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Rizipisciculture: An Improved Possibility for Sustainable Development

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ABSTRACT

Broad studies and researches on fish farming in rice field have enumerated various biological and ecological advantages; the most important being effective biological weed and pest control, reduction in pollution, and environmental sustainability. Other advantages include the increased ion contents of soil, expansion in leaf area and root network activity in rice plants, and help overcome protein deficiency in the diet of the rural poor. The other spin offs are fish excreta as manure and conversion of unproductive swamps into productive system through proper land revitalizing.

Key words: Pest control, Soil fertility, Biological pollution, Environmental sustainability, Community health.

INTRODUCTION

Rizipisciculture, rearing fish along with paddy is a sustainable system involving concurrent harvesting of paddy and fish as a unit reaping multiple benefits. Paddy cultivation is a major agricultural operation in many of the northern, north-eastern and south-eastern coastal states of India. Large areas otherwise remaining unused because of water logging can provide natural habitat for various kinds of fish. Thus, the proposition of rearing fish and raising fish nurseries, in spite of its high mortality rates, is workable and hold high income prospects. (Baruah, 2010).

Rizipisciculture is a straight forward and low cost activity when performed in a systematic and technical way. Such a venture will also give increased rice yield simultaneously without the need of application of extra fertilizer, food for fish and water. Researches related to rizipisciculture indicate that promoting aquaculture will put the agriculture water and land resources to double usage in addition to profitable use of water logged areas yielding valuable economic, social and environmental dividend (Saha and Nath, 2013).

Rizipisciculture systems have recently come in focus because of poverty alleviation, sustainable rural development and food security measures of the government. There are so many reviews on socio-economic, historical and ecological features of fish farming in paddy fields have been in print worldwide or a countrywide (Niyaki and Allahyari, 2011).

In the present review, an attempt has been made to discuss some significant socio-environmental effects and benefits of rizipisciculture that have not been given due importance heretofore.

Layout of paddy fields for fish culture

Integration of fish farming with rice cultivation is crucially dependent on availability of sufficient water for proper growth of fish without any detrimental effect on rice crop. Therefore, it is imperative that the plot must be renovated for holding

sufficient water**.** Terrace paddy fields and low-lying fields with good sources of water and spacious benches/plots are preferred under this system.

The paddy fields (25×30 m) may be cut on either side of a deep dug central line to act as a main supply or drain canal. Each field is bordered on all the sides by bundhs (dike) of approximately 0.3 m height and 0.3 m in width. Towards the side of drainage canal, the dike is provided with inlet and outlet devices made suitably of hollow bamboo pipe or other material, placed in the middle of the length of the dike and are fitted with screens to avoid entry of predators or escape of fish.

Alternatively, a marginal channel may be dug alongside the bundh bordering the paddy field. This channel may connect with several oblique channels running across the field. At one side of the field the marginal channel connects with water inlet pipe from the main supply channel and at the other with the outlet pipe draining into main water collection channel. The space between outlet channel of marginal canal and the collection channel may be dug deep to trap fish during release of water from the field (Saha and Nath, 2013).

Methods of fish cultivation in paddy fields

Topography of land and available variety of water which differ from country to country, place to place determine the simultaneous or rotational culturing of fish with paddy. In simultaneous culturing, the fry or fingerlings of fish are introduced in the field after about 5 days of plantation of paddy allowing both to grow simultaneously till harvesting. The depth of water in the field is determined by the variety of paddy to be cultivated and the choice of fish species. During harvesting, water is released from the field and the fish are captured from channels of the field using hand nets. During the period of growth, if the planktons decrease markedly or else the water is poor in food for the fresh, artificial feed may be supplied (Bhatnagar *et al*., 2014).

Rotational fish culture has many advantages over the simultaneous culture e.g. (i) raising phytophagous fish improves the conditions of paddy field (ii) the period of paddy cultivation gives enough time for vegetative growth of the fish (iii) the water in rotational culture may be increased up to a depth of 60 cm or more, making the fish to adjust easily with the conditions of the field (iv) rotational culture dispenses with pesticides and insecticides generally used to protect paddy crop in simultaneous culture and checking the mortality due to pesticides (v) intensification not being tied to paddy crop results in a higher yield of fish per unit area (Natuhara, 2013).

Fish species best suited for rizipisciculture

The fish species should be able to thrive in shallow water, tolerate temperature fluctuations, withstand high turbidity, and grow to marketable size in a short period. Species such as *Catla catla*, *Labeo rohita*, *Tilapia mossambicus*, *Cyprinus carpio*, *Cirrhinus mrigala*, *Clarias batrachus*, *Anabas testudineus*, *Heteropneustes fossilis*, *Channa punctatus* and *Channa gachua* are suitable to be cultured in paddy fields. The air breathing fish, because of their accessory breathing organ, can thrive even when the field gets dry and the water level in capture channel goes down (Ali *et al*., 1998).

Food safety and environmental integrity

Rizipisciculture is expected to address the increasing environmental concerns and demand of safe protein food. Such practices certainly uplift environmental integrity and bringing not only more income to the farmer but also contributing to holistic rural development. The movement of fish for food search or otherwise rotates the surrounding so as to increase mineral putrefaction. Decrease of NH_3 and H_2S converts insoluble nitrogen ion in the soil to the soluble state, increasing the soil productivity significantly. Similarly, another study also established that rizipisciculture increase methane scattering (Natuhara, 2013).

Social health benefits

A great number of pathogens of malaria, filariasis, and encephalitis normally were found to decrease by the use fingerlings on common carp and grass crop in paddy fields. Also, it was reported that integrated fish-rice farming showed decrease in concentration of mosquito larvae in paddy fields (Mirhaj *et al*., 2014).

Organic Weeds control

Decrease biomass of weed may lead to reduce struggle to attain the basic amenities like

food and particularly rice (Lightfoot *et al*., 1992). Carp fries like *Cyprimus carpis* are able to decrease 39% weed biomass (Rothuis *et al*., 1998). Complete elimination of filamentous algae in paddy plants have been observed due to feeding of common carp and *Oreochromis niloticus* L (Niyaki and Allahyari, 2011).

Problems of rizipisciculture

The most common problem faced in rizipisciculture is loss of fish during the period of their growth. The loss amounts to about 40-60% for the young and 20-30% for the large fish. This could be predatory birds like herons and others etc., inadequate oxygen level, abrupt change in temperature, and insufficient depth of water. Fish yield in simultaneous culture is less profitable, though the rice production increases because the fish not only destroy rice bugs, but also disturb the biological film at the bottom which otherwise helps the falling weed seeds to germinate. The decrease in fish production may also be due to application of fertilizers to the main crop (paddy), and inadequate preparations of the field. Fish culture in rotation is however, a more efficient and profitable proposition. It helps in overcoming the various disadvantages of simultaneous fish culture (e.g. water depth, limitation of growth time, and high loss ratio etc.) and is independent of the paddy crop for fertilization and intensification (Natuhara, 2013).

Constraints in rizipisciculture

Though the paddy *cum* fish culture gives so many benefits to the farmer, it also has its limitations. It is labour intensive involves risk during such as flooding, drought, poaching, and poisoning. Generally, the farmers, who being tenants mainly focus on the short-term gains, are least concerned with the long-term environmental concerns.

Scope of rizipisciculture in India

India has exceptional prospect for rice fish farming. The north-east region of India usage negligible amount of pesticides, chemical fertilizers and other chemicals therefore it is acknowledged as the most appropriate zone for organic farming (Fujioka *et al*., 2014). *Cyprinus carpio* grow fast in paddy fields giving an average yield of 6.7 kg/ per acre, provided measures are taken to bring down high rate of their mortality. The average yield of *Tilapia* is reported to be about 31.3 kg per acre. Simultaneous culture of *Catla* recorded an increase from 3.5 to 12.5 percent without any artificial feeding. Mishra and Mohanty (2004) extolled in depth study of rice fish culture practiced by the Apatani tribes in Arunachal Pradesh. It has been suggested to adapt such techniques for other areas where there are scope of fish production in rice fields to achieve sustainability.

CONCLUSIONS

Rizipisciculture, if promoted in an organized and technological manner, will bring water-logged paddy fields into this integrated farming contributing more protein in the nutrient cycle. Besides giving lucrative returns to farmers this will generate additional employment, and promote ecological and biological sustainability with biological controlling of pests and weeds.

Other benefits include saving of 50% expenses on harrowing, utilization of fish excreta as manure, conversion of unproductive swamps into productive system through proper land shaping and also augmentation of mono-cropping paddy fields into multi-cropped multi aqua croppers.

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