ICAR – Mahatma Gandhi Integrated Farming Research Institute

Model Write up for Background Information

1. **Title of the project:** Land shaping for diversification and development of horti-based farming system model for low lying areas of Bihar
2. **Funding agency:** Institute (ICAR-MGIFRI)
3. **Total outlay:** ≈125 lakhs
4. **Duration: 5 years**
5. **Single/ Multi-institutional:** Single
6. **Lead Centre if multi-institutional**
7. **Cooperating Centre(s):**
8. **Principal Investigator:** Dr. S.K. Purbey
9. **Co-Investigators:** Dr. P.K. Bharti, Dr. Amol Kailash Jadhav
10. **Rationale:** Substantial area of the Bihar state is under waterlogging in form of permanent and seasonal waterlogged, marshy land condition. An estimated area of 6841.09 sq km equivalent to 7.26 % of the area of the Bihar state is under wastelands in form of permanent and seasonal waterlogged, marshy land condition. A substantial area of this type of low-lying water-logged area could be rehabilitated into cultivable land through adoption of land treatment techniques and these rehabilitated lands may be utilized for successful production of horticultural crops along with other crops and fisheries etc. components through integrated approach of farming system. If, some area of this type of low-lying water logged could be rehabilitated into cultivable land may be added additionally in the map of state cultivable land and can be utilized for successful production of horticultural crops along with other crops and fisheries etc. components through integrated approach of farming system. At present, the farmers concentrate mainly on crop production, which is subjected to a high degree of uncertainty in income and employment to the farmers. In this context, it is imperative to evolve suitable strategy for augmenting the income of a farm. Integration of various agricultural enterprises *viz*., cropping, animal husbandry, fishery, forestry etc. have great potentialities in the agricultural economy. These enterprises not only supplement the income of the farmers but also help in increasing the family labour employment. Although integrated farming is economically and environmentally sound, the motivation for integration would appear to be the national policy of diversification of production. Adoption of horti-based farming system can enhance production of grain, fruit, vegetables, fish etc., the community becomes self-sufficient in regard to food and this contributes to be a high degree of self-reliance. Farming system leads to improve the productivity per unit area and time and also make possible to judicious utilization of resources and inputs. Evidently integrated farming system is dynamic in nature in the time and space dimensions; risks and uncertainty are also associated. The cultivation of horticultural crops under horti-based farming system play an important role in the farming systems, which increase nutritional security, employment and sustainable development in any agro-ecosystems, and waterlogged ecosystems are not the exception. Various problems which small and marginal farmers face solved by adopting the horticulture based integrated farming systems. Surface drainage by land modification technology and recycling of drainage water seem to be feasible in waterlogged ecosystems. This approach and

practices would ensure the nutrition security to farmers, employment generation round the year, and enhanced productivity of the most challenged ecosystem i.e. waterlogged areas.

11. **Research Gaps:** A substantial area (162715 and 519945 ha permanent and seasonal type in India and (69465 and 86940 ha permanent and seasonal type, respectively) in Bihar is under waterlogged and marshy condition and majority of the area falls under those districts which are suitable for various crops including horticultural crops cultivation. In low lying area, water is available in the surface of the land and stands seasonally for 4-5 months during monsoon season or even for most part of the year. This condition prevails usually in lands located in plain areas associated with the drainage congestion. Some parts of India remain waterlogged (> 1m surface water) for 4-5 months and become unproductive during *kharif* and very low utilization in *rabi* season too. The challenges like climate change, degradation of natural resources, shrinking of land, low farm income coupled with increasing malnutrition and nutritional security has become a problem of major concern and calls for location specific measures to optimize land and water productivity on sustained basis. Majority of the farmers in India are small and marginal. They often follow a monoculture approach which leads to low farm income from agriculture/horticulture/aquaculture to run their families. Under such circumstances the integration of various agri-components so as to make farming more remunerative, reliable and sustainable. Land shaping technique includes modification of the land surface primarily for harvesting of rainwater and creating a source of water for irrigation, reducing drainage congestion and growing of multiple and diversified crops round the year, and efficient use of stored water.

12. **Objectives:**

- To develop suitable horti-based cropping system model integrating with different production systems for low lying/waterlogged land situation.
- To increase farm resource use efficiency to enhance income and employment opportunity.
- To assess the cost/ benefit ratio of different system

13. Activities:

14. Details of experiments

(a) **Treatment details:** 3 types of land form/ land modification techniques (3 heights of raised bed/ bund i.e. 1.0m, 1.4m, and 1.8m) will be developed considering the depth of waterlogging.

i. No. of treatments for raised bed (3 no.)

- Major fruit crops (mango, bael, jamun; water apple, jackfruit & custard apple)
- Minor fruit crop in b/w (Guava/drumstick/ pomegranate; banana/ papaya/ lime)
- Various combinations of vegetable/ field crops during Rabi, Kharif and Zaid season

ii. No. of treatments for sunken bed/ pond/ low land (9 no.)

- Sunken bed 1-3 (1.8m): Fish culture/ paddy/ dhaincha – wheat/ mustard
- Sunken bed 4-7 (1.4m): Fish + W. Chestnut (green); Fish + W. Chestnut (red)/ paddy/ dhaincha – wheat/ mustard + animal components + vermicompost bed
- Sunken bed 8-10 (1.0m): Makhana/ wheat/ mustard - Water chest nut (green)/ paddy – water chestnut (red)/ paddy/ dhaincha
- Down side (Eastern) of the pond bunds shall be utilize for plantation of teak, arhar, tephrosia etc.

(b) Fertilizer doses: RDF
(c) Variety: Mostly ICAR/ SAU developed
(d) Replications: 3
(e) Observations to be recorded

- Growth performance of various component
- Yield (kg/ ha) and yield attributes of various component
- System productivity (kg/ha/ day)
- Sustainable yield index (SYI)
- Sustainable value index (SVI)
- Relative production efficiency (%)
- Employment generation in different system
- ✓ Disease and pest incidence
- Economics of various systems - Gross return ($\times 10^3$ ₹/ha); Cost of cultivation ($\times 10^3$ ₹/ha); Net return ($\times 10^3$ ₹/ha); Relative economic efficiency (%), return on investments (ROI)
- System economic efficiency (₹/ha/day)
- ✓ Water budgeting under different waterlogged condition
- ✓ Soil health related parameters study

15. GPS Coordinates of Field:

16. **Expected Output:**

- Development of suitable and sustainable horticulture-based integrated farming system model particularly for small and marginal farmer under waterlogged condition.
- Screening of fruit, various crops including aquatic crops and fish species of economic value for development of IFS models suitable for waterlogged ecosystem.

17. Expected Outcome

- Rehabilitation of waterlogged soil that can be utilized for cultivation.
- Reduced waterlogging risk and higher land-water use efficiency
- Increased livelihood and nutritional security

18. History of the experimental plot

(a) When the field was developed; 2021
(b) What are crops being cultivated season-wise:
Kharif-paddy, water chestnut, maize, millets, sesamum, cucurbits, bhindi, brinjal, dhaincha
Rabi-wheat, mustard, lentil, pea, cauliflower, leafy vegetables, makhana
Summer-moong, cucurbits, dhaincha
Fruit crops-guava, drumstick, banana, papaya, ber, jamun, water apple, mango, custard apple
(c) Soil type: Sandy loam
(d) Soil pH, EC, OC: pH->8; ECF-0.150-0.350; OC-0.15-0.315
(e) Soil depth: >2m
(f) Soil NPK and micronutrient status:

(g) Common pests and diseases: fruit borer, fruit fly, anthracnose, blight