



PADDY-FISH INTEGRATED FARMING SYSTEM FOR NORTH-WESTERN HIMALAYAS



**CENTRAL SOIL & WATER CONSERVATION
RESEARCH & TRAINING INSTITUTE**

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FOREWORD



Fish being rich in protein and micro-nutrients and an integral part of the diet amongst 3 billion people globally, is recognized as the protein of the poor. The introduction of fish farming in existing crop-based farming systems is more relevant for improving nutritional status and providing livelihood support to the people of north-western Himalayan region since the region depends on low yielding and traditional cropping systems.

In India, wide scope for paddy-fish culture exists since only 0.23 million ha is presently under this integrated farming, against the potential of 20 million ha out of 43 million ha of paddy cultivation. In Uttarakhand, presence of extensive area of 2,88,225 ha under paddy culture, prevalence of limited pesticide uses, relatively higher rainfall (1758 mm) and extensive irrigation canals and ghuls provide opportunity for the development of paddy-fish integration. The technology refined at the watersheds adopted by the Institute is new to the region, which has potential to increase the productivity of paddy fields and provide fish for food and income to the resource-poor farmers.

(K.S. Dadhwal)

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INTRODUCTION

- ▶ Paddy cultivation in mountainous terrain and in foothills and plains of the north-western Himalayan region has potential for fish production.
- ▶ Paddy-fish farming is one of the most useful integrated farming methods to judiciously utilize land, water resources and other farming inputs like labour and agricultural wastes.
- ▶ Provision to maintain regular water depth at 20-30 cm, use of screens to prevent escape of cultivated fishes and entry of unwanted wild fishes, and some means like trenches or small ponds to provide shelter to cultivated fishes in paddy fields during moments of distress are pre-requisites to take up paddy-fish culture.
- ▶ Paddy-fish culture being practiced in north-eastern Himalayas, Kerala and other plain locations may not hold good for north-western Himalayas due to the prevalence of small terraced fields.
- ▶ Suitable farming techniques for the region were refined by the Institute to raise fish and cultivate paddy synchronously so as to enhance the productivity of paddy fields and provide food and economic security to the people of the region.

SITE SELECTION

- ▶ Downstream locations nearby human settlements, where minimum upstream-downstream conflicts exist and needed watch and wards become easier are most suitable for paddy-fish culture.
- ▶ The paddy fields should have sufficient and assured water supply and higher water holding capacity.

- ▶ Fish culture in paddy fields nearby irrigation canals or *ghuls*, where water impoundment is possible for longer period are most suitable sites.
- ▶ The fields should, be amendable for the construction of small to medium size trenches and refuge pond(s).

PREPARATION OF FIELDS FOR PADDY-FISH CULTURE

- ▶ Strengthen field bunds all around paddy fields to 30-40 cm height to avoid floods and breach of dikes.
- ▶ Make 'L', or 'U' or 'I' shaped trenches of 30-50 cm depth and 40 cm width for a length of at least 8-10 m (Photo 1) over an average area of 2.0 m² in 1-4 side bunds.



Photo 1: Trenches made in paddy fields

- ▶ A refuge pond of 1-2 m² with 0.5-1 m depth (Photo 2) at downward side of the field would safeguard the stocked fishes during periods of occasional water scarcity for sometime or emergence situations to escape from predators like crabs, snakes and birds.
- ▶ Sometimes, deep-water refuge may not be required if continued water supply exists, since upland areas being cooler than plains, higher temperature related problems in the paddy fields with low water depth may not arise.

- ▶ Put suitable net line (Photo 3) at both inlet and outlet of the fields to prevent entry of unwanted materials and wild fish species and escape of stocked fishes, respectively. Plug all leakages to prevent water loss and escapes of stocked fishes.



Photo 2: A refuge pond in a paddy field

- ▶ Use minimum pesticides and fertilizers to kill pests or promote growth of paddy and fish foods (planktons) and fishes in the fields. Do not dewater the fields during fertilizer use application and grain filling stage in the belief to get higher fertilizer efficiency and better grain filling, respectively.



Photo 3: Outlet of a paddy field plugged with netline

- ▶ Fishes in paddy fields improve crop health and yield by reducing insect or pest attacks on crops since they eat or kill live stem borers, leaf folders and snails and fertilize crops by their excreta and in turn paddy ecosystem nourishes fishes.
- ▶ Use of animal dung as fertilizer in paddy fields reduces the fertilizer needs of paddy by 45-50%.
- ▶ Regulate water flow into paddy fields on need-basis instead of continuous through-flow so as to maintain warmer water

temperature and avoid flushing out of applied fertilizers and developed natural fish foods.

- ▶ Low dissolved oxygen (O_2) below 3 ppm (parts per million, 1 mg in 1 litre = 1 ppm) may be growth limiting, which occurs very rarely in paddy fields and the ideal content is 5 ppm.

FISH SPECIES, PADDY VARIETIES AND STOCKING RINCIPLES

- ▶ Exotic common carp (*Cyprinus carpio*) is most suited for culture in paddy fields. Indian Major Carps (Photo 4) such as catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) and others like catfishes (*Clarius* spp.), *Channa* spp. and exotic silver carp (*Hypophthalmichthys molitrix*) can also be cultured in paddy fields of north-western Himalayan region.



Photo 4: Common carp and Indian Major Carps: Catla, rohu and mrigal

- ▶ Tall-growing and long-duration paddy varieties are preferred for paddy-fish integration. Other paddy varieties, viz; Gobind, Pant-10 and Pant-12 can also be considered for the cultivation.
- ▶ Before stocking, weed out wild fishes and predators like crabs and water snakes, if any, by complete dewatering.
- ▶ Stock bigger size, stunted (80-90 gm) and good quality fish fingerlings (Photo 5) at a density of 0.5-0.8 fish/m² in paddy fields with 20-30 cm water level after 15 days of paddy transplantation or 30 days of paddy sowing and harvest fish either simultaneously with paddy or few days or months after paddy harvest as per water availability.



Photo 5: Fish stocking in a trench and refuge pond

- ▶ If production of fish fingerlings is planned instead of table size fish, stock 5-10 fish seedlings (5-10 gm)/m².

FISH FEEDS AND BIOMASS MANAGEMENT

- ▶ A mixture of rice polish and Mustard Oil Cake (MOC) in the ratio of 1:1, prepared in dough may be enough for supplementary fish feeds (Photo 6).
- ▶ Feed fish daily with supplementary feeds at 1-3% of fish biomass weight or as per consumption, besides maintenance of natural foods to increase fish production.



Photo 6: Fish feeds prepared in dough

- ▶ Provide 50 gm feeds per day initially and gradually increase up to 400 gm kg day⁻¹ towards the end of culture (4th-6th months) for 30-40 fishes stocked in 40-50 m² fields. Addition of animal dung at 0.5 kg per 100 m² field area in alternate days may reduce the need for external or farm-formulated feed supplements by 20-25%.
- ▶ Provide watch and wards to control predation due to birds & snakes and poaching.

PRODUCTION POTENTIAL

- ▶ Carps (Photo 7) grow on an average to 450 gm in foothills and 400 gm in mid-hill Himalayas during a paddy culture season of 5-6 months, if stunted yearlings are stocked.



Photo 7: Harvested fishes from paddy fields

- ▶ Fish culture in paddy fields with a loss of 4% paddy area allocated for refuge pond and trenches yielded about 600-900 kg fish ha⁻¹ yr⁻¹.
- ▶ An additional net profit of about ₹ 600-800 per 100 m² is realized from paddy fields on integration of fish culture with bare minimum inputs such as fish seeds, feeds and screen or nets at a unit cost of ₹ 120 per 100 m².
- ▶ About 15-20% improvement in paddy yield over non-integrated fields is possible mainly due to synergetic benefits of the integration. Fish excreta serves as a rich source of manure.

CONSTRAINTS AND REMEDIES

- ▶ Paddy plots being small, narrow and contiguous with shallow soil depth, most farmers are unwilling to remove fertile top soil to construct trench & refuge pond and believe that it would reduce area under paddy and yield due to stocking of fishes.
- ▶ Conflicts of tenant farmers-landowner farmers on modification of fields, *i.e.*, digging of trenches and refuge ponds, prevent adoption.
- ▶ Fragmented and terraced fields often located in remote areas and have common inlet for many fields, which cause problems of coordination and management amongst farmers, besides poor watch and wards.
- ▶ Absence of adequate hatcheries, lack of fish seeds and effective seeds transport mechanisms prevent spread of fish farming in the region. Prevailing problems and possible solutions for paddy-fish culture are suggested in Table 1.

OUTREACH AND SCOPE OF APPLICATION

- ▶ The paddy-fish farming technology has opened up a new vista of incorporating fish farming into the existing farming systems in the region. Within the villages and watersheds adopted by the institute, farmers are realizing the potential of the technology. State Government's line Departments and NGOs in the region have been appraised about the technology. Self multiplication potential by the farmers and beneficiaries themselves with technical guidance from the Institute is promising.
- ▶ This technology can be replicated in wide range of mid-hills and foothills of north-western Himalayas. Particularly in paddy fields near irrigation or stream channels, where sufficient water is impounded for long period can be suitably used for fish farming. The technology can suitably

be applied in at least 10-20% of the paddy fields available in the region.

Table 1: Problems and remedies suggested

Sl. No.	Problems-cause	Remedies suggested
1.	Escape of stocked fishes due to floods/ water flows	Raise bund height; install filters at inlet and outlet of the fields.
2.	Small size of fishes at harvest due to short culture period (90-120 days)	Stock bigger size fish seedlings. Provide supplementary feeds. Produce only fish fingerlings that can be harvested and stocked in nearby ponds.
3.	Poaching	Select plots nearby settlements. Avoid plots where easy or complete dewatering can be done.
4.	Crab problems	Plug holes or crevices in bunds or fields and strengthen bunds. Stock bigger size fish seeds.
5.	Birds' menace	Stock bigger size fingerlings and provide deeper refuge pond & trenches.
6.	Dewatering of fields during fertilization and grain filling stage. Water scarcity and poor water holding capacity of fields.	Protect fishes by providing refuge pond(s). Avoid dewatering of fields for fertilization. Practice paddy-fish, culture only in fields with good water availability.
7.	Field difficulties due to continuity of plots, especially in terrace landscape with common inlet.	Select downstream locations nearby human settlements, where minimum upstream-downstream conflicts for paddy-fish culture exists
8.	Unwillingness to modify paddy fields for trenches and refuge pond.	Take up massive mobilization and awareness campaign.
9.	Lack of fish seeds availability and their transport mechanisms.	Promote fish seeds production and their small-scale transport mechanisms through networking of farmers and governmental support agencies.



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