



GNNS-ICAR-KRISHI VIGYAN KENDRA



Supported under
Rural Infrastructure Promotion Fund (RIFP)



Impact Study Report on Self-Sustainable Bio-Ecosystem Model with Aquaculture, Poultry, Protected Vegetable Culture and Solar Energy System

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Impact Study Report on Self-Sustainable Bio-Ecosystem Model with Aquaculture, Poultry, Protected Vegetable Culture and Solar Energy System - Supported under Rural Infrastructure Promotion Fund (RIPF) – NABARD

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1. INTRODUCTION :

The project titled “Self-Sustainable Bio-Ecosystem Model with Aquaculture, Poultry, Protected Vegetable Cultivation and Solar On-Grid System” was implemented under the Rural Infrastructure Promotion Fund (RIPF), supported by NABARD, Hyderabad. The initiative aimed to promote Integrated Farming Systems (IFS) as a means to enhance rural livelihoods, improve income diversification and encourage the adoption of sustainable agricultural practices. This report presents a comprehensive evaluation of the social and economical impacts of the project.

Ensuing food security and access to basic nutrition for the majority of the population remains a key focus area for both Central and State Governments. To achieve these goals, various programmes have been introduced across the country. One such focus area is fish and fish-based products, whose domestic demand has significantly increased due to their high nutritional value. Meeting this growing demand poses a challenge and an opportunity for governments and farming communities alike.

In recent years, the fisheries and aquaculture sector has evolved from being a traditional subsistence activity into a sustainable and economically viable enterprise. With improved technologies, changing consumer preferences, greater health awareness and emerging market opportunities, this sector is now being recognized as a remunerative livelihood option. Particularly, land-based aquaculture systems are gaining momentum as they align with resource-efficient and environmentally responsible farming.

Fish, being an affordable and rich source of animal protein, is one of the healthiest dietary choices and plays a vital role in addressing public health concerns and nutrient deficiencies, especially in rural populations.

Recognizing these emerging needs and opportunities, the National Bank for Agriculture and Rural Development (NABARD), Hyderabad has supported the implementation of innovative integrated farming models under RIPF. The present project integrates aquaculture, poultry, protected vegetable cultivation and solar energy systems to create a self-sustaining bio-ecosystem that can serve as a model for climate-resilient, economically viable and environmentally sustainable rural development .

2. Project Overview

Implementing Agency: GNNS - ICAR-Krishi Vigyan Kendra (KVK),
Jammikunta, Karimnagar District, Telangana.

Sanctioned Budget: 10.0 Lakhs and **Date of Commencement:** 24.07.2024

Key Components:

Aquaculture: High-density fish fingerling production using solar energy.

Poultry: Rearing BV380 layer birds in protected cages with solar energy.

Protected Vegetable Cultivation: Leafy vegetables grown under shade nets using fish waste water.

Solar On-Grid System: 5 KW solar system for energy sustainability.

3. Unique Features of Low cost Self Sustainable Integrated farming Systems:

- ◆ Utilization of fish wastewater for vegetable cultivation which reducing fertilizer expenses.
- ◆ Chemical-free vegetable growth due to the utilization of fish waste water.
- ◆ Poultry waste used as manure for horticulture crops.
- ◆ Low maintenance due to reduced labour and zero electricity charges with On Grid Solar System.
- ◆ Savings in Electricity bills and revenue generation from excess electricity units.
- ◆ Simplified management requiring minimal manpower, reducing labour costs.
- ◆ Poultry egg sales which cover fish working expenses.
- ◆ Vegetable and food waste utilized as feed for egg layer birds, reducing feed costs diversified farm produces (Fish seed, Poultry Eggs & Meat and Vegetables)

➔ Multi-Component Integration

Components like aquaculture, poultry, vegetable cultivation and solar energy are interconnected and ensures year-round income and food supply.

➔ Climate Resilience

Diversification helps mitigate risk from climate extremes (floods, drought, crop failure). Protected cultivation and solar power provide adaptability.

➔ Year-Round Income Generation

Different enterprises yield income at different times (e.g., poultry every 45 days, vegetables weekly, fish bi-annually).

Reduces seasonal dependency and stabilizes cash flow.

➔ Energy Self-Reliance

Use of solar energy for air blower, bio filters, mini water pumps and lighting which minimizes electricity cost and ensures uninterrupted water and air supply.

➔ Nutritional Security

Access to eggs, fish and fresh vegetables improves dietary diversity at the household level.

➔ Scalable and Replicable

Suitable for 0.5–1 acres landholding it can be Promoted through Farmer Producer Organizations (FPOs), SHGs, or village clusters.

➔ Training and Capacity Building Friendly

Acts as a live demonstration unit for nearby farmers.

Facilitates learning-by-doing and extension outreach.

3.1 Operational Details of the Self-Sustainable Integrated Farming System

➔ Solar-Powered Operations: The entire integrated farming model operates primarily on solar energy, significantly minimizing dependence on supply from DISCOM. Daily electricity consumption is limited to approximately 15-18 units/day, which is fully met through the installed solar power system.

➔ Surplus Energy Utilization: On average, 8-10 units of excess solar power per day are generated and carried forward into the system. This surplus reduces operational energy costs over time and contributes to long-term sustainability and savings.

➔ Low Labour Requirement: The system is designed for ease of management, allowing a single individual often a woman farmer or farm family member to operate the entire unit efficiently. This minimizes labour costs and empowers rural women through direct involvement in farm management.

➔ Daily Schedule Efficiency: Farm operations like feeding poultry, monitoring fish tank, harvesting vegetables and watering plants can be completed in 2–3 hours per day, enabling time for other household or income-generating activities.

➔ Efficient Water Management: The system uses solar-powered drip irrigation and recycles water wherever possible (e.g., nutrient-rich fish water for vegetables), ensuring optimal water usage in water-scarce areas.

3.2 Completion of Physical Works & Facilities :

All proposed physical works and facilities have been successfully completed in accordance with the original project proposal and as per the recommendations of the First and Second Project Monitoring and Review Committee (PMRC) meetings.

The major infrastructure and systems established under the project include:

➔ Protected Poultry Shed: A well-ventilated and bio-secure poultry shed was constructed, equipped with suitable poultry cages, feeders, drinkers and other necessary infrastructure. The shed currently houses the sanctioned number of poultry birds and all required farm inputs (feed, vaccines, supplements) have been provided as per standard protocols.



IFS-Poultry Layer unit with Protected Portable Cage



IFS- High Density Fish Culture Tank

- ➔ **Intensive Fish Culture Tank:** A bio-filter system was established for the intensive fish culture unit. This allows for better water quality management and improves fish and fish seed health and productivity.
- ➔ **Protected Vegetable cultivation unit:** A bio filter bed was installed to channel nutrient rich fish waste water from fish tank for protected vegetable cultivation, ensuring effective nutrient recycling and minimizing water wastage.
- ➔ **5KW On-Grid Solar Power System:** A 5-kilowatt on-grid solar power system was successfully installed and integrated with the farm's power requirements. The system generates adequate power to run essential operations, such as air blower, bio-filter, mini water pumps and lighting, while also exporting surplus units to the grid thereby significantly reducing electricity costs.



IFS-Protected Vegetable cultivation Unit



5KW Solar on-grid power system

4. Key Interventions and Activities

- ◆ Project physical works were completed by the end of January, 2025.
- ◆ Conducted 5 demonstrations benefiting 450 farmers, FPO members, SHGs and agricultural students.
- ◆ Organized 2 field days and 8 group discussions to raise awareness about IFS benefits. Initiated on-farm trials for fish seed rearing in aquaculture units.
- ◆ 25 farmers, 3 FPOs and 5 SHGs expressed interest in adopting the model .



PMRC meetings to review the progress of project activities



Visit of the General Manager, NABARD, Hyderabad



Visit of the Deputy General Manager, NABARD, Hyderabad



Creating awareness on IFS systems to Farmers



Creating awareness on IFS Systems to Agriculture Students



Creating awareness on IFS systems to Farmers

5. Economic Impact of a Self-Sustainable Bio-Ecosystem Model

Component I:

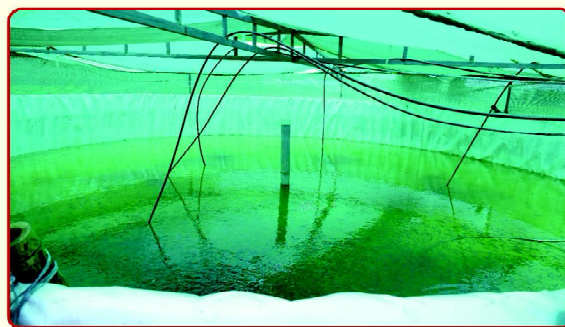
High-Density Fish Fingerlings Production with Filter Bed (Solar powered) and air blowers - This component focused on producing high-density air breathing and IMC fish fingerling production using a solar-powered aquaculture system with a filter bed, ensuring efficient water and energy use.

Sl. No.	Particulars	Value
1.	Stocked No (Stripped Murrel seed)	15,000 No
2.	Duration of Culture Period	45 Days
3.	Fish Survival Rate	72%
4.	Final Harvested No (Fish Fingerlings)	12,600 No
5.	Total Fish Seed Biomass Yield (q/Ha)	3.15
6.	Cost of Cultivation (Seed, Feed, Operations)	Rs. 96,075/-
7.	Gross Returns (12.5 per Fingerling)	Rs. 1,57,500/-
8.	Net Returns	Rs. 61,425/-
9.	Benefit-Cost(BC) Ratio	1.63:1
10.	Additional Monthly Income	Rs. 30,712/-

The intervention demonstrated a profitable and short-cycle model for fish seed production, utilizing solar power and recycled water through filter beds. This ensures low input cost, high survivability and efficient resource use making it suitable for replication by small and marginal farmers.



IFS-High Density Fish Culture Unit



IFS-High Density Fish Seed Rearing Activity

Component II: Poultry Layer Rearing in Protected Prototype Cages

This component demonstrates efficient egg production using BV380 layer birds reared in protected cages, powered by a solar energy system, ensuring reduced operational costs and better bird health through environmental control.

Sl. No.	Particulars	Value
1.	Stocked BV380 Poultry Birds	200 Birds
2.	Total Feed Consumed (60 days@75g/bitd/day)	900 kgs
3.	Total Feed Cost (@Rs.38/kg)	Rs. 34,200/-
4.	Medicines & labor Cost	Rs. 9,500/-
5	Total Eggs Produced (60 days)	7,353 No.
6	Cost of Cultivation	Rs. 43,700/-
7	Gross Return (Egg Sale @ Rs 8 per Egg	Rs. 60,280/-
8	Net Returns	Rs. 16,580/-
9	Beniefit-Cost (BC) Ratio	1.38:1
10	Additional Monthly Net Income	Rs. 2,763/-

The layer poultry model ensures regular income, low space requirements and low-cost maintenance. When combined with solar power and cage systems, it becomes ideal for women farmers and smallholders seeking quick returns with manageable operational needs.



IFS-Poultry Layer in Protected Portable Cages



Explaining to farmers on Layers in Protected Portable Cages

Component III: Protected Vegetable Cultivation Under Shade Net (Utilizing Fish Wastewater & Solar Energy):

This component highlights the use of nutrient rich fish pond water for cultivating leafy vegetables under 400 Sq.mt shade net. The system ensures efficient water use, low input costs and consistent yield in a protected environment.

Sl. No.	Particulars	Value
1.	Protected Shade Net Area	400 Sq.Mt
2.	Total Cost of Cultivation (leafy Vegetables)	Rs. 6,500/-
3.	Gross Returns From Leafy Vegetable Sale	Rs. 8,500/-
4.	Net Returns	Rs. 2,000/-
5	Benefit-Cost(BC) Ratio	1.30:1
6.	Additional Monthly Income	Rs. 1000/-

The use of fish wastewater as natural fertilizer reduces the need for chemical inputs, while solar powered irrigation keeps operational costs low. This low investment model is ideal for continuous income through short duration leafy vegetables and is suitable for replication by women and marginal farmers.



IFS-Protected Vegetable Cultivation unit



IFS-Protected Vegetable Cultivation unit

Component IV: 5 Kw Solar On-Grid Power System (5 Months Period) :

This component ensures uninterrupted, low-cost power supply to the entire integrated farming system, with surplus energy exported to the grid leading to direct economic savings.

Sl. No.	Particulars	Value
1.	Solar System Capacity	5Kw
2.	Total Electricity Produced (150 days)	3,750 Units
3.	Gross Returns from Electricity Bills	Rs. 13,125/-
4.	Total operational Cost	Rs. 0/-
5	Net Returns	Rs. 13,125/-
6	Additional Monthly Net income	Rs. 2,625/-

The **on-grid solar system** powers all farm units without incurring energy costs. Surplus generation offers a **steady return through savings on electricity bills**, contributing to the system's self-sustainability and energy independence.



IFS-Solar On grid Power System



IFS-Solar On Grid Running Status

Overall Economic Impact of the Integrated Bio-Ecosystem Model

Sl. No.	IFS Component	Monthly Income
1.	5 Kw Solar On-Grid System	Rs. 2,625/-
2.	Poultry Layer Rearing	Rs. 2,763/-
3.	High-Density Fish Fingerling Culture	Rs. 30,712/-
4.	Protected Vegetable Cultivation	Rs. 1,000/-
5	Additional Income	Rs. 37,100/-

The integrated model generates a substantial total monthly income of **Rs. 37,100/-**, showcasing the potential of combining aquaculture, poultry, protected cultivation and solar energy systems to enhance rural livelihoods sustainably.

6. Socio Economic Impact:

- ➔ **Awareness Creation:** A total of 450 farmers were trained on sustainable integrated farming practices, enhancing community knowledge and capacity.
- ➔ **Adoption Potential:** 33 stakeholders, including individual farmers, Farmer Producer Organizations (FPOs) and Self-Help Groups (SHGs), have expressed strong interest in replicating the bio ecosystem model.
- ➔ **Sustainability Benefits:** Significant **reduction in electricity** costs through the adoption of solar power. Promotion of a **circular economy** by reusing nutrient rich fish wastewater for **vegetable irrigation**, reducing chemical fertilizer use and conserving water.

7. Farmers Feedback:

1. Sri Gudipati Pradeep Reddy: The integrated model has transformed my farming. With fish, poultry and vegetables running together, my income has increased significantly. The solar system saves me money on electricity and makes daily work easier. I'm proud to show this to my neighbours.



Fish Farmer Singapoor village, Huzurabad

2. Smt. Kambampelli Pravalika: Managing the poultry and vegetable units is simple and fits well with my daily routine. The training helped me understand how to use fish water for my crops, which has improved vegetable growth and reduced costs. This model empowers women like me.



Navyateja Women Self Help Group,
Vavilala Village, Jammikunta Mandal-

3. Sri Sanda Mahender: The project's integrated approach is practical and sustainable. We are planning to adopt this model for other members in our FPO. The savings on inputs and energy are impressive and it promotes environmental care.



Chairman, Jammikunta
Raithu Pragathi Utpatti Paraspara Sahakaara Sangham Limited (FPO)
Jammikunta

4. Sri Regula kumaraswamy: I was sceptical at first, but after seeing the results, I'm convinced. The system uses renewable energy and recycles waste effectively. It creates jobs for youth in the village and supports local food security.



Young Entrepreneur,
Fish Farmer, Annaramu Village, Manakonduru Mandal

8. Challenges and Recommendations :

Challenges

- ➔ **High Initial Investment:** The upfront costs for installing the solar on grid system and developing infrastructure for protected vegetable cultivation were relatively high, posing a barrier for small and marginal farmers .
- ➔ **Need for Continuous Technical Support:** Successful adoption of the Integrated Farming System (IFS) model requires regular technical guidance, particularly for managing interlinked components like aquaculture, Poultry, Protected Vegetable and solar on grid systems maintenance.

Recommendations :

- ➔ **Scale-Up with Supportive Policies:** Expand the model to more villages and clusters through demonstrations and pilot projects, with targeted subsidies or financial assistance for solar and other components Physical structures.
- ➔ **Capacity Building and Follow-Up:** Ensure hands-on training, exposure visits and periodic follow-up support for farmers to build confidence and ensure sustained adoption of the IFS model.

9. Conclusion:

The Self-Sustainable Bio-Ecosystem Model has proven to be economically viable and environmentally sustainable, generating a monthly income of Rs. 37,100/- through the integration of poultry, aquaculture, protected vegetable cultivation and solar energy. This model effectively demonstrates how Integrated Farming Systems (IFS) can enhance rural livelihoods, diversify income sources and reduce dependency on external inputs.

The model has delivered multiple benefits:

- Increased production of vegetables, eggs and fish seed
- Reduced power costs through solar energy utilization
- Improved soil health through organic waste recycling
- These outcomes support the model's replicability and scalability, particularly for small holder and marginal farmers.

However to ensure long-term sustainability and wider adoption, there is a need for:

- Continued technical support and capacity building
- Subsidies and policy incentives for initial setup, especially for solar and protected cultivation infrastructure.
- Further research and field trials to refine and optimize individual components and system linkages

Support from **NABARD, KVK and Agricultural and Allied extension agencies** will be critical in promoting this model as a **mainstream sustainable agricultural practice**. With appropriate backing, the Self-Sustainable Bio-Ecosystem can become a **corner-stone of climate-resilient and economically stable rural farming systems**.

Acknowledgement :

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Their collective contributions have been instrumental in the successful implementation and impact of the project under the **Rural Infrastructure Promotion Fund (RIPF), NABARD**.



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