Item	Description
1. Name of the product/ technology (as defined above)	**Fish-Poultry-Duck-Fruit Crop IFS Model for Floodplain Wetland Ecosystems**
2. Name and address of the Institute	ICAR-Mahatma Gandhi Integrated Farming Research Institute (MGIFRI), Motihari, Bihar
3. Institution(s) responsible for developing/ evaluating/ identifying including collaborators, if any	ICAR-Mahatma Gandhi Integrated Farming Research Institute (MGIFRI), Motihari, Bihar
4. Source of product/ technology (Research Project/ Student Research/ Any other ad-hoc research study)	Institute Funded Research Project: "***Development and Assessment of Fish-based Integrated Farming Models under Floodplain Wetland Ecosystems***"
5. Period of development/ evaluation/ validation	October 2020- March 2024 (3 Years)
6. Developers (Lead and Associates)	Dr. Ravi Kumar (Lead Developer) Dr. P.K. Bharti (Associate Developer) Dr. S.K. Purbey (Associate Developer) Dr. S.K. Samal (Associate Developer)
7. Summary of the product/ technology (maximum of 200 words)	• India having 0.35 million ha of floodplain wetlands, mainly distributed in eastern region. Rice and fish farming are major farming practices in floodplains, but their productivity is lesser than the national average productivity of rice and fish. • Therefore, **high-density fish-poultry-duck-fruit crops IFS model** was developed & assessed during October 2020 to September 2023. The fish fingerlings were stocked at the rate of 10000 number ha^{-1} of an average body weight 30.5±1.8 g comprised of *Catla catla* (30 %), *Labeo rohita* (20 %), *Ctenopharyngodon idella* (20 %) *Cirrhinus mrigala* (15 %) and *Cyprinius carpio* (15 %). In the IFS model, birds were integrated @ 800 number ha^{-1}, (Vanraja, 85 % and Khaki Campbell duck, 15 %) and on-dyke fruit crops (banana, lemon and guava) were cultivated. • The supplementary fish feed (mixture of rice bran 25%, mustard oil cake 25% and pelleted floating fish feed, 50%) was supplied daily at the rate of 1 % of fish biomass. The birds were provided 30-40 g supplementary feed (mixture of paddy, maize and crumbs) on daily basis.

	• After a culture period of one year, the minimum and maximum ABW were recorded as 362.5±35.9 g of *C. mrigala* and 624.5±35.3 g of *C. catla*. • The survival rate of fish was found to be 85.6 %. • Pond water quality parameters viz., pH, dissolved oxygen, alkalinity, hardness, turbidity etc. were measured to be within the optimum tolerance limit for fish rearing. • The fish equivalent yield was recorded 6.1 t ha^{-1} yr^{-1} from the IFS model, against 3.4 t ha^{-1} yr^{-1} from conventional fish polyculture system having same stocking density and feeding rate. • The benefit-cost ratio (B:C) was estimated to be 2.06 from the current IFS model, against 1.64 from conventional fish polyculture system. • The net income earned was recorded to be ₹ 5.6 lakh per hectare per year from the IFS model, against ₹ 2.4 lakh from conventional fish polyculture system. • The pond bottom soil's organic carbon content increased from 0.174 % to 0.304 % in the IFS model. • The energy use efficiency (EUE) of the IFS model was estimated to be 0.70, whereas in conventional fish polyculture systems the EUE ratio lies between 0.1 and 0.2 only. • Human energy profitability (HEP) of the IFS model was estimated to be 18.1 MJ/ MJ of human energy, against 5.5 MJ/ MJ of human energy from conventional fish polyculture systems. • The water productivity of the IFS model was analysed and found that 7.24 m^3 of water (ground water & rainwater) was required to produce 1.0 kg fish equivalent yield (FEY), against 7.51 m^3 of water required in conventional fish polyculture systems. The current IFS model required 270 litre less water to produce 1.0 kg fish than conventional fish polyculture system. • Further, greenhouse gas emission 0.451 kg CO_2 e was emitted to produce 1.0 kg of fish equivalent, which was much lower than that of the production of rice, mutton, milk and conventional fish farming systems fed concentrated diets. • Furthermore, the crude protein conversion provided through supplementary feeds and fertilizer/ manure (N x 6.25) into fish protein equivalent was analysed and found as 44.2 % in IFS model, against 34.45 % in conventional polyculture system.
8. Is it a new technology? (Yes/ No). If no, provide the details of the technology modified	Yes! The IFS model i.e. **high-density fish-poultry-duck-fruit crops** is location specific suitable for floodplains/ waterlogged ecosystems of North Bihar

9. IPR involved, if any (Patent/Copyright/ Industrial Design Registration/ Variety/ germplasm registration). Provide Filed/ Granted number	No IPR
10. Validation procedure followed (within Institute, collaborators, multilocation/ multi-site testing)	Validation was done at the institute research farm as well as at farmers' field in East Champaran, Bihar
11. Brief description of research output/ technology: **a. Objective of the product/technology**	**a. Objectives:** 1. To develop fish-based IFS models suitable for floodplain wetland ecosystems 2. To assess physicochemical properties of soil and water of fish pond under different components of integration 3. To assess productivity, economics and energy use efficiency of IFS models 4. To organize capacity building and awareness programs
b. Detailed methodology of the proposed product/technology	**b. Detailed methodology of the proposed product/ technology**: · The experiments for development and assessment of **high-density fish-poultry-duck-fruit crops** IFS model the was conducted at the farm ponds of research farm of ICAR-MGIFRI, Piprakothi, and at the selected farmers' fields in East Champaran during October 2020 to March 2024 · The fish fingerlings were stocked at the rate of 10000 number ha^{-1} of an average body weight 30.5±1.8 g comprised of *Catla catla* (30 %), *Labeo rohita* (20 %), *Ctenopharyngodon idella* (20 %) *Cirrhinus mrigala* (15 %) and *Cyprinius carpio* (15 %). · In the IFS model, birds were integrated @ 800 number ha-1, (Vanraja, 85 % and Khaki Campbell duck, 15 %) and on-dyke fruit crops (banana var. G9, lemon var. Kagazi & Seedless, and guava var. L49) were cultivated. · The supplementary fish feed (mixture of rice bran 25%, mustard oil cake 25% and pelleted floating fish feed, 50%) was supplied daily at the rate of 1 % of fish biomass. The birds were provided 30-40 g supplementary feed (mixture of paddy, maize and crumbs) on daily basis. · The parameters like growth, survival, production, productivity, energy efficiency, nutrients flow, soil/ water quality parameters, water footprint etc. were collected and analysed.
c. Yield/ productivity gain	**c. Yield/ productivity gain:** The fish equivalent yield was recorded 6.1 t ha^{-1} yr^{-1} from the IFS model, against 3.4 t ha^{-1} yr^{-1} from conventional fish polyculture systems having the same stocking density and feeding rate.

d. Saving of water, labour, time and energy	**d. Saving of water, labour, time and energy:** The water productivity of the IFS model was analysed and found that 7.24 m^3 of water (ground water & rainwater) was required to produce 1.0 kg fish equivalent yield (FEY), against 7.51 m^3 of water required in conventional fish polyculture systems. The current IFS model required 270 litres less water to produce 1.0 kg fish than conventional fish polyculture systems.
e. Conservation of soil	**e. Conservation of soil:** The pond bottom soil's organic carbon content increased from 0.174 % to 0.304 % in the IFS model.
f. Capacity	**f. Capacity:** The current IFS can play a significant role in effective and sustainable utilization of floodplains, waterlogged ecosystems of the country, especially in eastern India, and fish productivity can be increased significantly
g. Efficiency	**g. Efficiency:** The IFS model is efficient in waste recycling, energy use, nutrients flow, and also it is economically efficient.
h. Cost effectiveness including B:C ratio	**h. Cost effectiveness including B:C ratio:** The benefit-cost ratio (B:C) was estimated to be 2.06 from the current IFS model, against 1.64 from conventional fish polyculture system.
i. Uniqueness of the technology in comparison to existing ones	**i. Uniqueness of the technology in comparison to existing ones:** The IFS model instead of fish; it has both the birds (Vanraja & Khaki Campbell) at the rate of 800 number/ ha. poultry (85 %) and duck (15%), wherein duck play a vital role in improving and maintaining of some of the critical water quality parameters like dissolved oxygen. Also, it consists on-dyke fruit plants i.e. lemon (Kagazi), guava (L49) and banana (G9).
j. Passport data of the product/ technology	**j. Passport data of the product/technology**: The data is available with the PI of the project
12. Details of relevant data generated during the development/ validation	The following data were collected during the experiments: • Growth, survival, production, productivity of the fishes • Growth, survival, production, productivity of the birds (poultry and duck) • Fruit production and productivity • Water quality parameters of the ponds • Soil pH and organic carbon • Data for the analysis of energy and economic analysis • Data for the calculation of water footprints/ water productivity • Data for GHGs emission analysis • Data on resource/ nutrients recycling

13. Proposed stakeholders	Farmers, Extension workers, Scientists, Entrepreneurs and Policy makers
14. Commercial potential, if any	No
15. Publications/ photos/ video clipping, if any	The publication of the findings is under process. Photos/ videos are available with the PI
16. Any other information not covered above	No