

Integrated rice-fish system

Dr. Md. Akhtar Hossain, Professor, Dept. of Fisheries, RU

Concept

Rice-fish culture, which means the concurrent or rotational farming of rice and fish, is one of the best options for increasing food production from limited land through ecological agriculture.

Practice

Practice exists in Bangladesh, Cambodia, China, Egypt, Indonesia, Republic of Korea, Madagascar, Thailand and Vietnam

Potentials/benefits

- **Additional crop (fish)** in the paddy field
- **IPM** (fish controls weeds and pests in the paddy fields)
- **Increased nutrient availability** to the rice crop and thereby **increased rice production** (10-15% crop increased by fish excreta as fertilizer)
- **Aeration** by fish while searching for food in rice fields
- **Offering natural fish feed** (planktonic, periphytic and benthic food) by rice field
- **Reduced production cost** in terms of fertilizer, feed and labour
- **Minimizing risks** through producing more than one crop
- **Producing safe food** for human consumption
- **Increased biodiversity** through different plants and animals grown

History and development

- Started in China and practice of around 2000 years
- Development of rice-fish-azolla system is also found in China
- In the traditional rice-fish farming systems in Bangladesh, farmers excavate a small ditch in their fields, modify the dikes and add brush to improve collection and capture of wild fishes. Fry of different carp species are sometimes stocked
- In coastal areas of the country, tidal water carrying shrimp and fish juveniles are trapped after the rice harvest in *ghers*
- Various agencies in Bangladesh have undertaken a number of on-station and on-farm experimental studies over the years on integrating aquaculture with agriculture
- IPM efforts were initiated by CARE Bangladesh through rice-fish system
- Efforts on fish species suitability, appropriate ditch size for fish refuge, incorporation of azolla to rice fish system, decentralized fish seed production in rice field, fish culture

in rice fields by poor indigenous people etc. are successfully taken by WorldFish centre in different geographic locations of Bangladesh.

Riceland ecosystem

- Fish farming in **irrigated rice ecosystem** (ensure water availability)
- Fish farming in **rain fed rice ecosystem** (does not ensure water availability)

Integration of fish to rice field in Bangladesh

	J	F	M	A	M	J	J	A	S	O	N	D
Rice cropping pattern												
Boro crop												
Transplantation	■	■										
Harvesting					■	■						
Aus crop												
Transplantation			■	■	■							
Harvesting							■	■				
Aman crop												
Transplantation							■	■	■			
Harvesting											■	■
Rice fish integration system												
Boro												
Stocking		■	■									
Harvesting					■							
Aman												
Stocking							■					
Harvesting											■	■

Major approaches to rice-fish farming system

- The concurrent rice fish culture system involves rice and fish being cultivated simultaneously
- In rotational approach, the fish is raised first before the rice is planted
- The concurrent rice-fish system with active fish management is considered to be more efficient and effective of the two modes
- Concurrent schemes are found under both irrigated and rain-fed conditions.

Steps followed for a concurrent fish farming in rain fed rice field ecosystem

Selection of the rice plot:

- Water holding capacity between 3 and 6 months;
- Irrigation facility is considered good;
- Plot location at plain land is desirable; and
- Well exposed to sunlight.

Selection of the rice variety:

Some important considerations for selecting the rice variety are:

- High yielding;
- Resistant to diseases and pests;
- Tolerant to high level of water depth; and
- Good market demand
- Examples of HYV rice are BR -11 (Mukta), BR -14 (Gazi), BR -3 (Biplob), BR -16 (Shahibalam), BR -20 (Nizami), BR -24 (Rahmat), BR -26 (Shraboni), BR -27, BR -32, BR -33 etc.

Fish species selection for rice field:

Important considerations are:

- Fast growing;
- Tolerant to higher water temperature;
- Ability to survive in lower water depth;
- Growth mostly dependent on the natural feed;
- Easily available in time; and

- Not harmful to rice
- Silver barb (Sarpunti/Rajpunti) and carpio (Common carp) are the good options for natural feed based farming whereas tilapia and prawn require supplementary feeds for their smooth farming within shorter period
- As a fast growing species, silver carp is more suitable for pond than that of rice field due to lower water depth in rice plot
- Grass carp also grows fast with the availability of plant feed (grass, leaves, weeds, vegetables etc.) and **thus it is not considered as a suitable candidate** for stocking in rice field due to its harmful effect on rice.

Pre-stocking preparations of the rice plot:

- Keeping **rice straw** (10-12 cm) with roots of previous season
- Preparation of **embankments** (About 1.5m height and 1.0m width)
- Fish **refuge** (ditch of 1.0 m depth; 10-20% of plot area, at lower part)
- **Ditch preparation** (frequent ploughing, followed by liming (CaCO_3) @ 125 kg ha⁻¹, cattle dung @ 500 kg ha⁻¹, and urea and triple super phosphate (TSP) @ 25 kg ha⁻¹ after 7 days of water filling)
- **Rice plot preparation** (ploughing- 3 times, leveling and removing weed)
- **Transplantation** of rice seedlings (35 days after seedling; space of 20-25 cm between rows, 10-15 cm between clusters; water level of <5 cm)
- **Rice plot fertilization** (In case of BR-11 variety, fertilizers like TSP, MP and zipsam @ 52, 82, and 60 kg ha⁻¹, respectively. Also urea @ 150 kg ha⁻¹ at 15, 30, and 45 DAT).

Stocking of aquaculture species:

- In **nursery**, the spawn can be stocked @ 2-3 g decimal (600-800 fishes/decimal) and fry can be stocked @ 150-180 fishes/decimal
- In **grow out** system, fish species are stocked under both mono culture and polyculture practices
- During **monoculture**, the stocking density of fish (Carpio/silver barb/tilapia) is maintained as 15 to 20 fishes/decimal

- In case of **polyculture**, the stocking density is recommended as 20 fishes/decimal (Carpio-10 and silver barb-10 **or** carpio-10 and tilapia-10 **or** carpio-8, silver barb-8 and tilapia-4 per decimal)
- In case of **prawn**, both lower (20 individuals/decimal) and higher (50-60 individuals/decimal) density is recommended with co-species like silver carp (3-4 individuals/decimal)
- **Special considerations** (provision of shelter and shading; maintaining clean bottom; and supply of protein rich pelleted feed) are required for prawn farming in rice field
- **Stocking time:** fish in morning and prawn in evening (at 15-20 DAT)
- **Stocking size:** comparatively larger sized fish seed (Silver barb and tilapia of 5-7 cm; carpio of 7-10 cm; and silver carp of 10-15 cm) is recommended for stocking in rice field so as to escape from predation by snake or frog and thereby to increase the survival rate

Post stocking fertilization and supplementary feeding:

- No extra fertilizers are used for post stocking management of fish, but only recommended fertilizer doses are used for the rice plant
- Usually, there is no necessity of supplementary feed application for fishes at appropriate or lower stocking densities
- Fish feeds on algae, weeds, insects, insect larvae etc. that are naturally found in rice field
- Low cost feed item like rice bran may be used for fish farming at comparatively higher stocking densities
- Incorporation of duckweed or azolla as supplementary feed is found very much useful for macrophytophagous species
- However, it is almost essential to provide tilapia or prawn with supplementary feed (30-35% protein content) for their farming at higher stocking densities.

Fish and rice harvesting:

- Fishes are harvested after harvesting the rice.
- Culture period for rice is found as 90-120 days for HYV whereas the culture period for fish is found as 120 days and more depending upon species and market requirement.