

Indirect:

In indirect integration of pig-fish farming pig sty are constructed at any convenient places of the fish farm and pig dung are stored in a storage tank and from there it is applied to the fish pond in required quantity as and when necessary. Pig farming management practices are-



Fig: A view of cemented pig sty with Hampshire variety

1. Construction of pig house.
2. Selection of pigs.
3. Feeding of pigs.
4. Health management of pigs.
5. Harvesting.

1. Construction of pig house.

Normally pigs are raised under 3 systems- Intensive system, semi-intensive and free range system. covered area system. The floor space requirement of a pig sty is determined on the basis of 3- 4 m²/ pig weighing 70-90 kg. The height of the sty should be in between 5- 5.5 m. Height of the concrete wall should be in between 1.0- 1.2 m and over this concrete wall iron netting is done to a height of 0.5 - 1.0 m. This iron netting helps in ventilation i.e. aeration in the pig sty which keep the pig house in dry condition. An enclosed run is attached to the pig sty towards the pond, so that the pigs get enough air, sunlight, exercise and dunging space. Apart from feeding and drinking troughs (30 cm/ pig) in the pig sty these are also constructed in the run. This helps in keeping the pig house dry and clean. In case of direct integration system the floor of the sty and the run is cemented with drainage facility to a soak pit which have the built in shutter facility and this soak pit is connected to the fish pond with a drainage pipe. This soak pit of pig sty wastes helps in storing the pig sty wastes when the application of pig dung is stopped to the fish pond by closing the shutter. Again when the application of pig dung is started then the shutter of the soak pit is opened. On the other hand in case of indirect system of integration the floor of the pig sty is connected to a soak pit where the pig sty wastes are stored and from the soak pit they are carried away to the site of application in the fish pond as and when needed in required quantity. The pig sty can be constructed by wide variety of locally available materials like, bamboo, wood etc. but the floor and the wall up to a height of 1.0- 1.2 m must be concrete made. This floor is need to be little rough and sloppy towards the drainage canal of the pig sty. There should be a door in between the sty and the open run, so that during night time pigs can be locked in the house. During night the iron netting of the sty should be covered by a black P.V.C. sheet or with a black cloth, so that the pigs can get sleep peacefully. The thatched roof is most preferred over the tin or asbestos roof as it helps in maintaining the temperature in the pig sty.

2. Selection of pigs.

Pigs to be raised along with fish are selected with the following criteria-

1. Resistant to disease.
2. Good growth.
3. Early maturity.
4. Prolific breeding.

Pig Varieties:

upgraded breed/cross breed

Exotic breeds such as White Yorkshire, Landrace, Hampshire, Berkshire are reared in pig-sty near the fish pond. Hampshire variety is preferred for pig-cum-fish farming because- it grows up to 60-70kg in 6 months on an average and a maximum of 110 kg has been recorded in 6 months growing period, in one litter it can produce 6-12 piglets and it attains its 1st maturity within 6-8 months growing periods. And thus 2 crops of exotic variety of pigs can be raised in one crop of fish in 1 year. To fertilize 1 ha water spread area 40-50 pigs are sufficient, therefore, in 6 months fish culture period 40-50 pigs/ ha water spread area are raised. Thus for 1 year fish culture period 80- 100 pigs/ ha water spread area are required. 2- 3 months old weaned piglets are brought to the pig sty for raising in this integration.

3. Feeding of pigs.

Pigs are reared in pig-cum-fish farming in intensive way. They are fed in the house itself with balanced pig ration at the rate of 1.4- 1.5 kg/ pig/ day. Maize, groundnut, wheat-bran, fishmeal, mineral mixture are provided as concentrate feed-mixture.



Fig: A stock of Maize bran

4. Health management of pigs. Pigs are also susceptible to diseases like- swine fever, swine plague, swine pox and may be infested with parasites like- round worm, tape worm, liver fluke, etc. Maintenance of hygienic and healthy condition in the pig sties keeps the pigs away from danger from diseases. The pig sties should be cleaned daily in the morning and evening hours. The pigs should also be given bath during the summer months so as to keep away from ecto-parasites. The pig sties and the other appliances used in the pig husbandry practices should be disinfected at least once in a week using disinfectant like- potash or lime. The pigs are dewormed after every 3 months interval to control the worm. The piglet usually suffers from piglet anaemia which can be overcome by injecting Infeon/Iron dextran injection. Apart from this they should be well vaccinated for all viral diseases.

5. Marketing:

After attaining slaughter age of 6 months the pig grown up to 65 kg live weight on an average and at that time they are slaughtered. The whole batch can be replaced by a new batch. From this integration system during a year 6000 kg or more pig meat and about 4000 kg fish can be expected from a ha of water spread area.

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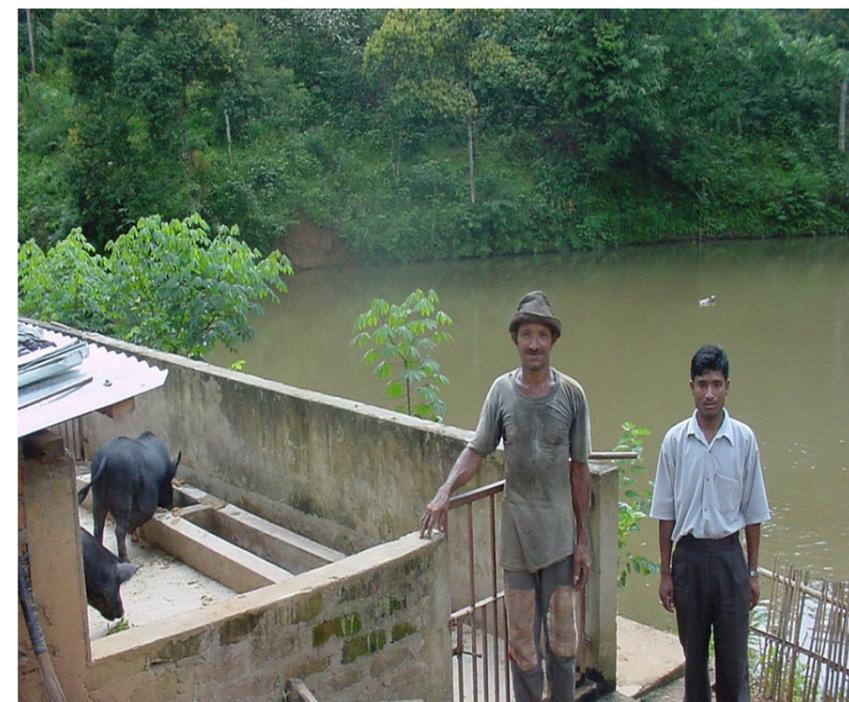
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INTEGRATED PIG CUM FISH FARMING SYSTEM



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What is Integrated Pig cum Fish system?

The raising of pigs can fruit-fully be combined with fish culture by constructing animal housing units on the pond embankment or over the pond in such a way that the wastes are directly drained into the pond.

The system has obvious advantages:

- The pig dung acts as excellent pond fertilizer and raises the biological productivity of the pond and consequently increases fish production.
- Some of the fishes feed directly on the pig excrete which contains 70 percent digestible food for the fish.
- No supplementary feed is required for the fish culture, which normally accounts for 60 percent of the total input cost in conventional fish culture.
- The pond dikes provide space for erection of animal housing units.
- Pond water is used for cleaning the pigsties and for bathing the pigs.
- It has special significance in certain areas as it can improve the socio-economic status of weaker rural communities.

This integrated farming of fish and pig can be divided into 2 groups:

- ◆ **Fish culture practice.**
- ◆ **Pig husbandry practice.**

Fish culture practice

Fish culture practice followed in the integration of pig-cum-fish farming is the “Composite fish culture system”.

Composite fish culture:

composite fish culture system can be divided into-

1. Pre-stocking management.

i. Construction of a fish farm/ Renovation of an existing fish farm.

2. On stocking management.

- Selection of species.
- Fish species to be stocked.
- Stocking

3. Post stocking management.

- Liming.
- Fertilization.
- Feeding.
- Water quality management.
- Fish health management.
- Harvesting management.

1.. Pre-stocking management.

i. Construction of a new fish farm/ Renovation of an existing fish farm:

Pond digging: During digging of a pond along the side slope should maintained so that it is not eroded. This side slope depends upon the soil quality. For loamy or clay loam soil the side slope should be 1.5: 1. If the selected site contains more sand then this side slope should be little more. Fish pond embankment should be strong enough and their height should be 1 ft. more than the high flood level of the selected site. The bases of the embankments are constructed based on the height and slope required for it.

Renovation measures of fish ponds of an existing fish farm.

Pond should be completely dried during dry season by pumping out the pond water and the pond bed is exposed to sunlight. After drying mud from the pond bed should remove. Here in this case pond water depth is need to be considered, in any case it should not go beyond 2.5 meters for good productivity. Then the pond bed is ploughed and dried. Then apply lime to the dry pond bed depending on the pond soil



Fig: A view of de-siltation proc-

pH given in the table:

Repairing of dykes:

During the drying period repairing of pond embankments (if required) are done.

Water filling, liming & fertilization:

Afterwards the pond is filled with water to a depth of 2- 2.5 meter. To maintain a desire 2- 2.5 m water depth water inlet and out let may be constructed at the pond dyke with measures to prevent the entry of unwanted organisms and also to prevent the escape of cultured fishes. Then water pH is measured and based on the pH value liming is done as mentioned above.

After 7- 10 days of liming fertilization pond water is done. The pig excreta is rich in nitrogen and phosphorous. Therefore, there is no need of using extra fertilizer as mentioned above in this type of integrated farming. Pig-cum-fish culture is done through the integration of direct or indirect method. In case of direct integration everyday during the cleaning of pig house pig dung are washed directly into the fish pond. In the indirect integration 10- 15 days just before stocking the fish pond with fish seed pig dung is applied at the rate of 1000 kg/ ha water spread area.

Renovation measures of a pond, which cannot be dried even by dewatering:

Renovation measures of an existing fish farm's ponds which can not be dried even by pumping out water are:

i) Removal of aquatic weed:

These unwanted aquatic weeds could be removed- manually, mechanically, chemically and biologically.

ii) Removal weed fishes, insects, unwanted organisms, etc.:

This is done by repeated netting or by using chemicals. Soap-oil emulsion (soap: oil = 1: 3) over the pond water surface is most commonly used technique to kill the insects in fishponds. Commercially available bleaching powder@ 97- 113 Kg/ha can also be used as fish toxicant.

iv) Partial replenishment of water:

Since total dewatering is not possible, so depending on the feasibility some percentage of pond water may be pump out and the same is refilled with new water. But the water depth should be restricted to 2- 2.5 m for good production of fish.

2. On stocking management.

i. Selection of species.

Numbers of fish species are available for composite fish culture. But a species selected for culture should have the following characters-

1. Fast growth rate.
2. Good food conversion efficiency.
3. Acceptability of supplementary and natural food.
4. Adaptability to crowded conditions and resistance to diseases.
5. Ability to withstand changing physico-chemical and biological conditions of the pond water.
6. Good market value

ii. Fish species can be stocked:

Rohu (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus mrigala), Silver carp (Hypophthalmichthys molitrix), Common carp (Cyprinus carpio), Grass carp (Ctenopharyngodon idella), Tilapia (Oreochromis mossambica), Magur (Clarias batrachus), Java puthi (Puntius javanicus) Kurhi (Labeo gonius), etc.

iii. Stocking:

In composite fish culture in stocking pond fish seed of 10- 15 cm length (fingerling) is stocked at the rate of 7000- 8000 nos. / ha. Considering the seed availability, productivity, size & depth of pond, market demand etc.

Soil pH	Lime (kg/ha)
4.5-5.0	2,000
5.1-6.5	1,000
6.6-7.5	500
7.6-8.5	200
8.6-9.5	Nil



Fig: Liming in sun dried pond

1. Post stocking management.

i. Liming.

It is done based on the soil and water pH. Liming dose and schedule mentioned above.

ii. Fertilization.

In the integration of fish farming with pig farming practice supplementary feeding to the cultured fish is not required. After stocking the pond with fish seed pig dung is applied at the rate of 50 kg/ ha/ day.

iii. Feeding.

Apart from natural food most of the cultured fish species takes artificial feed. In the integration of fish farming with pig farming practice supplementary feeding to the cultured fish is not required. This is because pig excreta helps in fertilizing the pond water and produce the fish food organism like- phytoplankton and zooplankton. Apart from that some fish like- common carp take pig dung directly as their feed.

iv. Water quality management.

Some of the water quality problems encountered in fish farms are-

a) Depth of water:

The depth of water in the fish cultured pond is important factor from the productivity point of view. The optimum depth of water in fish pond is 2- 2.5 m. If there is any change in the depth of water in the fish pond is seen then it should be corrected.

b) Turbidity of pond water:

This is occurring may be due to more clay content in the soil of fish pond or it may cause due to overgrowth of phytoplankton. To control this water quality problem apply aluminium (filter alum) sulphate i.e. $Al_2(SO_4)_3 \cdot 14 H_2O$ @ 10-40 mg/ lit of water. In pig-cum-fish farming siltation and thereby cause of turbidity in the fish pond water is a major problem. To check the problem pig dung should be applied to the fish pond at different locations every day. Again at every 1 year interval the pond bottom muck should be removed after partial dewatering. After 3 years complete dewatering and desilting is a must in this integration.

c) Dissolved oxygen (DO):

Dissolved oxygen range in the stocking pond should be in between 5- 8 ppm. In low DO case feeding and fertilization in the pond should immediately be stopped. Turbulent the water with the help of a split bamboo. Harvest the table size fish and reduce the density of fish in the pond. Supply of water from a nearby source.

d) Ammonia:

ammonia (NH_3) is lethal at a level above 0.02 ppm. If the unionized ammonia concentration is increased then the fish may die. Control the water temperature, pH and also the concentration of phytoplankton in the pond.

e) pH of water:

For fish culture soil and water pH should be in the range of 7.5- 8.5. Acidic pH is controlled through liming . Alkaline pH can be controlled by water replenishment and through the application of gypsum.

V. Fish health management:

Cultured fish should check regularly for their health.

Vi. Harvesting management:

When the cultured fish reaches 750 gm to 1 kg in weight then they are harvested from the pond. The harvesting may be done by removing the complete stocks of cultured fishes or by removing the only table size (750 gm to 1 kg) fishes partially based on market demand. In case of partial harvesting the numbers of fish harvested from a pond is replenished with equal numbers of small fishes from nursery ponds of the farm. This helps in getting more money. As pigs attain slaughter size within 5-6 months and fish raising of Indian exotic carp is done for 10-12 months, two lots of pigs can be raised along with one lot of fish.

2. Pig husbandry practices.

Integration of pig and fish farming is done through 2 ways –

Direct:

In this direct integration of pig-cum-fish farming pig house are constructed on the pond embankment and the pig excreta are washed away directly to the fish pond.



Fig: Algal bloom in fish pond