MULTITIER RICE-FISH-HORTICULTURE BASED FARMING SYSTEM FOR DEEPWATER AREAS

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Introduction: Deep water rice is grown in about 4 million (m) ha in India out of total 44 m ha of rice area, of which around 3.0 m ha is in the eastern India. Mostly, a mono-crop of traditional rice is grown in deepwater areas with very low productivity of around 0.5-1.0 t of clean rice/ha due to various abiotic and biotic stresses and poor socio-economic conditions. On the other hand, deepwater rice ecology is suitable for alternate farming by way of farm diversification with the integration of components like horticulture, aquaculture, livestock, agro-forestry and others. Adoption of rice-fish-horticulture based farming system can ensure higher farm productivity, income and employment besides, providing food, nutrition and also environmental security in these under-utilized areas. This farming system is highly acceptable in the eastern India because of resources, food habits and other social conditions.

Multitier rice-fish-horticulture based farming system technology includes field design and land shaping and package of practices for different components.

1. Central Horticultural Experimental Station of IIHR, Bhubaneswar.
2. Regional Centre of CTCRI, Bhubaneswar.
• Provide feed daily @ 2% of body weight of fish and prawn with a mixture containing 95% of oil cake + rice bran (1:1) and 5% of fish meal.

• Provide hideouts (earthen pipes, twigs) for shelter of prawn during molting.

• Monitor health condition by regular nettings. Control deadly disease like Epizootic Ulcerative Syndrome with the application of CIFAX®@ 1 litre/ha metre of water. Alternately, lime application@ 200 kg/ha can also effectively control the infection at preliminary stage.

• Harvest periodically the bigger size fish and prawn from the pond refuge.

**Fish fingerlings production**

Raise fish fingerlings of catla, rohu and mirgal species in the small pond at the upper end of the farm.

**Management**

• Apply cow dung @ 3-4 t/ha one week prior to release of fish fry followed by fortnightly equal dose of 0.5 t/ha. Also fertilize the pond with urea and single super phosphate @ 10 and 15 kg/ha, respectively, for plankton production.

• Release good quality fish fry of about 2.5 cm size of catla, rohu and mirgal species at a ratio of 35%, 35% and 30% @ 2-3 lakh/ha of water area.

• Feed the fish fry daily with a mixture of rice bran and ground nut oil cake at 1:1 ratio by weight @ 8-10% of stocked biomass (body weight) during first month, followed by 6-8% and 4-6% during the second and third months, respectively.

• Harvest the fish fingerlings of 8-10 cm size and 8-10 g weight by periodic nettings after three months of culture onwards.

• Release the required fingerlings in the pond refuge of the farm and sell out the rest produce.

• Rear the left over stock up to yearlings/marketable size, which also will fetch good amount of money.

**On bunds**

**Fruit crops:** Plant 150 seedlings of improved varieties of papaya and 50 suckers of banana of ripe fruit and plantain types.

**Plantation crops:** Plant 20 coconut (Txd varieties) and 20 arecanut on bunds of the pond refuge. Follow the management practices like, manure and fertilizer application, irrigation, pruning and pests and diseases control.

**Agro-forestry:** Plant Acacia mangium, A. auriculiformis, Casuina equiseifolia (in coastal areas) 2-3 m apart east to west on northern and north to south on western side bunds.

**Production Methodologies:**

The production technology for one hectare of farm area is as follows:

**In Upland (Tier I and II)**

**Tier I (Fruit crops)**

- **Mango:** Plant 15 seedlings of improved (grafted) mango varieties such as, Gulabkhas, Amrapali, Mallika, Deshehari, Banganapalli etc after 3-4 monsoon showers with a spacing of 5mx5m between rows and plants. Follow management practices like, canopy management, manure and fertilizer application, irrigation, pests and disease control, mulching and pruning. Rely more on Integrated Pests Management (IPM), bio pesticides and organic sources of nutrients.

- **Guava:** Plant 15 seedlings of improved (air-layered or grafted) guava varieties like, Allahabad Safeda, Arka Amulya, Arka Mriddula, Safed Jam, Sardar etc during rainy season with a gap of 4-5 m in between rows and plants. Maintain low plant height by regular pruning. Follow all management practices as in the case of mango plants.

- **Sapota:** Plant 6 seedlings of improved sapota cultivars like, Kalipatti, Cricket Ball, CO-1, CO-2, PKM-1, PKM-2 during rainy season with a gap of 5mx5m between rows and plants. Follow management practices as in the case of mango and guava plants.

- **Papaya:** In the initial 2-3 years, plant 100 seedlings of dwarf varieties viz., Coorg Honey Dew, Pusa Dwarf, Pusa Majesty, Pusa Giant, Pusa Nanha, Pusa Delicious, CO-2, CO-6, Washington etc during wet season with a gap of 1.5-2.0 m in the interspaces between mango, guava and sapota plants. Adopt proper management packages. Replace regularly the virus infected plants with healthy ones.
Management

The harvesting of rice crop depends on the growing season type they are raised under in the pond relief area. The yield and quality of rice depend on the water level and the flood period.

Fertilizers: Grow Indian major crop

Fish and Finishing

Grow all crops in pond relief- type field environment.

Fertilizer

Apply at 720 kg N, P, K to raise fish productivity. Seed dressing of seed dressing is also required. Use of fungicides, insecticides, and pesticides as per instructions. Use of heavy metals and other sources. Neem based pesticides like neem oil, neem seed, and neem seed oil are effective against diseases and pests.

Applying 10% of the total amount of water in the pond relief area, and 20% of the total amount of water in the flood period. Apply the remaining 32% after the flood period. Use of resistant varieties is also effective. Use of fungicides and pesticides is also required.

Inorganic fertilizers

Apply at 50-100 kg N, P, K, and 100% Phosphate fertilizers. Apply at 10-15 days after planting. Use of N, P, and K fertilizers is also effective.

Apply at 100 kg N, P, K, and 150 kg Phosphate fertilizers. Apply at 10-15 days after planting.

You can also grow crops in the vegetable areas during the initial stages.

Adopt proper management, irrigation, and pest management practices. Keep the pond relief area clean and free from pests.

During every season in staggered double row system, with spacing of 30 cm between rows and 90 cm between two rows. During every season, 2% of the total area is dry cropped. Use of chemical fertilizers is also effective.

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**Management**  

**Wet season rice**  
- Prepare the land well before the monsoon using bullock/tractor drawn plough.  
- Apply FYM @5t/ha at the time of land preparation or in furrow at the time of seeding.  
- Sow in dry soil well before the monsoon using 75 to 100 kg/ha of good quality seed. Use a spacing of 20 cm in between rows and 15 cm in between plants. Line sowing preferably, dibble seeding using 3-5 seeds is advantageous.  
- Transplant, if so required, early using around 40 days-old and healthy seedlings.  
- Apply fertilizer at the time of seeding @ 50:25:25 kg N, P, O, and K/ha for lowland rice in Tier III and @40:20:20 kg N, P, O, and K/ha for deepwater rice in Tier IV.  
- For weeding, use finger weeder in dry condition and/or cono-weeder in 5-10 cm standing water. Fill the gap with fresh seedlings.  
- Avoid insecticides and herbicides. Use sex pheromone traps (@ 20 numbers/ha) in rice field and light traps (electric bulb or kerosene lamp above water of pond refuge in 3-4 places) for control of yellow stem borer and other insects pests. In sex pheromone traps, replace the chemical (sex pheromone) once or twice with a fresh one during the rice growing season. Neem based botanicals like Neem or Nimbeclyne @1% can also be used for control of insect pests.

**Dry season rice**  
- Puddle the field twice in a gap of 7-8 days between initial and final puddling and properly level the land.  
- Apply 5t/ha of FYM during land preparation.  
- Plant 20-25 days old seedlings in January/February with a spacing of 15 cm between rows and 10 cm between plants. Gap fill the sparse areas after a week of transplanting.

**Vegetable crops**  
- Grow round the year location specific vegetables using the suitable high yielding varieties.  
- Grow vegetables like, okra, ridge gourd, cowpea, snake gourd, bottle gourd etc during wet season, tomato, french bean, radish, cabbage, cauliflower, leafy vegetables etc during winter season and Amaranthus, cowpea, bitter gourd, pumpkin, cucumber etc during summer season.  
- Follow the recommended management practices, like land preparation, sowing, manure and fertilizer application, irrigation, weeding, earthing, insect pests and disease control and harvesting.

**In lowland (Tier III and IV)**

**In wet season**  
**Rice:** During wet season, select high-yielding rice cultivars with the desirable characters such as semi-tall/tall, long duration, stiff-culm, photo-period sensitive and in-built tolerance to pest and diseases.

**In Tier III (rainfed lowland),** cultivate varieties like Gayatri, Pooja, Sarala, Bhudev, Golak, Jogen, Sudha, Madhukar, Barh Awarodhi, Ranjit, Jalashree etc.

**In Tier IV (semi-deep/deepwater),** grow cultivars such as, Varshadhvan, Durga, Hanseswari, Saraswathi, Jalaprabha, Jalpriya etc.

**In dry season**  
**In Tier III (rainfed lowland),** grow non-rice crops like, sweet potato, watermelon, mung bean, ground nut, sunflower, vegetables with irrigation from the harvested rainwater. Zero tillage-established sweet potato can also be grown after rice with the advantages like saving of two irrigations and reducing crop duration by about two weeks.