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Integrated Fish Farming: A Sustainable Approach

Aleena Antony
College of Fisheries, Dholi, Dr. Rajendra Prasad Central Agriculture University, Bihar

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Introduction

Integrated fish farming (IFF) is a sustainable system of aquaculture where sequential linkages between two or more farming activities are utilised with fish farming as the major component. IFF ensures maximum utilisation of resources, reduces risk of crop failure and provides additional income to farmers and food for small scale farming household. Integrated aquaculture like any other integrated farming system involves recycling of by-products and interconnected nutrient flow of one system as input for other, thus maximising the production from a unit area at minimum cost. This system paves path for an organic aquaculture management system that can augment integrated soil water fertility management (ISWFM) and can boost biodiversity and biological cycles. IFF has been successfully practiced in several Asian countries like China, Malaysia, Vietnam and India over many years. Fish farming can be integrated with agriculture, horticulture, poultry or livestock.

Fish Species in IFF

In India usually traditional system of IFF is practiced, where poly-culture fingerling stocking of six species combination of Indian Major Carps (catla, rohu and mrigal) and exotic major carps (grass carp, silver carp and common carp) is done. Minor carps like Labeo calbasu, L.bata, Puntius sarana etc. are candidate species of regional significance in IFF poly-culture system. The carp species can also be cultured under mixed system with freshwater prawns like Macrobrachium malcolmsonii, M.rosenbergii etc. or with catfishes like Heteropneustes fossilis (singhi), Channa striatus (murrel), magur, ompok and mystus species with proper combination and ratio for optimum utilisation of organic resources.

Food Web in Fish Pond

The by-products obtained from agricultural crops such as the rice bran, rice polish, wheat flour, mustard oil cake, soya bean etc., can be processed into fish feed while the excreta, dung, urine or left over feed from livestock can be used as a source of fertilizer. The

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released nutrients can contribute to the generation of fish food organisms such as the planktons. However, a proper knowledge about the pathways of animal waste application in ponds, nutrient accumulation in sediments, conversion of natural fish food organisms etc. is necessary for successful implementation of IFF and achieving duel benefit.

Types of IFF Systems In India

Indian farmers usually follow two types of IFF; agri-aquaculture based systems and livestock-fish systems. These are 'one to one single system' approaches. The agri-aquaculture based systems include paddy-fish, horticulture- fish, mushroom- fish, sericulture-fish, vermicomposting-fish systems etc., whereas the livestock- fish systems encompasses goat-fish, cattle-fish, pig-fish, duck- fish, poultry-fish, rabbit-fish systems etc. The 'multi-system approach' is another innovation which involves the combination of agri-aqua-animal husbandry commodities.

Agri-Aqua Based System

Paddy–fish system is an age-old practice in India. The paddy fields that remains water logged even after the harvest of crop are ideal for fish culture and provide farmers with off-season income. Pokkali of Kerala, Khazans of Maharashtra etc. are some the examples of traditional rice cum fish/prawn culture. The ecological benefits of such systems include weed and pest control, bioturbation of soil-water interface etc.

Horticulture-Fish System

Olericulture which involves the production of nutritious fruits and vegetables can be incorporated with aquaculture. The pond dykes can be utilised for cultivation of fruits like pineapple, banana, papaya etc. or vegetables like okra, tomato, carrot, peas etc. Plantation of flowers like jasmine, gladiolus, rose, marigold etc. can add remuneration to farmers. Here, pond water is used for irrigation and the plant wastes are incorporated in to the pond. Herbivorous species like the grass carps are ideal for this culture system.

Mushroom-Fish System

Mushroom cultivation requires high degree of humidity which can be fulfilled by the aquaculture environment. Spent mushroom substrate is an ideal manure for aquaculture as well as agriculture.

Sericulture-Fish System

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Mulberry plants can be planted along the dykes of fish pond and the waste products such as the silk worm excreta can replenish the nutrient content of pond. Vegetables can be inter-planted with mulberry plants. The estimated production from this type of IFF is about 2-3 tonnes/ha/year of fish.

Animal husbandry-Fish Based System

Fish farming using raw cow dung is a common practice everywhere. Cow dung fertilises the pond and hence increases its productivity. Estimated production from cattle cum fish culture is around 3-5 tonnes fish/ha/year without any supplementary feed and about 2400-3000 litre of milk per cattle. Goat excreta are also very good manure. Pig-fish systems are preferred for production of meat and fish at low coast. About 40-75 pigs can be grown per hectare of pond and the fish production can be up to 4500kg/ha/year. Common carps are ideal candidate fish species for this IFF system.

Figure 1: Poultry Cum Fish Farming

Duck-fish system is very common in states like Kerala, Tamil Nadu, Bihar, Assam, Odisha etc. Duck droppings and urine are sources of nitrogen, phosphorus and carbon which are required for the production of natural fish food organisms. Ducks feed on tadpoles, frogs and insects like dragonfly thus making a safe environment for fish .Also the movement of ducks will aerate the pond. About 250-300 ducks and 5000-6000 fish can be grown per hectare of pond. The estimated production is around 3000-4000 kg of fish, 500-600 kg of duck meat and 18000 eggs.

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Table 1: Possible Integration of Fish Farming With Livestock

Type of IFF	Suitable Number Of Livestock Per Ha of Pond.
Duck-Fish	400-550 Ducklings
Poultry-Fish	500-600 Chicks
Cattle-Fish	Cattle
Buffalo-Fish	Buffaloes
Goat-Fish	Goats
Pig-Fish	30-40 Piglets

Conclusion

Aquaculture is a sunrise sector in India with enormous scope. About 60% of the total aquaculture production cost is accounted by artificial feed that is given to the farmed fish. This problem can be overcome to a great extent through integrated fish farming (IFF) as in this system the by-product or waste generated from one culture system can be utilised as nutrient input for another system. Fish farming can be integrated with agriculture, horticulture or animal husbandry practices. IFF has myriads of benefits such as supporting farmer's income, sustainable organic production, decreasing inorganic pollution due to excessive use of fertilisers, control on sewage production etc. Presently IFF is done based on traditional knowledge of fish farmers. Increased scientific knowledge, planning and proper management strategies are required to establish IFF as a sustainable approach to aquaculture in its full potential.

Reference

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