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Review Article

DOUBLING INCOME OF PADDY FARMERS OF TRIPURA THROUGH RAISED AND SUNKEN BED TECHNOLOGY

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Abstract: Tripura is a tiny and land locked hilly state of the North-East India with a geographical area of 10492 sq. km and a total population of 36, 71,032 (as per 2011 census).The State Tripura characterized by varied physiographic and climate is endowed with a variety of land use types and agricultural systems. With over sixty percent area under forests and wastelands, the cultivated area is hardly 25 percent. The per capita availability of land is about 0.97 ha. Notwithstanding small arable land resource, the agriculture remains to be main source of livelihood to the people of the state. Rice (*Oryza sativa* L) is the major crop of the state which covers an area of 2,54,254 ha. Out of total paddy land 19,7502 ha area is under rainfed lowland (77%) and 56,752 ha area is irrigated (23%). The state receives high rainfall during *kharif* season. The root zone of the most agricultural farms of the region remain saturated or over saturated through *kharif* as well as *rabi* season, and farmers can hardly grow any crop other than rice under such situation. The productivity of paddy in the state is low (2.8 ton/ha). Since, rice farming is not remunerative and majority of crop land is under rice farming, doubling the farmers income as per Governments target by 2022 is a major challenge for the state. Under the above circumstances, a package of eco-friendly and economically viable technology for crop diversification and higher economic return in medium and low lands of Tripura is the need of the hour. In earlier study it has been found that rose and sunken bed technology have the potential to increase the net profit of the farmers by modification in field topography through construction of alternate raised and sunken beds which improves physical environment, particularly aeration status of the soil and creates proper condition for growth of crops other than rice. High value arable crops like vegetables, flowers etc. on raised beds and rice, fish during rainy season and pulses or other crops during dry season are the choice on sunken beds for enhancing income of the farmers Besides crop diversification this technology also found to have positive influence on income and employment generation, as well as meeting the nutritional security in changing climate. The technology is mainly suitable for the small holding of paddy lands where drainage is either inadequate or proper drainage is not available.

Keywords: *Doubling farmers income, Tripura, Raised and sunken bed technology*

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Introduction

Agriculture in India is now facing a great challenge of declined water availability. Inter-sectoral competition for fresh water is pressing agricultural researchers hard to evolve water-use efficient technologies suiting to small and marginal farmers [1]. In subtropical north eastern region (NER) of India, rainfall is very high (average annual rainfall [2,000 mm). Drainage in valley lowlands is a major problem in this region during rainy season. Very often crop plants suffer from poor drainage leading to crop failure [2]. The hill and mountain topography of the region further aggravates the situation. The excess water from such lands comes down as runoff and creates temporary flooding in valley lands causing damage to agriculture [3]. Root zone soils of most agricultural lowland farms in this region remain over saturated throughout the year. Especially in low-lands after harvest of *kharif* rice, it is not possible to grow arable crops such as vegetable due to excess moisture. Second, rice is not possible due to early onset of winter that results in spikelet sterility [4,5]. Rice is the only crop which is grown in lowland during after harvest of *kharif* rice, temporary raised beds are rainy season [6]. Modification in field topography through construction of alternate raised and sunken beds improves the physical environment, particularly aeration status of the soil and creates proper condition for growth of crops other than rice [7-10]. It also provides an opportunity to partially diversify cropping under such situation. Crop diversification ensures balanced food supply, conserves natural resources, reduces fertilizer and drains pesticide loads, and creates employment opportunity [11].

Raised and Sunken Bed System

Fields may be modified into alternate raised and sunken beds by digging soil of one strip (4-5m wide) to a depth of 20 to 30 cm and putting the dugout soil over the adjacent strip (4-5m wide). The width of beds may be fixed as per convenience up to 5m and length may be fixed as per availability of land. Elevation of the raised beds thus may be 40 to 60-cm higher than that the adjacent sunken beds. Top 20 to 30 cm soil of the raised beds remains in unsaturated condition. Arable status of such soils allows growing of several vegetable crops, and rice may be grown simultaneously in adjacent sunken beds where soils remain submerged. Removal of topsoil may reduce fertility level and create poor physical conditions in sunken beds. To minimise this adverse impact, application of FYM or compost @ 10 t/ha and/ or growing of sesbania in sunken beds during dry season and mixing the same before rice planting is recommended for the initial 1-2 years. For checking soil erosion from the raised dwarf varieties of papaya plants may be grown along the borders at 1.5 m interval. Farmers thus get additional yield and income from the system. Nevertheless, some soil may be eroded from raised beds and deposited in sunken beds during rainy season due to High intensity of rainfall, which may be recovered and fixed again on raised beds during dry season every year. Different vegetable crops may be grown on the raised beds. Recommended fertilizers, pesticides and weed control measures for the vegetable crops are required to be used in raised beds. Soil moisture conditions in raised beds at the time of establishing vegetable crops should be optimum.

For this, a pre-Sowing irrigation may be required in raised beds. No irrigation may be required after the establishment of the crops since a lot of moisture is available in 20 to 30 cm below the surface layer of these beds and in the adjacent sunken beds, which move both in lateral and upward direction to meet crop water requirements. Height and width of the raised beds may be fixed according to physical properties of the soils (soil texture) and type of vegetable crops (rooting depth) so that they do not require irrigation. Vegetable crops may be selected, according to the market demand, type of soil, root zone moisture availability and climatic conditions of the area. Under this system, farmers can put their lands under crops for a longer period than under conventional system and can get regular income. Dry season is the best time for preparation of raised and sunken beds. These beds may be prepared manually by the farmers themselves or by hired laborers. Preparation of beds by hired laborers costs about Rs 34,000 to 36,000 per hectare depending on soil type. The cost will be less for light soils than for heavy soils. Most of the farms in eastern region of the country are small in size and farmers themselves can prepare alternate raised and sunken beds in their farms during dry season when they do not have much work at hand. Labour and / or money spent for preparation of beds is one-time investment which is generally realized from the one or two years profit it.

Rice-Fish Integration in raised and sunken bed system

Stocking of healthy fingerlings of more than 100 mm length is essential to enhance fish production. However, inadequate land based nursery ponds available at present and financial constraints in developing new infrastructure facilities impede the desired stocking programme. With these constraints and available resources, rice field ecosystem provides a viable opportunity for mass scale fry to advanced fingerling rearing, as a part of stocking programme. Further, out of 44.5 million hectare of rice cultivated land in India, 20 million ha is suitable for adoption of rice-fish integration system mainly in low and medium lands. However, only 0.23 million ha is presently under rice-fish culture. This low degree of adoption and yield is primarily due to introduction of high-yielding rice varieties involving the use of pesticides that has greatly impeded fish culture in paddy fields. Besides this, insufficient water availability, water level fluctuation and erratic monsoon have adversely affected fish rearing in rice fields. Achieving a higher productivity from these underutilized high potential areas is thus an immediate need, particularly in the eastern region. If these lands were brought under integrated rice-fish system with suitable scientific innervations. It would help to compensate for the economic losses in rice production brought about by natural calamities. Integrated rice-fish farming not only accommodates crop diversification, enhance productivity, generate employment opportunity, increase income and provide nutritional security to resource-poor farming community but also distribute the risk (both biological and economic), since two or more subsystems are involved instead of a single-commodity farming system.

Species suitability

Fish Species should be adaptable, compatible, resistant to environmental changes, high-yielding and be able to tolerate heavy doses of fertilizer. Since water column in the refuge and paddy field in the renovated system is suitable for rearing of carps, Indian major carps, *viz. Catla catla, Labeo rohita and Cirrhinus mrigala*, and exotic carps like silver carp and common carp may be stocked for culture in the integrated system. Improved high yielding, tall, long-duration, submergence and pest-resistant variety of rice with in-built characteristics of photoperiod-sensitivity, and strong seedling vigor can be tried along with fish.

Application of fertilizer and chemicals

The growth and development of paddy and the fish are greatly influenced by the kind and quantity of fertilizers applied and the method of application. Nitrogen, phosphorous and potassium needed by the paddy are also nutrients required by the planktonic and benthic organisms, which are in turn, the natural food for fish. But too much of inorganic fertilizer is also toxic to fish. Improved technique of fertilization needs to use nutrient rich organic manures as much as possible and inorganic fertilizer as little as possible. Organic manure should be applied after fermentation. Seventy percent of the total manure should be applied as basal and rest as supplementary manure, which should be applied in small amounts frequently. Although fish in rice fields can eat some of the pests and play a role in the biological control, they cannot totally replace insecticides, so chemical control is needed. However, chemical plant protection should be avoided to prevent fish mortality. But in emergency, broad-spectrum chemicals that have low toxicity, low residue and high effectiveness can be applied. Chemicals in powder form should be applied in the early morning hours, while there is still dew around, and application of sprays should be delayed until after the due fades. Nowadays, splashing method is adopted with good results especially when the rice grows tall. It is always economical and advisable to reduce the water level before application of fertilizer and chemical

Fish culture

After proper preparation of sunken bed, liming @ 500-750 kg ha',manuring with raw cattle dung @ 5000 kg ha-1 as basal dose can be carried out at the onset of monsoon during June. Before fish-fry are released in the sunken beds, it is essential to clear it from aquatic vegetation and predatory fishes. The floating and emergent weeds may be removed manually instead of using chemical weedicide. It is better to use MOC (mahua oil cake) @ 250 ppm at the onset of monsoon during June when rainwater starts accumulating. MOC not only helps in eradicating predatory / unwanted species such as catfish, *Channa punctatus, C. Orientalis, Glossogobius giuris, Puntius ticto, Esomus danricus, Ambasis* spp. and *Barilius* spp., but also acts as a manuring substance. During the months of July-August, when the rainwater starts accumulating in the sunken bed, early fingerlings of catla, rohu, mrigal, silver carp, and common carp along with prawn seed (2-3/ m^2) of *M. rosenbergii* may be stocked with a composition of 20:30:50 (surface feeder: column feeder: bottom feeder). *Labeo bata* can also form a stocking component in this system. As the culture duration is short, fry (@ 50000/ha) or fingerlings (10-15 g size) should be stocked at a higher density of 15,000-20,000 per ha for continuous rearing for a duration of 4-5 months, based on the principle of phased harvesting. An optimal stocking density of fish species is critical in attaining high cumulative fish yields and in reaching the upper carrying capacity of the system. Ways to intensify fish production from integrated rice-fish farming system therefore, involve management strategies like high-density stocking (stocking with a higher initial fish biomass) followed by phased harvesting, when the growth curve of stocked fish/ prawn starts to slow down. This helps in reducing the population pressure and enhances the growth of remaining stock. To augment growth, supplementary feed comprising mustard oil cake/ groundnut oil cake and rice bran in 1:1 ratio may be given to fishes daily @ 3% in the initial two months and then 2.5% rate of mean body weight of stocked fish / prawn. In this culture system, the fish/ prawn will grow for a period of 3-4 months in the entire area and then 2-3 months in the confined area of infield refuge / perimeter canal. Under this system, production will range between 2400-3000 kg ha' per crop with a survival rate of about 70-90 percent.

Impact on livelihood and nutrition of farmers

The potentiality of any intervention lies not only in efficient utilization of resources and enhanced production but also in improving the quality of life of the farmers on adoption of it. The increased farm production and income is expected to bring changes in livelihood of the farmers that includes physical, social, financial, human and natural assets of the farm households.

Conclusion

The potentiality of diversified farming through land topography modification has been realized as it has facilitated the multifarious growth of overall farming system of the adopted farmers. It can provide better earning and living to the small and marginal farmers of the of high rainfall and shallow water table areas of Tripura. Rice being the staple food, it is very difficult to bring complete substitution of rice crop. However, the "rice plus" cropping system in sunken and raised bed through land modification can be a potential option for growth and development of farming system and doubling the income of the small and marginal farmers of Tripura.

Application of review: Study doubling the paddy farmers income of Tripura.

Review Category: Agriculture economics

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References

[1] Sing R., Kundu D.K., Mohanty R.K., Ghosh S.(2004) *In proc National Symposium of Recent advances in rice based farming system held at CRRI, Cuttack, Orissa, 753006, India*

[2] Datta K.K., d Jong C. (2002) *Agriculture Water management* 57(3),223-238

[3] Calder I.R. (2000) *Land Use impacts on Water Resources.Back Ground paper1.In FAO Electronic workshop on Land Water Linkages in Rural Watersheds 18th September to 27th October* 2000.

[4] Munda G.C., Patel D.P., Das A., Kumar R., Chandra A. (2006) *Journal of Eco-Friendly Agriculture*, 1(1),12-15.

[5] Das A., Patel D.P., Ramakrushna G.I., Munda G.C., Ngachan S.V., Kumar M., Bordoloi J.S., Naropogla (2013) *Journal Biological Agriculture & Horticulture,* 30(2), 73-87.

[6] Das A., Patel D.P., Munda G.C., Ghosh P.K., Saha R., Bordoloi J.S., Kumar M.(2010) *Environmental Ecology*, 28(1), 160-163.

[7] Siddiq E.A., Kundu D.K. (1993) *International Crop Science, Crop Science Society of America, WI 53711.USA*, 152-162.

[8] Tomar S.S., Tembe G.P., Sharma S.K., Tomar V.S. (1996) *Agriculture and Water Management*, 30(1),91-106.

[9] Kanan K., Sing R., Kundu D.K. (2003a) *Indian Journal of Agricultural Science*, 73(8),453-455.

[10] Kanan K., Sing R., Kundu D.K, Reddy G.P.(2003b) *Environmental Ecology*, 21,1-3.

[11] Gill M.S., Ahlawat I.P.S.(2006) *Indian Journal of Fertility*, 2(9),125-138.