Chapter XI

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Fresh water bodies are among the most productive life support systems in the world and are of immense ecological importance for survival of natural biodiversity. By virtue of natural functioning, they play a very important role in the improvement of water quality, removal of sediments, production of O₂, recycling of nutrients, control of flood etc.

In our country there are so many derelict fresh water bodies in the form of tanks, ponds, swamps and flood plains. These ecosystems, if managed properly, can support fresh water culture fisheries in the country, provide livelihood to large number of fisherman and, therefore, can contribute significantly to the total inland fish production.

The fisheries of these derelict fresh water bodies are poorly developed. It is represented by minor carps, catfishes and certain air breathing fishes only and big commercial fishing is absent. The reasons are the slow rate of growth, low catch and inadequate management. In the Indo-Gangetic plains, the commercial fishery is dominated by major carps, catfishes and some air breathers. For obtaining high fish yield from these derelict fresh waters, adequate management practices are needed. These management practices differ from system to system and region to region e.g. the management approach in case of high mountain water bodies will differ from those located in plains. The mountain freshwater bodies are ecologically short food chain systems, mostly oligotrophic and with few plankton and benthos populations. On the other hand, the fresh water bodies in plains where the climatic conditions are not very harsh, range from mesotrophic to eutrophic in nature (Vass, 1995). These can be very well exploited for obtaining sustainable fisheries. It is said that comparative higher rate of primary production in these derelict freshwater bodies in the plains can be channelised into fish biomass by proper stock adjustment and adopting adequate management methods. The stocking density and species combination can be based on production potential food spectrum of each water body. At the same time efforts should be made to conserve the breeding grounds for the local varieties. For fishery
management and to obtain high yield from these derelict water bodies the following aspects are to be taken into consideration:

**Weed control:** Almost all-derelict water bodies in the Indo-Gangetic plains, including the present ones, are generally infested with rooted, submerged and free floating weeds, which in the long run may cause swampification. These aquatic weeds have been reported as menace to fisheries, as they prevent harvesting, they remove large quantities of nutrients from the water, after death and decomposition they raise the BOD of the water body thereby help in depleting D.O., sometimes form algal- blooms causing congestion and choking resulting in the death of culture fish, they provide escape cover to low value air breathing and predatory fishes and sometimes their filaments (e.g. filamentous algae) entangled in the gills of fishes causing suffocation resulting into death. While submerged weeds can be biologically controlled by using certain herbivorous fishes in the fish culture practices, the floating aquatic weeds, like water hyacinth, have to be eradicated through other means. For smaller water bodies, manual or mechanical methods of removal can be used, but for larger ones technology demands a combination of both mechanical and chemical means. Under biological control of submerged weeds, generally indigenous and exotic herbivorous fishes like, *Puntius punchellus*, *P. dobsoni* and *Ctenopharyngdon idella* are used. The former two species are endemic to India, while the last one is an exotic form.

**Control of unwanted fish species (Predatory weedy fishes):** Weed fishes are those, which are uneconomic, small sized that naturally occur and breed in the ponds or accidentally introduced in the ponds. Since, these unwanted fishes create problems in the aquaculture practices, their removal is must. The common methods to remove them is the repeated drag netting but some of them, like murrels, climbing perch and certain air breathing fishes which burrow themselves in the bottom soils can not be caught easily. In such cases the best method is to remove them by draining, the water out of the pond completely. In this way the water body can be cleared completely from such fishes. In addition, certain plant derivatives and organic chemicals are also used for their removal. Among plant derivatives, herbs, derris powder with 5% rotenone is commonly used. *Rotenone* is a plant product widely used in aquaculture.
(Jhingran, 1991). Other plant poisons used, are Safedsirri (*Albizzia procera*), Nogdona tithwan (*Artemisia vulgaris*), Akhrot (*Juglans regia*) and Kuchla (*Strychnos nuxvomica*). Besides these, seed powder of some plants, seed cakes (tea seed cake) and oil cakes (*Mahua oil cake*) are used for killing unwanted fish species. Among organic chemicals the most common are *Aldrin*, *Dieldrin*, and certain organo-phosphates.

**Control of Aquatic Predatory Insects:** Aquatic predatory insects form about less than 4% of total insect fauna of the world (Pennak, 1978). Nursery and rearing ponds generally inhabit large number of aquatic predatory aquatic insects, especially during and after rains. Most of them, either in their larval stage or adult stage, prey directly upon carp spawn and fry and some of them compete with the fry for food. There are 11 orders of class insecta comprising aquatic forms. Among them, members of orders Coleoptera, Hemiptera, Odonata are of great significance and importance. Among Coleoptera, diving bettles (*Cybister* sp.) and water scavenger bettles (*Sternolophus ruffipes*) are important. They feed on fish spawn and all kind of aquatic metazoans including small fishes. Among hemipterans, the back swimmers (*Notonecta*), giant water bugs (*Bellostoma indica*) and water scorpions (*Nepa* sp.) are predatory in nature and cause heavy loss to carp fry and spawn. Among Odonata, dragonfly nymphs are aquatic and predatory in nature and cause damage to carp fry and spawn. These aquatic predatory insects multiply very rapidly between initial poisoning and stocking of the pond. Many of them also fly from pond to pond, thus a pond, which has been cleared from the population, is soon repopulated with insects. Therefore, for effective control certain insecticides, which have capability to kill the insects but not the plankton, are used. They include emulsion of mustard and coconut oil with a cheap washing soap, oil of Alexendrian lorel (*Calophyllum inophyllum*) along with *Gammexene* and emulsion of high-speed diesel oil, hydride and water (Jhingran, 1991).

**Manuring:** In order to supplement natural fertility of the water body, it is necessary to apply some fertilisers which help in enhancing natural productivity through providing essentially needed nutrients, minerals, vitamins required for the production of aquatic biota particularly plankton. Before applying fertilizers, it is
desirable to use lime as it supplies calcium, one of the essential nutrients. Other uses of lime include correction of acidity of both bottom soil and water, speeding up the decomposition of organic matter thereby releasing CO₂ from bottom sediments, in raising the bicarbonate contents, establishment of strong pH buffer system, which prevents wide fluctuations in the pH of water and through its toxic and caustic actions kills bacteria as well as fish parasites in their life history stages. Among fertilizers, the most common are phosphate fertilizers (like super phosphates), nitrogenous fertilizers (sodium nitrate, ammonium sulphate, ammonium nitrate, urea etc.) potassium fertilizers (potassium nitrate and potassium sulphate) organic fertilisers like liquid manures and farm yard manures, sewage and activated sludge. In addition, soybean meal, cottonseed meal, mustard oil cake, mahua oil cake, green manure and compost are also used for manuring the culture ponds along with certain inorganic fertilizers.

**Stocking:** Stocking should be done with selected species of fishes in particular combinations. A desirable combination of four species of fishes is Catla 3, Rohu 1, Mirgal 1 and Common Carp 2. In the case of 6 species combination the Catla 1, Silver Carp 2, Rohu 3, Grass carp 1, Common Carp 1 and Mirgal 1 are used (Jhingran, 1991). Higher production is generally obtained with the species combination of the Indian and exotic fish species. The rate of stocking is computed from the following formula given by Jhingran (1991).

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\text{No. of fishes to be stocked per Unit area} = \frac{\text{total expected increase in weight}}{\text{expected increase in weight of individual fish}} + \text{mortality}
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The number of fingerlings to be stocked also depends upon the size of fingerling.

**Auto-stocking:** The sustainable development of commercial fisheries in these derelict waterbodies would involve a recurring expenditure on the collection of spawn and its transport for stocking. Auto stocking of I.M.C. during floods in such waterbodies, therefore, is the only viable alternative for their quick and profitable development. For this their effective management is a pre-requisite. The operation of sluice gates, wherever installed, is to be oriented in such a way as to facilitate the entry of brood fish and juveniles into the water body proper (Vass, 1995).
Supplementary feeding: Fertilization and natural food alone cannot help in obtaining high production of fish. To achieve this, it is necessary to provide some supplementary food to the fish in the culture ponds. A mixture of powdered oil cake of either groundnut, mustard, til or coconut with an equal weight of sieved rice or wheat bran is generally given at different rates as recommended by CIFA (Bhubneshwar). Grass carp, if stocked, may be fed with aquatic weeds such as *Hydrilla*, *Najas*, *Spirodella*, *Lemna* and *Ceratophyllum* etc.

Bio-manipulation: A proper understanding of the complex relationship of the food chain and patterns of energy flow in these water bodies will help in formulating policies for stocking. In general, there are two main routes through which energy flows in the aquatic ecosystem viz. grazing food chain and detritus food chain. Taking into consideration the vast load available in these derelict waterbodies and also the eutrophic character of these waterbodies, one may expect a continuous high rate of production by stocking a detritus-oriented fishes such as *Cirrhinus mrigala*, *C. reba*, *Labeo rohita* and *L. bata*. Nevertheless, the cascading effects of biomanipulations at different trophic levels need to be evaluated carefully. The sustained fisheries in these derelict water bodies require both micro and macro-planning. As the micro-planning approach is essentially project oriented, the macro-planning is divided into sector development. The major issues under sector development include cooperative development, credits and subsidiary schemes, technology transfer, changes in lease period policy, marketing, human resources development, insurance schemes and socio-economic considerations. Spawning areas of the fish need to be conserved and improved. Restricting the grazing pressure of animals along the catchment and regular planting of the nuded areas should be done. This will help in checking erosion, nutrient retention and reducing silt load into the system. The manipulation of biotic communities can be tried to obtain reasonable biological productivity from these derelict water bodies and subjected to a desirable level of exploitation.

Pen and Cage Culture: In recent years new culture systems have emerged. Of these, mention may be made of pen and cage culture. In India at CIFA, Bubneshwar, pen and cage culture has been field-tested for fry and fingerlings rearing in reservoir and to culture table size fish in these derelict waterbodies.
CONCLUSIONS

These derelict water bodies are valuable national resource and aquaculture is a viable option. At present, these ponds have a limited capacity for holding fish crop and their productivity is almost constant. However, by using management practices, we can increase it to a greater extent. The state fisheries department, district administration, and the village administration reserve the right to auction depending on the size and ownership of the water body. In these water bodies, intensive fish culture, if practiced, would be profitable and a production of approximately 5 - 10 t of fish can be achieved easily from one hectare of pond. In addition, they can also be used for integrated fish farming using *Makhana* or *Trapa* as other crop.

Stocking: To achieve the proposed harvestable fish yield of at least 500 kg/ha/annum or more, the water bodies need to be stocked with fast-growing fish species. It is suggested that a stocking density of 5000 No/ha of advanced fingerlings (> 4 inches) be followed. In view of the greater dominance of carnivore fish species like *Wellago attu* and other cat fishes in these derelict water bodies, stocking of fingerlings > 4 inches is a full-time exercise. These waterbodies have high infestation of aquatic weeds and so have very rich periphyton and rich detrital load at the mid column and the bottom respectively. These are important components of the food chain largely when in underutilized, it is suggested that the water body is stocked with Indian Major Carps (IMC) in the ratio of *Labeo rohita*-2, *Cirrhinus mrigala*-2, *Catla catla*-1. The migratory and resident variety of birds are the important component of these waterbodies as they help in maintaining the ecological balance by consuming forage fishes and providing nutrients. It is, therefore, also proposed that killing of birds be banned by enforcing suitable measures.

Conservation and Management: All water resources including shallow derelict water bodies have enormous social value. Besides, they provide substantial amount of food of both plant and animal origin. They also act as habitats for many plants and animals including threatened and endangered species. Their role in agriculture and irrigation, flood control, ground water recharge, water pollution,
filtration and sediment trapping, soil protection from erosion, food production and over and above as water reservoir is notable and need no mention. These environmental benefits also provide many social benefits like recreation, open space, aesthetic and economics. As we must be aware that these ecosystems are not entirely closed, they will interact with and be influenced by surrounding ecosystems. External influences arising from outside the adaptive boundaries will continue to be important and must be taken into account.

Management generally involves activities that can be conducted within and around aquatic ecosystems, both natural and manmade to protect, restore, manipulate or provide for their functions and values. The management goal for urban waterbodies is generally constrained by regulatory and other governmental programmes. However, two major facets of managing wetlands for protection include buffering wetlands from direct human pressure and maintaining natural process in surrounding lands that affect wetlands and that may disrupt human activities. The major objectives of management of these derelict waterbodies, under study, are restoration from eutrophication, commercial fish production, water sports, eco-development and eco-tourism. Several management methods have been suggested for the restoration or recovery of lentic waterbodies (Sinha 2001). These are as follows:

i) Reduction in external and internal loading,

ii) Biomanipulation to create clear water conditions in the summer,

iii) Re-establishment of macrophytes on the marginal areas only, and

iv) Stabilization of the lake ecosystem, including the re-establishment of appropriate fish population.

Zalewski (1999) has also suggested the eco-hydrological approach in lake restoration, which regulate water and biota dynamics. Although, several mechanisms have been suggested for the maintenance of macrophyte communities in restored lakes, the importance of interactions between fish, zooplankton and macrophytes is to be established in the process of restorations (Perrow et al., 1997, 1999). Although the process of eutrophication is a natural phenomenon, its rate in nature is extremely slow. However, it is accelerated by pressure generated from dense human population
in urban areas. All these ponds are sewage fed and can be utilized for sewage fed fish culture.

Planners need to be able to identify activities, which are possible in different water bodies, and at what intensities. Research related to such waterbodies is essential as a basis for sound science including more studies of applied problems. These might include studies on the importance of individual waterbodies in fish production, the hydrobiological and ecological functions, the impact of waste disposal upon the productivity, traditional system of their use, the impact of change in traditional land use controls upon the resources, the impact of population change and climate change upon these and other critical characteristics. Rural communities are dependent upon these and these are overused to meet their basic family need. Project activities should be designed to assess the concerned communities and to find solution for their economic and resource management problems.