AQUACULTURE EXTENSION MANUAL NEW SERIES NO. 5 • DEC. '85

FISH-CUM-LIVESTOCK FARMING

PACKAGE OF PRACTICES FOR INCREASING PRODUCTION

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ISSUED BY : **Information and Extension Divisions of CIFRI.**

PUBLISHED BY : **D. D. Halder** *on behalf of*
The Director,
Central Inland Fisheries Research Institute,
Barrackpore-743101, India.

ISSUED IN DECEMBER 1985.

Printed by : Roman Printers
37 Andul Road, Howrah-711 109 Phone : 67-6126

FOREWORD

Integration of fish farming with crops and livestock aims at increased efficiency of resource utilisation, reduced investment risks through crop diversification and additional sources of food and income to farmers. Integrated farming has already taken deeper roots and extensively practised in countries like China and Thailand where the technique has been successfully implemented with greater degrees of sophistication.

Integration of fish with livestock, however, was initiated in this country under the Operational Research Project of the Institute in the year 1977. The studies revealed a production rate in the range 2.0-7.0 tonnes/ha with carp seed as a major input.

The package of practices for increased production in fish-cum-livestock farming system has been described in this manual keeping in view the needs of trainers, extension workers, bank officers and progressive fish farmers. It is hoped this revised and updated manual would generate the necessary momentum in transferring the technology to users.

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PACKAGE OF PRACTICES FOR INCREASING PRODUCTION IN FISH-CUM-LIVESTOCK FARMING SYSTEM

—B. K. Sharma, M. K. Das & D. P. Chakraborty

About 83% of India's population living in rural areas, are under-nourished and need not only a large supplement of animal protein to their diet but also new sources of gainful employment and sustained income. As their land-holdings are small and fragmented, the modern large scale production technologies with high input requirements offer no tangible solution to their problems of low income and low productivity. Besides, small land holdings, these small and marginal farmers have live-stock, in the form of a few heads of cattle, a few pigs, a small flock of ducks or chicken and surplus family labour.

With these problems and resources in mind, efforts were made to develop low cost farming systems suitable for Indian conditions, based on the principles of productive utilization of farm wastes and fuller utilization of available resources and man power. The sustained research efforts have resulted in the development of integrated farming systems involving fish culture, livestock raising and horticulture. The package of practices for fish cum pig, fish cum duck and fish cum poultry farming have been developed and verified extensively for economic viability and feasibility at the farmer's level. The systems can be adopted with suitable modifications in appropriate areas where water resources and healthy stock of animals viz. pigs, poultry and ducks are available.

According to livestock census, 1972, pig population of India was around 6.9 million mostly distributed in the states of Madhya Pradesh, West Bengal, Assam, Andhra Pradesh, Uttar Pradesh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu and North Eastern Hill states. Similarly, duck population of around 10 million was widely spread in the states of West Bengal, Assam, Madhya Pradesh, Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, Bihar, Orissa, Tripura, Uttar Pradesh, Rajasthan, Punjab, Manipur, Maharashtra, and Haryana etc. The poultry

population of India was placed at 138.5 million distributed extensively in the states of Andhra Pradesh, West Bengal, Tamil Nadu, Maharashtra, Bihar, Kerala, Tripura, Assam, Gujarat, Haryana, Madhya Pradesh, Orissa, Punjab, Rajasthan, Uttar Pradesh and North Eastern Hill states. Coupled with this, most of these states have pond hectarage ranging from 29,000 to 80,000 ha, except the North Eastern Hill states where the ponds exist relatively in lower range of 100-200 ha, mainly due to small size of these states. The systems, if adopted in these areas, can go a long way in increasing the animal protein production and genera.ion of gainful employment.

The tribal population of India according to 1972 census was 38 million. concentrated in the above mentioned states with the exception of Punjab, Haryana and Jammu where tribal population is nil. These tribal communities traditionally raise small livestock, especially the pigs and can easily be motivated to integrate their empirical skill of small livestock raising especially the pigs with fish culture. Thus the integrated fish cum livestock farming system can be a useful technology for the tribal development of the country and is the most effective and possible way to help economically, the small and marginal farmer who has a small land base but surplus family labour.

2. Integrated fish cum pig farming

Through a number of experimental trials, a production system integrating pig husbandry with fiish culture has been evolved for Indian conditions. The raising of pig is fruitfully combined with fish culture by siting pig-sties on the pond embankment or near the pond so that the wastes are directly drained into the pond or lifted from the animal house and applied to the pond. The pig dung acts as excellent pond fertilizer and raises the biological productivity of the pond water and conequently increases fish production. Further the fish also feed directly on the pig excreta which contains 70% digestible food for the fish. No supplementary fish feed or pond fertilizer is required in this system.

The expenditure on fish culture is drastically reduced as the pig excreta acts as substitute to fish feed and pond fertilizer which accounts for 60% of the input cost in the fish culture. The expenditure incurred on raising of pigs is off set through the sale proceeds of pig meat. As the pigs attain slaughter maturity in about 6 months time the system envisages raising of two crops of pigs and one crop

of fish during culture period of one year. Fish yield ranging from 6000-7000 kg/-ha/yr is generally obtained, along with 4200 kg to 4500 kg pig meat (live weight).

This system has a special significance as it can improve the socio-economic status of weaker rural communities, especially the tribal community who traditionally rear pigs and can easily take to fish cum pig farming, if proper incentives are given. Further, the system has particular relevance in the North Eastern Hill states of India where pig raising is almost a way of life of the people.

2.1 Pond management practices

Successful pond management is the basis of profitable fish culture. The following package of practices are involved in pond management.

2.1.1 Selection of pond

The ponds in India are natural depressions in land or excavated ponds, which are generally rain fed, non drainable with stagnant water. They are of varying shapes and sizes with multipurpose uses, one of which is fish culture. The ponds may be seasonal or perennial. The perennial ponds which retain water through out the year are selected for culture of table size fish. A depth of about 2 meters is considered congenial for good biological productivity.

The ponds located on different soil types viz. alluvial, laterite, black cotton soil etc. differ as one soil type is more productive than the other types because of its rich nurtient and organic matter content.

The new fish ponds to be excavated should be rectangular in shape and of manageable size (0.4 ha) preferably with a source of water nearby for replenishment of water as and when necessary. The ponds should be dug on non-porous, stable and fertile soil for water retention and better productivity. The ground water level should not be very high. The soil of a good and productive fish pond should be loamy and clay loamy with pH ranging from 6.5-7.5, available nitrogen 50 mg/100g, available P_2O_5 above 6 mg/100g and organic carbon 1.0-2.5%. The nutrient status of the soil can be enhanced by application of fertilizers, lime and other chemicals.

2.1.1 Clearance of aquatic weeds

Ponds are generally infested with various types of weeds which are not desirable for healthy growth of fish. These weeds not only consume nutrients from the water body resulting in poor plankton and fish production but also pose serious problems in exploitation of fisheries and cause oxygen depletion on cloudy days days and when they die and rot. The weeds in ponds can be grouped as under on the basis of their habit and habitat.

i. Free floating surface weeds

These weeds have free floating leaves above the surface of water with roots hanging free underneath. The most common floating weeds are water hyacinth (*Eichornia crassipes*) *Salvinia* spp., *Pistia stratiotes*, *Spirodela*, *Lemna minor*, *Azolla*, *Wolffia* etc.

ii. Emergent weeds

These weeds are rooted in the bottom of the pond but their leaves float on the water surface. The common emergent weeds are *Nymphaea*, *Nelumbo*, *Trapa* etc.

iii. Submerged weeds

These weeds remain submerged under the water and can be rooted or free floating. The rooted ones are *Hydrilla*, *Naja*, *Ottelia*, *Vallesneria*, *Potamogeton* etc. The floating submerged weeds do not have roots e.g. *Utricularia*.

iv. Marginal weeds

These weeds are mostly rooted and fringe the shore line of the water body. The most common marginal weeds are *Ipomea*, *Typha*, *Phragmites*, *Cyperus*, *Colocasia* etc.

2.1.2 Methods of control

The aquatic weeds can be controlled by any of the following methods, depending upon the intensity of infestation and type of weed.

i. Manual and mechanical method

When infestation is scanty and scattered, and water body is small, the weeds are controlled manually by hand picking, uprooting the emergent and marginal weeds and cutting them with scythes.

The rooted submerged weeds are dislodged mechanically by dragging with log weeders fitted with spikes and barbed wires. Sometimes, mechanical winches are used for cutting and dragging of submerged weeds.

ii. Chemical method

A large number of chemical weedicides are used for control of aquatic weeds. The lethal action is either by direct contact or by translocation of chemicals from the treated part of the plant to the other areas of its system, resulting in both cases in the death of the plant. The common weedicides, the weeds on which they effect, their dozes and method of application are given in table—I.

iii. Biological method

Some species of submerged weeds viz. *Hydrilla* and *Najas* can effectively be controlled by grass carp (*Ctenopharyngodon idella*). The surface floating duck weeds also form the food of this fish and can be controlled by stocking grass carp. Normally, the grass carp ranging from 200-250 mm in size are stocked in weed infested ponds for controlling the weeds as the smaller fish are likely to be preyed upon by predatory fish. *Puntius gonionotus* is also reported to feed upon the aquatic weeds.

The ducks also keep the aquatic weeds under check, as they feed on the weeds.

2.1.3 Clearance of unwanted fish

The predatory fish directly prey upon the stocked fingerlings whereas, the weed fishes compete with them for their demand of food and oxygen. In view of the harm done by unwanted fish, their complete eradication from the pond before stocking is very essential.

The eradication of these unwanted fish is done by repeated netting, draining or by applying fish toxicants to the pond. Repeated netting is a very common method used but most of the fish escape the net and in deeper waters it completely fails, Another method is draining of ponds. This method can be applied in ponds which have the arrangements for drainage and refilling of water. Even in drainable ponds, some mud dwelling varities of predatory fish are not killed. So to ensure complete eradication fish toxicants or piscicides are used.

The suitability of fish toxicants or piscicides is judged on its properties like effective minimum dose, revibility of effected fish, consumability of poisoned fish, least adverse effect on the pond biota, short duration of residual toxicity, non-cumulative residual effect in the pond, commercial availability, easiness of application etc. Taking the above facts into consideration, the piscicides of plant origin are preferred over chemical piscicides.

The fish toxicants can be classified as plant derivatives, chemicals, chlorinated hydrocarbons and organophosphates. The dozes and other details of the commonly used piscicides are listed in table—2. However, the most commonly used toxicant of plant origin is oil cake of Mahua, which is applied @ 2500 kg/ha meter of water. The desired quantity of mahua oilcake is soaked in water and uniformly spread over the pond surface. A net is dragged in the pond after application so that mahua oilcake is mixed in water. After a few hours of application, the fishes are seen in distress, loosing their balance and swimming upside down. The fishes are then collected by dragging or hand nets and can safely be used for human consumption. The toxicity of mahua oilcake lasts for about two weeks. Toxicity test is done before stocking the pond by keeping a few fingerlings for 48 hrs. in a hapa fixed in the pond. Mahua oilcake not only kills the unwanted fish but it also acts as an organic pond fertilizer.

2.1.4 Stocking

The application of pig dung in the pond provides a nutrient base for dense bloom of phytoplankton particularly nanoplankton which, in turn, trigger intense zooplankton development. The zooplankton have an additional food source in the bacteria which thrive on the organic fraction of the added pig dung. This calls for stocking filter feeding phytoplanktophagous and zooplanktophagous fish.

In addition to phytoplankton and zooplankton, there is a high production of detritus at the pond bottom which provides substrate for colonization of micro-

organisms, and other benthic fauna especially the chironomid larvae. A stocking emphasis, therefore, must be placed on bottom feeders. Another welcome addition will be macro-vegetation feeder grass carp, which in the absence of macrophytes can be fed on green cattlefodder grown on the pond embankments. The semidigested excreta of this fish forms the food of bottom feeders. The Chinese say, if you feed one grass carp well, you are feeding three more fish.

For exploitation of the above food resources, polyculture of Indian major carps, catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*) and exotic carps, silver carp (*Hypothalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*) is taken up in fish cum pig farming ponds.

The pond is stocked after the pond water gets properly detoxified. The stocking rates vary from 8000-8500 fingerlings/ha and a species ratio of 40% surface feeder, 20% column feeders, 30% bottom feeders and 10%-20% macrovegetation feeder is preferred for high fish yields. The stocking density and species ratio can alter depending upon the availability of seed. Mixed culture of Indian major carps can be taken up with species ratio of 40% surface feeders, 30% column feeders and 30% bottom feeders.

2.1.5 Time of stocking

Water temperature below 18-20°C adversely effect the growth of fish as such, in areas where winter is severe, the ponds should be stocked after the severe winter time is over. In the Northern and North-Western states (Uttar Pradesh, Madhya Pradesh, Haryana, Punjab and Delhi) the ponds should be stocked in the month of March and harvested in the months of October-November.

In the coastal and North Eastern States where winter season is mild, the ponds should be stocked in June-September months and harvested after rearing the fish for 12 months.

2.1.6 Use of pig waste as manure

The washings of the pig-sties are channelled into the pond which brings pig dung, urine and spilled feed into the pond or pig dung collected from the pig houses is applied to the pond every morning after sun rise. Each pig voids

between 500-600 kg dung in a year's time (250-300 kg/pig/6 months) and the excreta voided by 30-40 pigs is adequate to fertilize one ha water area under polyfish culture. The quantity of excreta going to the pond decreases after 6 months when 1st lot of pigs is disposed off and a fresh lot of weaned piglets is brought to the pig-sties. This does not affect the fish growth as the organic load in the pond by that time is sufficient to tide over for next two months when the piglets grow and the quantity of excreta increases. In places where pig dung is available from the Government or privately owned pig farms, the pig dung can be purchased and recycled in the fish ponds. In West Bengal, pig dung is sold @ Rs. 50/- per tonne.

The application of pig dung is deferred on the days when algal blooms appear and water becomes green.

The pig dung contains 69-71% moisture, 1.36-2% nitrogen, 0.36-0.39% phosphate, when the pigs are fed with pig mash having 16-17% protein. The quantity and quality of excreta, however, depends upon the feed provided and age of the pigs.

Lime is applied @ 250-350 kg/ha/yr depending upon the soil and the water conditions. Half of the quantity is applied before stocking the fish and rest in 2-4 instalments as and when necessary. It keeps the pond water alkaline and hygienic.

2.1.7 Feeding the grass carp

Aquatic weeds such as *Hydrilla*, *Najas* etc. or chopped green cattle fodders such as Barseem, Napier grass, maize leaves etc, are provided to the grass carp. The cattle fodder is grown on the terraced embankment of the pond and fed to grass carp and pigs.

2.1.8 Periodical netting

Trial netting is done once a month to check the growth of fish. It also helps in timely detection of parasitic infection, if any. The netting also helps in raking the pond bottom which results in release of gases from pond bottom as well as release of nutrients from the bottom soil.

2.1.9 Control of algal blooms

Planktonic algae viz. *Microcystis*, *Anabaena* and filamentous algae vlz. *Spirogyra*, *Pithophore* etc. some time appear in great abundance in the manure loaded ponds creating algal bloom conditions especially during the summer season. An over abundance of these weeds, which are not eaten by most of the cultivable fish. upsets the dissolved oxygen balance in the ponds resulting in mortality of fish. These weeds are kept under control by using herbicides like Diuron or Simazine at dozes ranging from 0.1-0.3 ppm and 0.3-0.5 ppm respectively.

2.1.10 Health care

As in fish culture ponds, most of the fish diseases encountered in fish cum livestock farming ponds are caused by bacteria, fungus, protozoa and crustacea. The commonly encountered diseases in integrated ponds and their control measures are given below :

i. Gill spot disease : caused by the parasites *Thelohanellus catlae* infecting the gills of young ones of *C. catla*. Cysts of these parasite encroach the gill surface resulting in excessive mucus secretion and irregular cell growth. The disease is mostly encountered during post-monsoon months. Mortality of fish occurs during depleted 0_2 condition in pond.

ii. Scale and body spot disease : caused by the parasites *Myxobolus mrigalae* infecting the scales and body of young ones of *C. mrigala* and *Myxobolus rohitae* infecting the scale of *L. rohita*. White cysts of these parasites are embedded in the scales and body surface, resulting in degeneration and falling off of scales followed by secondary infection- The disease in *L. rohita* is encountered mostly in pre-monsoon months and in *C. mrigala* it is most frequent in monsoon and post-monsoon months.

Control : The above mentioned myxozoan infection is controlled by 2 to 3% NaCl. dip treatment and appication of lime in the pond @ 200 kg/ha.

iii. Trichodiniasis : caused by *Tripartiella* sp. infecting the gills and body surface of both Indian and Exotic carps. The fish show excessive mucus secretion, pale gills and come to the surface. The incidence is more in colder months.

Control : The disease is controlled by 2 to 3% NaCl dip treatment or 25 ppm formaldehyde treatment.

vi Ergasilosis : occasional heavy infection of the parasitic copepod, *Ergasilus* sp. is encountered in Indian and Exotic carps on the gills and body surface especially in pre-winter and winter months. The fish show heavy mucus secretion and most affected is *H. molitrix* resulting in retarded growth and mortality.

Control : The disease can be partially controlled by application of 1 ppm gammaxene and liming. Dewatering wherever possible and liming @ 200 kg/ha completely control the disease.

2.2 Pig husbandry practices

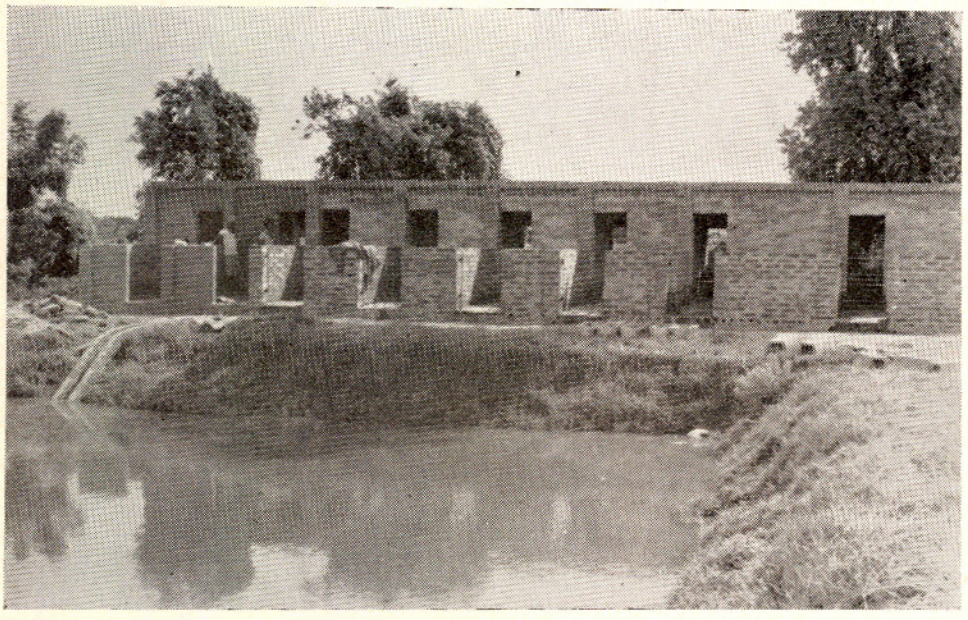
Growth of pigs depends upon many factors including breed and strain, but good management contributes considerably to the achievement of optimum production.

2.2.1 Construction of pig house

Good housing with adequate accommodation, incorporating all essential requirements are provided to give pigs, healthy stalling conditions. The pigs are poorly provided with heat regulating mechanism and sweat only from the snout, so it is difficult to keep them cool in very hot weather. The temperature in a pig house is, therefore, one of the important factors to be taken care of, while erecting a pig house.

The pigs are raised under two systems i.e. open air system and indoor system. A combination of the two, however, is followed in fish cum pig farming system. A single row of pig pens facing the pond is constructed on the pond embankment. An enclosed run is attached to the pen towards the pond so that the pigs get enough air, sunlight, exercise and dunging space. The feeding and drinking troughs are also built in the run to keep the pens dry and clean. The gates are provided to the open run only, The floor of the run is cemented with drainage to the pond. A built-in shutter is always provided in the drainage canal to stop the flow of wastes to the pond as and when necessary. The drainage canal is provided with a diver-

sion cannal towards a pit, preferably cemented where the wastes are stored on the days when the pond is having algal bloom. This stored excreta can be applied to the pond subsquently.



Fig—1

The pjg house can be constructed by using widely traditional and locally available materials but the floor must be cemented. Bamboos are most suitable for making low cost pig houses. The pigs need well ventilated enclousre with facilites for sheltering from the sun, especially during summer months. As such pig house with thatched roof is preferred over the tin or asbestos roof. The height of the house should not exceed 1.5 meter where as the height of the walls separating the pens and surrounding the open run should be only 1 meter. For healthy growth of pigs, a living space of 1-1.5 m^2/pig is regarded quite adequate.

2.2.2 Selection of pigs

The kind of pigs to be raised must be chosen with care since all domesticated races are not productive. Four types of pigs are presently available in our country viz. wild pigs, domesticated or indigenous pigs, exotic breed of pigs and upgraded

stock of exotic pigs. The local Indian variety are small sized animals, grow slowly, produce small litters, meat is of inferior quality, are kept under unhygienic conditions and can be termed as scrub animals. The exotic upgraded stock of pigs such as large-white Yorkshire, Middle-white Yorkshire, Berkshire, Hampshire and Land race are most suitable for raising with fish culture as they are well known for their quick growth and prolific breeding. They attain slaughter maturity size (60-70 kg) within six months and give 6-12 piglets in very litter. The age at first maturity ranges from 6-8 months. Thus two crops of exotic and upgraded pigs of six months each, are raised alongwith one crop of fish which are cultured for one year. About 30-40 pigs are raised for a ha of water area. About two months old weaned piglets are brought to the pig-sties and fattened for 6 months when they attain slaughter maturity and are harvested.

2.2.3 Feeding

The pigs are single stomached animals and their dietary requirements are much more exacting than those of the ruminants. Intensive raising of pigs is done under fish cum pig farming. The pigs are not allowed to go out of the pig house where they are fed on balanced pig mash @ 1.4 kg/pig/day. Grasses and green cattle fodder are also provided. To overcome any mineral deficiency. 'sod' (30 cm $\times$ 30 cm bed of grass with all its roots intact and interlocked soil) is provided once a week. Provision for built in feeding troughs 30 cm/pig is essential to minimize the food spoilage and to facilitate proper feeding without scrambling and fighting. Similar separate troughs are also required for drinking water.

The composition of concentrate pig mash required for good and healthy growth of pig varies from place to place depending upon the avalibility of various ingredients locally. However, the composition of the pig mash used by various farmers in West Bengal is given below. To reduce quantity of ration and also to reduce the cost, spoiled vegetable, especially the rotten potatoes from the cold storage can be mixed with pig mash and fed to pigs after boiling.

COMPOSITION OF PIG MASH

Rice bran	30 kg.
Rice polish	15 kg.
Wheat bran	27 kg.
Maize broken	10 kg.
Groundnut oil cake	10 kg.
Fish meal	04 kg.
Mineral mixture	03 kg,
Common salt	01 kg.
	100 kg.

Rovimix (A, B_2, D_3) 20g for 100 kg.

2.2.4 Health care

Though pigs are hardy animals yet they may suffer from diseases like swine fever, swine plague, swine pox and may be infested with parasites viz. round worms, tape worms, liver fluke etc. Maintenance of healthy and hygienic condition of pig-sties keeps the pigs away from the danger of infection and thus adds considerably to profit. The pigs are not water animals yet they like taking bath, hence there should be no hesitation in washing them. Pig-sties should be washed daily in the morning hours, after sun rise, to drain all the excreta and feed offal into the pond. Disinfectants must be used at weekly intervals while washing the pig-sties. It is advisable to get all the piglets vaccinated against swine fever and other viral diseases, before keeping them for fattening. Local veterinary expert may be eontacted in case of any disease.

2.3 Harvesting

Due to abundance of natural food in fish cum pig pond, the fish attain marketable size within a few months. Keeping in view the size attained, prevailing market rate, demand of fish in the local market, the partial harvesting of the table size fish is done. After harvesting partially, the stock is replenished with the same number of fingerlings, depending upon the availability of fish seed. Final harvesting is done after 12 months of rearing. Fish yield ranging from 6000-7000 kg/ha/yr is generally obtained (Table-3).

The properly fed pigs attain slaughter maturity size (60-70 kg) within six months. Over weight pigs are unsuitable for bacon products and are also uneconomical for further rearing. As such pigs are sold out after rearing for six months and a frcsh lot of same number of weaned piglets is introduced for further rearing.

2.4 Economics

Taking an average village pond as one acre in area, the variable cost and return functions of the system have been worked out for a 0.4 ha (1 acre) pond. The details are given in table—4. It is evident from the table that an investment level of Rs. 23,250.00 assures a return of Rs. 39,120.00. The net return on variable cost works out to 68%. The cost of fish production works out to Rs. 3.00/kg (Table-4).

It may be added that the investment level of Rs. 23,000.00 has to be viewed in the light of income generation which starts after 6 months from the sale proceeds of the first lot of pigs and partially harvested fish. If this income is ploughed back into the production process, the requirement of working capital is reduced to about half.

2.5 Benefits of fish cum pig farming

i. The fish utilizes the feed spilled by pigs and their excreta, which is very rich in nutrients for fish.

ii. The pig dung acts as a substitute to pond fertilizer and supplementary fish feed, therefore, the cost of fish production is greatly reduced.

iii. No additional land is required for piggery operations.

iv. Cattle fodders required for pigs and grass carp are grown on the terraced pond embankments.

v. Pond provides much needed water for washing the pig-sties and pigs.

vi. It results in high production of animal protein per unit area.

vii. It ensures high profit through less investment.

viii. The pond muck which gets accumulated at the pond bottom due to constant application of pig dung, can be used as fertilizer for growing vegetables other crops and cattle fodder,

3 Integrated fish cum duck farming

A viable and economically sound system integrating fish culture with duck farming relevant to this country has been evolved through a number of experimental trials. By this technique it is possible to obtain 3500-4000 kg fish, 18,000 to 18,500 eggs and 500 to 600 kg duck meat (live weight) from a hectare of pond area in one year without resorting to any supplemcntary fish feeding and pond fertilization.

The mutual beneficial effect of combined fish culture and duck raising is difficult to assess with accuracy due to complex interactions in the pond ecosystem but experience has shown that this combination increases the production of both the animals and decreases the input cost of fish culture operations considerably. The droppings of ducks act as a substitute to fish feed and pond fertilizers which account for 60% of the total input cost in fish culture. The expenditure incurred on duck raising is largely offset through sale proceeds of duck eggs and duck meat.

The raising of ducks over fish ponds fits very well with the fish polyculture as ducks are highly compatible with cultivated fish. The ducks feed on such organisms from the pond as larvae of aquatic insects tadpoles, molluscs, aquatic weeds etc, which do not form the food of stocked fish. The duck droppings act as excellent pond fertilizer and the dabbling of ducks at the pond bottom in search of food, releases, nutrients from the soil which enhances the pond productivity and consequently increases fish production.

The ducks in turn get clean and healthy environments to live and quality natural food from the pond for their growth.

The ducks are mostly concentrated in the states of West Bengal, Assam, Tamil Nadu, Andhra Pradesh, Kerala, Bihar, Orissa. Tripura, Karnataka and Uttar Pradesh. These are mainly used to produce eggs. The surplus drakes and ducks which are too old for laying are used for meat purposes. These states also have large potential for fish culture and could greatly increase their animal protein production and could generate gainful employment by integrating duck and fish farming.

3.1 Pond management practices

As given under 2.1

3.1.1 Selection of pond

As given under 2.1.1

3.1.2 Clearance of aquatic weeds

As given under 2.1.2

3.1.3 Clearance of unwanted fish

As given under 2.1.3

3.1.4 Stocking

As given under 2.1.4. The stocking density is however, reduced to 6000 fingerlings per ha. The advanced fingerlings of over 10 cm size are stocked as the ducks are likely to prey upon the small ones.

3.1.5 Time of stocking

As given under 2.1.5

3.1.6 Use of duck droppings as manure

No manures are applied to the pond, instead the ducks are given a free range over the pond surface from 9 am to 5 pm., when they distribute their droppings in the whole pond, automatically manuring the pond. The droppings voided at night are collected from the duck house and applied to the pond every morning. One duck voids between 125-150 gms of droppings per day. So by stocking ducks at the density of 200-300 ducks/ha, about 10,000 to 15,000 kg of droppings are recycled in one hectare pond every year. The droppings contain 81% moisture, 0.91% nitrogen and 0.38%phosphate on dry matter basis.

Lime is applied @ 200-250 kg/ha/yr depending upon the soil and water conditions. Half of the quantity is applied before stocking the fish and rest in 2-4 instalments to keep the water alkaline and hygienic.

3.1.7 Feeding the grass carp

As given under 2.1.7

3.1.8 Periodical netting

As given number 2.1.8

3.1.9 Control of algal blooms

As given under 2.1.9

3.1.10 Health care

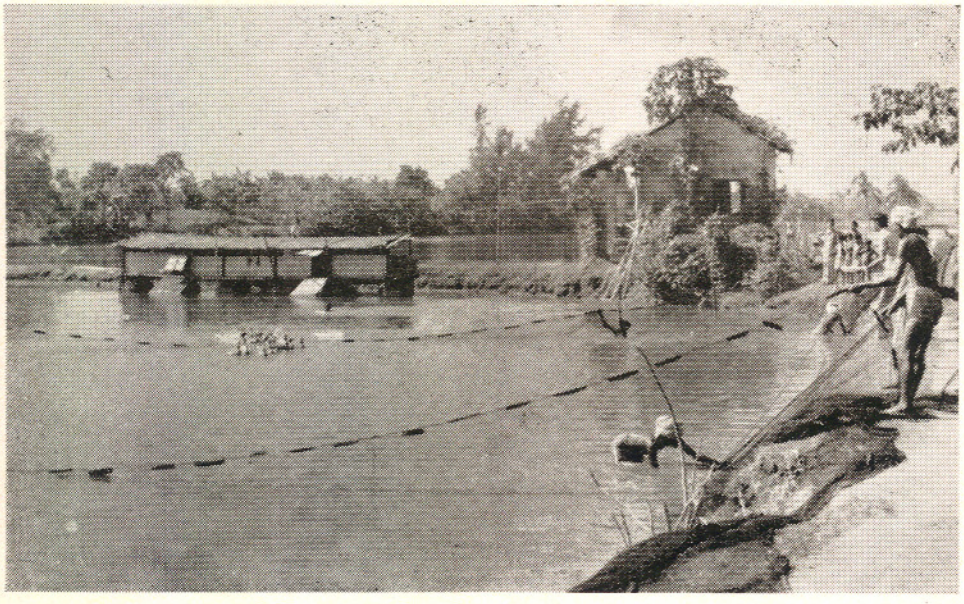
As given under 2.1.10

3.2 Duck Husbandry practices

The egg laying by ducks depends upon many factors including the breed and strain, but good management contributes considerably towards the achievement of optimum egg and flesh production.

3.2.1 Construction of duck house

The ducks do not need much elaborate house since most of the time during day they remain in the pond. Any house on the farm not being utilized, can be effectively converted into night shelter for the ducks. Alternatively, a low cost night shelter can be constructed on the pond embankments, using split bamboos or any other cheap wood. A floating duck house can also be constructed on the water surface using empty mobile oil barrels as floats. The house should be well ventilated and so designed that the washings are drained into the pond. An mportant care is to keep the duck house clean and dry as far as possible.



Fig—2

The overcrowding of the ducks in the night shelter should be avoided as this results in poor growth and reduction in egg production. About 0.3-0.5 m^2 of floor space per bird is enough for night shelter.

3.2.2 Selection of ducks

The kind of duck to be raised must be chosen with care since all the domesticated races are not productive and hardy enough for keeping in open ponds in all weathers. The important breeds of Indian ducks are Sylhet Mete and Nageswari, The improved breed ('Indian runner') being hardy has been found to be most suitable for this purpose, although they are not as good layers as exotic khaki campbell. The number of ducks required for proper manuring of one hectare fish pond is also a matter of consideration. It has been found out that 200-300 ducks are sufficient to produce manure adequate enough to fertilize a hectare of water area under fish culture. Two to four months old ducklings are kept on the pond after

providing them with necessary prophylactic treatments as safeguard against epidemics.

3.2.3 Feeding

Ducks kept in the open water are able to find natural food from the pond but that is not sufficient for their proper growth. This natural food is, therefore, supplemented with artificial feed. Since duck feed is not commercially available in our country, a mixture of any standard balanced poultry feed and good quality rice bran in the ratio of 1 : 2 by weight can be fed to the ducks @ 100g feed/bird/day in addition to the natural food which they get from the pond. The first feeding is done in the morning and second in the evening. The feed is given either on the pond embankment or in the duck house and spilled feed is then drained into the pond. Water must be provided in the containers deep enough to submerge their bills, along with feed. The ducks are not able to eat withuot water.

Ducks are quite susceptible to afflatoxin contamination. therefore, the mouldy feeds or feeds kept for long time should be avoided. The groundnut oil cake and maize are more susceptible to *Aspergilus flavus* which cause afflatoxin contamination may be eliminited from the daily feed.

3.2.4 Egg laying

The ducks start laying after attaining the age of 24 weeks and continue to lay for two years. The ducks lay only at night, so there is no possibility of eggs being laid when the ducks are in the pond during the day time. It is advisable to keep some straw or hay in the corners of the duck house for egg laying. The eggs are collected every morning after the ducks are let out of the duck house.

3.2.5 Health care

Compared to chciken , ducks are subjected to relatively few disesase. The local Indian variety of ducks is more resistant to diseases than other varieties. However, proper sanitation and health care are as important for ducks as for chickens. 'Prevention is better than cure' is the best formula for proper duckery management.

The transmissible diseases of ducks and ducklings are duck virus, duck hepatitis, duck cholera, keel disease etc. Ducks be vaccinated for viral diseases like duck-plague.

An experienced farmer can detect a sick bird among the flock by a careful look, listening to the sounds of the birds and by observing any reduction in the daily feed consumption. A sick bird becomes listless, eyeslack brightness and watery discharge comes out of the eyes and nostrils.

The sound of sneezing and coughing from the duck house is a warning for the coming disease. The sick birds should immediately be isolated and not allowed to to go to the pond. Local veterinary expert may be contacted immediately for further treatment and advice.

3.3 Harvesting

Some fish attain marketable size within a few months. Keeping in view the size of the fish, prevailing rate and demand of the fish in the local market, partial harvesting of the table size fish is done. After harvesting partially, the pond should be restocked with the same species and the same number of fingerlings depending upon the availability of the fish seed. Final harvesting is done after 12 months of rearing. Fish yields ranging from 3500-4000 kg/ha/yr and 2000-2600 kg/ha/yr generally obtained with 6 species and 3 species (Indian major carps) stocking respectively (Table-3).

The eggs are collected daily in the morning hours after the ducks are released. Ducks should be sold after completion of two years of rearing because the egg laying capacity of the ducks decreases after two years.

3.4 Economics

Taking an average village pond as one acre in area, the variable cost and return functions of the system have been worked out for a 0.4 ha (1 acre) pond in Table-5. It is evident from the table that an investment level of Rs. 14,490/- assures a return of Rs. 21,760/-. The net return on variable cost works out to 50.0%. The cost of the production comes to Rs. 4.48/kg.

It may be added that the investment level of Rs. 14,490.00 has to be viewed in the light of income generation which starts after 3-4 months, when ducks start laying. If this income is ploughed back into the production process, the requirement of working capital is reduced to half.

3.5 Benefits of fish cum duck farming

(i) The fish utilizes the feed spilled by ducks and eat their droppings which form very nutritious food for fish.

(ii) Due to high manurial value of duck droppings complete saving on pond fertilizers and supplementary feed for the fish is possible.

(iii) Ducks keep water plants in check.

(iv) Ducks loosen the pond bottom with their dabbling and help in release of nutrients from the soil which increase the pond productivity.

(v) No additional land is required for duckery activities.

(vi) Duck get 50-75% of their total feed requirement from the pond in the form of aquatic weeds, insects, molluscs, etc. which do not form the food of the fish.

(vii) Major quantity of droppings are spread by the ducks themselves over the whole pond area. This is an efficient and labour saving method of pond manuring. The ducks thus act as living manuring machines.

(viii) It results in high production of fish, duck eggs and duck meat in unit time and water area.

(ix) It ensures high profit through less investment.

4. Integrated fish cum poultry farming

The scientists of the Institute have developed a simple and an economically viable system of integrating fish culture and poultry raising. Under the system the fully built up poultry litter from the poultry pens is recycled in the fish ponds which results in production of 4500 to 5000 kg fish, more than 70,000 eggs and about 1250 kg (live weight) chicken meat from a hectare of pond area in one year, without the use of any supplementary fish feed or chemical pond fertilizers.

The poultry farming is mostly concentrated in the states of Andhra Pradesh, West Bengal, Tamil Nadu, Maharashtra, Bihar, Kerala, Karnataka, North Eastern

Hills states etc. which also abound in large number of water areas. The integrated system of poultry cum fish farming in these states can go a long way in increasing the animal protein production with economic gains to the rural folk.

4.1 Pond management practices

As given under 2.1

4.1.1 Selection of pond

As given under 2.1.1

4.1.2 Clearance of aquatic weeds

As given under 2.1.2

4.1.3 Clearance of unwanted fish

As given under 2.1.3

4.1.4 Stocking

As given under 1.4

4.1.5 Time of stocking

As given under 2.1.5

4.1.6 Use of poultry litter as manure

The fully built up deep litter removed from the poultry pens is stored in suitable places and is applied to the pond @ 50 kg/ha/day every moring after sun rise. The application of litter is deferred on the days when algal bloom appear in the pond.

One tonne of deep litter fertilizer is produced by 25-30 birds in a years time. As such 500-600 birds are adequate to produce manure for a hectare of water area under polyculture. The fully built up deep litter contains 3% nitrogen, 2% phosphate and 2% potash.

The built up deep litter is also available in big poultry farms as well as Government farms at the rate of Rs. 20/- per quintal. The farmers who do not have the facilities for keeping poultry birds can purchase poultry litter and apply in their ponds.

4.1.7 Feeding the grass carp

As given under 2.1.7

4.1.8 Periodical neetting

As given under 2.1.8

4.1.9 Control of algal blooms

As given under 2.1.9

4.1.10 Health care

As given under 2.1.10

4.2 Poultry husbandry practices

The egg and meat production in poultry raising depends upon multifarious factors such are breed, variety and strain of birds but good housing arrangement, balanced feeding, proper health care and other management measures go a long way in achieving the optimum egg and flesh production.

4.2.1 Housing of birds

The best egg production is achieved from the birds that are comfortable and happy. To keep the birds comfortable, a poultry house must provide adequate accommodation, be reasonably cool during summer and sufficiently warm during winter, provide adequate supply of fresh air, sun shine and always remain dry. Given the above facilities the layers respond excellently.

There are three systems of keeping the poultry birds.

(i) Extensive system (free range)

(ii) Semi-intensive

(iii) Intensive system

In integrated fish cum poultry farming the birds are kept under intensive system. In this system, the birds are confined to the house entirely, with no access to the land outside. The intensive system is further of two types *viz.* Battery system (cage system) and Deep litter system. The deep litter system is preperred over the cage system due to higher manurial values of the built up deep litter.

In this system, the poultry birds are kept in pens upto 250 birds per pen, on floor covered with litter. The deep litter pens are started when the weather is dry and is likely to remain so for about 2 months for the microbial activity which alters the composition of the litter. For starting the deep litter system the floor of the pen is covered with any easily available dry organic matter. The cost and ease of obtaining is the main guide. Dry organic material like chopped straw, dry leaves, hay, ground nut shells, broken up maize stalk, saw dust etc. is used to cover the floor

upto a depth of about 6 inches. The birds are then kept over this litter and a space of about 0.3 square meter to 0.4 m^2 per bird is provided. The over crowding of birds is avoided as it results in poor laying.

The droppings of the birds which fall on the litter gradually combine with the material used through the bacterial action. When the pen is not crowded, the droppings are regularly absorded and correct condition of the litter is maintained. When the depth of litter become less, more organic matter is added to maintain sufficient depth. In case the litter becomes damp, superphosphate or lime is added to keep it dry. The litter is regularly stirred for aeration and upkeep of its hygienic qualities.

In about 2 months time it become deep litter and in about 10-12 months time it becomes fully built up litter. At this stage, the built up deep litter becomes a complete fertilizer and it is very difficult for any one to say as to what material was initially used. The level of nitrogen in the fresh poultry droppings is only 1% where as in a fully built up litter the nitrogen content is 3%.

4.2.2 Selection of birds

The fowls may be classified on the basis of utility, economic value or fancy purpose. These include :

(i) Meattype (Broilers)
(ii) Egg type (Layers)
(iii) Game
(iv) Ornamental
(v) Bantam (fighter)

They are further classified into classes, breeds, varieties and strains. The kind of fowl to be raised alongwith fish may be chosen with care from the meat type (broilers) or Egg type (Layers) birds. The fowls which are proven for their ability to produce more and large eggs in case of layers or rapid body weight gains in case of broilers are selected. The fowls of Rhode island or Leghorn breed are suitable for the purpose. About 500-600 birds (layers) produce litter adequate enough to fertilize a hectare of water area under polyfish culture. About eight week old chicks, after vaccination against viral diseases and providing other necessary prophylactic measures as a safeguard against epidemics are kept in poultry house near the pond.

4.2.3 Feeding

Balanced poultry feeds under different trade names are available in the market. The poultry birds under keep litter system should be fed regularly with balanced poultry feed according to their age. Grower mash is provided to the birds during the age of 9-20 weeks @ 50-70 g/bird/day where as layer mash is providedto the birds above 20 weeks @ ranging from 80-120 g/bird/day. The feed is provided to the birds in feed hoppers to avoid wastage and for keeping the house is proper hygienic conditions.

An ample supply of water is made available at all times otherwise egg production is adversely affected.

An earthen pot 2 feet diameter is filled with dry, clean earth and placed in the shed for dust bath of the birds.

Chicken start roosting when they are about eight weeks old. Perches are provided in the pen for roosting of birds at the rate of 8 inches per perch per bird.

4.2.4 Egg laying

Each pen of laying birds is provided with nest boxes for laying eggs. Empty kerosene tins make excellent nest boxes. One nest should be provided for 5-6 birds. Egg production commences at the age of 22 weeks and then gradually decline. The birds are usually kept as layers upto the age of 18 months. The birds lay from 210-250 egg per year.

4.2.5 Health care

Well managed deep litter kept in dry condition has a sterilizing action. The level of coccidiosis and worm infection is very low on a properly managed litter.

The poultry house and equipment must be disinfected atleast 30 days prior to bringing in the new flock either initially or as replacement.

The diseases of poultry birds are grouped as viral diseases, bacterial diseases and parasitic diseases according to the type of causative organism. Vaccine has been developed for most of the viral diseases like infectious bronchitis (I.B.), infected laryngo tracheitis (I.O.T.) Mark's disease, Ranikhet disease, Fowl pox etc. The birds are vaccinated at the appropriate age against these diseases. Some of the bacterial diseases *viz.* Salmonellosis, Coryza, Fowl cholera etc. are caused by various bacteria. The diseases can be kept under control by maintenance of proper

hygienic condition in the pen, feeding the right type of feed and keeping the feeders and other equipment in the pen clean. Broadspectrum antibiotics may be added to the water in case the infection is mild. However, in severe cases the local veterinary surgeon may be contacted. The poultry birds are infected both with internal and external parasites. The treatment of parasites and worms may be done after consulting the local veterinary expert.

4.5 Harvesting

As given under 3.3. The eggs are collected every morning and evening. The birds are sold after 18 months of rearing as the egg laying capacity of birds decrease after that period.

4.6 Economics

Taking an average village pond as one acre the variable cost and return functions of the system have been worked out for a 0.4 ha (1 acre) pond, the details are given in Table 6. It is evident from the table that an investment level of Rs. 29,000.00 assures a return of Rs. 43,000.00. The net return on variable cost works out to 50%. The cost of fish production works out to Rs. 3.20 / kg.

The investment level of Rs. 29,000.00 has to be viewed in the light of income generation which starts after 4 months, when birds start laying. If this income is ploughed back into the production process, the requirement of working capital is reduced to half.

5. Constraints

(i) Despite technological support, scientific fish farming has yet to be adopted widely. The under staffed extension departments of the State Fisheries departments have not been able to play the desired role. The existing communication gap between the scientists and the farmer needs to be bridged by reorienting the existing extension set up.

(ii) The availability of production technology is not the only factor. influencing production decisions. The produce should be marketed efficiently. The producers cooperatives in the areas with multipurpose objectives can go a long way in sustaining production programmes.

(iii) In order to meet the short term requirements of funds for buying core inputs, a charge can be created by hypothecation of produce (Livestock and fish). The existing practice of insistance on securities and collatorals may be modified to the advantage of producers.

(iv) In respect of private waters, structural rigidities *viz.* multiple ownership, public leasment rights and multiple use of water have often been unhelpful to the development of fish culture. There is a need for framing appropriate tenancy legislation similar to agricultural land.

(v) Poaching (illegal removal) of fish is another production disincentive. This is however, a law and order problem. The existing provision in the law of the land may be made more stringent.

TABLE—1

Commonly used weedicides in fish ponds

Weed	*Weedicide*	*Doze*	*Method of application*
Water hyacinth	2, 4-D	8-10 kg/ha	Foliar spray.
Ipomea spp.	2, 4-D	2-4 kg/ha	Foliar spray.
Sedges & rushes	2, 4-D	5-10 kg/ha	Foliar spray.
Lotus & Lillies	2, 4-D	5-10 kg/ha	Root zone treatment.
Vallisneria	2, 4-D	10-20 kg/ha	Root zone treatment.
All submerged weeds	Ammonia	10-15 ppm	Application in water column.
Pistia	Ammonia	1% aqueous solution with 0.25% wetting agent.	Foliar spray.
Pistia	Paraquat	0.2 kg/ha	Foliar spray.
Salvinia	Paraquat	0.4 kg/ha	Foliar spray.
Salvinia	Ammonia	2% aqueous solution with 0.25% wetting agent.	Foliar spray.
Aquatic grasses	Paraquat	2 kg/ha	Foliar spray.
Aquatic grasses	Dalapon	5-10 kg/ha	Foliar spray.

Note : In root zone treatment the brick pellets are soaked in the desired solution of weedicide and put in the root zone.

TABLE—2

Fish toxicants for eradication of unwanted fish

Name/of/the piscicide	*Doze*	*Time taken for fish kill (hrs)*	*Toxicity lasts for (days)*	*Fish killed for human consumption*	*Acts as pond fertilizers*
		Plant derivatives			
Mahua oil cake	200-250 ppm	8-12	15-20	yes	yes
Derris root powder.	4-6 ppm	6-10	7-10	yes	—
Seed cake of tea (*Camellia sinensis*).	75-100 ppm	6-12	10-12	yes	yes
Barringtonia Barringtonia acutangula					
Stem bark	20 ppm	1-1.1/2	2	—	—
Root bark	10-15 ppm	1-1.1/2	2	—	—
Seed	15 ppm	1-1/2	2	—	—
Coroton tiglium (seed powder)	3-5 ppm	1-2	3-5	—	—
Milletia pachycarpa (root powder).	2-6 ppm	1-3	2-3	—	—
Milletia piscida (seed powder).	4-5 ppm	6-8	5	—	—
Tamarindus indica (seed husk).	5-10 ppm	—	—	—	—
Randia (unripe fruit).	13 ppm	—	—	—	—
Walsura piscida	10 ppm	—	—	—	—

Chemicals

Ammonia	200-250 ppm	—	26-40	no	yes
Bleaching powder.	25-30 ppm	3-4	7-8	yes	acts as disinfectant.

Chlorinated Hydrocarbons

Tafadrin 20	0.01 ppm	7-8	30	no	no
Aldrin	0.2 ppm	7-8	30	no	no
Dieldrin	0.01 ppm	7-8	30	no	no

Organophosphates

DDVP 'Nuvan 100 EC'	3-30 ppm			no	no

TABLE—3

Fish production through integrated fish cum livestock farming system

Expt. trial No.	*Type of system*	*Pond area (ha)*	*No. of fish (species)*	*Species ratio*	*Fish stocking density/ha*
1.	Fish-pig	0.1	6	C 20 : R 20 : M 20 : Sc 15 : Gc 20 : Cc 5	5800
2.	Fish-pig	0.1	6	-do-	8500
3.	Fish-pig	0.5	6	-do-	8500
4.	Fish-duck	0.5	6	C 25 : R 20 : M 20 : Sc 15 : Gc 10 : Cc 10	6000
5.	Fish-duck	0.5	6	C 25 : R : 20 : M 20 : Sc 20 : Gc 10 : Cc 10	6000

6.	Fish-duck	0.1	3	C 40 : R 30 : M 30	6000
7.	Fish-duck	0.1	3	C 40 : R 30 : M 30	6000
8.	Fish-poultry (fresh droppings)	0.5	5	C 20 : R 30 : M 30 : Sc 15 : Gc 5	8000
9.	Fish-poultry (Deep litter)	0.1	5	C 25 - R 20 : M 30 : Sc 15 : Cc 10	6000

Livestock stocking density/ha	*Egg production ha/yr*	*Flesh production ha/yr*	*Fish production ha/yr*	*Year of experimentation*
	FISH-CUM-PIG			
60	—	10950	7306	1977-78
40	—	5610	6790	1980-81
40	—	5631	6644	1979-80
	FISH-CUM-DUCK			
300	32,256	750	3561	1979-80
300	29,200	748	3941	1980-81
200	14,000	400	2230	1979-80
200	15,000	513	2276	1981-82
	FISH-CUM-POULTRY			
300	40,000	500	3940	1980-81
500	76,500	500	5200	1983-84

TABLE—4

Gross output, variable costs and net farm income (Fish cum pig culture in 0.4 ha pond)

A. *Expenditure*	*Quantity*	*Rate (Rs)*	*Expenditure*
1. Rent of water body	—	3000/ha	1500.00
2. Pond preparation with mahua oil cake.	1000 kg	80/100 kg	800.00
3. Cost of fingerlings	3400 nos.	200/1000	680.00
4. Annual depreciation on the cost of pig-sties.	—	10% of the total cost.	400.00
5. (a) Fattening of 1st lot of piglets for 6 months.			
(i) Cost of weaned piglets each weighing 15 kg.	12 nos.	8.90/kg	1440.00
(ii) Cost of pig feed	2916 kg	1.50/kg	4374.00
(iii) Cost of medicines	—	—	40.00
(iv) Cost of green fodder	—	—	120.00
(b) Cost of fattening of 2nd lot of weaned piglets for 6 months.	—	—	5974.00
6. Netting charges	—	—	400.00
7. Labour charges	530 man days	10/man day	5300.00
8. Incidentals/contigencies	—	—	200.00
9. Interest on working capital	—	15%/annum	3033.00
Total variable costs	—		23,253.00

B. *Return*

1. Sale of fish - 2400 kg @ Rs. 10/- per kg	Rs. 24,000.00
2. Sale of 1680 kg pig meat @ 9.00/ kg.....	Rs. 15,120.00
Total Returns	Rs. 39,120.00

C. *Net profit*

B/A = Rs. 15,867.00

Percentage of return on variable cost — 68%
Cost of production per kg of fish — 3.0

TABLE—5

Gross output, variable cost and net farm income (Fish cum duck culture in 0.4 ha pond)

A.	*Expenditure*	*Quantity*	*Rate (Rs)*	*Expenditure (Rs)*
1.	Rent of water body	—	3000/ha	1500.00
2.	Pond preparation with mahua oil cake.	1000 kg	80/100 kg	800.00
3.	Fingerlings	2400 nos.	20/100 nos.	480.00
4.	Annual depreciation on the cost of duck house.	—	10% of total cost.	200.00
5.	Ducklings cost	80 nos.	12/Ducklings	960.00
6.	Duck feed cost	2920 kg	1/kg	2920.00
7.	Medicines cost	—	—	40.00
8.	Netting charges	—	—	200.00
9.	Labour charges	530 man days	10/man day	5300.00
10.	Incientals/contingencies	—	—	200.00
11.	Interest on working capital	—	15%/annum	1890.00
	Total variable cost			14,490.00

B. *Return*

1.	Sale of 1480 kg of fish @ Rs. 10/kg	Rs. 14,800.00
2.	Sale of eggs 6334 nos. @ 0/60 Paise/egg	Rs. 4,160.00
3.	Sale of 200 kg duck meat @ Rs. 14/kg	Rs. 2,800.00
	Total return	Rs. 21,760.00

C.	Net Profit B-A	Rs. 7,270.00
	Percentage of return on variable cost	50%
	Cost of production per kg of fish	Rs. 4.48

TABLE—6

Gross output, variable cost and net farm income (Fish cum poultry farming in 0.4 ha pond)

A.	*Expenditure*	*Quantity*	*Rate (Rs.)*	*Expenditure (Rs.)*
1.	Rent of the water body		3000/ha	1500.00
2.	Pond preparation with mahua oil cake	1000 kg	80/100 kg	800.00
3.	Fingerlings	2400 nos.	20/100 nos.	480.00
4.	Annual depreciation on the cost of poultry pens feeders, waterers, laying nests, etc.	—	—	500.00
5.	Cost of 8 weeks old chicks (given a margin of 10% mortality rate).	220 nos,	7/bird	1540.00
6.	Cost of feed (1-3 month @ 7 kg/bird) (4-12 months @ 29 kg/bird)	7340 kg	2/kg	14,640.00
7.	Cost of medicines	—	—	50.00
8.	Netting charges	—	—	240.00
9.	Labour charges	530 man days	10/man day	5300.00
10.	Incidental/contingencies	—	—	200.00
11.	Interest on working capital	—	15%/annum	3793.00
	Total variable cost			29,083.00

B.	*Return*	
	1. Sale of 2080 kg fish @ Rs. 10/kg	Rs. 20,800.00
	2. Sale of 28,000 eggs @ Rs. 55/100 eggs	Rs. 15,400.00
	3. Sale of 500 kg chick @ 15/kg (live wt.)	Rs. 7,500.00
	Total return	Rs. 43,700.00
C.	Net profit (B-A)	Rs. 14,617.00
	Percentage of return on variable cost	50%
	Cost of production per kg fish	Rs. 3.20