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Integrated Livestock- Fish Farming: A Sustainable Eco-friendly Farming

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Introduction

In the conventional fish culture system, fish feed and fertilizer play the key role for fish production. In most cases, farmers cannot afford to purchase feed and fertilizer round the year. As a result, improper feed and fertilizer management do not contribute to achieve the target production. But these feed and fertilizer could easily be supplemented by livestock through integrated fish culture. Integrated livestock-fish culture approach envisages the integration of fish farming with Cattle, Sheep, Goats, Poultry, Pigs or Rabbit husbandry in a design allowing wastes from one system to be used as inputs in another system. The aim is to conserve resources while increasing farm returns. Aquaculture contributes to human food fish demands, poverty alleviation and rural development and is often mooted as the fastest growing food production sector in the world. Integrated Agriculture Aquaculture (IAA) combines aquaculture with different agricultural systems into an interactive relationship with the expectation that together, they will generate synergistic effects on conservation of resources and profitability. Livestock production and processing generate by-products that may be important inputs for aquaculture. The main linkages between livestock and fish production involve the direct use of livestock wastes, which function as fertilizers to stimulate natural food webs in fish ponds. The integration of aquaculture with livestock or crop farming provides quality protein food, resource utilisation, recycling of farm waste, employment generation and economic development. Integrated fish farming is well developed culture practice in China followed by Hungary, Germany and Malaysia. Our country, India, is organic-based and derives inputs from agriculture and animal husbandry. India supports largest bovine population of over 222 million Cattle heads, along with 181 million Sheep and

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Goats, 16 million Pigs and over 150 million Poultry and other livestock. The integrated fish farming is accepted as a sustainable form of aquaculture. Integration of fish farming with animal husbandry is considered as sustainable fish farming system, which offers greater efficiency in resource utilization, reduce risk by diversifying crop, provides additional income and food for small scale farming household. Integrated farming can play a significant role in increasing manifold production, income, and nutrition and employment opportunities of rural populations.

Integrated Livestock fish farming:

Cattle-cum-fish farming

Fish farming using cow manure is one of the common practice all over the world. Among all livestock excreta, cow excreta are the most abundant one in terms of availability. A healthy cow weighing about 400-450 kg excretes over 4,000-5,000 kg dung, 3,500- 4,000 litre urine on an annual basis. Cow manure particles sink at 2-6 cm/minute as against 4.3 cm/minute of pig manure. This provide sufficient time for fish to consume edible portion available in dung. Furthermore, biological oxygen demand of cow manure is lower than that of other livestock manures as it is already decomposed by microorganisms in rumina. The faeces and urine are extremely beneficial for filter feeding and omnivorous fish such as Catla and Silver carp. A unit of 5-6 cows can provide adequate manure for 1 ha of pond. In addition to 9,000 kg of milk, about 3,000-4,000 kg fish/ha/year can also be harvested with such integration.

Cows shed should be built close to fish-pond to simplify handling of cow-manure. The excreta and the urine is collected separately or can be flushed directly in to fish pond. This method saves time and labour. Grown up cow requires about 7,000-8,000 kg of green grass annually. The leftover grasses which are about 2,500 kg, are utilized by Grass carp.

Goat-cum-fish farming

It is considered as poor man's cow and a goat's excreta is considered as a very good organic fertilizer. The goat excreta contain Organic carbon 60%, Nitrogen 2.7%, Phosphorus 1.78%, Potash 2.88% and its urine is also equally rich in both Nitrogen and Phosphorus. At least 50-60 goats are essential to fertilize 1 ha pond. The goats should be provided with dry, safe, comfortable house protected from excessive heat. The goat breeds are Jamanapari, Beetal, Barbari for milk and Bengal, Sirohi, Deccani are used for meat purpose. Goats are selective feeders and consume Berseem, Napier grass, Cowpea Soybean, Mulberry etc.

An adult goat weighing about 20 kg discharges 300-400 kg excreta on a daily basis. For manuring 1 ha of water area with a herd of 50-60 goats will be needed. It has been observed that *Labeo rohita* and *Cirrhinus mrigala* grow well when pond is manured with goat excreta. This integration can produce 3.5-4 tonnes/ha/year of fish without supplementary feed or fertilizer in addition to goat-meat which has ready market throughout the country.

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Duck-cum-fish farming

The duck is commonly called as biologicals aerator. They are reared on the dyke of the pond in a low-cost house. This farming is practised in Tamilnadu, Assam, Bihar, Andhra Pradesh, Tripura, Orissa, Karnataka, Kerala and Uttar Pradesh. The 'Indian runner' and 'Khaki campbell' varieties are found more suitable in this culture. Duck droppings and urine from the house used as nutrient source provide carbon, nitrogen and phosphorus, for production of natural food organism used by fish in duck-fish integration. Housing for layer duck should have good ventilation, space area, laying boxes, egg trey with multi-door facility to remove washing, feeding and collection of eggs. In duck-fish integration, the houses are built in the middle of the pond or on the pond dykes or in a centralized system or in floating house. Day-old ducks are available for rearing in duck shed. These weigh about 50-60 g and need brooder house lighting temperature, ventilation etc., with a brooding period of 1-3 weeks to be allowed to swim freely in water.

Ducks laying eggs after 6 months of age and continues for 2-3 years depending on the duck species, nutrition, health and environment since egg laying is in the night-time, there is no possibility of an egg laid when birds are in ponds. About 300 no. of ducklings (some spp. are reared 450-500 in no.) are reared to fertilize the 1 ha. pond. The duck not only act as live aerator by splashing water with their webbed feet but also control the aquatic weed (Lemna, Azolla etc.), aquatic insects, molluscs, tadpoles etc. Each duckling requires about 0.3-0.5 square meter area as living space. The total production from such type of culture is about 3500-5000 kg fish, 18000-18500 eggs and 600 kg of duck meat. The duck droppings are used as manure for primary production.

Pig-cum-fish farming

This system of integration is very common in China, Taiwan, Vietnam, Thailand, Malaysia, Hungary and some European countries. The White Yorkshire, Hampshire and Landrace are the popular breed of pig for integration with fish. Pigs need clean housing which should provide adequate protection from adverse climates. This system has certain advantages over others. The 30-35 pig's waste may produce 1 tonne of Ammonium Sulphate and 40-45 pigs are adequate to fertilize 1 ha water area under polyculture. Each pig requires about 3-4 sq.mt. floor space. Pig-fish integration system are better compared to other integration system because of production of meat and fish at a cheaper feeding cost. A floor space of 3-4 m^2nis required for a pig weighing 70-80 kg. The popular exotic pig breeds that are preferred by farmers for rearing are White Yorkshire, Landrace and Hampshire. The pig dung and urine is utilized for fertilization of culture ponds which is either channelized directly or partially decomposed before application in ponds.

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Scientifically prepared base feed-mixture offered to pigs comprise maize, groundnut, wheat-bran, fishmeal and mineral mixture. To reduce the cost of feed for pig, many farmers in India use agro-industrial waste (press mud, poultry droppings, distillery waste), vegetables waste (rotten potatoes, tomatoes, pumpkin etc.) mixed with pig feed mash. A full grown provides 500 to 600 kg of dung in a year and excreta of 40-45 pigs provides required quantity of manure of fertilize 1 ha pond. Pigs attain slaughter size (60-70 kg) within 6 months. Polyculture practices of fish with Indian major carp and exotic carps is undertaken in fish-pig farming ponds. Partial harvesting of marketable fish offers higher yield in this type of integration. Fish harvest results in 3-4 tonnes/ha without any feed and fertilization in 12 months culture period at the stocking rate of 8000-8500 fingerlings/ha.

Poultry-cum-fish farming

Poultry fish system provides poultry droppings and litter in to fish pond and acts as a fertilizer source for production of fish. In India it is practised in Andhra Pradesh, Bihar, Haryana, Kerala, West Bengal, Uttar Pradesh, Maharashtra, Orissa, and Tamilnadu. In this system farmer's efficiency in management, experience, aptitude and ability helps to get better economics. Management including includes good quality of chicks housing, brooding equipment, feeder, water treys and prevention and control of disease. This system utilises poultry droppings of fully built- up poultry litter for fish culture. They require 0.3-0.4 square meter space/bird. Hoppers are used to feed them and to minimise feed wastage. The poultry birds (layers) are fed with starter, grower, and brooder feed according to their age. Recycling of poultry waste such as leftover feed, droppings and litter are used to increase biological productivity of pond water. The deep poultry litter is applied to pond at 30-50 kg/ha on daily basis. One adult chicken produces about 25-30 kg of compost poultry manure in a year to provide sufficient manure. For 1 ha water-bodies, 1000 birds produce sufficient manure with 90,000-100,000 eggs and over 1500 kg of meat per year while boiler rearing provides over 1500 kg meat/batch. At least 5-6 batches can be reared in a year. A production of 3,000-4,000 kg of multispecies fish could be harvested from such system.

Rabbit-cum-fish farming

Until recently, rabbit was considered, at least in India, as a pet animal by common citizen, while an experimental animal by professionals, but currently it has emerged as an alternate meat source and can play an important role as a non-conventional meat animal. Rabbit meat is preferred by most of the health-conscious consumers owing to its low fat in comparison to other meats. The important meat breeds are Soviet Chinchilla, Grey Giant, and White Giant etc. Rabbits are reared in cage, hutch and floor system (floor should be cemented). Rabbit excreta contain organic carbon-50%, N-2%, P-1.33%, and K-1.2%. The rabbit excreta are high in nitrogen content and

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low in moisture, thus quality manure for sustained plankton production. It is estimated that excreta from 300 rabbits would be enough for 1 ha pond fertilization.

Nutritive values of different animal excreta

Animal	Excreta	Moisture (%)	Organic matter (%)	Nitrogen (%)	Phosphorus (P_2O_5) (%)	Potash (K_2O) (%)
Cattle	Faeces	80-85	14.0	0.3	0.2	0.1
	Urine	92-95	2.3	1.0	0.1	1.4
Pig	Faeces	85	15	0.6	0.5	0.4
	Urine	97	2.5	0.4	0.1	0.7
Chicken	Faeces	78	25.5	1.4	0.8	0.6
Duck	Faeces	81	26.2	0.9	0.4	0.6
Rabbit	Faeces	10	37	2.0	1.3	1.2
Goat	Faeces	10	-	2.7	1.7	2.9

Advantages of Integrated Livestock- Fish Farming systems

Integrated fish farming systems utilise the waste of livestock, poultry by products for fish production. About 40-50 kg of organic manure can produce 1 kg of fish. Pond silt can be used as fertiliser for fodder crops which in turn can be used to raise live-stock and poultry or as fish feed. Thus, a recycling of waste is done in integrated fish farming system. The scope of integration in a fish farm is considerably wide. Ducks and geese may be raised on the pond, pond dykes may be used for fruit plants and mulberry cultivation or for raising pigs, cattle, and dyke slopes for fodder production. From integrated fish farming systems not only fish but meat, milk, eggs, fruits, vegetables, mushrooms etc. can be obtained. This system fully utilizes the water body, the water surface, the land, and the pond silt to increase food production for human consumption. The integrated fish farming system holds great promise and potential for augmenting production, betterment or rural economy and generation of employment. In India this has a special significance, as it can play an important role in improving the socio-economic status of a sizeable section of weaker rural community, especially the tribals.

Constraints

Most of the integrated aquafarms in Asia are under operation in traditional way without proper planning, application of available latest technology and management techniques. The farmers in most of the case depends on the personal experience. Marketing of the farm produce is another constraint faced by farmers except where there are established markets. Due to lack of

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knowledge and inadequate experience farmers may face loss due to disease outbreaks. Animal feeds and veterinary medicine manufacturers generally offer extension service to farmers, but due to lack of proper roads, distances, this may not be possible. Lack of working capital may force farmers to sale their produce to middleman, usually at low price.

A sustainable technology is the need of the hour for higher production from existing agricultural land water. In this regards, integrated farming offers a possible solution and holds a great promise and potential for augmenting production, betterment of rural economy and employment generation, and finally improving socio-economic status of weaker rural community.

Conclusion

Although integrated farming has now been proved to be highly profitable, its practice remains very limited in scale. This is because the relevant scientific and technological information on diversification of methods is unavailable to farmers. To remedy this, there must be a bridge between the information sources and the farmers, perhaps through extension services. A multidisciplinary approach is needed, including technological, economic, social and political aspects which are interrelated. Any approach must, however, be relevant to national economic, social and environmental conditions and to the farmers need.

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