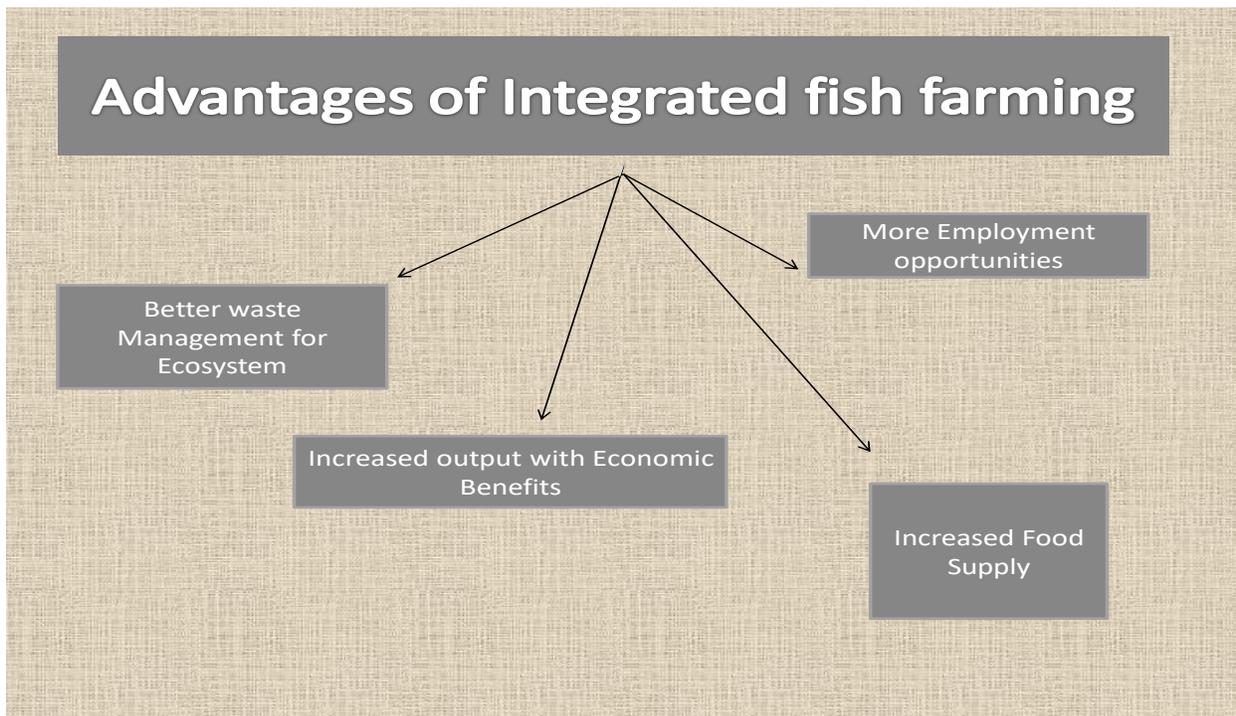


INTEGRATED FISH FARMING (IFF) & THEIR MANAGEMENT
Prepared by Prof. SUNIL P. TRIVEDI, DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF LUCKNOW, LUCKNOW-226007

Integrated farming may be defined as a sequential linkage between two or more farming activities. When the fish becomes a major commodity of this system it is known as integrated fish farming (**IFF**). Thus, the practice of Combining Fish Culture with Agriculture or livestock for full Utilization of resources and increased production is commonly known as Integrated Fish Farming.

PROSPECTS /Advantages of IFF: They include efficiency in resource utilization, efficient utilization of wastes from other culture practices, reduction in risks by diversifying crops, recycling of wastes/ by products of one farming system as input for another system, efficient utilization of available farming space for maximum production, additional source of food and income, a reduction in additional cost for supplementary feeding & fertilization. In fact, IFF is an artificial balanced ecosystem without any waste. It generates more avenues for employment, it reduces the input and increases output and economic efficiency. IFF provides fish, meat, milk, vegetables, fruits, fodder, eggs, grains, & mushroom etc. Altogether, IFF has enough potential for rural livelihood & socio-economic status.



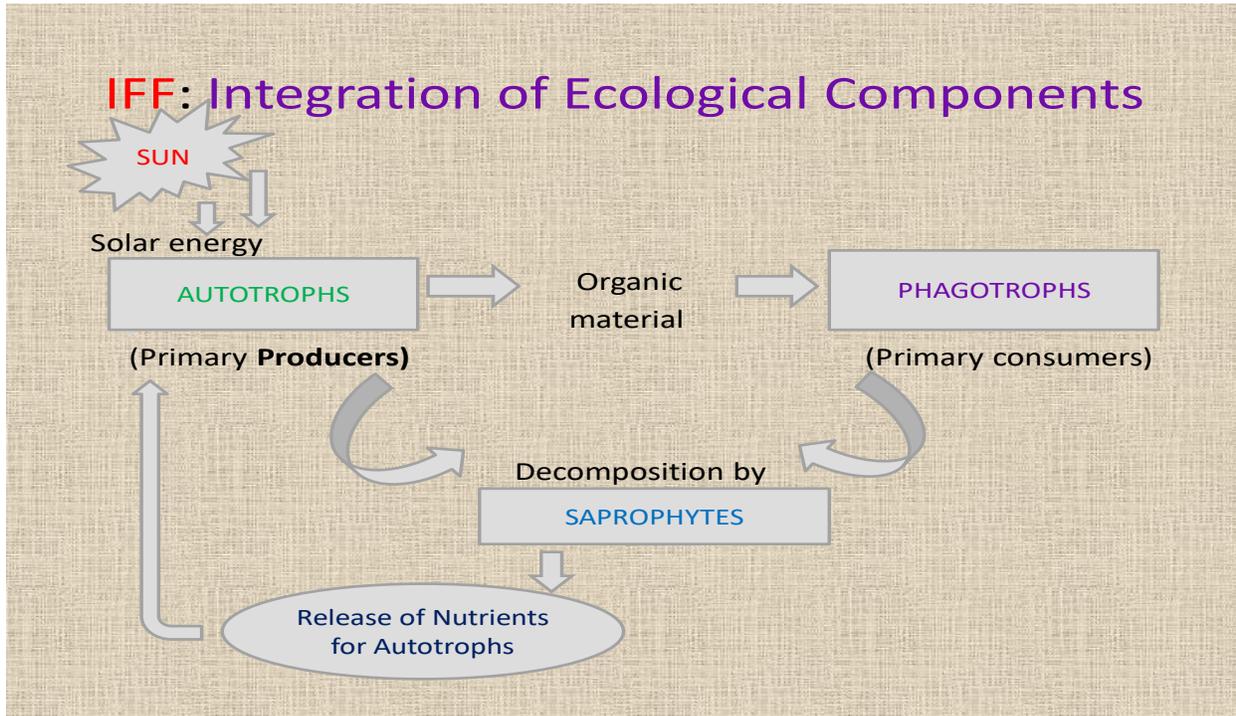
SCOPE

- Utilizes wastes from different components, livestock, poultry, & agriculture by products for fish production.
- Complete recycling of wastes: Organic wastes(40-50 kg) → Fish (1kg), pond silt utilized as fertilizer for fodder crop → livestock/poultry/fish feed
- Raising of ducks and geese
Pond dykes → horticulture , agriculture crop production & animal raising.

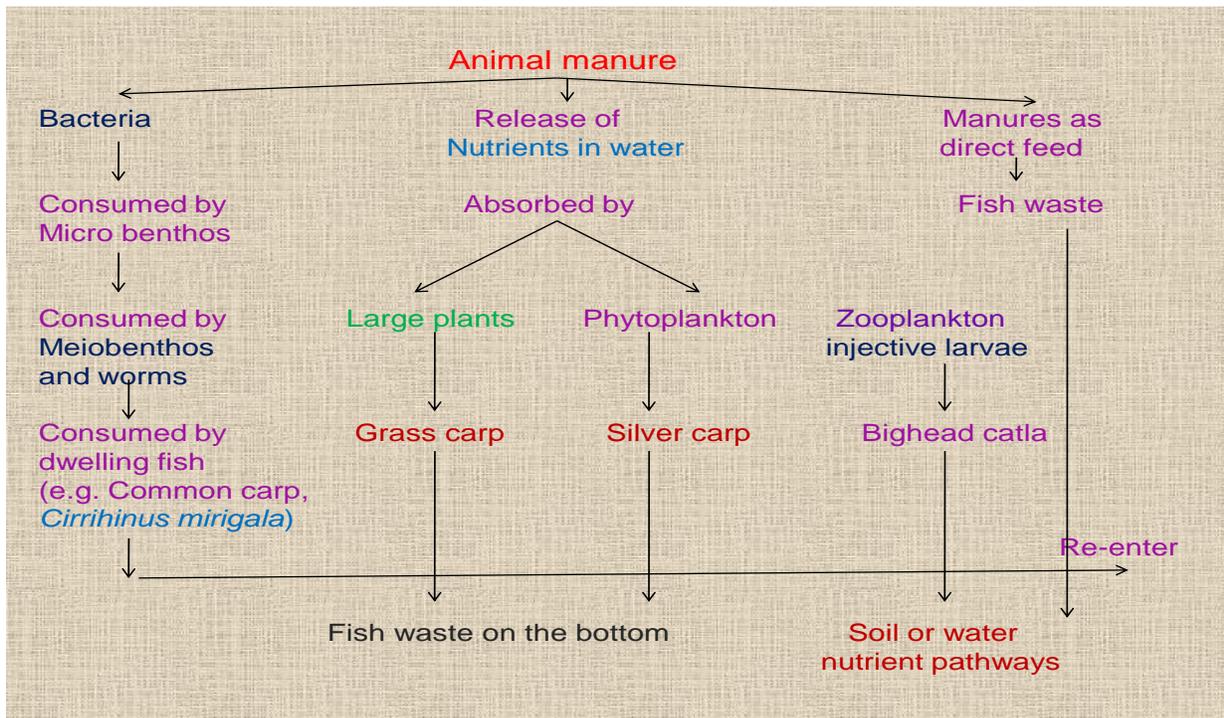
- The system provides meat, milk, eggs, fruits, vegetables, mushroom fodder & grains, in addition to fish.
- Utilizes water bodies, water surface, land , and pond silt for increased food production
- Holds great promise for augmenting production, betterment of rural economy, employment generation, and improving socio-economic status

IFF: Displays Integration of Ecological components- In IFF different ecological components displays a perfect integration. Sun is the ultimate source of energy. Solar energy is trapped by chlorophyll bearing autotrophs. They produce food (organic material) and thus, are designated as primary producers. The food is consumed by primary producers (Phagotrophs). Both

autotrophs and phagotrophs after their death are decomposed by saprophytes. Ultimately, the nutrients are made available in the pool for autotrophs.



IFF: A model for sustainable food production: IFF is an appropriate model for sustainable food production. Wastes (output) of one biological system serve as nutrients (in-put) for another system in IFF. For example in carp farming, animal manure can be efficiently employed as potential nutrients. Likewise, plants & fish integration results in a polyculture that enhances diversity and multiple yields. In IFF, water is re-used through biological filtration and re-circulation. IFF also involves local production of healthy foods and improvement in local economy.



SOURCE: Handbook of Fisheries and Auaculture, ICAR, New Dwlhi, (2006).

Justification of IFF for country like INDIA: India being an agrarian economy produces large quantities of animal & plant residues, to the tune of over 322 & 1,000 million metric tones, respectively, on annual basis. Our country provides larges bovine population of over 307 million cattle heads, along with 181 million sheep & goats, 16 million pigs, & over 150 million poultry and other livestock. Apart from activities like mushroom cultivation, rabbit rearing, Sericulture, Laculture and Apiculture, which provide huge quantities of organic material for aquaculture, different agro-based industries also produce effluents which could be effectively used after proper recycling for aquaculture in addition to the domestic sewage to the extent of over 4,000 million liters on daily basis.

Integred Fish Farming: Types A. Fish farming with Agriculture (Agri-based fish farming);

1. Paddy-cum Fish culture, 2. Horticulture-cum Fish culture: Vegetable-cum Fish culture, Fruits-cum Fish culture, Flowers-cum Fish Culture, Mushroom-cum Fish Culture, Sericulture-Fish Culture, Fodder crops-fish Culture

B. Fish farming with Livestock (Live-stock fish farming): Fish cum pig Culture, Fish cum duck culture, Fish cum Poultry culture, Fish cum cattle culture.

A. Agri-based fish farming

1. Paddy – cum Fish Culture

- It is commonly practiced in countries like Japan, Malaysia, China and India (Southern and North eastern states: Assam, Bengal, Bihar Orissa, AP).
- Paddy fields remain flooded with water for considerable duration (3-8 months) hence fish can be grown along with rice at low additional cost.
- Traditional varieties of rice that require little inputs of harmful pesticides and fertilizers are more suited.

Advantages of fish- cum paddy culture

- Fish production is done at no additional cost.
- Rice production is increased by 10-15% due to increase in fertilization by fish excreta.
- Unwanted aquatic weeds and algae are eliminated by fish.
- Insect pests of rice like stem borers are eaten by fish.
- Mosquito larvae are eliminated by fish, thus controlling malaria.
- Fingerlings produced can also be sold in market.

Paddy-cum Fish Culture: **Types of paddy plots**

- (i) Perimeter type: paddy is grown in the middle
- (ii) Central Pond type: paddy is grown on the perimeter of paddy fields.
- (iii) Lateral trench system: Paddy is grown in the trenches provided on either one or both the sides of the moderately slopping field.
- **NOTE: Interest in paddy-cum fish culture is declining, CPC, High Yielding Rice Varieties**

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2. Horticulture-cum Fish Culture

- ICMR recommends 85g of fruits and 300g of vegetables for every human being on daily basis.
- Fruits and vegetables are rich in vitamins & minerals.
- Crops of fruits, vegetables & flowers can be cultivated on inner and outer dykes and adjoining areas of the fish pond.
- Crop plants should be seasonal, evergreen, dwarf, remunerative and less shady.

Horticulture-cum Fish Culture

(i) Fish cum aquatic herb culture

- *Euryale ferox* (Makhana) and *Trapa indica* (Singhara), two aquatic herbs, can be integrated along with air-breathing or carnivorous fishes.
- These cash crops are cultivated in many states as they have both nutritional & medicinal values.
- This acts as additional income with little input and care.

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Horticulture-cum Fish Culture :

Makhana cum fish culture

- It is a common practice in Bihar to grow air breathing fishes with Makhana plants.
- Fish species suitable for culture are *Heteropneustes fossilis*, *Clarius Batracus* and *Anabas testudeni*.

Trapa cum fish culture

The common chestnut, *Trapa indica* is another herb cultured in Tropical water bodies. It can also be coupled with Fish farming .

(ii) Horticulture-cum Fish Culture

Fruits- Fish Culture

- Banana, mango, papaya, lime and coconut plants can be cultivated on the pond embankments in rows, by making ditches between the rows, ditches have continuous supply of water.
- Air breathing and larvivorous fishes such as *Channa marulius*, *C. striatus* and *Tilapia* can be cultured in these ditches, which have a rich population of insects larvae.

(iii) Horticulture-cum Fish Culture: **Vegetable-cum fish culture**

- Vegetables are rich in a variety of nutritive elements.
- Selection of the suitable crop is the main criterion.
- Seasonal, fast growing and market ready crops should be preferred.
- Brinjal, tomato, gourds, cucumber, chili, carrot, radish, turnip, spinach, cabbage, cauliflower, ladies finger etc may be the choice.

(iv) Horticulture-cum Fish Culture: **Flowers-cum fish culture**

- Flowering plants like Rose, jasmine, Marigold, Gladiolus, Chrysanthimum and poppy etc. can be successfully cultivated along the pond embankment.
- Flowers provide fragrance and beauty.
- They have ready market.
- Flowers-cum fish culture provides 20-25% more returns in comparison to aquaculture alone.

(B) Live-stock fish farming

- Live-stock resources can be successfully cultured along with a variety of fishes having good food value.
- Both indigenous and exotic breeds of live-stock can be accommodated.
- Pigs, Poultry, Ducks, Cattles, Goats and Rabbits are good reference of live-stock.
- Major carps are the suitable choice.

(i) Fish cum pig culture

- Fish culture is linked with pig husbandry by providing pig houses on the pond embankment.
- wastes and excreta is directly drained into pond.
- Pig dung is a good fertilizer.
- Fish feeds directly on the excreta which contains 70% digestible food for fish.
- This system of integration is very common in China, Taiwan, Vietnam, Thailand, Malaysia, Hungary and some European countries.

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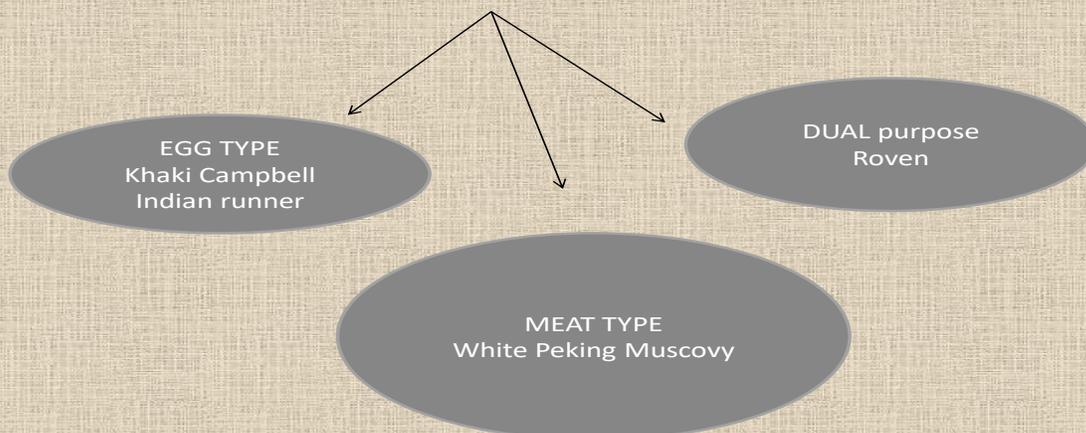
Advantages of fish cum pig culture

- Pig meal is very cheap. The pigs are fed on pig mash which is largely composed of agricultural wastes, viz. rice bran, rice polish, wheat bran, broken maize, ground-nut oil-cake, fish meal mineral mixture, salt, spoiled vegetables etc.
- Annual yield: 3000-4000kg/ha/fish; 4500kg pig meat; 800 piglets.
- **Popular breeds** of pigs for integration with fish: **The white Yorkshire, Hampshire, & Landrace.**

(ii) Fish -cum duck culture

- The raising of ducks along with composite fish culture is a profitable practice in terms of flesh produced per unit area.
- The ducks feed on aquatic insect larvae and enrich the water with their droppings which act as fish feed and also proliferate growth of planktons.
- Duck droppings contain 25% inorganic substances including carbon, phosphorus potassium, nitrogen, calcium etc., which acts as fertilizers in fish ponds.
- Fish-cum duck culture is plasticized in Assam, A.P., Tripura, Bihar, Tamilnadu, Orissa, Kerala, U.P. etc.

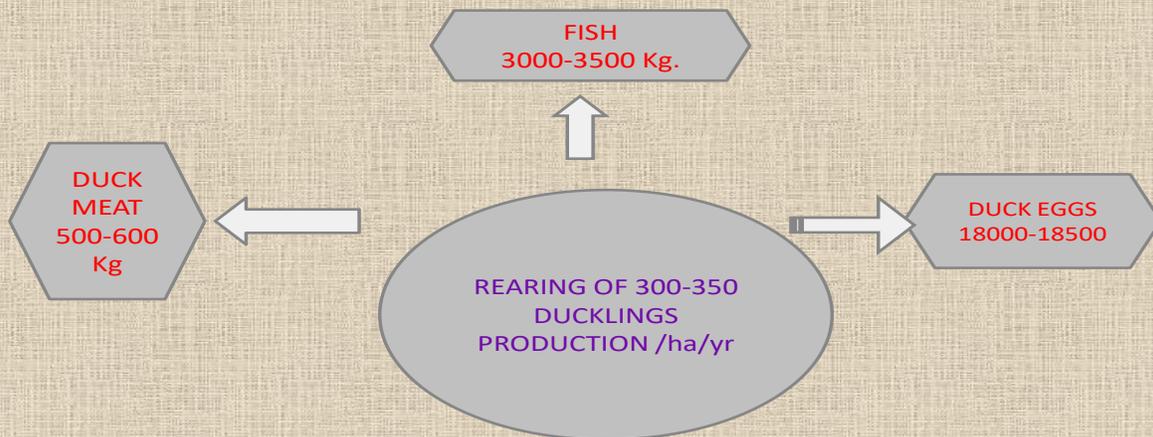
COMMONLY CULTIVABLE DUCKS



Advantages of fish cum duck culture

- Enhanced production coupled with decreased expenditure on fertilizers for the pond.
- Duck droppings cause enhanced production of planktons which serve as fish food.
- Ducks help in eradication of aquatic weeds (*Lemna*, *Azolla* etc.), aquatic insects, other like mollusks, tadpoles etc.
- Ducks act as 'biological aerators' by splashing water with their webbed feet.
- Rearing of 300-350 of ducklings is sufficient to fertilize 1 ha of pond by their droppings.

Fish- cum Duck Culture



(III) Fish -cum poultry farming

- This practice utilizes poultry droppings of fully built-up poultry litter for fish culture.
- The droppings of poultry are rich in nitrogen and phosphorus and are used as fertilizer for fish ponds.
- Poultry houses (0.3-0.4 sq. m. space /bird) are constructed above the pond with bamboo sticks so that droppings may directly fertilize the water.
- The enhancement in meat and egg production is accompanied by decreased use of fish food in combined cultures.
- Under the integrated fish cum poultry farming chemical fertilizers and supplementary feed for fishes are not required.

- Approximately 500-600 no. of birds are reared in 1ha pond.
- The annual yield includes: 4500-5000 kg/ha fish, 1250 kg. chicken meat, and 70,000 no. of eggs.
- The poultry birds (layers) are fed with starter, grower and brooder feed according to their age. Hoopers are used to feed them and to minimize the feed wastage.
- In India, this practice is prevalent in A.P., Bihar, Haryana, Kerala, Ms., UP, WB, TN, & Orissa.

Commonly cultivable Breeds



(iv) Cattle- cum fish culture

- In this system of integration where the cattle dung, oxidized in biogas plants is transferred to fish pond through small channels to act as manure.
- It is advantageous to construct cowsheds near the ponds as the cow dung acts as fertilizer for propagation of natural fish food in water like planktons.
- 5-6 cows can provide adequate manure for 1 ha pond in addition to 9000 lt. milk & 3000-4000 kg. fish annually.

Species suitable for cattle- cum fish culture

Fish species	Breeds of cattle
• <i>Cyprinus carpio</i>	Holstein-Frisian.
• <i>Cirrhinus mrigala</i>	Brown Swiss
• <i>Catla catla</i>	Jersey
• <i>Hypothalmichys molitrix</i>	

Advantages of cattle -cum fish farming

- It is common practice all over the world.
- The cow excreta is most abundant in terms of availability. A health cow may excrete over 4000-50000 kg of dung and 3500-4000 lt. of urine.
- The BOD of cow manure is lower than other livestock manure.
- It provides higher source of income to farmers with small land holdings.
- This practices realizes the full potential of aquaculture.
- The fish survival rate in cow-manured ponds was found around 98 per cent.

(v) Goat-cum fish integration

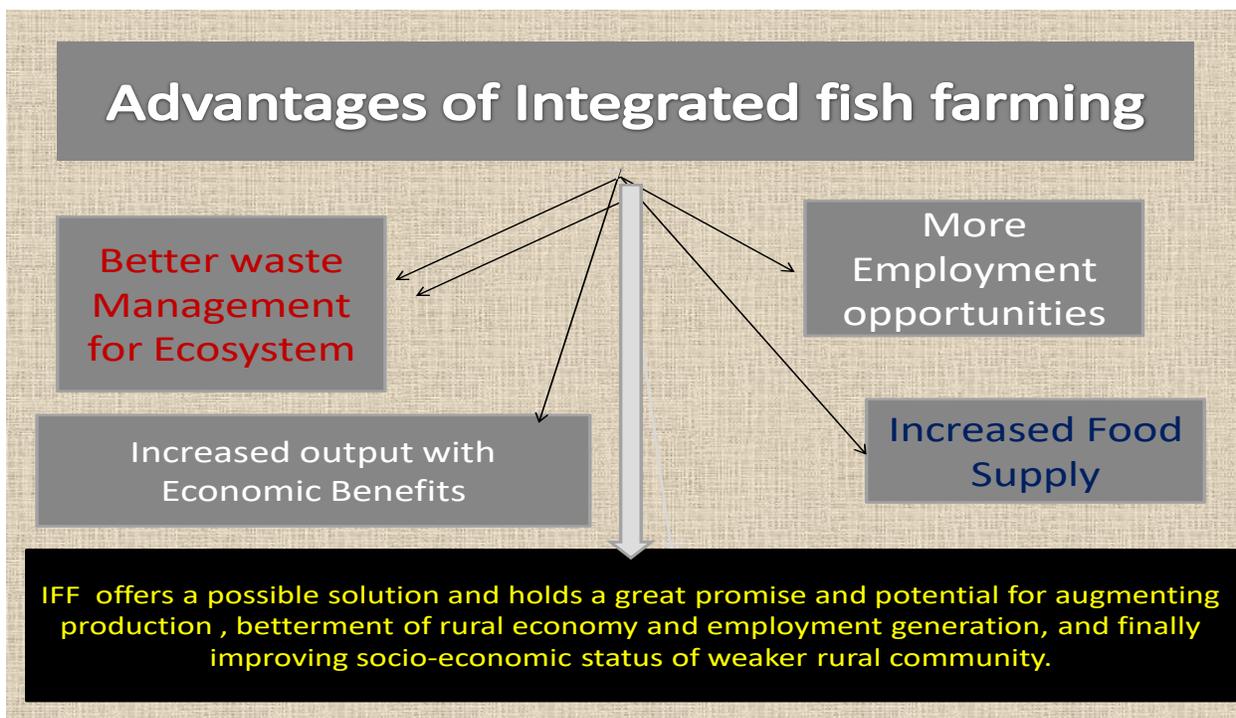
- Goat's excreta is considered as a very good organic fertilizer. (organic carbon-60%, N-2.7%, P-1.78%, k-2.88%) and its urine is also equally rich in both N & P.
- 50-60 goats are required to fertilize 1 ha pond.
- The goats should be provided with dry, safe, comfortable house protected from excessive heat.
- Goats are selective feeders and consume Berseem, Napier grass, Cowpea Soybean, Mulberry etc.
- The suitable goat breeds are Jamanapari, Beetal, Barbari, Barbari for **milk** and Bengal, Sirihi, Deccani are used for **meat**.
- This integration can provide 3500-400 kg fish/ha/year without supplementary feeding and fertilizer.

(VI) Rabbit-cum fish integration

- Rabbit meat is preferred due its low fat content.
- Rabbit excreta (carbon-50%, N-2%, P-1.33%, and K1.33%) is high in nitrogen content and low in moisture, thus forms quality manure for sustained plankton production.
- The excreta of about 300 rabbits would be enough for 1 ha pond's fertilization.
- Important meat breeds of Rabbit: Gray Giant SovietChinchilla,, & White Giant.

Constraints of IFF: Aqua farms in Asian countries are still operated by traditional ways without proper planning, application of latest technologies and management techniques, farmers largely depend on personal experience., Marketing of farm produce is not certain for reasonable price, lack of knowledge and inadequate experience may bring losses to farmers due to disease outbreaks, lack of working capital, middleman, low price, non-availability of extension services.

CONCLUSION: Fish culture integrated with agriculture and livestock provides a higher source of income to the farmer having a small land holding. These practices help in improving production with little additional expenditure. It is expected that IFF practices will increase in the near future in suitable agro-climatic regions of the country as they are dependent on eco-friendly measures and ensure higher returns as well as sustained production levels of fish and other bio-resources.



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