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Integrated pig - fish farming: A case study in imphal west district of Manipur

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Abstract
In India the system of integrated farming with various components has gained momentum due to higher production and income. In Manipur, integration of pig with fish as a major component is practiced. A case study was conducted including a farmer of Khabi Bamdiar village of Imphal West district of Manipur adopting integrated pig - fish farming. The innovation made by the farmer is found to be acceptable with few modifications. The practice is socially, ecologically and economically viable. The farmer has been making a net profit of 1433242 in the first year and then 2565242 from second year onward form his 3.5 ha of land i.e. 732923 ha^{-1} yr^{-1} from this integrated approach. This technique may be promoted to improve the present level of farm production in the state of Manipur and in the country where fish remain as a major commodity for local consumption.

Keywords: Integrated farming, Farming technique, Marginal level, Adopting

Introduction
The model behind the integrated farming is based on "there is no waste", and "waste are only a misplace resource which can be converted to a valuable material for other products" [1, 2]. Practice of linking together two normally separate farming system i.e. livestock and fish is known as the integrated livestock-fish farming, where the fish and livestock farming become the sub-systems of a whole farming system. Best figure of the annual fish production has a range between 1 ton ha^{-1} yr^{-1} to 1.5 ton ha^{-1} yr^{-1} and it can be obtained by following intensive management inputs, maintaining the stocking density of the fishes, feeding the right proportion with their respective weights of energy-rich supplementary feed to a significant of natural feed. There is an increase interest in the utilization of animal manures in aquaculture with the rising cost of high protein fish feed and inorganic fertilizer, as well as for the general concern of the energy conservation. It is a traditional system, which integrate animal husbandry with the aquaculture [3, 4]. Considerable attention has lately emphasized on the integration of livestock with fisheries as incorporation of animal manure as fertilizer and nutrients for promotion of natural feed in fish ponds [5, 6]. The rationale behind integrating fish with livestock is the availability of large amount of nutrients (N-P-K) which are present in the animal feed and are being recovered in the manure. With possible proportions of 72-79 % nitrogen, 61-87% phosphorus, and 82-92% potassium, which act as a fertilizers in the fish pond to produce plankton that comprises of high-protein natural food for certain species of fish. Recent experiments have demonstrated that considerable fish production can be obtained when animal manures are properly applied to fish poly-culture systems [7]. A yield of 4 ton ha-1 yr-1 as the only source of nutrients is obtained from the poly-culture of carps, channel catfish and largemouth bass with manure wastes from 66 pig ha^{-1} [8].
An appropriate means for increasing returns from a limited land area and reducing risk of diversifying crops can be obtained from the integrated animal-fish farming [9, 10, 11]. However, development of such cultivation practices depend on the adaptability with the prevailing local climate and locally marketable fish seeds, feeds and the economic viability of the system ascertained.
Manipur, a small state situated at the North-Eastern corner of India. It is rated as one of the highest fish consumer in the country instead of its limited fishery resources. The state does not have any marine coastlines and seas. Its only fishery resources available are from inland waters. The production of fishes can be increased by use of animal manures particularly pig manure in fish pond. The pig manure contains about 70% of digestible food for fishes besides certain digestive enzymes. It also provides nutrient base for planktons which are ultimately used by the fishes as natural food. Recently,

increasing trend of pig farming has enhanced the availability of pig manures which can be successfully used in inland fisheries through integrated farming approach. On this backdrop, a case study was conducted on integrated pig - fish farming in Manipur.

Methodology

The case study method was followed to explore the pros and cons of integrated pig - fish farming in Manipur. During the study a farmer Mr. Leisangbam Dhanachandra of Khabi Bamdiar of Imphal West district of Manipur adopting the integrated pig - fish farming system is selected and the entire system is thoroughly studied.

Findings and discussion

Mr. Leisangbam Dhanachandra of Khabi Bamdiar of Imphal West district of Manipur, is an enthusiastic and progressive farmer in nature, with a family size of six members, was cultivating only fish farming at 3.5 ha of land. He was upset by experiencing low annual income of around 800000-850000/- only from the fish cultivation i.e. 1200 kg ha^{-1} and sometime even lower than that due to frequent flood occurrence at the state. His effort, however, was continued in search of suitable innovation to increase his farm income and a solution when flood used to occur. He attended a training programme, which was conducted by the ICAR Research Complex for North Eastern Hilly Region, Lamphel Centre, Manipur on "Composite fish farming practice and integration of piggery and fish cultivation" during the year 2014. Thereafter, he has started practicing with the new ideas of integrated farming system of fish and piggery in his farm. He has utilized his land by designing the plot layout by some interventions through building a pig shed on 0.011 ha in the middle of land and four ponds of different sizes - three small pond/ nursery pond of each 0.25 ha and a grow out pond of 2.25 ha for final composite culture. He has raised the height and width of the bund. He has connected four ponds with the four corners of the pig shed by well ventilated drains through fitting 50 feet of suction pipe to depositing the outlets towards the four ponds (Plate 1). Three nursery ponds of 0.25 ha each are used for spawn fish rearing for 3-3.5 months and one grow out pond of 2.25 ha for rearing the fingerling size (5-15 gm) fish from the nursery till attain table size fish of 150-250 gm within the duration of three months.

Plate 1: Integrated Pig and Fish farming

Details of Piggery and Fish Farming

Table 1: Details of the pig-fish integrated farming

Total plot area	
a) Piggery	0.011 ha
b) Fish	3 ha
i. Early fry	0.25 ha × 3=0.75 ha
ii. Composite fish culture	2.25 ha
Total area for fish	3 ha
Fish stocking density	
i) Early fry	80 Spawn (1 Spawn=100000 small fry)
ii) Fingerling	35000 pieces
iii) Integration of composite fish	40000/ ha × 3 ha= 120000 pieces
Ratio of the fish species stocks **Rearing durations**	[(Rohu (*Labeo rohita*) + Pengba (*Osteobrama belangeri*)] +[Mrigal (*Cirrhinus mrigala*) + Ngaton (*Ompok pabo/bimaculatus*)]+ Catla (*Catla catla*) @ 65%, 25%, 10%
Pig	26 piggery and 4 sow
Date of rearing of piggery	Feb/March of 2015
Date of rearing of 3 spawn (Rohu+Mrigal+Pengba)	July/July of 2015
Date of integrating the compositing fish	Oct./Nov. of 2015
Period of fish rearing	6 months (2 times in a year)
Period of pig rearing	1st time 8 month and 6month from onward(2 time a year)

Design of the Plot

While designing the plot, the total land is being distributed into five parts (Table 1). One part for constructing piggery shed of area 0.011 ha containing six chambers - two big chambers for rearing piglet and four small chambers for farrowing process. The waste materials and other outlets are made to be drained in the ponds with the help of 50 feet suction pipe fitted at the drainage for the supply of manure to the ponds. Remaining three parts of 0.25 ha each are prepared as ponds for rearing the small fry until it attains the fingerling size that takes a time interval of three months. The last part of 2.25 ha is prepared as a big pond to cultivate the composite fishing. The bund height is fixed as one meter above the depth of water level.

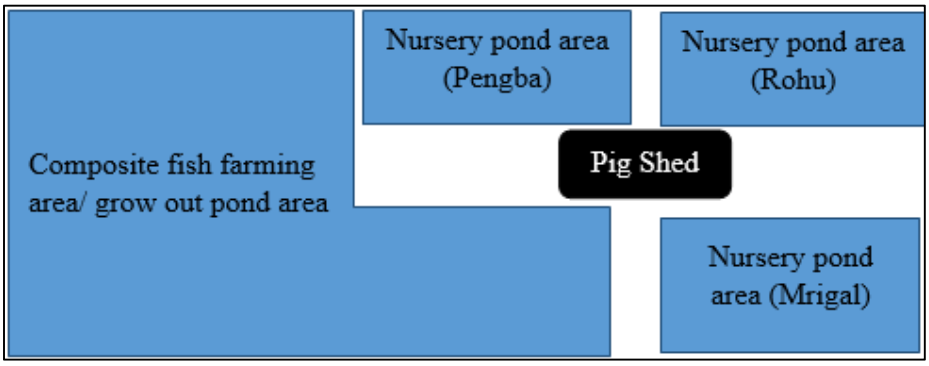

Fig 1: Lay out of the cultivated plot

Plot Preparation
The whole land is divided into 5 parts (Fig 1). Three parts of 0.25 ha each as nursery pond for rearing spawn fishes and a grow-out pond for rearing composite fish of 2.25 ha was dug with the help of machine at a deep of 2 meters for all the ponds. A pig shed of size 0.11 ha was also constructed to rear 26 piglets and 4 sows at the middle of the plot by dividing the ponds and high bunds were constructed to surround on all side of the ponds.

Nursery Pond Renovation
Each nursery pond was applied with 36 kg per 0.25 ha of quicklime to maintain the soil pH for fish farming. Oil cake of 50 kg per 0.25 ha and cow dung of two power tractors were applied in the field and keep it for 15 days at the nursery pond for production of phytoplankton and zooplankton. The pond was kept for 15 days first with a water level not above the level of 0.5 feet for zooplankton and phytoplankton to develop easily with the help of sunlight. Irrigation is applied up to a level of 1 meter for the rearing of spawning fish till it attains up to fingerling size (5-20 gm), within the duration of 3-3.5 month. Oil emission was done 15 days after the spawning fish was introduced in the nursery pond to remove or kill the unwanted insect or organism. Weekly 1 feet of irrigation was applied until it reaches 2 meters and maintains it till the fingerling size.

Grow-Out Pond Renovation
The Grow-out pond was prepared at a deep of 2 meters. After attaining the size of fingerling from three nursery ponds of separate Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*), Pengba (*Osteobrama belangeri*). Other two fish Catla (*Catla catla*) and Nganton (*Ompok pabo/bimaculatus*) were brought from the local market at fingerling size. All the treatments were stocked with fish component consisting of fingerling at the percentage of (Rohu + Pengba) at 65%, (Mrigal + Nganton) at 25% and Catla at 10% with a stocking density of 40,000 fingerlings ha^{-1}. The water level in this pond was kept at 2 meters till the harvesting.

Pig Shed Renovation
The pig shed of 0.011 ha was constructed in the middle of the plot surrounded by the four ponds. The shed was constructed of six chambers. Four chambers of small size were made for the farrowing process by rearing a sow each while two chambers of large size were kept for keeping 13 piglets in each. The pig excreta were washed away directly to the fish ponds by using the 50 feet suction pipe fitted to each pond.

Rearing of pig
The four sows and the piglets were reared intensively that they were not allowed to go out of the pig shed. The sow and the piglets were fed with different proportion of balance feed mixture of rice bran and company concentrated pig feed twice a day.

Plate 2: Demonstration of pig shed maintenance by the farmer

Table 2: Balance feed mixture for the pig

Types of Pig	Rate of mixture	
	Concentrate	Rice Bran
Sow	1.5 kg per Sow day^{-1}	2 kg per Sow day^{-1}
Piglets	0.25 kg day^{-1}	0.50 kg day^{-1}

Along with these balanced feed, they are also fed with green grass and locally available vegetative materials, kitchen waste, spoiled vegetables, etc. These piglets were ready for slaughter in 6 months, hence lots of pigs were being raised in the year. The piglets born from the sow were sold after 3 months of its birth. Each sow used to give birth to 7-10 piglets after 8 months for the first time and after that, it used to take 5-6 months. In this system, 2 piggeries can be raised in a year afterward.

Fish Stocking

Fingerlings of Rohu, Mrigal, Pengba from the nursery ponds after 3 months were taken with initial weight of 5-15 gm and fingerlings of Catla and Ngaton were procured from the local market and stocked at the grow out pond at the density of 40,000 ha^{-1} and stocking percentage of (Rohu + Penga):(Mrigal + Ngaton): Catla = 65%:25%:10%. Lime at 25 kg ha^{-1} was applied in all the ponds for each month of growing period. Stocking of grass carp is not recommended for such farming situation.

Economics of Integrated Pig and Fish Farming

Table 3: Input cost on plot construction (A)

Sl. No.	Particulars	Quantity	Rate(□)	Amount (□)
1	Plot construction(A)			
	Pig shed	1(0.011 ha)	-	321000
	Nursery Pond	3 (0.25 ha)	240000/ ha	180000
	Grow out Pond	1 (2.25 ha)	240000/ ha	540000
Total (A)				1041000

The total input cost of the plot construction (A) is found to be □ 1041000.

Table 4: Input cost on Pig Rearing (B)

Sl. No.	Particulars	Quantity	Rate (□)	Amount (□)
1	Pig (sow)	4	15000/pig	60000
	Piglets	26	3500/piglet	91000
2	Pig feeds			
	Concentrate feed	84 bag	1450/bag	121800
	Rice Bran	6200 kg	10/kg	62000
	Others			10000
Total (B)				344800

The total input cost on Pig rearing (B) is found to be □ 344800.

Table 5: Input cost on Labor (C)

Sl. No.	Particulars	Quantity	Rate(□)	Amount (□)
1	Maintenance (yearly)	2	250/day	180000
2	Weeding and Liming	72	400/day	28800
3	Stocking(Netting + liming +land preparation	27	400/day	10800
4	Harvesting	168	400/day	67000
Total (C)				286800

Total input cost on labor (C) is found to be □ 286800.

Table 6: Input cost on Fish Rearing (D)

Sl. No.	Particulars	Quantity	Rate(□)	Amount (□)
1	Fish Spawns			
	Rohu	50 Spawn	450/Spawn	22500
	Mrigal	10 Spawn	450/Spawn	4500
	Pengba	10 Spawn	800/spawn	8000
2	Fingerling fish			
	Catla	5000	1/fingerling	5000
	Ngaton	30000	2.5/fingerling	75000
3	Fish feed			
	Oil cake	150 kg	35/kg	5250
	Cow dung	2 tractor	750/tractor	1500
4	Liming	1524 kg	17/kg	25908
5	Water pumping oil (Diesel)	800 litter	55/litter	44000
6	Oxygen gas			5000
Total (D)				196658

The total input cost on the fish rearing (D) is found to be □ 196658.

Total Input cost on the Integration of Pig and Fish (I) = A+B+C+D=□1041000 + 344800+ 286800+196658= □1869258

Table 7: Return from pig farming (E)

Sl. No.	Particulars	Quantity	Rate (□)	Amount (□)
1	Pig	26	16000/pig	416000
2	Piglets	79	3500/piglet	246500
Total (E)				662500

Total return cost on Pig Return (E) is found to be □ 662500.

Table 8: Return from fish farming (F)

Sl. No.	Particulars	Quantity	Rate (□)	Amount (□)
1	Fish fry	1200000 fish fry	0.20/fish fry	240000
2	Table size Fish	12000kg	200/kg	2400000
Total (F)				2640000

Total return from Fish (F) is found to be □ 2640000

Total return from Integrated Pig and Fish

Gross Return (R) = E+F= □(662500+2640000) = □3302500

The total return from the Integrated Pig and Fish is found to be □3302500

Net return= R-I= □3302500- □1869258=□1433242 (in 1st year)

The net return of the integrated pig and fish is found to be □1433242 in the first year and from the second year onwards, the cost for incurring the plot construction, piglet cost will be excluded and hence the net return is□ 2565242 yr^{-1} from 3.5 ha farm of the selected farmer i.e. □ 732923$ha^{-1}yr^{-1}$

Conclusion

Integrated pig with fish farming is a high income earning practice. Cultivation and promotion of such farming not only boosts the economy but also enhances the employment opportunity. It helps in getting higher growth of fish, optimum utilization of the given resources and net income. Nevertheless, it has proved to be more profitable than unitary system of farming and ensures the minimization of financial risk, reduction of wastes and thus is ecologically more sustainable.

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