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Applied aquaculture related simple management practices

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Aquaculture which is recognized as a very efficient form of animal production system depends to a great extent on the correct husbandry practices for improvement in fish yield as well as to sustain the natural resources. The yield increase especially in small scale aquaculture is expected primarily from optimization of inputs used . This can be achieved through adoption of simple scientific principles and management measures wherever possible. Earlier, in the absence of a precise knowledge on the control of reproduction and breeding, farmers resorted to collection of larvae and juveniles from rivers for stocking in the culture ponds. Subsequently, with the advent of induced spawning technique to breed the fishes in a consistent manner, simple improvements in hatchery technology for mass breeding followed by genetic selection procedures accelerated the development of carp aquaculture. Despite all these changes, the yield gap of fish production in India is still very high.- 15tonne/ha/year at experimental farm level, 10 tonne/ha in pilot farm, 6tonne/ha in well managed farm while little more than 2 tonne/ha is the national average. The reasons for low fish yield in rural aquaculture are many (Fig 1). Continued application of research findings in fish farming followed by participatory approaches of the stakeholders would certainly bridge the gap by improving growth, health and reproduction . In order to increase the food fish supply as per the FAO projections (Fig. 2), adoption of appropriate management practices like monitoring the water quality parameters, taking care of nourishment of the cultured fishes following of appropriate feeding strategies , using correct fish stocking size and ratio and density, maintenance of pond hygiene, management of broodstock and larval rearing, prevention of disease and problems like predation by birds, snakes and the like are indeed very crucial not only to achieve high survival and rapid growth of cultured fish but also to

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ensure the consistent product quality in terms of vital nutrients like long chain n-3 PUFAs in particular which have direct bearing on

human health and nutrition..

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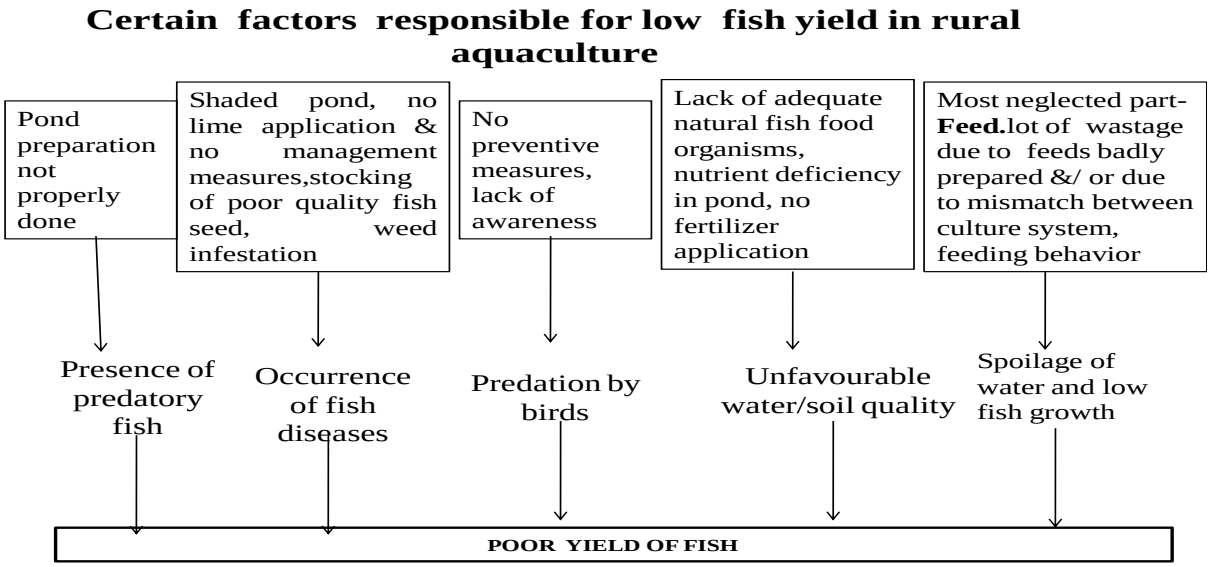

Fig 1

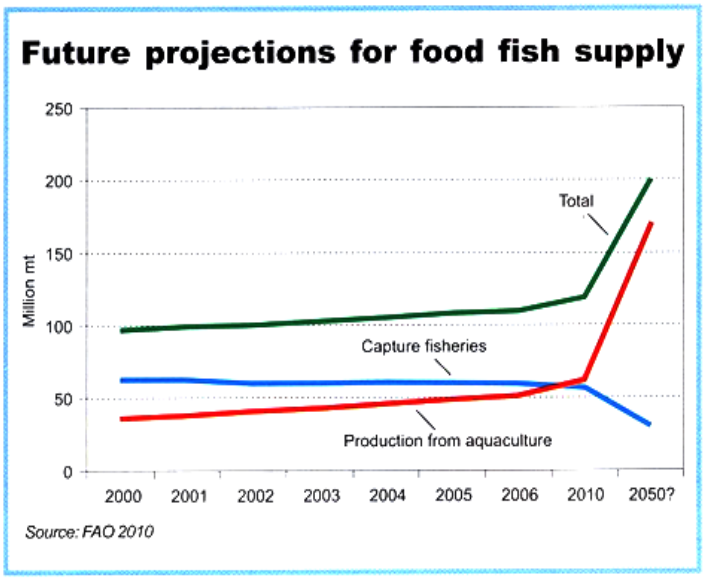

Fig. 2

Environmental factors such as water temperature, light intensity and soil/water quality and their interactions determine the carrying capacity of a pond and thus influence the fish

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production .The ability to support the growth of natural fish food organisms in the ecosystem is the result and effect of abiotic and biotic factors. Release of inorganic nutrients from pond soil in presence of sunlight enhances phytoplankton growth on which again the growth of zooplankton depends. Maintaining a balance of both these kind of plankton population throughout the culture period, will therefore be of help in enhancing the survival and growth of fish like carps. Water temperature also affects the dissolved oxygen content which, in turn, is responsible for nutrient absorption, bioenergetics and growth as well as aerobic decomposition of organic matter .In general, Indian Major Carps thrive well between a wide range of 20-30^0 C. Dissolved oxygen (DO) is considered the most critical water quality parameter in aquaculture. DO increases with the increase of light intensity and is recorded maximum around mid day and minimum in the early morning. Oxygen level below 3 ppm can create asphyxiation and therefore it is desirable to provide aeration in water in the early morning hours in case the cultured fish come to water surface for gasping air. Certain simple aeration devices followed by farmers are depicted in fig.-3(3a-3d). There have been found to work very well.

Unionized ammonia build-up may cause mass mortality in higher concentration. Aeration of pond is the most important step in maintaining these parameters within the desirable range .It reduces the free CO_2 as well as converts unionized ammonia into nitrate nitrogen. Liming of pond helps to maintain pH, alkalinity and turbidity in desired level and make nutrient available to the pond environment .It helps in buffering and enhancing the microbial action, thereby reducing the organic load at the pond bottom. Periodic raking the pond bottom with a nailed iron rod helps escape of obnoxious gases formed at the pond bottom and it also helps in mineralization.(Fig. 4) Generally lime is applied @ 250kg/ha- m which varies according to pH of the water.(Fig 5). Application of lime and organic manure form the basis of rural aquaculture in India.

Pond manuring is an extremely useful management protocol to enhance biological productivity using organic manure as well as inorganic fertilizer. There is difference in the fertilizer dose in ponds depending on their purpose, duration of culture and required size of stocked fish. Optimum fertilization rate is the amount that can be cost effective and utilized in a pond ecosystem without having any deleterious effect on water quality and fish growth.

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Some farmers maintain small poultry birds housed in bamboo cage thatched house (fig 6). near the pond sites The excreta are periodically collected and used for pond manuring after thorough sun drying. To avoid bird predation (like kingfisher, cormorant, heron etc.) in fish ponds fig 7, some farmers employ ingenious method of putting cotton threads and also hanging cassette tapes from such threads to control bird predation fig 8. Similarly predation by water snakes also is controlled by frequent visit to pond site and through netting.Post larval management.

Initial exposure of spawn to the external environment makes them susceptible to various infections including parasitic disease. Due to their slow moving ability they are easily accessible to predatory insects as well as food fishes; therefore it is mandatory to ensure predatory insect free water as far as possible for enhancing survival and growth of larvae. Lower digestive enzyme secretory profile of larvae makes them difficult to digest and assimilate exogenous feed properly; therefore first larval feeding is of crucial importance. Some farmers progressive in North 24 Parganas district,West Bengal collect the mixed zooplankton and allow them to get enriched with long chain-3 PUFA using shark liver oil / linseed oil. Rearing larvae on live food, for first few days and then adopting them slowly on dry powdered feed can help to enhance the survival and growth rate of larvae. Management of predatory fishes and snakes, monitoring the critical physicochemical parameters are important to ensure better survival and growth. The nutritional quality of live food like zooplankton get considerably enhanced through nutrients enrichment procedure like essential fatty acids which are generally found deficient in this community.

Zooplankton enrichment method:

Zooplankton culture can be maintained in outdoor tanks which are provided with a mixture of ground nut oil cake, cattle manure and single super phosphate by simple broadcasting. 10 days before addition of zooplankton inoculum, 50% of the fertilizer mixture may be broadcast into 2 split doses, followed by 2 equal 25% doses at 5 day interval after the inoculation. After 15 days of culture zooplankton can be collected and suspended @ density of 150-200 numbers /ml in stored and well aerated tap water maintained in glass jars. Fortification with vitamin C in the form of ascorbic palmitate can be made. Similarly, fatty

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acid enrichment can be done using olive oil in the presence of mayonnaise. Enriched plankton can be collected, washed and stored in clean freshwater for use in larvae culture.

Direct method of fatty acid enrichment of artemia

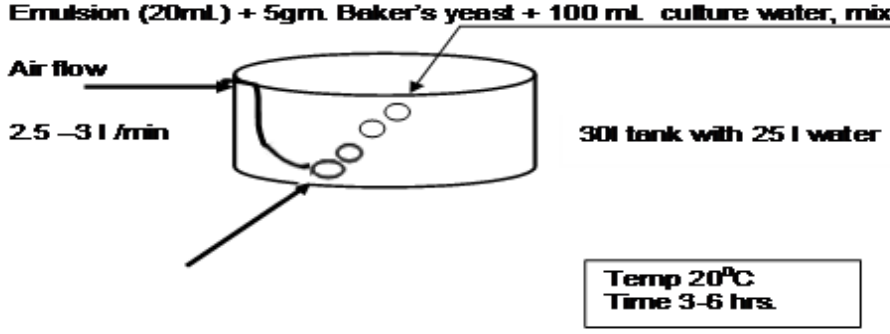
In this method, lipids containing n-3 fatty acids (HUFA) are homogenized with a small amount of raw egg yolk and water and the resulting emulsion is fed directly to live food such as artemia nauplii along with baker's yeast.

Preparation of emulsified lipid :

5g. good quality fish oil with fat soluble vitamins
+
10g. water soluble vitamins
+
1 g. raw egg yolk
+
100mL H_2O
→ then homogenize for 2-3 min using a mixer
Check under microscope for homogeneous state of emulsion
Store at 4°C until use.
Before use, check again & mix if needed

Enrichment of Artemia

Emulsion (20mL) + 5gm. Baker's yeast + 100 mL culture water, mix well



(100 - 200 nauplii / ml) 10h after hatching or 40h after incubation

Fig: 3 Fatty acid enrichment of live food organisms

Stocking intensification and management

The main aim of aquaculture practices is to harvest maximum fish yield per unit area of pond I the minimum period of time. Moreover it is also important to run the system in such a way that it becomes sustainable. Fish yield is the product of growth increment (Weight gain of the individual per unit time) and density (number of fish [per unit pond area). So, it is essential to manage the both to explore the yield product properly. The degree of

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intensification is the central theme of the aquaculture management; it is measured in terms of the levels of inputs and outputs. Extensive system involves a little management. Fish are stocked at low density and no feed is applied, producing relatively low yields at low productive cost. In contrast, intensive system is densely stocked and fish require high inputs of water oxygen, feed and industrial energy and removal of waste. High yields are obtained at high production costs.

Semi intensive systems lie between two extreme utilizing a combination of natural and applied feeds. This system requires varying levels of management. This is relatively less expensive system.

Stocking management also depends on some factors associated with the fish itself, like species, commercial value, sex, feeding habits, physiological states and heterozygosity. Mostly species having better growth are preferable for polyculture system while the commercial value of the species is equally important to make the system economically viable. Choice of stocking material depends on the targeted harvest size and pattern. If larger size (> 800 g) of fish is to be harvested under single cropping system, the stocking material of more than 100 g is preferred. Moreover, stocking of stunted fingerlings is a better option for the system. Monosex culture of fish compromising of male is always more productive in the system. Moreover lack of heterozygosity of stocking material is a matter of concern in present day polyculture systems. Inbreeding depression sets in most of the carp hatchery of India, as a result seed production in farm is suffering from asynchronous growth pattern and growth retardation. This problem can be tackled by genetic upgradation programme. Already some farmers have been using selectively bred rohu (Labeorohita) to tackle the problem.

A fish farmer should be made aware of the recommended management practices which have positive influences on fish growth and health. This is possible through periodic hands-on training towards capacity enhancement. It is necessary that fish gets the favourable water quality adequate nutrition for its growth and well being. It is well known that there are some common items like cow dung, lime, potassium permanganate which are very useful in water quality maintenance and therefore, their timely application will be vital. Organic carbon content of pond soil plays a key role in maintaining pond productivity and how best its normal content be maintained has to be demonstrated. For example, water quality monitoring especially increased demand of dissolved oxygen after feeding, observing feeding

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behavior and feed intake, timely availability of quality larvae (since this is still a serious impediment due to variable reproductive performances and unpredictable reproductive failure of brood stock). Again, since regulating the role of maternal nutrition on reproduction has profound effects on fecundity, hatchability and larval viability, providing the adequate nutrition through the application of suitable feeding strategy will benefit the production efficiency and protection of ambient water. The farmer ,therefore ,must be aware of i) the type of feed needed for various growth stages, ii) their declining consumption pattern for example with decrease in water temperature ,iii) the correct feeding methods for fry, fingerlings and the brood stock , iv) then quantity to be fed , v) time of feeding as per the biological rhythm, vi) mode of feed dispensation – all these are aimed to ensure enhanced nutrient utilization, optimize productivity and improve quality. Farmers often use hand woven cane trays hung from bamboo poles to feed the fish in culture ponds (Fig . 9)

Provision of aeration of pond water is required in case fish is found on water surface gasping for air. This is required to mitigate the oxygen deficiency – a common condition experienced by most fish farmers during aquaculture.

The rate of weight gain decreases when the biomass approaches the limit of the natural carrying capacity of the pond. Rate of stocking of fish is important for aquaculture; when too few are stocked, the result is large sized fish but low production; when too many are stocked the result is high production but small size; when optimum number is stocked there will be high production of marketable size. For every species it is necessary to find out the fast growing period when FCR (Feed Conversion Ratio) is the most efficient. The fish should be harvested when FCR starts getting upward trend. Maximum production is obtained by using combination of species of different feeding habits. Large no. of small fish can utilize the available food better than smaller number of large fishes.

Monosex population culture of tilapia & prawn : The monosex culture strategy for Tilapia and Scampi (Macrobrachiumrosenbergii) in particular is expected to be adopted on a large scale over mixed population culture for increased yield and for the simple reason that inherent energy is channelized for somatic growth only thereby preventing the unwanted breeding.

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The production is based on the single gene silencing for sex reversal (non-GMO technology) developed in Israel . This does not require chemicals or hormones and does not produce genetically modified organisms. It is based on the principle that a gene encoding insulin-like androgen hormone could be silenced through RNAi (not transmissible to future generations) at an early stage of maturity

Conclusion:

Water is the vital source for production system and its efficient use needs to be ensured and thus proper utilization of the available aquatic resources is essential for fish production in a sustainable manner. Pre-stocking management i.e. operational activities before stocking which includes lime and organic manure treatment has to be done religiously with scientific precision. Once pond become stabilized, stocking at per with the available nutrient sources in the different ecological niches, post stocking management mainly feed and fertilizer application, provision of aeration etc and finally harvesting of cultured fishes on attaining the desired weight can ensure profitability of the aqua culturists. The farmers will have to consider the necessary pros and cons so that they are able to harness the best water use efficiency and at the same time achieve their desirable production target. To make the efficient use of water from given water body, application of simple management practices is essential from the view point of economy and ecology. This will also have relevance for the production of human food of very high biological value at par with recommended hygienic standard.

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Figure 4 Oxygen deficiency conditions &its provision in pond during emergency needs

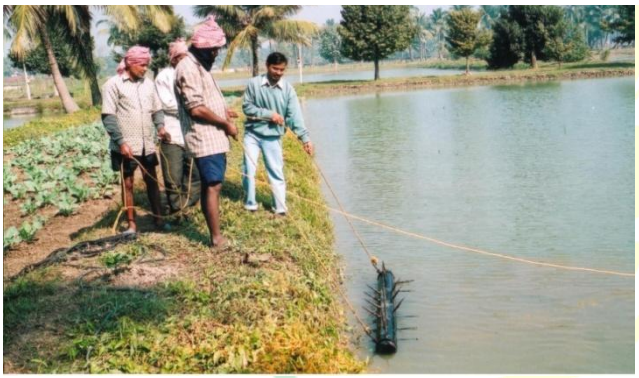

Figure 5 : Periodic raking of pond bottom & application of lime is crucial in aquaculture

Figure 6: Predatory birds may pose a common hazard in fish culture.

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Figure 7: A simple means to protect the pond from predatory bird

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Fig 8 A simple ways to provide feed the fish on a tray hung from a bamboo

Fig 9 Hand feeding & bag feeding with finely ground mixture of rice polish and ground nut Cake

Figure 10 Oxygen, pH & water transparency measurement