculture and the later shows the constant production.

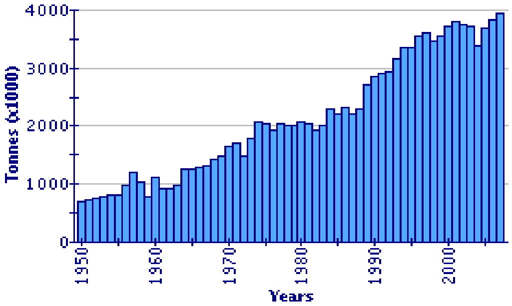


Figure a - inland

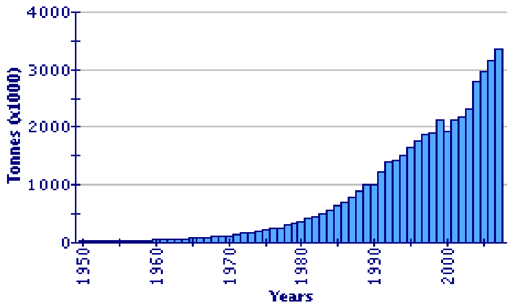


Figure b - Marine

Indian Fisheries

Table-1: India Total Fish Production (2011-2012)

Total Fish Production (Marine & Inland)	8.67 million tonnes
Marine	3.37 million tonnes
Inland	5.30 million tonnes
Export Fish and Fishery Products (2011-12) Qty	8.62 lakh metric tonnes
Export Fish and Fishery Products (2011-12) Value	Rs.16,597.23 crores
GDP at current prices (Fisheries Sector)	Rs.76,699 crores
GDP share in overall	1.07percent
GDP share in Agriculture	4.15 percent

Source – State Fisheries Department, Tamilnadu

Fishery Resources in India

Coastal line	-	8129 kms
EEZ	-	2.02 million sq. km
Continental shelf	-	0.506 million sq. km
Rivers and canals	-	1, 97, 024 km
Reservoirs	-	3.15 million ha
Tanks and Ponds	-	2.35 million ha
Oxbow lakes and derelict waters	-	1.3 million ha
Brackish water	-	1.24 million ha
Estuaries	-	0.29 million ha

(Source by NFDB, Hyderabad)

Tamilnadu Fishery status

Tamilnadu has 3.7 lakhs hectare of water spreads suitable for fish culture. It comprises of major reservoirs (52,000 ha.), big/small Irrigation tanks (98000 ha.), small lakes and Rural Fishery

Demonstration tanks (158000 ha.) and Brackish water areas, swamps, estuaries (63,000 ha). Tamilnadu is also endowed with rich cold water fishery resources. Apart from this 7400 km length of rivers and canals offer good scope for fisheries development. The Inland Fisheries policy of the state focuses in maximizing the fish production utilizing available inland water resources by adopting scientific freshwater aquaculture management and quality seed production. The inland fishery resources of Tamil Nadu yield 0.87 lakh metric tones of fishes. The total inland water spread has a potential to yield about 4.5 lakhs metric tones. The inland programmes initiated are focused to bring additional water bodies for fishery development. In Tamilnadu the Inland Fishermen population is 1.83 lakhs. There are 270 nos. of Inland Fishermen Co-operative Societies with total registered membership of 59,000 actively engaged fishermen in fishing activities in the inland water spread areas. The following are the main Inland Fisheries activities implemented by the department.

Tamilnadu is ranking 4th in Marine fish production with 3.65 lakh MTs during 2011-12 and 9th in inland fish production with 1.76MTs. Tamilnadu is gifted with more number of long and short seasonal water resources which are giving hope of more fish production. The average fish production in perinneial seasonal tanks is 750 Kgs per hactare and in short seasonal tanks, 500 kgs per hactare. The average productivity per hacatre is very less when comapred to scientific fish farms. Not only the productivity, the average per capita consumption of Tamilnadu is very less, 9 Kgs when compared to national average consumption, 11.50 Kgs. The world average per captia consumption is 17 Kgs.

Tamil Nadu-Inland Fisheries at a Glance

1	Inland Fishery Resource	**3,73,696** hac
2	Annual rain fall	970mm.
3	No. of Reservoir	61
4	Inland Fisher folk population	2,21,705 nos.

Table-2: Source wise Inland Fish Production

Resources	No.	Area (ha.)	%	Fish Production (in tonnes)	%
Reservoirs	**61**	**52,055**	**13.93**	**1,922.30**	**1**
Long Seasonal Irrigation Tanks	**2012**	**92,304**	**24.70**	**69,269.56**	**39**
Short Seasonal Tanks	**6007**	**163486**	**43.75**	**84,894.99**	**48**
Brackish water & Swamps		56,000	14.99	10,744.00	6
Others		9,851	2.63	9,394.15	6
Total		**3,73,696**	**100**	**1,71,305.00**	**100**

INLAND AQUACULTURE MANAGEMENT

Water body Management plays a vital role in fish farming before and after the stocking of fish fingerlings. Water body management will vary depending upon the culture method. The least managed water body is suitable for extensive culture. For semi-intensive and intensive culture required proper management of water body is needed. In management of water bodies, various measures that are required to be undertaken in pre and post stocking practices are tabulated below:

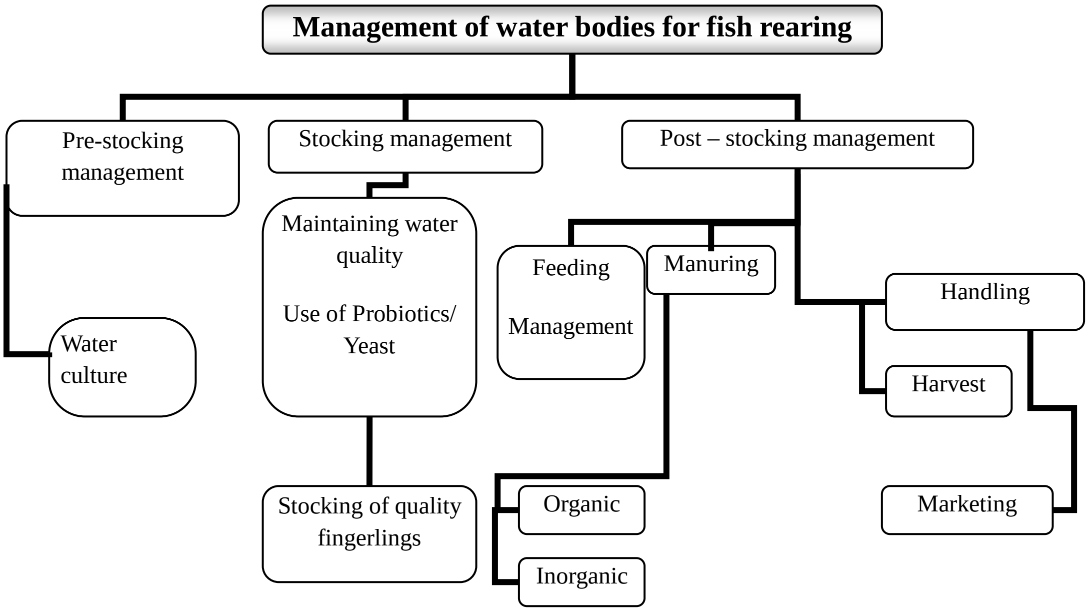


Figure-1 : Management of Water bodies for fish rearing

IMPORTANCE OF WATER QUALITY IN WATER COMMONS

Water commons are multi purpose water resources. The prime objective of village tanks are irrigation. Apart from this, each village tank eco system has its own flora and fauna, the major flora and fauna are various trees, aquatic plants, Fishes, Molluscans, aquatic animals such as frags, insects etc. Water quality plays a major role in maintaining eco system of village commons. Now a days pollution, Encroachments, Sewages discharging are the major causes of water quality in water commons.

Maintenance of a healthy aquatic environment and production of sufficient fish food organisms in tanks and ponds are two factors of primary importance for successful pond cultural operations. To keep the aquatic habitat favorable for existence, physical and chemical factors like temperature, turbidity, colour, odour, pH, dissolved gases like oxygen, carbon dioxide and also reducing gases like hydrogen sulphide, methane working lethal on fish life, will exercise their influence individually or synergistically, while the nutrient status of water and soil play the most important role in governing the production of plankton organisms or primary production in fish ponds. Rating of fish ponds on the basis of these factors is a difficult problem because of the complexities influencing and governing these factors and also for the fact that it is not possible to study the effect of any individual factor under uniform optimal conditions.

Water quality maintenance involves the following parameters:

Temperature

Maintenance of fish in their optimum temperature range is important in keeping them healthy.

Tropical species typically require water temperatures that range from 75 to 85o F. The cold-water species require temperatures below 50 o F. Fish exposed to temperatures slightly out of their optimum temperature range may suffer from diseases (typically infectious diseases) associated with immunosuppression.In Tamilnadu, north east monsoon is the major source of rainfall which fall during October to December every year. The rearing season is also during

October to March every year in rainfed water commons. During this period, temperature is low during winter, which affect metabolic rate of fishes, effect slow growth in Tamilnadu.

Water hardness

Water hardness refers to the concentration of mineral ions in water predominated by calcium and magnesium. It is expressed in terms of calcium carbonate ($CaCO_3$). One degree of hardness equals 17ppm $CaCO_3$. Soft water refers to water with 0-75ppm $CaCO_3$ and has the lowest buffering capacity. Moderately hard water has 75-150ppm $CaCO_3$. Hard water has 150-300ppm $CaCO_3$ and very hard water had a concentration of $CaCO_3$ greater than 300ppm, which has the highest buffering capacity. Fishes grow well even in mild water hardness.

pH

The pH of a freshwater should range between 6.8 and 8.6. It should be noted that an alkaline pH favors ammonia toxicity in a system having issues with increased ammonia levels. Also, an acid pH decreases oxidation of NH_3 by bacteria and a pH of 4 and 5 will damage gills. The pH level is maintained between 7 to 8.5, by applying lime.

Turbidity

Turbidity is a measure of the amount of suspended material in the water and is a direct assessment of the penetration of light through the water. Turbidity is caused by living organisms such as algae (minute plants) and zooplankton (small animals), and by nonliving components such as suspended clay or silt.

Dissolved oxygen (DO)

Dissolved oxygen is measured using electronic meters. A DO of 5 ppm is adequate for tropical fish. Marine systems should have DO of 5.5 to saturation (6.8 is approaching saturation for salt water). The DO decreases as temperature and salinity increase.

Ammonia, Nitrite, and Nitrate or the Nitrogen cycle and nitrification:

1. Excess food, feces, plant debris, and expired NH_4 from the gills produce ammonia.
2. Ammonia is converted to nitrite by bacterial (*Nitrosomonas*) decomposition.
3. Nitrite is converted to nitrate by bacterial (*Nitrobacter*) decomposition.
4. Bacteria, algae, and higher plants utilize nitrate as a nutrient
5. Ammonia and nitrite are toxic to fish.

DVTF'S EXPERIENCE IN WATER COMMONS

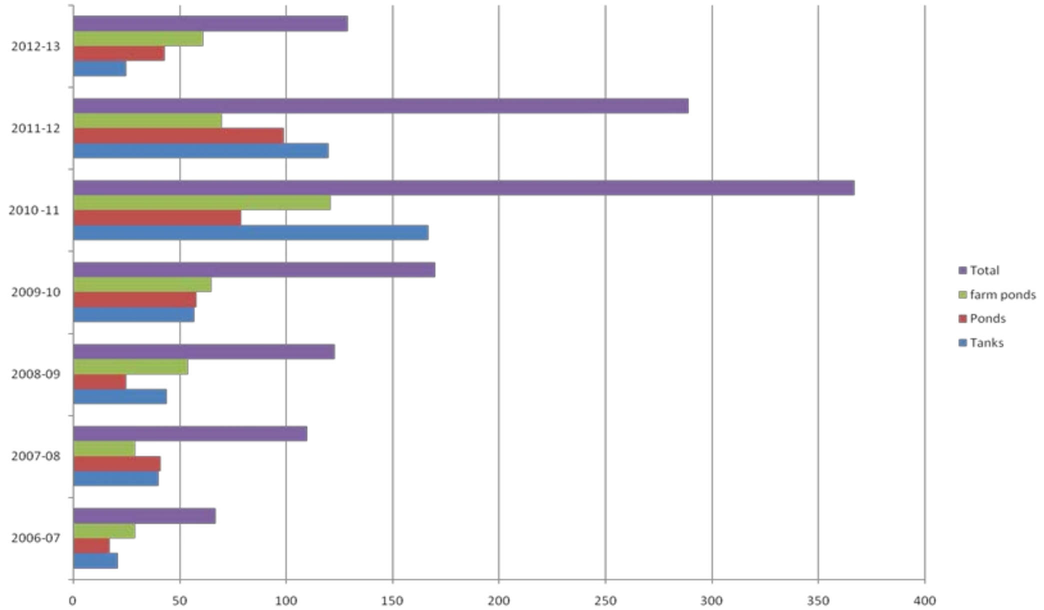
Adopted techniques

Poly culture technique is adopted in rainfed tanks by stocking fish seeds of carps and Murrel. The seeds of Murrel are naturally collected seeds and the carps are **Catla, Rohu, Mrigal, common carp, silver carp and grass carp**. Apart from these, we have stocked **Pangasius** and Iridescent or **Stripped Shark** species also. **Composite fish culture** technique is adopted in village ponds and Farm ponds.

Growth of Fish Rearing

Inland Fishery in tanks and Ponds are in growth phase in a steady and sustainable manner. The success in fish rearing was achieved by selecting suitable fish varieties with enough number of seeds based on the nature of water bodies. We have practiced extensive and semi intensive ways of rearing depend upon the water and natural food availability in the selected water bodies. Supplementary feeding, G'nut oil cake and rice bran, is also practiced to achieve maximum growth within the limited period.

The average success rate of this activity is around 60%. The details of Tanks and Ponds are given in below chart (excluding the small water storage structure and household ponds which are taken up more than 2000 nos)



The year wise success rate is given in below table and the success differs for each year due to lack of water availability and also the seed quality.

Particulars	2006-07	2007-08	2008-09	2009-10	2010 -11	2011-12	2012-13
Success rate in %	62	71	62	73	68	58	46

Categorization of potential Tanks

Normally rainfed tanks are considered as non potential for Pisciculture due to uncertainty of available water for fisheries and the available duration varies from three to ten months that also depends upon the maintance of tanks and ponds. Due to that we have categorized the tanks and ponds, based on water available duration and based on the categorization, techniques are adopted such as intensive, semi intensive and extensive. The major criteria taken up for categorization are Water available duration which is calculated with minimum of five feet depth. This helped the farmers to identify the potential water bodies and chosen opt technique.
Total feasible tanks are 542 out of 1200 in our working area.

- Water available duration was calculated with minimum five feet depth
- Duration still varies based on rainfall, which cause to reach 100%

- Out of 482, we have so far taken up 186 water bodies that show 40% of possible water bodies reached.
- Competition for Fishery rights for highly potential tanks are more

Target Groups

- Small and marginal farmers in vayalagams
- Landless in Micro Finance groups
- Local artisans

Areas

- Community tanks
- Village ponds
- Farm ponds
- Check dams, small water storage structures

Creating Awareness on Fish rearing

Awareness creation on Inland fish rearing was given more important to develop this activity. Awareness creation made to Vayalagam leaders, People workers, Vayalagam members and Professionals. Through formal discussion at various events with Community and leaders on fish rearing, clarifying their doubts and also explaining the advantages of fish rearing activity has created well awareness on this activity at all level and also Vayalagam members showed their interest in this activity. More than 45 awareness programmes conducted exclusively as well as combined with other events.

Skill building on Fish rearing

After creating awareness, skill building trainings were conducted to People workers and members on fish rearing activity. We have adopted composite fish culture, simple and effective technique in fish rearing. Selection & preparation of water bodies, Manuring, Fish seed selection and Procuring, Stocking and feeding, Harvest and sustainability are given importance during the training. More than 50 trainings were organized and more than 500 members gained knowledge on fish rearing in commons which helped to take up fish rearing in large scale even during the drought year.

Sustaining Community organizations

Suitable tanks and ponds are identified at block level and supported seed money for initiating fish rearing in tanks and ponds by Vayalagams. This initiation started with 35 water bodies in 2006 and reached maximum of more than 250 water bodies in a year, fish rearing was taken up. The results are highly encouraged the growth of this activity to reach more in numbers within short period. The success rate and the income depend upon various factors.

1. Water spread area
2. Water available duration
3. Water body management
4. Community involvement
5. Social issues- Poaching, poisoning

Table-3: Climate Change & Implication, Adaptation:

Climate Change	Implication	Adaptation
Delayed onset and early withdrawal of monsoon	Lack of enough stored water for fish rearing, lack of time for water culture, getting quality seeds, reduced rearing period	Decision taking on either doing fish rearing or not
Reduced rainy days and varied rainfall intensity	Affecting top up with rain water cause water quality due to stagnet for more time, less stored water and flood	Creation of Dead storage Top up with available source for ponds and farm ponds
Delayed filling of tanks	Earlier leasing of tanks bring loss	**Need policy change**
Unexpected summer rainfall	Refilling of tanks and harvest become difficult	Phase harvest and continues rearing

Phase Harvest and selling fishes within the village and adding nutrition

During the rearing period of fishes, instead of waiting for fishes to reach the marketable size, start the harvest in the end of third month in rain fed water bodies. Fishes reached above 500 grams have been sold and the smaller ones back into the water. Partial harvest starts in fourth month of rearing period, and the mesh size of the gear is insisted to catch fishes above 500 grams in weight. Marketing within the village are the ways to address the hidden hunger in rural villages. Partial harvest method is used to harvest and the catching is sold within the village. This method helps the community to fetch nominal price for fishes, Nutritional food within the village, increased production and reduced risk of marketing. This method will sustain this activity for long run. Through this activity, we can provide nutritional and food security to rural poor, employment opportunity to artisan. Through community action available of fishes in their village at prime quality, cheaper cost and for more days are the major advantages of partial harvest.

Additional Livelihood to Rural

More than 1000 farm ponds were created with the support of various watershed development programmes and other donors to more than 1000 farmers. We have taken up Farmer participatory action research programme supported by Government of India, and one of the action research is fish rearing in farm ponds.The result of the action research is encouraging and the same taken up to more number of farm ponds as an additional livelihood. So far more than 500 farm ponds are taking up fish rearing whenever feasibility is there.

WATER QUALITY IN WATER COMMONS – VILLAGE TANKS AND PONDS

The catchment area and the nature of soli determines the quality of water in water commons initially. If the catchment is block cotton soil or red soil, the turbidity level is high. The colour of water is milky white in BC soil and red in red soil area. Apart from turbidity, other water quality isues are lack of natural food esp phyto and Zoo planktons, Dissolved Oxygen level , detergents used for domestic, Residual Pesticides in catchment are the major issues in water commons.

Maintaining water quality in water commons

Based on our own experience, we are facing all the above said water quality issues in water commons which are affecting the fishery activity other than poaching and water scarcity. We have expanded fish rearing in water commons since 2006 onwards and we are trying to come over the above siad water quality issues with exiting practices and innovative methods. Even though we are trying to over come the issues, still some of the issues we couldn't because of multi purpose and multi owners.

Organic and inorganic manuring

Fertilization is needed frequently in the management of water quality especially maintaining the population of Phyto and Zoo planktons, basic food for fishes, in water commons. However, these water commons are typically fertilized with dung waste of different animals, agriculture waste which are in the catchments of water resources. For rearing fishes, still more of fertilization to be done to meet out natural food demand of fishes of both natural stock and man made stocking. For that, water commons are fertilized with organic and inorganic fertilizers.

Organic fertilizers are dungs of cow, cattle, pigs, and poultry are majorly used in water commons.

Inorganic fertilizers are also used containing nitrogen, phosphorus and potassium (N, P, and K). These elements, especially phosphorus, stimulate the growth of microscopic plants called phytoplankton, which in turn, serve as food for microscopic animals. Nutrients are applied to increase pond productivity, that is, aquatic life. The greater abundance of plant and animal life supports larger populations of the desired species such as largemouth bass and bluegills.

The wastes produced by farmed aquatic animals usually support substantial phytoplankton blooms in production ponds without adding inorganic nutrients. But, organic fertilization has been used to improve pond productivity for the culture of several species. A wide variety of organic materials have been used to promote the growth of zooplankton and phytoplankton as well as other invertebrates and pond micro-organisms. Organic fertilizers include manure, cottonseed meal, soybean meal, rice bran, alfalfa meal and other processed grains or hays. While the use of animal manure is very effective for stimulating the growth of aquatic plants and animals, it creates a negative image for the average consumer in the United States. People do not like to think about manure in association with the fish sandwich they just ate. As a result, manure is not commonly used in the United States to produce aquatic animals for food. Manure also contains high concentrations of ammonia and therefore, could be toxic to aquatic life if too much is added to a pond.

Organic fertilizers are primarily used to increase populations of aquatic invertebrates such as worms, crustaceans and insect larvae, as well as zooplankton. These organisms provide food for fish and other farmed aquatic animals. Organic fertilization has been used extensively to produce several species of juvenile game fish, including hybrid striped bass, red drum and largemouth bass.

Often, chemical fertilizers such as triple super phosphate (0:46:0, N: P: K) are used in combination with organic fertilization to ensure that robust phytoplankton populations are established along with the zooplankton.

In new or unfertilized ponds, especially those that have been empty for several weeks or months, benthic invertebrates and zooplankton would be sparsely distributed. The pond could be compared to a desert; that is, relatively void of life. Juvenile culture animals would have difficulty finding either natural food items or broadcast feed. All of these conditions could result in poor growth and survival. Consequently, using an organic fertilizer 14 days before stocking could also help stabilize water quality when the feeding of commercial diets begins.

Organic fertilization was remarkably efficient. By providing a carbon and nitrogen pool, virtually all of the essential amino acids, vitamins and essential fatty acids required by the juvenile culture animals were produced by the biosynthetic activity of bacteria, plankton and other invertebrates. The populations of plankton and benthic invertebrates produced were heterogeneous and offered a diversity of foods for larval fish or post-larval crustaceans. A variety of organisms would be more likely to supply the nutritional needs of young fish and crustaceans than any single species of plankton or prepared feeds. Stimulating the development of bacteria and fungi prior to stocking and feeding would enhance water quality by augmenting the breakdown of uneaten feed and other wastes. Organic fertilization may have additional applications for a multiplicity of aquatic species cultured around the world.

Opposing application of Organic manure in tanks and Ponds used for Domestic purpose

Water commons which are used for domestic purposes like bathing, washing clothes are objecting using of cowdung manure due to its bad odour and making the water body into turbid. Because of this, we are manuring the water body by filling up dung manures in Gunny bags and dumping it different areas of the water spread. This will help to avoid turbidity and the bad odour.

Even in some areas, they are opposing cowdung in any form. In those areas we are suggesting using of inorganic fertilizer in day time.

Dissolved Oxygen

It is commonly thought that if there is not enough oxygen in the water, then the fish will be seen gasping at the surface but this is a last resort means to breathe. The first indication there may be a dissolved oxygen problem in the water is when the fish become unusually lethargic and stop feeding. As oxygen levels decrease, the fish do not have enough energy to swim and feeding utilises yet more oxygen. Often it is recognised the fish have a problem at this stage but frequently some form of medication is added to the water and this can actually cause the oxygen level to drop even lower, leading to a number of mortalities. This can lead to the mistaken conclusion that the fish were suffering from some form of disease. In terms of managing any aquatic system, it is always advisable to increase the aeration when any fish start to behave abnormally, before adding any form of medication to the water. Increasing the aeration will certainly make the environment more comfortable for the fish, even if the dissolved oxygen level was already satisfactory. With respect to improving the aeration before adding medication, this will allow for any depletion of the oxygen level caused through a chemical reaction with the medication . The recommended minimum dissolved oxygen requirements are as follows: Cold water fish - 6 mg per litre (70% saturation) Tropical freshwater fish- 5 mg per litre (80% saturation)

Effects of oxygen level on growth and food conversion ratios of fish

Successful fish production depends on good oxygen management. Oxygen is essential to the survival (respiration) of fish, to sustain healthy fish and bacteria which decompose the waste produced by the fish, and to meet the biological oxygen demand (BOD) within culture system. Dissolved oxygen levels can affect fish respiration, as well as ammonia and nitrite toxicity. When the oxygen level is maintained near saturation or even at slightly super saturation at all times it will increase growth rates, reduce the food conversion ratio and increase overall fish production.

Turbidity

Turbidity is caused by living organisms such as algae (minute plants) and zooplankton (small animals), and by nonliving components such as suspended clay or silt (Block cotton soil and Red soil). A certain amount of turbidity is required in dams, Tanks and ponds. In very clear water freshwater, chance of macro weeds growth which cause reduced DO level and also the swimming of fishes. And there is also the risk of increased predation from birds etc. However, too high a turbidity can also cause problems For example, if a high turbidity is due to clay particles in the water then the light penetration is reduced. As a result of this, photosynthesis by the algae in the water is reduced and limited to the top layer of water. This can result in a reduction of the amount of oxygen in the water and, in particular, deoxygenation of the bottom water layer. If the turbidity is caused by algal blooms in the pond, then this also affects the oxygen levels in the water. For example, if the bloom is too large, then large amounts of oxygen are produced during the day by photosynthesis. During the nighttime, the plants respire and consume oxygen which, under certain conditions, also leads to depletion in the oxygen levels and therefore possible loss of stock.

Adoptation: We are suggesting to take up air breathing fishes especially Murrel and ifted Tilapia.

Use of Detergents

Water commons which are used for bathing and washing, detergents are used highly which use to form a thin layer in the surface of water bodies . This thin layer act as a barrier which block atmospheric oxygen get dissolved in water. Thus reduce the Dissolved oxygen which lead to suffocation and mortality of fishes. Even if the fishes are surviving, that affect the growth of fishes and also other living organisms in the tank eco system.

Adoptation; We are suggesting the farmers to swim in the tanks and ponds which won't allow to form the layer and the detergents float in the edges of the tanks. This can be easily removed by using Dhotis and saree.

Later stage of fish Rearing and water availability

Fish rearing in irrigation tanks and ponds are considered as an additional activity. Irrigation is given more importance which lead to reduced water level and also the fishes grow to larger size. The biomass of fishes increase and the water availability reduce is really a risky one which make problem for habitat and feeding.

Adoptation

Dead Storage or Fish Pond or Deeper Storage creation

Dead Storage is the stored water below the sill level of Sluice which cannot be taken by gravitational force for irrigation. This will help to store water for two more months which help to rear fishes additional for two months and also will help to cattle and mulch animals as drinking water source. While implementing the conservation and development of Tank eco system, DVTF is creating dead / Deeper storages in village tanks which are used as Fish ponds, can hold water more days which aloe the fishes to grow in to considerable size.

Phase Harvest and selling fishes within the village and adding nutrition

During the rearing period of fishes, instead of waiting for fishes to reach the marketable size, start the harvest in the end of third month in rain fed water bodies. Fishes reached above 500 grams have been sold and the smaller ones back into the water. Partial harvest starts in fourth month of rearing period, and the mesh size of the gear is insisted to catch fishes above 500 grams in weight. Marketing within the village are the ways to address the hidden hunger in rural villages. Partial harvest method is used to harvest and the catching is sold within the village. This method helps the community to fetch nominal price for fishes, Nutritional food within the village, increased production and reduced risk of marketing. This method will sustain this activity for long run. Through this activity, we can provide nutritional and food security to rural poor, employment opportunity to artisan. Through community action available of fishes in their village at prime quality, cheaper cost and for more days are the major advantages of partial harvest.

Uasge of Probiotics in Maintaining water quality

The water probiotics, readily available probiotics are available in market contain multiple strains of bacteria like Bacillus acidophilus, B. subtilis, B.lecheniformis, Nitrobacter sp, Aerobacter and Sacharomyces cerevisiae. Application of probiotic through water of tanks and ponds may also have an effect on fish health by improving several qualities of water, since they modify the bacteria composition of the water and sediments. When probiotics are applied in culture water they multiply and over grow the pathogenic organism present in the water. Beside this reported that probiotic bacteria are generally called bacteria which can improve the water quality of aquaculture and inhibit the pathogens in water thereby increasing production.

Yeast Application

Live yeast can be enumerated and applied directly on farm. This will help to improve water quality in fish ponds. In Andra Pradesh, most of the small and medium fish farm owners are applying yeast culture to improve water quality and FCR. They use to enumerate baker's yeast by adding Rice bran, Molasses, Sugar in water. The same we are doing in Odisha.

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