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RICE-FISH INTEGRATED FARMING SYSTEM FOR LOW-LYING FIELDS

भाकृअनुप
ICAR

ICAR Research Complex for Goa

Ela, Old Goa, Goa - 403 402.

TECHNOLOGY FOR RICE-FISH INTEGRATION

The low-lying rice field is a unique aquatic environment. It has a standing column of water and a natural plankton growth in it, in addition to its insect and molluscs, which serve as fish food. Therefore, it has a great potential for fish culture as an additional and simultaneous operation for enhancing production per unit area.

Rice cultivation is a major agricultural operation in many of the southeastern coastal states of the country. Rice occupies an aggregate of about 40 lakhs hectares in the four states of Kerala, Karnataka, Goa and Maharastra. In Goa alone, there are about 40,000 hectares of rice land. In most of the rice fields, particularly in low-lying paddies, it is possible to increase income substantially by incorporating fish culture without much additional expenditure towards the fish component.

Many rice fields in the villages of Bardez, Tiswadi, Ponda, Salcete and Canacona talukas of Goa are suitable for establishing the system. Most of these fields are already having marginal bunds and a pond situated inside for irrigation during rabi and summer. These can be straight away put under the rice-fish combination. Out of about 16,000 ha of Kher lands in Goa, atleast in 9,600 ha, two crops of rice are cultivated in a year, wherein it would be easy to integrate fish culture.

Basic principle behind the integration is that the abundantly produced plankton in the stagnant water maintained for the rice crop, is recycled through a combination of fast growing carp species. The fertilization applied for the rice crop induces the production of plankton for the use of fish, which would go waste otherwise.

Recently, there is a slow shift from rice cultivation to other crops or non-agricutural activities, due to increase in the cost of rice cultivation and declining returns. As rice and straw are important commodities, this declining trend has t be checked. Introduction of fish culture as an additiona component in the traditional rice fields would be an attractiv proposition to sustain rice cultivation.

SUITABILITY OF THE AREA :

Low-lying rice fields where 10 to 50 cm of wate column could be maintained and regulated for a period of months or more are suitable for this combination. In the field where two crops of rice are cultivated in a year, it could b easy to integrate culture of freshwater fish as well. I addition to the two crops of rice and fish, it would also b possible to have a third summer crop, if irrigation is available This would be an effective utilization of the available land.

To make the combination functional, field should b bunded and a pond should be provided in the field t facilitate the fish to get collected during rice transplanting harvest and non-rainy period.

PREPARATION OF RICE FIELD :

The identified field should be separated from the rest b bunds, not less than 60 cm high, with a base of 90-120 cr width. Field and adjoining garden land are preferable, a bunds are not required to be raised on the upland side Outlet of the field are to be fitted with 25 cm diameter earthe pipes at 45 cm height, covered with net to prevent escape c stocked fish. Another such outlet which should normall remain closed may also be provided at 15 cm height t regulate water. By adjusting its height, water level could b regulated as required.

A pond 1/10 of the size of the field should be escavate at its lower side. If a natural pond is present nearby, it i enough to connect it to the field. The water column up to 3 cm height has to be maintained in the field for the majo period of culture.

SELECTION OF SUITABLE FISH SPECIES AND CROP VARIETIES :

Many freshwater fish species are tried under the combination of which cat fish *(Clarias batrachus)* and murrels *(Channa striatus* and *Channa marulius)* need particular mention as they can survive low oxygen, turbid and shallow water condition. But carps like catla, rohu, mrigal and common carp could be stocked and cultured in rice field with high production rate. Recent trials showed that an average individual growth of about 1 kg could be attained under the rice-fish system, provided advanced fingerling of size 10-15 cm (100-150 g) are stocked in the field.

Advanced fish fingerlings have to be raised separately in a small adjoining pond during the previous season itself and these advanced fingerlings should be stocked in the field during June for better results. This would also prevent loss of stocked fish due to predation by local fishes which may enter the field subsequently. The stocking density suggested is 1,500 to 2,000 fingerlings/ha of the field with 2:2:1:1 ratio of catla, rohu, mrigal and common carp, respectively.

Rice varieties of medium to long duration and medium to tall in height which are less susceptible to the pests and diseases should be selected for the combination. While the first crop of rice may be sown by broadcast in May/June, the second crop should be necessarily transplanted. Some of the local rice varieties are suitable for the combination. Trials conducted in this Institute have indicated that Jyothi and Vyttila-1 are suitable for both Kharif and Rabi cultivation in Goa. For the third crop, cowpea, vegetables, groundnut or water melon could be grown under irrigation, when water would not be stagnated in the field. If the bunds are broad enough they also be utilized for the cultivation of fodder grass, banana, vegetables or even coconut.

WATER MANAGEMENT :

Water column of certain minimum height is required for sufficient plankton production, which form the food of the selected fish species. Therefore, after planting, water level should be slowly raised in the field, keeping pace with the growth of rice. However, the water level should never be more than half the height of the plant. This could be done by suitably adjusting the inlet and outlet pipes in the bunds.

HARVEST :

During harvest of first crop and transplanting of the second crop, water has to be drained from the field allowing the fishes to move to the pond. However, the second crop can be harvested without draining the water so that a column of water is retained in the field for longer duration when there is no water replenishment by rain.

The fish could be harvested after the second crop when water level goes down. Harvest of fish could also be done after draining water from the field so that fish could be collected from the pond.

RICE AND FISH YIELD :

Vyttila-1 has the desired height and yield, suitable for the water-logged condition. It was observed to grow over one meter height and yield 3.0 ton/ha during Kharif and 6.0 ton/ha in Rabi. A fish production rate of 1,250 kg/ha/8 months was recorded with an average individual growth of one kg when stocked with advanced carp fingerlings at 1,500-2,000/ ha stocking density and without supplementary feeding and pond fertilization.

In addition, the recommended package of practices for crops excepting application of insecticide for rice has to be followed.

CALENDAR OF OPERATION :

Based on the results of trials conducted by the Institute, a calendar of operation has been suggested below for adoption in low-lying area where water level management is possible:

Month		Operation
May / June	-	Preparation of field, bunds and pond. Sowing of rice.
		Liming the pond @ 300 kg/ha.
		Release of advanced fingerlings in pond 15 days after liming.
June / July	-	Water level management.
August/September	-	Draining water from the field. Harvest of rice crop.
September	-	Transplanting of second crop of rice. Water regulation.
October/November	-	Water regulation.
December/January	-	Harvest of second crop of rice.
January / February	-	Harvest of fish. Cultivation of third crop such as sesamum, cowpea, water melon, groundnut or vegetables, if possible.
April / May	-	Harvest of third crop.

ECONOMICS :

Economics of the system has been calculated based on the results of field trials conducted at Goa and Kerala and projected for a 0.1 ha field with a 0.01 ha pond inside. The calculations were based on the suggested combinations of four species of carps, two rice crops and one groundnut crop on residual moisture and the average of rates prevailing during 2000. Sesamum, water melon or vegetables can also be cultivated as summer crop, depending on water availability.

Economics of rice-fish culture system in 0.1 ha field.

ticular	1st crop (Kharif)	2nd crop (Rabi)	3rd crop (Summer)	Fish	Total yield/ year (kg.)	Total cost/ 0.1 ha (Rs.)
1. Expenditure (Rs.)						
a) Field Modification*	—	—	—	—	—	750
b) Operational cost**	1,400	1,200	1,000	2,000	—	5,600
2. Yield (kg)						
Rice	300	500	—	—	800	5,600
Straw	500	300	—	—	800	800
Groundnut	—	—	150	—	150	2,250
Fish (carps)	—	—	—	125	125	6,250
3. Gross returns***						
(Rs.)	2,600	3,800	2,250	6,250	—	14,900
4. Net profit						
(Rs.)	1,200	2,600	1,250	4,250	—	8,550

* Field modification: The initial non-recurring expenditure towards digging of pond up to 1 m depth and raising bunds of 60 X 90 cm on three sides for a running length of 140 m has been estimated to be Rs.7,500/-, 10% of which was taken as annual expenditure portion for each year.

** Expenditure includes preparation of land, pond, liming, sowing, transplanting, manuring, cost of rice and groundnut seeds, fish seed, fertilizers and harvesting charges.

*** Calculated at nominal rates of Rs.7/- per kg of rice, Re.1/- per kg of straw, Rs.15/- per kg of groundnut and Rs.50/- per kg of fish.

SALIENT FEATURES OF RICE-FISH INTEGRATION :

1. Introduction of fish component in the system could increase the income thereby inducing the sustenance of rice cultivation which is becoming increasingly uneconomical.

2. The system envisages maximum utilization of the available land and biological resources. Three crops and fish could be raised in a year, enhancing the income generation.

3. The naturally produced plankton in the field due to manuring the rice crop is effectively utilized for fish growth, which otherwise will go waste.

4. Utilization of plankton by fish and fish faeces for fertilizing the field is the effective way of organic waste recycling.

5. Only minimum area is used for pond excavation (1/10 area) and this along with water stagnation, facilitates faster fish growth.

6. Stocking of pre-reared advanced fish fingerlings in the month of May results in better survival and growth of fish.

7. Due to water stagnation and fish movement, weed growth in the field is minimized.

8. Marketable fish of over one kg size can be harvested with in a short period of about eight months.

9. Pond bunds can be utilized for growing vegetables, fodder, banana, etc., for additional income.

10. Rice-fish integration generates much homestead employment and the much needed carbohydrate and protein are produced in the same field with minimum input.

Material prepared by:

S. Subramanian
B. L. Manjunath
K. N. Mohanta

Published by:

D.G. DHANDAR
Director,
ICAR RESEARCH COMPLEX FOR GOA
ELA, OLD GOA 403 402