Project Completion Report:

Project title: ***"Livelihood Generation for Women Community of Phanda Block in Bhopal District Through Innovative River Pen Culture Practices in Ajnal (River) Dam of Madhya Pradesh"***

Project Reference No: ***NABARD****/MCID/FIF/LEDP/SHG-92(206)2022-2023 (21/02/2023).*
Project Duration: The project duration is from February 21, 2023, to June 21, 2025.

(1). Introduction:

This report presents a comprehensive overview of the successful implementation and completion of the project. Spanning over two years **from February 21, 2023, to June 21, 2025,** this initiative was designed with the central objective of empowering rural women by integrating them into the field of sustainable agri-based integrated aquaculture through the adoption of innovative, low-cost pen culture technology. The project aligned with broader development goals by addressing multiple socio-economic dimensions, including livelihood enhancement, nutritional security, environmental sustainability, and women's economic empowerment. At its core, the project introduced pen culture an eco-friendly aquaculture method involving the rearing of fish in fixed enclosures set within natural water bodies. These enclosures, typically constructed from nets or wooden frames, allow for free water circulation. This design ensures high levels of dissolved oxygen and grants the fish access to natural food sources, such as benthic organisms. Unlike traditional pond aquaculture, pen culture leverages the natural ecology of dams and rivers, making it a cost-effective and scalable solution for rural communities.

Recognizing India's position as the third-largest fish producer globally and the increasing demand for protein-rich food sources, the project sought to unlock aquaculture's potential for grassroots-level rural development. The initiative specifically targeted the Phanda Block of Bhopal District, where women from marginalized and economically vulnerable backgrounds were organized into Self-Help Groups (SHGs) to engage in collaborative fish farming activities. These SHGs received comprehensive training in aquaculture techniques, along with refresher sessions, capacity-building workshops, and exposure to best practices in Ajnal River pen culture. The project placed strong emphasis on environmentally sustainable methods, particularly the use of natural feed alternatives such as periphyton (a blend of algae, microbes, and organic matter) and *azolla* (a nitrogen-fixing aquatic fern). These alternatives helped reduce dependency on commercial feed, minimized costs, enhanced fish health, and maintained water quality.

Beyond improving economic livelihoods, the initiative also had strong social and ecological dimensions. By empowering women and building local capacity, the project addressed key issues including nutrition, poverty alleviation, skills development, and community resilience. Furthermore, it aimed to establish a replicable model of success that could be scaled and adapted to other regions across Madhya Pradesh, thereby informing broader state-level strategies for sustainable aquaculture and livelihood generation. This project was not merely an aquaculture intervention but a comprehensive rural development strategy. By integrating scientific innovation with traditional knowledge and community participation, it fostered lasting change. Its success has laid a solid foundation for the continued empowerment of rural women and the advancement of environmentally sustainable livelihood practices across rural landscapes.

(2). Project Overview:

The innovative Pen Culture Practices initiative in the Ajnal River Dam, located in the Phanda Block of Bhopal District, Madhya Pradesh, was conceptualized as a pioneering effort to introduce and establish pen culture as a viable, sustainable aquaculture practice in rural communities. With a strong focus on women's empowerment and environmental sustainability, the project aimed to transform underutilized aquatic resources into productive, income-generating assets by integrating the fish farming of Indian Major Carps (IMC) and Exotic Carps within the dam's natural ecosystem. At the heart of the project was a clear and multifaceted objective: to enhance the productivity of local water resources, conserve aquatic biodiversity, and create long-term, sustainable livelihoods for rural women. To achieve this, the project specifically targeted 150 women beneficiaries residing in three villages Narohna Sankal, Tanda, and Bilkhiriya. These women were organized into five structured and well-functioning Self-Help Groups (SHGs), with two SHGs formed in Narohna Sankal, two in Tanda, and one in Bilkhiriya. The formation of SHGs not only provided a collective identity and mutual support system for the women but also enabled effective coordination, training, and implementation of the pen culture model.

The chosen approach pen culture technology involved the rearing of fish within fixed enclosures built in the natural water body of the Ajnal Dam. These pens, constructed using locally available materials such as nets and bamboo or wooden poles, allowed for the free flow of water while containing the fish within a defined area. This system created an optimal balance between natural aquatic conditions and controlled aquaculture practices, ensuring high oxygen levels, exposure to natural food sources like plankton and benthic organisms, and minimized environmental disruption. By integrating women into this innovative aquaculture system, the project sought to unlock their economic potential and empower them to become active stakeholders in their local economy. Training and capacity-building sessions were conducted to equip the beneficiaries with both technical knowledge and practical skills necessary for successful agri-based integrated fish farming. These included modules on paddy fields and pen fields preparation, fish stocking density, feeding techniques using low-cost and eco-friendly inputs like azolla and periphyton, water quality management, disease control, harvesting, and post-harvest handling.

Moreover, the initiative emphasized the responsible and sustainable use of natural resources. By promoting eco-friendly feeding practices and reducing reliance on commercial fish feed, the project not only cut operational costs for the beneficiaries but also contributed to maintaining the ecological health of the water body. The sustainable model adopted ensured that the fish farming practices would not lead to the degradation of the dam's ecosystem, making the project both economically viable and environmentally responsible. The outcomes of the project extended far beyond financial gains. The initiative fostered increased self-confidence, leadership, and decision-making capacity among participating women. It also strengthened community cohesion and laid the groundwork for replicating similar models across other rural regions in Madhya Pradesh and beyond. In this project has proven to be a transformative development model that successfully blends scientific innovation with community participation. By leveraging natural resources for economic empowerment while maintaining ecological integrity, the pen culture initiative in Ajnal River Dam has set a benchmark for future livelihood and agri-based interventions. It stands as a testament to how targeted, inclusive, and environmentally mindful strategies can significantly uplift rural communities, particularly women, by opening new pathways for sustainable growth and prosperity.

(3). Total Project Sanction Cost (NABARD): Rs. 9,85,250/-.

The total expenditure was **Rs. 6,89,500/-** covering all phases of the project, including agri-based integrated river pen culture system material procurement, training and demonstration setups.

(4). Key Components of the River Pen Culture Project:

The innovative pen culture practices in Ajnal River (Dam) of Bhopal, was designed with several key components to ensure its successful implementation and sustainability. These components include:

- **Site Selection and Assessment:** The Ajnal River (Dam) was chosen for its suitable characteristics, including shallow regions along the banks that are ideal for integrated pen culture. A thorough assessment of the site ensured that it met the necessary conditions for effective fish farming, such as water quality, depth, and accessibility.
- **Formation and Mobilization of Women Self-Help Groups:** A total of five women Self-Help Groups (SHGs) were formed and mobilized to participate in the project. These SHGs included two groups from Sankal village, two from Tanda village, and one from Bilkhiriya village, comprising a total of 150 women beneficiaries. The women received the necessary support and training to engage in pen culture practices.
- **Pen Construction and Setup:** A pen unit was fabricated and installed in the village of Narohna Sankal in the Phanda block of Bhopal. It was constructed using locally available materials, such as nets and wooden structures. The design allowed for the free circulation of water while keeping the fish contained within a controlled environment. The lake's bottom formed the floor of the pen, providing natural benthic fauna as a food source for the fish.
- **Fish Stocking:** The project integrated the farming of Murrel. Indian Major Carps (IMC) and Exotic carps. These species were selected for their suitability to the local environment and their economic value. Fish stocking was carefully managed to ensure optimal growth and yield.
- **Training and Capacity Building:** Comprehensive training sessions were conducted for the women in the SHGs, focusing on pen culture techniques, fish health management, water quality monitoring, and business skills. This training aimed to build their technical capacity and enable them to manage the pens independently.
- **Natural Food Enhancement:** The project emphasized the use of natural food sources like periphyton and azolla to supplement the diet of the fish. This approach reduced the need for costly artificial feeds and promoted a more sustainable and eco-friendly aquaculture practice.
- **Monitoring and Maintenance:** Regular monitoring of the pens was conducted to ensure the health of the fish and the integrity of the enclosures. Maintenance activities, including repairs and adjustments to the pen structures, were carried out as needed to sustain optimal conditions for fish farming.
- **Economic Empowerment and Market Linkages:** The project facilitated the economic empowerment of the women by creating direct linkages with local markets for the sale of the harvested fish. This ensured that the beneficiaries could generate a stable income from their aquaculture activities.
- **Environmental Sustainability:** The project was designed with a strong emphasis on environmental sustainability. By using natural resources efficiently and minimizing the environmental impact of aquaculture practices, the project aimed to create a long-lasting

positive effect on the local ecosystem.

- **Community Engagement and Awareness:** Community engagement activities were conducted to raise awareness about the benefits of pen culture and to encourage broader participation. These activities also helped in garnering community support and ensuring the project's long-term success.

By integrating these key components, the project successfully promoted sustainable livelihoods, improved resource utilization and empowered the women of Phanda Block through innovative pen culture with agri-based integrated aquaculture practices.

(5). Group Monitoring Workshop at Sankal village, Phanda Block, Bhopal District:

A Group Monitoring Workshop (GMW) was successfully organized in Narohna Sankal village, located in the Phanda block of Bhopal District. The workshop aimed to promote and initiate project activities at the beneficiary level, focusing on enhancing awareness and participation in integrated river pen fish culture systems among marginalized communities. The event brought together five women Self-Help Groups (SHGs) actively engaged in innovative river pen fish culture practices along the Ajnal River. These groups are also involved in utilizing river embankments and shorelines for allied activities such as horticulture, livestock rearing, and integrated river fish farming. District-level administrative officials also participated, reflecting strong institutional support and coordination for the project's objectives.

Approximately 250 women participants attended the workshop. All of them are involved in river pen culture-based integrated aquaculture enhancement activities and represent a diverse range of rural livelihoods centered around sustainable aquaculture development. During the workshop, experts from the organizing institution provided in-depth knowledge and practical demonstrations on the concepts and benefits of Ajnal River-based integrated aquaculture systems. They explained how the river's natural resources such as water flow and aquatic vegetation can be effectively utilized for sustainable fish farming.

A key highlight of the workshop was the introduction of the duckweeds or azolla and periphyton-based feeding system within the river pen culture model. Experts demonstrated how periphyton, a natural aquatic biofilm composed of algae, microbes, and detritus, can serve as a nutritious and cost-effective feed for fish. This method not only reduces dependence on commercial feed but also contributes to improved water quality and better fish health. The workshop concluded with interactive sessions, during which participants asked questions and shared their local experiences. The overall response was highly positive, with beneficiaries expressing increased interest and confidence in adopting integrated river pen fish culture systems, particularly those based on sustainable, river-centric models. This workshop played a crucial role in knowledge transfer, community engagement, and strengthening grassroots capacities. It aligned with the objectives of the Ajnal River Pen Culture Project and contributed to the broader goal of promoting sustainable rural livelihoods.

(6). Preliminary Survey of Ajnal River Pen Fish Culture:

A survey of Ajnal River pen fish culture units was conducted in Narohna Sankal village, located in the Phanda Block of Bhopal District. During the survey, one pen culture unit was evaluated, and water samples were collected for further analysis. The water quality data from the pen unit in the Phanda Block of Bhopal District are presented below:

Parameter of Ajnal river pen culture unit at Sankal	April 2023	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan-2024	Feb	March 2024
Air temperature	39	42	43	41	38	31	27	26	23	21	27	32
Water temperature (^{0}C)	32	35	38	36	32	25	23	21	18	17	20	23
pH	7.5	7.2	8	7.5	7.5	7.0	7.0	7.5	7.5	7.5	7.5	7.5
Conductivity (us/cm)	230	180	220	210	220	210	200	190	190	180	230	230
Dissolved oxygen (mg/l)	6.8	6.6	6.7	6.8	6.5	6.5	6.8	6.8	6.7	6.8	6.8	6.8
Total Alkalinity (mg/l)	120	110	105	115	110	105	110	110	110	115	120	120

(7). Objectives Achieved:

The primary objectives of the project were successfully met:

- *Interventions to improve the productivity of locally available resources by imparting the low-cost Pen Culture Technology with reference to aquaculture enhancement.*
- *Skilling local people in low-cost pen culture technology for poverty elimination in the area and addressing the health issues of the area by promoting the consumption of fishes.*
- *Economic Empowerment of the people through widespread introduction of pen culture in the area.*
- *Development of micro economic enterprises in the area and Aptitude building for undertaking group activity.*
- *Impart knowledge about production and purchase processes as well as Statutory assistance for the establishment of small enterprises.*
- *Generation of sources of finance and Development of marketing and distribution channels.*

i). Objectives Achieved: ***Interventions to improve the productivity of locally available resources by imparting the low-cost Pen Culture Technology with reference to aquaculture enhancement.***

The project successfully met its core objectives through targeted interventions designed to improve the productivity of locally available resources. The primary objective was to impart low-cost Pen Culture Technology to enhance aquaculture practices, particularly benefiting the five women Self-Help Groups involved in the project. The key achievements are as follows:

1. **Introduction of Low-Cost Pen Culture Technology:** The project effectively introduced and implemented pen culture as a viable and low-cost aquaculture practice. Women from the five SHGs were trained in constructing and managing fish pens within the Ajnal River Dam. This technology provided a sustainable and cost-effective method for fish farming, utilizing the natural environment to support fish growth without the need for expensive inputs.
2. **Enhancement of Aquaculture Productivity:** By adopting pen culture, the women SHGs were able to significantly improve the productivity of locally available water resources.

The project demonstrated how pen culture could increase fish yield by creating a controlled environment that optimizes water quality and provides natural food sources such as benthic fauna, periphyton, and azolla. The successful stocking and cultivation of Indian Major Carps (IMC) and Exotic carps resulted in higher fish production compared to traditional methods.

3. **Empowerment of Women through Skill Development:** The project provided extensive training and capacity-building sessions to the five SHGs, equipping them with the knowledge and skills required for successful fish farming. This empowerment enabled the women to manage the entire process independently, from pen construction to fish harvesting, thus fostering self-reliance and boosting their confidence in aquaculture practices.
4. **Sustainable Livelihood Generation:** As a direct result of the interventions, the women SHGs were able to generate a sustainable income from their fish farming activities. The increased productivity and direct market linkages established through the project ensured that the fish produced were sold at competitive prices, thereby providing a steady source of income for the women and improving their overall economic well-being.
5. **Community and Environmental Impact:** The success of the project had a broader impact on the community, encouraging more local women to explore aquaculture as a livelihood option. Additionally, the environmentally sustainable practices promoted by the project, such as the use of natural food sources and minimal environmental disturbance, contributed to the preservation of the local ecosystem.

The project achieved its objectives by effectively introducing low-cost pen culture technology, enhancing aquaculture productivity, empowering women through skill development, generating sustainable livelihoods, and fostering positive community and environmental outcomes.

ii). Objectives Achieved: ***Skilling local people in low-cost pen culture technology for poverty elimination in the area and addressing the health issues of the area by promoting the consumption of fishes.***

The project successfully achieved the following objectives related to skilling and health improvement for the five women Self-Help Groups (SHGs):

1. **Skilling Local People in Low-Cost Pen Culture Technology:** The project provided comprehensive training to women from the five SHGs in the Phanda Block, equipping them with the necessary skills to implement and manage low-cost pen culture technology. This training covered all aspects of fish farming, including pen construction, fish stocking, water quality management, and harvesting. By acquiring these skills, the women were empowered to engage in sustainable fish farming, which offered them a viable means of poverty elimination. The knowledge and expertise gained through the project allowed the SHGs to operate their fish farms independently, increasing their income and improving their economic stability.
2. **Poverty Elimination:** The adoption of low-cost pen culture technology enabled the women SHGs to generate a steady income through the sale of fish. This income contributed significantly to poverty alleviation within their communities. The project provided a sustainable livelihood that directly addressed the financial challenges faced by these women and their families, leading to an overall improvement in their quality of life.

3. **Addressing Health Issues through Fish Consumption:** In addition to economic benefits, the project promoted the consumption of fish within the local community, addressing prevalent health issues such as malnutrition and protein deficiency. By increasing access to locally produced, affordable fish, the project encouraged better dietary practices among the community members. The nutritional value of fish, rich in essential proteins, omega-3 fatty acids, and other vital nutrients, contributed to improving the overall health and well-being of the local population, particularly the women and children.
4. **Community Awareness and Health Improvement:** The project also included awareness campaigns and educational sessions on the health benefits of fish consumption. These efforts were aimed at changing dietary habits and promoting fish as a healthy and nutritious food option. As a result, there was a noticeable increase in fish consumption within the community, leading to improved nutritional outcomes and a reduction in health-related issues associated with poor diets.

The project successfully achieved its objectives by skilling the women SHGs in low-cost pen culture technology, leading to poverty elimination, and by promoting fish consumption to address health issues in the area. This dual approach not only empowered the women economically but also contributed to the overall health and well-being of the broader community.

iii). Objectives Achieved: ***Economic Empowerment of the people through widespread introduction of pen culture in the*** **area.**

The project successfully achieved its objective of economic empowerment through the widespread introduction of pen culture technology. The specific achievements for the five women Self-Help Groups (SHGs) are as follows:

1. **Economic Empowerment through Pen Culture:** The project introduced pen culture as a sustainable and economically viable method of fish farming to the five women SHGs in the Phanda Block. By providing these groups with the necessary training and resources, the project enabled them to actively participate in the local economy. The women were equipped with the skills to construct and manage fish pens, stock fish, and oversee the entire production cycle, resulting in a significant increase in their income.
2. **Creation of Sustainable Income Streams:** The successful implementation of pen culture allowed the SHGs to generate consistent revenue from the sale of fish. The project ensured that the women had access to local markets where they could sell their produce at competitive prices. This regular income stream contributed to the financial stability of the women and their families, reducing their dependence on traditional, less reliable sources of income.
3. **Widespread Adoption of Pen Culture:** Beyond the immediate impact on the five SHGs, the project facilitated the broader adoption of pen culture practices within the community. The success experienced by the SHGs served as a model for other community members, leading to increased interest and participation in aquaculture. This widespread adoption helped to establish pen culture as a key economic activity in the area, fostering community-wide economic growth.
4. **Strengthening of Women's Role in the Local Economy:** By empowering the women SHGs with the tools and knowledge needed to succeed in pen fish farming, the project

significantly enhanced their role in the local economy. The women transitioned from being primarily homemakers or engaged in low-income activities to becoming key contributors to the community's economic development. This shift not only improved their financial status but also elevated their social standing within the community.

5. **Long-Term Economic Impact:** The economic benefits of the project extended beyond the immediate income generated. The women SHGs were able to reinvest their earnings into expanding their operations, purchasing better equipment, or diversifying into other income-generating activities. This long-term impact has laid the foundation for continued economic growth and prosperity in the Phanda Block of Bhopal.

The project successfully achieved its objective of economic empowerment for the five women SHGs by introducing and promoting pen culture in the area. This initiative created sustainable income opportunities, fostered widespread adoption of innovative pen culture with integrated aquaculture practices, and strengthened the economic role of women in the community.

iv). Objectives Achieved: ***Development of micro economic enterprises in the area and Aptitude building for undertaking group activity.***

The project successfully achieved its objective of developing micro-economic enterprises and building aptitude for group activities among the five women Self-Help Groups (SHGs). The specific achievements in these areas are as follows:

1. **Development of Micro-Economic Enterprises:** The introduction of pen culture as a sustainable fish farming practice provided the women SHGs with a foundation to develop micro-economic enterprises. These enterprises centered around the production, management, and sale of fish, which became a reliable source of income for the groups. By establishing these micro-enterprises, the project enabled the women to create and manage small-scale businesses that contributed to the local economy, fostering entrepreneurship and economic diversification in the area.
2. **Formation of Sustainable Business Models:** The project guided the SHGs in developing business models that were not only sustainable but also scalable. The women were trained in essential business skills such as financial management, marketing, and operations, which allowed them to manage their pen culture activities effectively. These skills enabled the SHGs to operate their micro-enterprises with a focus on long-term profitability and growth.
3. **Aptitude Building for Undertaking Group Activity:** The project placed a strong emphasis on building the aptitude of the women for undertaking group activities. Through various capacity-building sessions, the women learned the importance of teamwork, collaboration, and shared responsibility. These skills were crucial for the successful management of their collective pen culture enterprises, as they required coordinated efforts in tasks such as pen construction, fish stocking, maintenance, and marketing.
4. **Strengthening Group Cohesion and Leadership:** The project fostered a sense of unity and collective purpose among the SHGs. Leadership development was a key component, with training focused on empowering members to take on leadership roles within their groups. This not only improved the overall efficiency of their operations but also built confidence among the women, enabling them to address challenges and make informed decisions as a group.

5. **Enhanced Economic Resilience:** The aptitude building for group activity translated into enhanced economic resilience for the SHGs. By working together, the women were able to pool resources, share risks, and support each other in overcoming obstacles. This collective approach helped to stabilize their micro-enterprises and ensure that they could withstand economic fluctuations or other challenges that might arise.
6. **Creation of a Supportive Community Network:** Beyond the immediate SHGs, the project also encouraged the formation of a broader supportive network among the women in the community. This network facilitated the exchange of ideas, experiences, and best practices, further strengthening the micro-economic enterprises established through the project. The supportive environment helped sustain motivation and drive, ensuring the long-term success of the group activities.

The project successfully achieved its objectives by developing micro-economic enterprises and building the aptitude for group activities among the five women SHGs. These achievements laid the groundwork for sustainable business practices, strengthened group cohesion, and fostered a collaborative approach to economic empowerment in the Phanda Block community.

v). Objectives Achieved: ***Impart knowledge about production and purchase processes as well as Statutory assistance for the establishment of small enterprises.***

The project effectively met its objective of imparting knowledge about production and purchase processes, as well as providing statutory assistance for establishing small enterprises. The key achievements for the five women Self-Help Groups (SHGs) are as follows:

1. **Knowledge Transfer on Production Processes:** The project provided comprehensive training to the women SHGs on the intricacies of fish production using pen culture technology. This included practical knowledge about pen construction, fish stocking, feeding practices, water quality management, and harvesting techniques. The women learned how to optimize production efficiency, ensuring that their operations were both sustainable and profitable. This knowledge was crucial for the successful management and scaling of their aquaculture enterprises.
2. **Understanding of Purchase and Supply Chain Management:** In addition to production skills, the project educated the women on the purchase processes involved in running their small enterprises. This included sourcing quality inputs such as fish fingerlings, feed, and materials for pen construction at competitive prices. The training also covered supply chain management, helping the SHGs to establish reliable networks for sourcing and distribution, ensuring a steady flow of inputs and outputs that supported their business operations.
3. **Statutory Assistance for Enterprise Establishment:** Recognizing the importance of formalizing the SHGs' micro-enterprises, the project provided statutory assistance to help them navigate the legal and regulatory requirements for establishing small businesses. This included guidance on registering their enterprises, understanding local laws and regulations related to aquaculture, and obtaining necessary permits and licenses. By ensuring compliance with statutory requirements, the project helped the SHGs establish legally recognized and sustainable businesses.
4. **Access to Government Schemes and Financial Support:** The project also facilitated access to various government schemes and financial support programs designed to assist

small enterprises. The women were informed about available subsidies, grants, and low-interest loans that could help them expand their operations. Assistance was provided in applying for these benefits, which played a crucial role in the initial establishment and growth of their enterprises.

5. **Empowerment through Knowledge and Compliance:** By imparting knowledge on production, purchase processes, and statutory requirements, the project empowered the women to take full control of their small enterprises. This empowerment extended beyond operational skills, as the women gained confidence in managing the legal and financial aspects of their businesses, ensuring long-term sustainability and growth.
6. **Enhanced Business Viability and Growth Potential:** With a strong foundation in both the technical and regulatory aspects of running an enterprise, the SHGs were well-equipped to scale their operations. The knowledge and statutory assistance provided through the project significantly enhanced the viability of their businesses, paving the way for future growth and success in the competitive aquaculture industry.

The project successfully achieved its objective of imparting knowledge on production and purchase processes and providing statutory assistance, thereby enabling the five women SHGs to establish and operate sustainable small enterprises. This comprehensive support ensured that the women were well-prepared to manage all aspects of their businesses, from production to compliance, contributing to their long-term economic empowerment and success.

vi). Objectives Achieved: ***Generation of sources of finance and Development of marketing and distribution channels.***

The project successfully met its objectives of generating sources of finance and developing marketing and distribution channels for the five women Self-Help Groups (SHGs). The key achievements in these areas are as follows:

1. **Generation of Sources of Finance:** One of the primary achievements of the project was securing financial resources for the five women SHGs. The project facilitated access to various sources of finance, including government schemes, microfinance institutions, and local banks. The women were guided on how to apply for and secure low-interest loans, grants, and subsidies that were critical for starting and expanding their pen culture enterprises. This financial support provided the necessary capital for purchasing inputs, constructing fish pens, and covering operational costs.
2. **Building Financial Literacy and Management Skills:** Alongside generating finance, the project also focused on improving the financial literacy of the SHG members. Training sessions were conducted to help the women understand financial planning, budgeting, and cash flow management. This knowledge empowered them to manage their finances effectively, ensuring the sustainability and profitability of their enterprises. The women learned to maintain records, monitor expenses, and reinvest profits, which further strengthened their financial stability.
3. **Development of Marketing Channels:** The project played a crucial role in establishing robust marketing channels for the fish produced by the SHGs. By identifying local and regional markets, the project connected the SHGs with buyers and distributors who were interested in purchasing their produce. The women were trained in basic marketing techniques, including pricing strategies, quality control, and customer relationship

management. These skills enabled them to negotiate better prices and secure regular buyers for their fish, thereby maximizing their income.

4. **Creation of Distribution Networks:** In addition to marketing, the project facilitated the development of efficient distribution channels. This involved setting up networks for transporting fish from the production site to the markets. The project helped the SHGs establish relationships with local transport providers and wholesalers, ensuring that their produce could reach the market in a timely and cost-effective manner. The creation of these distribution networks was vital for maintaining the freshness and quality of the fish, which in turn, increased the demand and profitability of their products.
5. **Enhancing Market Reach and Sales:** With well-established marketing and distribution channels, the SHGs were able to expand their market reach beyond the immediate locality. The project introduced the women to regional markets and facilitated connections with larger buyers, including restaurants and retail outlets. This broader market access not only increased sales volume but also provided opportunities for the SHGs to scale their operations and explore new business avenues.
6. **Sustainable Economic Empowerment:** The combination of secured financing and developed marketing and distribution channels resulted in sustainable economic empowerment for the women SHGs. The reliable flow of income from sales, coupled with effective financial management, ensured that the SHGs could maintain and grow their enterprises over time. This empowerment contributed to the long-term financial independence and improved living standards of the women and their families.

The project successfully achieved its objectives of generating sources of finance and developing marketing and distribution channels for the five women SHGs. These achievements were instrumental in establishing financially viable and sustainable integrated aquaculture enterprises, thereby enhancing the economic empowerment and livelihoods of the women involved.

(8). Implementation Methodology:

The implementation of this system was achieved through the development of the following activities under innovative river pen fish culture and additional agri-based integrated aquaculture practices, including land-based farming on dykes of paddy fields, embankments, shorelines of rivers and open land. ***The proposed activities were implemented by developing:***

(I) Paddy cum fish system:

Types of paddy/rice field for preparation method of the rice plot usually vary according to the land contours and topography, under present study following types were adopted.

(a) **Perimeter type:** The paddy/rice growing area was placed at the middle with moderate elevation and ground sloping on all sides into perimeter trenches to facilitate easy drainage.

(b) **Central pond type:** Paddy/Rice growing area was on the fringe with slopes towards the middle.

(c) **Lateral trench type:** Trenches was prepared on one or both lateral sides of the moderately sloping rice filed.

The Paddy/rice fields and small village ponds constructed under the project served as fish (seed rearing) nurseries to grow **fries into fingerlings** (within 90-120 days) for further stock in River Pen Culture for obtaining high fish yields. It is only a co-activity of agricultural operation, in which the drained-out water from the paddy farming was prudentially utilized for fish farming. The introduction of the fish culture in paddy cultivation enhanced the labour absorption potentials of women, during post-harvesting and marketing.

Under the present activity major carps like Catla *(Catla catla)*, Rohu *(Labeo rohita)* and Mrigal *(Cirrhinus mrigala)* as well as Common carp *(Cryprinus carpio)*; Silver carp *(Hypopthalmithys molitrix)* and Grass carp *(Ctenopharyngodon idela)* or Murrel *(Channa marulius)* were grown in the paddy fields by developing periphyton using agriculture refuse like paddy straw (puaal), poultry waste and manuring with cow dung, cow urine etc. with designated quantity and quality. Paddy fields served as fish nurseries to grow fries into fingerlings. The fingerlings thus, produced in large quantities, were stocked in production ponds for obtaining better fish yield under composite fish culture. Thus, fingerlings were stocked in production ponds for obtaining high fish yields. The stocking density was of **six-species** combination in the following ratio:

- Catla and silver carp 30-35%
- Rohu and Mrigal 15-20%
- Common carp 45% and Grass carp 5-10%.

Periphyton as natural fish food: Periphyton is a low-input, low-cost technology that can be effectively disseminated for enhancing fish culture. It plays a significant role in improving fish production by serving as a natural food source and contributing to better water quality in aquaculture systems. Periphyton consists of groups of microorganisms that live on submerged surfaces. It is defined as total assemblage of sessile or attached organism on any substrate (Wetzel, 2000). It may contain algae, fungi, rotifers, annelids, insect larvae and crustaceans, all these or some of them. Traditional milk fish, fish culture in Indonesia and Philippines is based on exploitation of periphytic "lab-lab" as food, which has also been tested as food in source in fish culture. Fertilization and feeding are the two major management measures applied to increase production from paddy/rice-cum fish culture to enhance the phytoplankton-based food web to reduce the need for external production inputs and to improve nutrient efficiencies. Unfortunately, little attention was given to the periphyton based food web. If paddy fields algae are grown on substrates, more fish species will be able to feed upon time. Most truly herbivorous fish species feed on larger periphytic algae. Periphyton is the tiny organisms that live on the surface of objects under water. Periphyton based practices have developed independently and are used to fish culture. Bamboo poles, mats, stems, branches, jute sticks and remains of sugarcane stalks or bagasse, trees branches, paddy straws/stems (recycling of agriculture waste) are all used as substrates.

Under this project various stalks/substrates were inserted vertically into the paddy fields of trench bottom, where they were colonized by the plankton, microbes, invertebrates and other organisms that make up periphyton. Periphyton served as quality natural food and improved water quality nitrification process. Culture condition play an important role in growth, length-weight relationship and condition factor of commercially important fishes.

Fertilization was done for ponds at fortnightly interval (two weeks) with an application of *4500 kg/ha, decomposed cow dung manure and 100 kg/ha, triple super phosphate (TSP).* Inclusion of

poultry manure and manuring with cow dung, which is rich in nutrients, resulted in increase of natural food organisms-detritus and bacteria in the rice fields.

Benefits of Integrated Farming or rice cum fish culture system;

- Improved the soil fertility & soil **health**.
- Increased economic yield per unit area.
- Reduction in **production** costs.
- Decreased **farm** input requirements.
- Enhanced multiple income sources.
- Strengthened family income.
- Efficient utilization of family labour.
- Increased organic fertilization by fish excreta and remains of artificial feed.
- Helped in additional income and diversified harvest such as fish and rice from and onion, bean and sweet potato through cultivation on dykes/bunds.
- Periphyton decreased the demands of artificial feed.

(II) Innovative Pen Culture in Rivers as an Alternative to Land-Based Nurseries:

The pen fish culture system was introduced to the beneficiaries, utilizing river pen culture technology. The low-cost, environmentally friendly nature of this technique attracted significant interest from the target population.

(a). Liming: To maintain a hygienic environment and hasten the mineralization of organic matter, liming was carried out at a rate of 400-500 kg/ha pen area. The initial dose was 200-300 kg/ha, followed by monthly applications of 50-75 kg/ha.

(b). Fabrication and Installation of River Pen: Pen was fabricated using HDPE mono-filament webbing material, known for its durability and resistance to damage. The pens were installed at various locations in the Ajnal Dam, covering areas from 0.5 to 2.5 hectares. The mesh size of the pen nets was set at 10-15 mm. This approach utilizes innovative pen structures in rivers to rear fingerlings, offering an alternative to traditional land-based nurseries. It provides a cost-effective and space-efficient solution for fingerling culture. River pen fish culture is an economically viable technology for ***in-situ*** rearing of stocking material and the production of marketable-sized fish. The method involves rearing fish fingerlings to table size or marketable stage within pen enclosures. The technology includes the eradication of aquatic weeds, predatory fishes, insects, and other undesirable aquatic organisms. This pen culture was implemented in the natural environment of the Ajnal River, with minimal or no supplementary feeding.

Stocking and rearing fish fingerlings for a period of 6–8 months proved to be an effective strategy. The fingerlings produced in large quantities were subsequently stocked in production pens to achieve higher fish yields, either under composite fish culture systems or specifically for murrel *(Channa marulius)* cultivation. Thus, the use of river pen culture for stocking fingerlings

in production pens has demonstrated the potential for significantly enhanced fish yields.

The stocking density was of six-species combination in the following ratio:

- Catla and silver carp 30-35%
- Rohu and Mrigal 15-20%
- Common carp 45% and Grass carp 5-10%.

(III) Horticulture cum fish system:

Indian Major Carps (IMCs) such as Catla, Rohu and Mrigal, along with exotic carp species or Murrel, were cultivated in the designated areas of the Ajnal River using agricultural waste products like paddy straw, cattle dung, and urine. Simultaneously, the dykes of rice fields and river pen enclosures were utilized for cultivating horticultural crops such as banana, papaya, and vegetables including tomato, potato, brinjal, chili, cucumber, sponge gourd (Gilki/Turai), beans, and various fruits. The Horticulture-cum-Fish System is an eco-friendly, resource-efficient, and economically viable integrated farming approach. It is designed to optimize the use of land and water resources while producing multiple outputs such as fish, fruits, and vegetables. This system has been successfully implemented in regions like the Ajnal River basin, where natural water bodies are effectively used to support both aquaculture and horticulture simultaneously.

(IV) Live-stock cum fish system:

Villagers were trained in livestock farming, including the rearing of cattle, poultry, goats, and other animals. Poultry droppings, cow dung, urine, and other waste materials were utilized as resource inputs to promote the growth of periphyton in paddy fields and pen or ponds, which in turn supported fish production. This agriculture-based integrated system provided multiple outputs such as milk, meat, eggs, fruits, vegetables, flowers, paddy, and fish, thereby enhancing food security, resource efficiency and rural livelihoods.

(a) **Cattle-cum fish system:**
Raw cattle dung was used for fertilizing fish pen or ponds and humus from the ponds for growing cattle fodder. Among all live-stock excreta, cow excreta was the most abundant one in terms of availability. A unit of 5-6 cows was provided for adequate manure for 1 ha of pen or pond. In addition to 9,000 kg. of milk, about 3,000-4,000 kg fish /ha/year were harvested with this integration. Farmer got both milk and fish which increased revenue for his household security and reduces working expenditure.

(b) **Poultry-cum fish system:**
A simple and economically viable system of fish-cum-poultry farming was developed by utilizing poultry droppings of fully built-up poultry litter recycled into fish pen or ponds with fish production levels. This system utilized poultry droppings of fully built-of poultry-litter for fish culture. Production levels of 2000-3,000 kg/fish/ha was obtained by recycling pen or pond manure into fish pen culture.

(c) **Goat-cum fish system:**
Goat is considered as poor man's cow and its farming is an age-old practice for meat, milk and manure. In the Goat-cum-Fish System, the primary aim is to recycle goat manure as a nutrient-rich organic input for fish ponds, promoting plankton production which forms the base of the fish food chain. This integrated model offers a sustainable, low-input, and eco-friendly farming solution for rural farmers. There are 13 well-known breeds of goat apart from local nondescripts, distributed in Himalayan region (Chamba, Gaddi, Kashmiri, Pashmia, Chegu), Northern region (Jamunapari, Beetal, Beebari), Central region (Marwari, Zelwadi, Berari, Kathiawari, Sirohi, Jhakrana), Southern region (Surti, Deccani, Osmanabadi, Malabari) and Eastern region (Bengal, Gangam Assam hilly breed). These breeds can be further categorized on the bases of fiber, meat, and milk.

(V) Wheat Crop Cultivation:

This technique involves the efficient recycling of agricultural waste and byproducts, ensuring that resources from one farming system are effectively utilized in another. By integrating wheat cultivation with pen cum-fish farming, available farming space is optimized, leading to increased productivity and sustainability.

Natural Food Sources (Periphyton and *Azolla):*

Periphyton was introduced as a low-input, cost-effective technology to enhance fish growth. Bamboo poles, mats, and other organic materials were submerged in the pens to promote periphyton growth, providing a natural food source for the fish.

Azolla cultivation was also integrated into the project. This fast-growing aquatic fern was used as a supplementary natural feed, significantly reducing the need for artificial feed.

Fish Feeding:

Supplementary fish feeding was carried out with commercial floated pellets at a rate of 5% of the fish's average body weight, adjusted bi-weekly to 2.5% towards the end of the culture period. The Feed Conversion Ratio (FCR) ranged from 1.3 to 1.8.

Culture of periphyton as natural fish food:

Periphyton is a low-input, low-cost technology that plays an important role in enhancing fish culture. Periphyton is comprised of groups of microorganisms living on submerged substrates. It is defined as total assemblage of sessile or attached organism on any substrate (Wetzel, 2000). It may contain algae, fungi, rotifers, annelids, insect larvae and crustaceans, all these or some of them. Traditional milk fish, fish culture in Indonesia and Philippines is based on exploitation of periphytic “lab-lab” as food, which has also been tested as food in source in fish culture. Fertilization and feeding are the two major management measures applied to increase production from pen fish culture to enhance the phytoplankton-based food web to reduce the need for external production inputs and to improve nutrient efficiencies. Unfortunately, little attention was given to the periphyton based food web. If pen fields algae are grown on substrates, more fish

species will be able to feed upon time. Most truly herbivorous fish species feed on larger periphytic algae. Periphyton is the tiny organisms that live on the surface of objects under water. Periphyton based practices have developed independently and are used to fish culture. Bamboo poles, mats, stems, branches, jute sticks and remains of sugarcane stalks or bagasse, trees branches, paddy straws/stems (recycling of agriculture waste) are all used as substrates.

Under this project various stalks/substrates were inserted vertically into the river pen fields of trench bottom, where they were colonized by the plankton, microbes, invertebrates and other organisms that make up periphyton. Periphyton served as quality natural food and improved water quality nitrification process. Culture condition play an important role in growth, length-weight relationship and condition factor of commercially important fishes.

Fertilization was done for ponds at fortnightly interval (two weeks) with an application of 4500 kg/ha, decomposed cow dung manure with 100 kg/ha and 100 kg/ha, triple super phosphate (TSP). Inclusion of poultry manure and manuring with cow dung, which is rich in nutrients, resulted in increase of natural food organisms-detritus and bacteria in the river pen fields.

Benefits of Integrated pen fish culture system;

- Improved the soil fertility & soil health.
- Increased economic yield per unit area.
- Reduction in production costs.
- Decreased farm input requirements.
- Enhanced multiple income sources.
- Strengthened family income.
- Efficient utilization of family labour.
- Increased organic fertilization by fish excreta and remains of artificial feed.
- Helped in additional income and diversified harvest such as fish and onion, bean and sweet potato through cultivation on dykes/bunds.
- Periphyton decreased the demands of artificial feed.

Culture of Duckweeds or *Azolla* in Aquaculture:

Duckweeds and *Azolla* (a genus of aquatic ferns) are excellent examples of low-input, low-cost technologies that play an increasingly important role in sustainable aquaculture practices. These fast-growing, floating aquatic plants offer numerous benefits, particularly in enhancing fish culture systems. Their ability to grow rapidly, coupled with their high protein content and minimal cultivation requirements, makes them valuable biological resources for fish farmers, especially in rural and small-scale operations.

a) Nutritional Value and Role in Fish Diet:

Duckweeds and *Azolla* are rich in protein, essential amino acids, vitamins, and minerals. Depending on the species and growing conditions, they can contain between 20–40% protein on a dry weight basis. This high nutritional value makes them an excellent supplementary feed for various herbivorous and omnivorous fish species such as tilapia, carp, and catfish. Unlike

commercial fish feed, which can be expensive and environmentally taxing to produce, these aquatic plants offer a natural, cost-effective alternative. Their rapid reproduction also ensures a continuous and reliable feed source. Under favorable conditions, duckweeds can double their biomass in as little as 24 to 48 hours, while Azolla can do so within 3 to 10 days. This makes them highly efficient in providing a consistent supply of fresh feed, thereby reducing dependency on external feed inputs and lowering overall production costs.

b) Environmental Benefits:

Beyond their nutritional contributions, duckweeds and Azolla also play a vital role in improving pond ecology. They act as natural biofilters, absorbing excess nutrients such as nitrogen and phosphorus from fish waste and uneaten feed. This nutrient uptake helps to prevent eutrophication and the associated risk of algal blooms, which can deplete oxygen levels and harm aquatic life. Additionally, by covering the water surface, these plants help regulate water temperature and reduce evaporation, which is particularly beneficial in arid and semi-arid regions. Their presence can also inhibit the growth of unwanted algae by limiting sunlight penetration into the water.

c) Cultivation and Management:

The cultivation of duckweeds and *Azolla* is relatively simple and requires minimal infrastructure. They can be grown in small ponds, tanks, or even on the surface of existing fish ponds, provided that conditions such as water temperature, pH, and nutrient availability are maintained within suitable ranges. These plants thrive in nutrient-rich water, which makes them particularly compatible with integrated aquaculture systems where fish waste serves as a fertilizer. To maximize their benefits, regular harvesting is essential to prevent overcrowding and to ensure continuous growth. Harvested biomass can be fed directly to fish or sun-dried and mixed with other feed ingredients to produce formulated fish feed.

d) Suitability for Rural Aquaculture:

Due to their low-cost and ease of cultivation, duckweeds and *Azolla* are especially well-suited to smallholder and rural aquaculture projects. They require little to no chemical inputs, making them environmentally friendly and accessible to farmers with limited financial resources. By incorporating these plants into their fish farming practices, small-scale farmers can enhance fish growth rates, improve pond water quality, and reduce operational costs. Integrating duckweeds and Azolla into aquaculture systems offers a practical and sustainable approach to enhancing fish culture. These aquatic plants not only provide a nutritious and low-cost feed source but also contribute significantly to maintaining a balanced pond ecosystem. Their adoption can lead to higher fish yields, reduced environmental impact, and improved profitability for fish farmers, particularly in resource-limited settings. As such, the culture of duckweeds and Azolla represents a promising strategy for promoting environmentally responsible and economically viable aquaculture.

Integration of aquaculture (Additional Agricultural and Aquaculture Enhancement):

Integrated fish farming is a well-established agricultural system that creates a sequential linkage between two or more farming activities to optimize crop production. It is a key component of sustainable agriculture, where fish serve as a primary commodity for improving livelihoods and combating malnutrition. Enhancing fish production through integrated aquaculture utilizing *azolla* and periphyton as natural food sources alongside livestock and crop farming significantly improves resource efficiency. This technique involves recycling agricultural waste and byproducts from one farming system as inputs for another, ensuring the efficient use of available farming space for maximum productivity.

Science & technology component (Technology package development/New innovations):

The use of periphyton represents a low-cost, low-input and innovative technology that plays a significant role in enhancing fish culture. Periphyton serves as a natural food source, reducing the dependency on artificial feeds, which are often expensive and resource-intensive. Integrated aquaculture systems range from extensive to intensive practices, depending on the level of resource utilization, input application, and management intensity. In a country like India, where government efforts are focused on increasing fish production to meet domestic demand and support sustainable livelihoods, adopting innovative and eco-friendly approaches is essential. Under this project, a novel method has been introduced to harness naturally available resources and agricultural refuse for the cultivation of periphyton. This approach supports the growth and development of fish fry into fingerlings in paddy-cum-fish culture, and the rearing of fingerlings to table-sized or marketable fish in river pen culture practices, primarily by enhancing their access to natural food sources. The method requires minimal input investment, making it accessible and cost-effective for small-scale farmers.

Initially, periphyton cultivation was implemented in rivers, reservoirs, and fish ponds using agricultural waste materials. Fingerlings were sourced from nearby authorized fish farms and reared to table-size fish under this integrated system. This strategy not only promotes resource efficiency but also contributes to sustainable aquaculture development.

(9). Training and Capacity Building:

Comprehensive training and capacity-building sessions were conducted to ensure the successful implementation of pen culture practices among the beneficiaries. These sessions focused on essential aspects such as pen fabrication, installation, fish stocking, feeding and harvesting techniques. The primary goal was to equip women beneficiaries with the knowledge and practical skills required to manage pen fish culture efficiently and sustainably.

Training Methodology and Implementation:

1. **Pen Fish Culture System Introduction:**
   Beneficiaries were introduced to the concept of river-based pen fish culture, emphasizing its low-cost, eco-friendly nature and high productivity potential.
2. **Liming Practices:**
   Liming was taught as a critical method for maintaining water quality, using 400–500 kg/ha of lime, with 200–300 kg/ha as an initial dose and 50–75 kg/ha monthly thereafter.
3. **Fabrication and Installation:**
   Training included hands-on demonstrations on building and setting up pens using durable

HDPE mono-filament nets, with a mesh size of 10-15 mm. Pens were installed across 0.5 to 2.5 ha, with stocking densities ranging from 20,000 to 40,000 fingerlings/ha.

4. **Species Stocking Composition:**
   Participants were trained on optimal fish species mix:
   - Catla and Silver Carp: 30–35%
   - Rohu and Mrigal: 15–20%
   - Common Carp: 45%
   - Grass Carp: 5–10%
5. **Natural Feed Integration – Periphyton and *Azolla:***
   Beneficiaries learned to use bamboo, jute sticks, and other organic substrates to cultivate periphyton and were trained to grow Azolla as a natural, cost-effective supplementary feed.
6. **Feeding Management:**
   Commercial floating pellets were used initially at 5% of the fish's body weight, reduced to 2.5% in the later stages. Feed Conversion Ratio (FCR) ranged from 1.3 to 1.8.
7. **Fertilization Techniques:**
   Participants applied decomposed cow dung (4500 kg/ha), urea (100 kg/ha), and triple super phosphate (100 kg/ha) biweekly. Poultry manure was also introduced to boost natural food availability.
8. **Integrated Farming Systems:**
   SHGs were trained in integrated systems such as:
   - Horticulture-cum-fish farming (vegetables and fruits on dyke bunds)
   - Cattle-cum-fish, Poultry-cum-fish, and Goat-cum-fish systems for better nutrient cycling and additional income sources.
9. **Training:**
   The Society for Environmental Conservation (SEC) conducted a training program as part of this project, with each of the women Self-Help Groups receiving ten days (10 days) of training on Ajnal River pen fish culture. The training sessions covered all aspects of the river pen fish culture system.
10. **Entrepreneurship and Skill Development:**
    Special sessions emphasized business planning, cooperative management, and marketing strategies to empower SHG women as rural entrepreneurs.
11. **Refresher Training:**
    Two-day refresher trainings were held for each SHG to reinforce concepts and provide post-implementation support. The schedule included:

- **Sankal SHG-I:** 16–17 March 2024
- **Sankal SHG-II:** 18–19 March 2024
- **Tanda SHG-III:** 12–13 January 2024
- **Tanda SHG-V:** 14–15 January 2024
- **Bilkhiriya SHG-IV:** 20–21 March 2024

Through these structured training interventions, the women of Sankal, Tanda, and Bilkhiriya acquired the skills necessary for effective fish culture, ensuring the long-term success and sustainability of the project.

Harvesting:
Harvesting was conducted after 6-8 months of culture. Murrel (800-850 gm), Indian Major Carps (700-800 gm) and exotic carps (800-850 gm) were partially harvested using gill nets, drag nets, cast nets, and scoop nets. The fish stock was replenished after each harvest, allowing for continuous culture and harvests per year.

Outcomes and Impact:

The project successfully achieved its objectives:

The Pen Fish Culture Project implemented at the Ajnal River (Dam) has proven to be a highly effective model of sustainable aquaculture. By integrating innovative techniques with strong community participation and environmentally friendly practices, the project not only met but also exceeded its original objectives. Below is a comprehensive overview of the outcomes and long-term impacts observed during and after the implementation of the project:

1. Increased Fish Production:
One of the most remarkable achievements of the project was the significant increase in fish production using the pen culture system. This method involved enclosing specific portions of the Ajnal river using netted pens for controlled fish farming. Key contributing factors included:

- **Utilization of natural feed sources** such as periphyton (attached algae and microorganisms) and azolla (aquatic fern), which provided essential nutrients for fish growth.
- **Optimal water utilization** through rainwater harvesting and natural flow systems.
- **Stocking of Indian Major Carps (IMC)** such as catla, rohu, and mrigal, along with selected exotic carps which are well-suited to the region's ecological conditions.
- **Steady and predictable yields** of high-quality, marketable fish, leading to an increase in availability and local consumption of fresh fish.

In addition to fish, the dykes and surrounding lands were efficiently used to cultivate a variety of horticultural crops and vegetables such as banana, papaya, tomato, brinjal, chili, cucumber, and sponge gourd. This multi-use approach further added to overall food production and increased nutritional security in the community.

2. Cost-Effective and Sustainable Aquaculture:
The project embraced cost-effective methods that relied on locally available, low-cost resources, significantly lowering the input costs for farmers. Several sustainability features included:

- **Reduced dependency on artificial feed**: By encouraging the natural growth of periphyton and integrating azolla, fish were able to feed on naturally occurring nutrition within the pens. This not only reduced feed costs but also helped maintain water quality.
- **No use of antibiotics or chemical fertilizers**: Ensuring the fish were safe for consumption and the surrounding ecosystem remained unharmed.
- **No water exchange system**: Eliminated the need for mechanical pumps, lowering energy usage and further reducing operational costs.
- **Organic fertilization** using cattle dung, poultry manure and plant waste ensured that

waste materials were effectively recycled back into the system.

This self-reliant model of fish culture demonstrated how aquaculture can be both economically viable and environmentally sustainable.

3. Community Engagement and Sustainable Livelihoods:
One of the core pillars of the project was community participation, particularly the involvement of Self-Help Groups (SHGs) and local fish farmers. The project's impact on community development was profound:

- **Employment Generation**: Local villagers, especially women, gained employment through various stages of the fish farming cycle pen construction, stocking, feeding, monitoring, harvesting, and selling.
- **Entrepreneurship Development**: Through targeted training programs, participants were taught skills in fish farming, resource management, record keeping, and marketing strategies, empowering them to operate independently.
- **Skill Enhancement**: The training extended beyond fish culture to include crop cultivation, livestock integration, and composting, encouraging a holistic approach to rural livelihood.
- **Women Empowerment**: Women-led SHGs played a vital role in maintaining pen culture operations, showcasing their capability in managing technical and business aspects effectively.

As a result, families who were once dependent on seasonal or migratory labor were now equipped with year-round income opportunities, significantly improving their standard of living.

4. A Model for Replication:
The Ajnal River Pen Culture Project stands out as a replicable model of sustainable aquaculture. Its success is rooted in its:

- Low cost of implementation
- Eco-friendly practices
- Use of renewable natural resources
- Community-centric approach

The model's adaptability makes it suitable for implementation in other regions with similar ecological and socio-economic conditions. It provides a template for rural development, women empowerment, and natural resource utilization.

5. Long-Term Sustainability and Recommendations:
The project's continuous cycle of stocking, rearing, and harvesting has ensured long-term sustainability through:

- Regular involvement of trained local beneficiaries
- Continued use of local organic resources

- Support from local governance and development agencies

To further promote sustainable fish culture across the region and the country, it is strongly recommended that:

- Similar pen culture projects be introduced in other potential water bodies.
- Additional training programs be developed to upskill more rural youth and women.
- Linkages to markets and financial institutions be strengthened to ensure scalability and growth.

The Pen Fish Culture Project at Ajnal River (Dam) has clearly demonstrated the potential of low-cost, environmentally friendly, and community-driven aquaculture in boosting rural livelihoods. With significant outcomes in terms of increased production, reduced costs, and socio-economic upliftment, this project serves as an inspiring example for replication and upscaling across other parts of India. By placing the power of aquaculture into the hands of the local community especially women it has successfully turned a simple resource into a source of food, income and empowerment.

(10). Comprehensive Training, Refresher Training, Exposure Visits Programme and Demonstration of Eco-Friendly Ajnal River Pen Culture Technology:

The project placed a strong emphasis on comprehensive training, refresher sessions, and practical demonstrations to ensure the successful implementation of eco-friendly Ajnal River Pen Culture Technology among five women Self-Help Groups (SHGs), each comprising 30 beneficiaries. The key components and outcomes of these training initiatives are detailed below:

(i). Comprehensive Training (Ten Days for Each Women's Self-Help Group)

Objective:
To equip women SHGs with the knowledge and skills needed to implement and manage pen culture technology in the Ajnal River.

Training Overview:

The training program spanned 10 days for each SHG, focusing on practical and theoretical aspects of pen culture technology. The sessions were designed to ensure participants gained hands-on experience and a thorough understanding of sustainable practices.

1. **Introduction to Pen Culture Technology (Day 1):**
    - Overview of pen culture, its benefits, and ecological importance.
    - Introduction to Ajnal River and its suitability for pen culture.
    - Preparation of the pen field and lime treatment for conditioning.
2. **Fish Species Selection (Day 2):**
    - Identification of suitable fish species for Ajnal River.
    - Criteria for selecting fish species for optimal results.
3. **Pen Construction and Setup (Day 3):**
    - Practical instructions on designing, constructing, and installing fish pens.
    - Infrastructure setup and stocking fish fingerlings.

- Best practices for fish feeding and pen management.

4. **Water Quality Management (Day 4):**
   - Understanding key water quality parameters.
   - Techniques for monitoring and maintaining water quality.
5. **Fish Health and Nutrition (Day 5):**
   - Disease prevention and biosecurity measures.
   - Ensuring optimal nutrition for fish growth.
6. **Pen Maintenance and Troubleshooting (Day 6):**
   - Routine maintenance of pens.
   - Addressing common issues in pen culture.
7. **Sustainable Practices and Environmental Impact (Day 7):**
   - Eco-friendly approaches to minimize environmental impact.
   - Adhering to environmental and safety regulations.
8. **Marketing and Entrepreneurship Skills (Day 8):**
   - Understanding market dynamics and demand for fish products.
   - Developing entrepreneurship skills and market linkages.
9. **Financial Literacy and Record-Keeping (Day 9):**
   - Practical budgeting for pen culture activities.
   - Importance of maintaining accurate financial records.
10. **Practical Hands-On Sessions (Day 10):**
    - On-site practical training, applying theoretical knowledge.
    - Demonstration and active participation in pen culture operations.

Hands-On Training:

The field demonstrations and training activities will be highly practical, allowing participants to perform various operations related to pen fish culture crop production. Experts from relevant fields will be invited to provide training on different aspects of the process.

To equip the beneficiaries with the necessary skills and knowledge, the project facilitated 50 days comprehensive training sessions across the five women SHGs. These sessions covered all aspects of setting up and managing pen culture systems. The training also emphasized sustainable practices, such as organic farming techniques and resource efficiency, ensuring that the participants could implement environmentally friendly and cost-effective systems.

Each training session was tailored to meet the specific needs and skill levels of the participants, providing both theoretical knowledge and practical, hands-on experience. Demonstration units were established in each women Self-Help Groups, serving as live examples where participants could observe and practice the operation of pen culture systems. This experiential learning approach helped demystify the technology and allowed beneficiaries to confidently engage with the systems. The training sessions were tailored to meet the specific needs of the participants, combining both theoretical instruction and practical experience. Demonstration units were established in each SHG, allowing participants to practice and observe pen culture operations firsthand. This approach ensured that the women could confidently implement and manage pen culture systems, promoting sustainable practices and resource efficiency.

Training sessions:

The *Society for Environmental Conservation (SEC)* conducted a training program as part of this project, with each of the women Self-Help Groups receiving ten days (10 days) of training on Ajnal River pen fish culture. The training sessions covered all aspects of the river pen fish culture system, as detailed below**:**

The schedule included

Sl. No.	Date of training Start	Date of training Completed (Ten days)	Place of training at Sankal village & SHGs name	Number of Training/day
1.	10/07/2023	19/07/2023 (10 days)	Sankal (SHGs-I)	**10** (days)
2.	29/07/2023	07/08/2023 (10 days)	Sankal (SHGs-II)	**10** (days)
3.	16/08/2023	25/08/2023 (10 days)	Tanda (SHGs-III)	**10** (days)
4.	26/08/2023	04/09/2023 (10 days)	Bilkhiriya (SHGs-IV)	**10** (days)
5.	06/09/2023	15/09/2023 (10 days)	Tanda (SHGs-V)	**10** (days)
		50, days training	**Tota**l	**Trainings completed.**

This training programme was successfully conducted by SEC, Bhopal, for five Self-Help Groups (SHGs) from the villages of Narohna Sankal, Tanda (Sankal), and Bilkhiriya. The structured approach and practical sessions ensured that participants acquired comprehensive knowledge and skills, empowering them to adopt pen culture practices as a sustainable livelihood option.

Outcome of the Program:

i). Successful Implementation: By the end of the program, the trained women SHG entrepreneurs were fully equipped with the knowledge and practical skills needed to independently manage integrated river pen fish farming operations. They were able to:

- Successfully cultivate fishes, vegetables and fruits in an environmentally sustainable manner.
- Use organic fertilizers and monsoon water to maintain their ponds and promote fish growth.
- Market and sell fish effectively, ensuring a steady income stream for themselves and their families.

ii). Enhanced Livelihoods and Economic Empowerment: The economic empowerment of the women entrepreneurs was one of the most significant outcomes of the program. By creating self-sustaining businesses, women were able to generate income not only for themselves but also for their families and communities. Additionally, the program helped to reduce reliance on external income sources, providing a more stable and sustainable means of livelihood.

iii). Community Development: The project also had a positive impact on the wider community, as it contributed to local food security and economic development. As the women successfully implemented and managed their river pen fish culture businesses, they also acted as role models for other women in their communities, inspiring them to engage in similar entrepreneurial ventures.

Paddy cum-fish culture (Fish fry into fingerlings):

Murrel River pen fish culture:

Ajnal River Pen Fish Culture Awareness and Workshop Programme at Sankal Village.

Ajnal River Pen Culture Awareness and Workshop Programme at Sankal Village:

Ajnal River Pen Culture Unit Fabrication and Installation at Sankal village.

Ajnal river pen field preparation at Narohna Sankal village.

Ajnal river pen field preparation at Narohna Sankal village.

Training program of Ajnal river pen culture unit fish seed stocking at Sankal village.

Fish fingerling stocking for the Ajnal River pen culture unit at Narohna Sankal village.

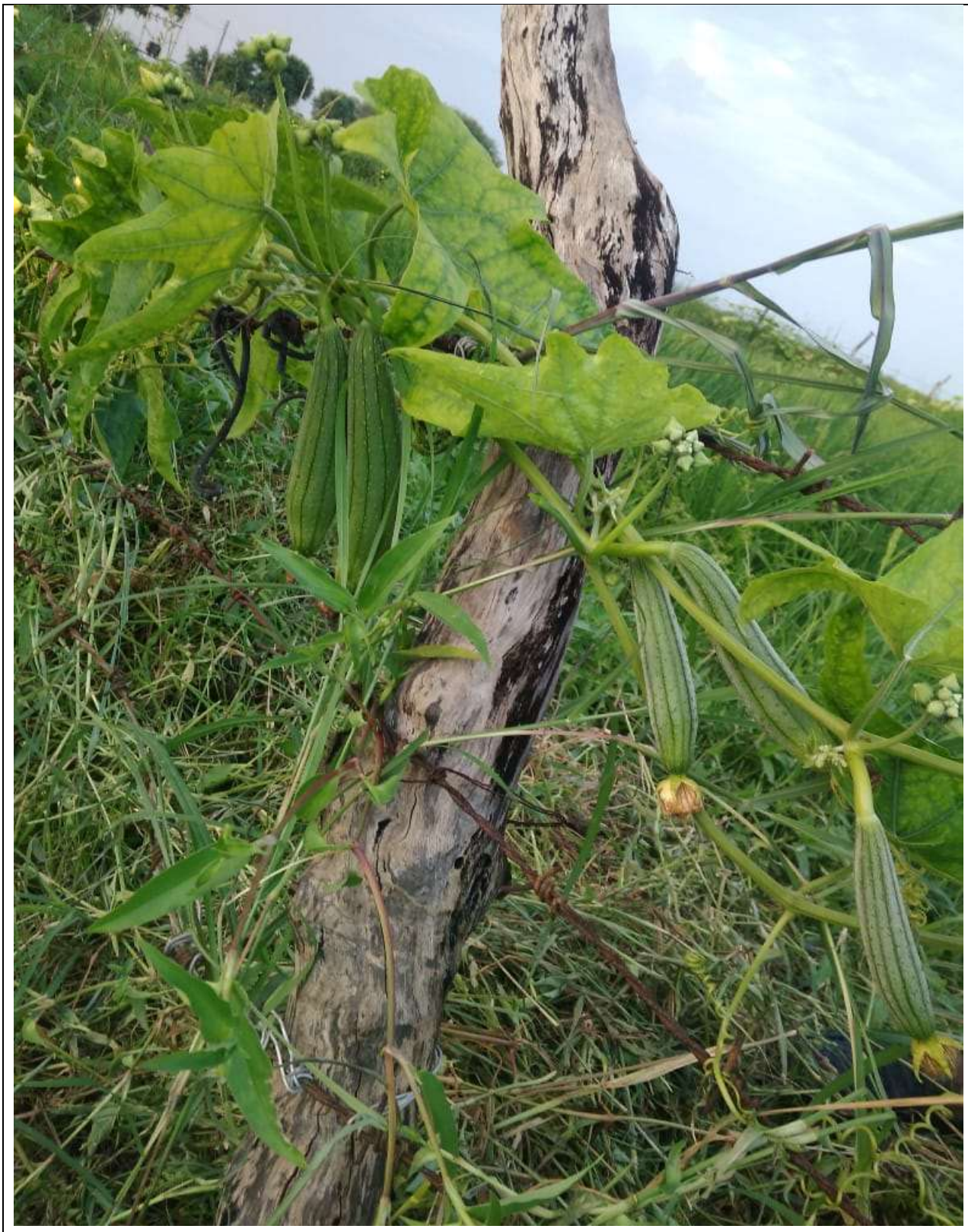
Training program of Ajnal river pen culture unit fish seed stocking at Sankal village.

Training program of Ajnal river pen culture unit fish seed stocking at Sankal village.

Ajnal river pen culture unit fish feeding at Narohna Sankal village:

Ajnal river pen culture unit fish crop cultivation at Narohna Sankal village.

Horticulture cum fish culture.



Horticulture cum fish culture.

Horticulture cum fish culture.

Paddy crop transplantation.

Paddy crop transplantation.

Fish crop cultivation: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Sale of fresh fish crop:

(ii). Refresher Training (Two Days for Each Women's Self-Help Group)

To reinforce the knowledge gained during the comprehensive training and address any challenges faced by the SHGs in the initial stages of implementing pen culture technology. The Society for Environmental Conservation (SEC) conducted a two-day refresher training program for each of the women Self-Help Groups as part of this project. The training focused on Ajnal River pen fish culture and covered all aspects of the river pen fish culture system, as detailed below:

S. N.	Date of training Start	Date of training Completed (10, days)	Place of training at Sankal village & SHGs name	Number of Training/days
1	12/01/2024	13/01/2024 (2 days)	Tanda (SHGs-III)	**2** (days)
2	14/01/2024	15/01/2024 (2 days)	Tanda (SHGs-V)	**2** (days)
3	16/03/2024	17/03/2024 (2 days)	Sankal (SHGs-I)	**2** (days)
4	18/03/2024	19/03/2024 (2 days)	Sankal (SHGs-II)	**2** (days)
5	20/03/2024	21/03/2024 (2 days)	Bilkhiriya (SHGs-IV)	**2** (days)
		10, days refresher training.	**Total**	**Trainings completed.**

Content:

- **Review of Key Concepts:** The refresher training sessions provided a review of the key concepts covered during the initial training. This included revisiting critical aspects such as pen construction, fish stocking, and water quality management to ensure that participants had a solid understanding of the processes.
- **Troubleshooting and Problem-Solving:** The refresher training offered a platform for the SHGs to discuss challenges encountered during the initial implementation. Trainers provided guidance on troubleshooting common issues such as fish mortality, disease management, and maintaining optimal pen conditions.
- **Advanced Techniques:** The sessions also introduced advanced techniques and best practices for enhancing productivity and sustainability, including methods for optimizing feed efficiency, improving fish growth rates, and enhancing overall management of the pen culture system.

Outcome:

The refresher training boosted the women's confidence in their skills. It equipped them with practical tools to address challenges effectively. SHGs became better prepared to sustain integrated pen fish culture. Training introduced advanced techniques for improved productivity. Best practices for sustainable fish farming were emphasized. Participants learned methods to optimize feed and growth rates. Overall pen culture management practices were significantly enhanced.

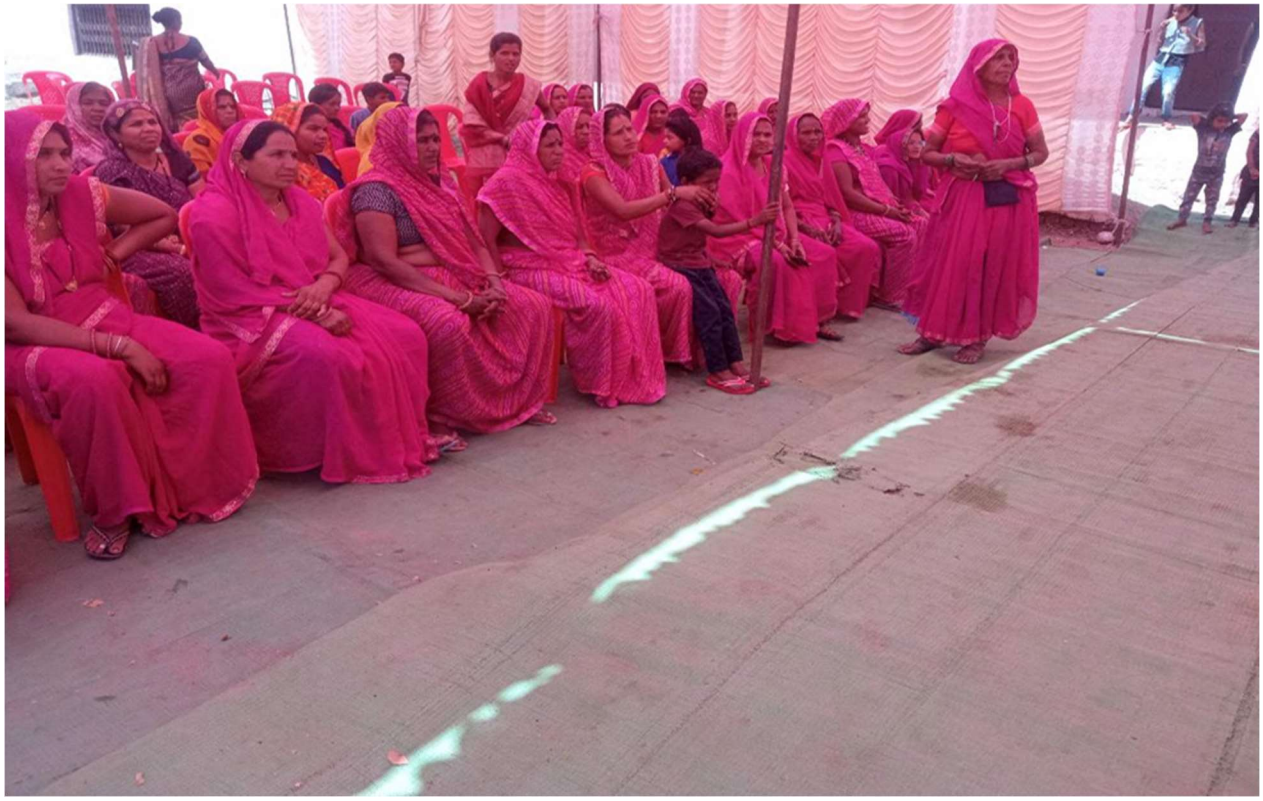
Refresher training for Women Self-Help Groups-at Sankal & Tanda Village.

Refresher training for Women Self-Help Groups- at Narohna Sankal & Tanda Village.

Refresher training for Women Self-Help Groups- at Sankal, Bilkhiriya & Tanda Village.

Refresher training for Women Self-Help Groups- at Sankal, Bilkhiriya & Tanda Village.

Refresher training for Women Self-Help Groups- at Sankal, Bilkhiriya & Tanda Village.



PMIC meeting was held on 06/06/2025 with NABARD DDM Bhopal to discuss Women SHGs.

PMIC meeting was held on 06/06/2025 with NABARD DDM Bhopal to discuss Women SHGs.

PMIC meeting was held on 06/06/2025 with PNB, Branch Manager Bilkhiriya Bhopal to discuss Women SHGs.

(iii). Demonstration of Eco-Friendly Ajnal River Pen Culture Technology

Objective: To provide hands-on experience and practical demonstrations of eco-friendly pen culture technology in the Ajnal River, enabling the SHGs to observe and apply the techniques in real-world settings.

Demonstration Activities:

- **On-Site Pen Construction:** Live demonstrations of pen construction were conducted in the Ajnal River, allowing SHG members to participate in the setup process. This hands-on experience ensured that the women could replicate the construction independently at their own sites.
- **Fish Stocking and Feeding:** The demonstrations included the actual process of fish stocking, where the SHGs learned how to introduce fish into the pens and manage their feeding schedules using natural and sustainable food sources.
- **Water Quality Monitoring:** Participants were shown how to use basic tools and techniques to monitor water quality in the pens. Demonstrations highlighted the importance of regular checks and adjustments to maintain a healthy environment for the fish.

Outcome: The practical demonstrations were instrumental in bridging the gap between theoretical knowledge and real-world application. The SHGs gained confidence in their ability to manage integrated pen fish culture systems effectively and sustainably, leading to improved outcomes in their aquaculture practices.

Through a combination of comprehensive training, refresher sessions, and practical demonstrations, the project successfully equipped five women SHGs in Phanda Block with the skills and knowledge necessary to implement eco-friendly pen culture technology in the Ajnal River. These initiatives not only empowered the women economically but also promoted sustainable aquaculture practices that contribute to the long-term health of the local environment and community.

(iv). Exposure Visits Programme for Women Self-Help Groups of Sankal, Tanda and Bilkhiriya Villages.

Exposure Visit Dates: Three visits conducted on **22/03/2024, 24/03/2024, and 26/03/2024.**

1. Exposure Visits Programme Details

2. Destination of Exposure Visits

Location: Dumel in Obedullaganj Block of Raisen District, Madhya Pradesh.

Reason for Selection: Dumel, located along the Betwa River, is home to well-established and successful river pen culture projects renowned for their innovative and sustainable pen aquaculture practices. The exposure visits were designed to provide participants with practical

insights and hands-on experience. The key components of the visit included:

- **Society for Environmental Conservation (SEC):** Known for its extensive training programs and research in aquaculture, particularly in pen culture.
- **Local Fish Farms:** Offering participants hands-on learning experiences in operational pen culture setups.
- **Community Initiatives:** Facilitating interactions with local women-led pen aquaculture projects to understand the socio-economic benefits and challenges of pen culture.

3. Learning Objectives and Methods

How They Learned:

a) Direct Observation and Interaction

- **Farm Tours:** Participants toured successful pen culture farms, observing infrastructure, cultured fish species, and day-to-day management practices.
- **Demonstrations:** Practical demonstrations covered pen construction, maintenance, feeding practices, and harvesting techniques.
- **Interactive Sessions:** Q&A sessions with experienced aquaculture practitioners and farm managers provided deeper insights into practical aspects.

b) Workshops and Seminars

- **Technical Workshops:** Conducted by SEC experts, covering advanced topics in pen culture, disease management, water quality control, and sustainable practices.
- **Marketing and Financial Management:** Sessions focused on effective marketing strategies, customer relations, financial management, and record-keeping.

c) Peer Learning and Networking

- **Group Discussions:** Participants engaged in discussions with local women involved in pen culture, sharing experiences, challenges, and solutions.
- **Networking Opportunities:** The visits provided opportunities to build relationships with other practitioners and experts, fostering a support network for ongoing learning and collaboration.

4. Impact of the Exposure Visits

a) Enhanced Knowledge and Skills

- **Technical Proficiency:** Participants gained a deeper understanding of advanced pen culture techniques, improving their ability to manage and sustain their own projects.
- **Problem-Solving Skills:** Exposure to practical solutions and innovative practices equipped participants to handle common challenges in aquaculture more effectively.

b) Improved Practices and Productivity

- **Implementation of Best Practices:** Learning from successful models enabled participants to adopt best practices in their own operations, leading to higher productivity and sustainability.
- **Innovation Adoption:** Exposure to new technologies and methods encouraged innovation, enhancing the overall efficiency of the pen culture initiatives in Phanda Block.

c) Economic and Social Empowerment

- **Increased Income:** By improving the productivity and efficiency of their pen culture practices, women can achieve higher yields and better market prices, leading to increased income.
- **Community Development:** Empowered women can become role models and leaders in their communities, driving broader socio-economic development and encouraging more women to participate in similar initiatives.

d) Strengthened Networks and Support Systems

- **Collaboration Opportunities:** Building networks with other practitioners and experts provided ongoing support, knowledge sharing, and potential collaboration opportunities.
- **Continued Learning:** Establishing connections with training institutes like SEC ensures access to continuous education and resources.

The three exposure visits to Dumel in Obedullaganj Block of Raisen District, Madhya Pradesh, provided a valuable opportunity for women from Phanda Block to learn from successful pen culture projects. Through direct observation, hands-on learning, and interaction with experts and peers, participants gained the knowledge and skills needed to enhance their own practices. The impact of these visits will be seen in improved productivity, increased income, and greater socio-economic empowerment, contributing to the overall success of the livelihood generation initiative in Bhopal District.

Self-Sustainability of the Project:

The River Pen Culture Project was developed with a clear focus on long-term sustainability both economic and ecological. A primary objective was to ensure that the participating women-led Self-Help Groups (SHGs) would be able to continue aquaculture practices independently beyond the project's completion.

Several strategic components contributed to the project's self-sustainability:

1. Capacity Building and Skill Development:

- Comprehensive hands-on training and refresher sessions equipped SHG members with the technical knowledge and practical skills necessary to independently manage pen

culture operations. Key training areas included pen construction, fish seed stocking, feeding methods, disease control, water quality monitoring, and harvesting practices.

2. Utilization of Low-Cost, Locally Available Inputs:

- The project promoted the use of natural feed resources such as periphyton and azolla, significantly reducing operational costs and reliance on commercial fish feed. Agricultural refuse and other locally available materials were used for pen construction, enhancing cost-effectiveness and sustainability.

3. Institutional Strengthening of SHGs:

- The project placed strong emphasis on the organizational development of SHGs, encouraging collective decision-making, financial planning, and enterprise management. Regular group meetings and exposure visits boosted confidence, facilitated peer learning, and fostered long-term group cohesion and motivation.

4. Eco-Friendly and Resource-Efficient Practices:

- By promoting organic inputs, avoiding chemical use and antibiotics and adopting zero water exchange practices, the project ensured environmental sustainability. These eco-friendly methods also enhanced consumer confidence in the quality of the fish produced.

5. Market Linkages and Value Chain Integration:

- The project facilitated direct linkages between SHGs and local markets, enabling participants to better understand market dynamics, including the high demand in the Bhopal fish market, pricing strategies and opportunities for value addition. Training in marketing and sales empowered the women to generate income and reinvest in their aquaculture enterprises.

6. Value-Added Fish Products Training Programme:

A two-day training programme on the preparation of value-added fish products was held from **8th to 9th June 2025** in Tanda village, located in the Narohna Sankal Panchayat of Phanda Block, Bhopal, Madhya Pradesh. The training was conducted through a joint collaboration between the ***Department of Zoology and Applied Aquaculture, Barkatullah University***, ***Bhopal***, and the ***Society for Environmental Conservation (SEC)*** *Bhopal.* This initiative is an extension of the ongoing River Pen Fish Culture Project. A total of 33 trainees participated in the programme, including members of the ***Dharti Aajeevika Swa Sahayata Samooh*** and other local trainees.

About Value-Added Fish Products: Value-added fish products refer to processed or transformed fish items that offer enhanced value, convenience, or appeal compared to raw or unprocessed fish. These products typically undergo techniques such as preservation, flavor enhancement, packaging, or culinary preparation to improve their marketability.

During the training, low-value fish mince was used to prepare high-value products such as:

- **Fish cutlets**
- **Fish balls**
- **Fish fingers**
- **Fish sausages**
- **Fish fillets**
- **Fish cakes**
- **Smoked Fish**
- **Fish soup**

These products have strong market potential due to their enhanced taste, shelf life, and convenience for consumers.

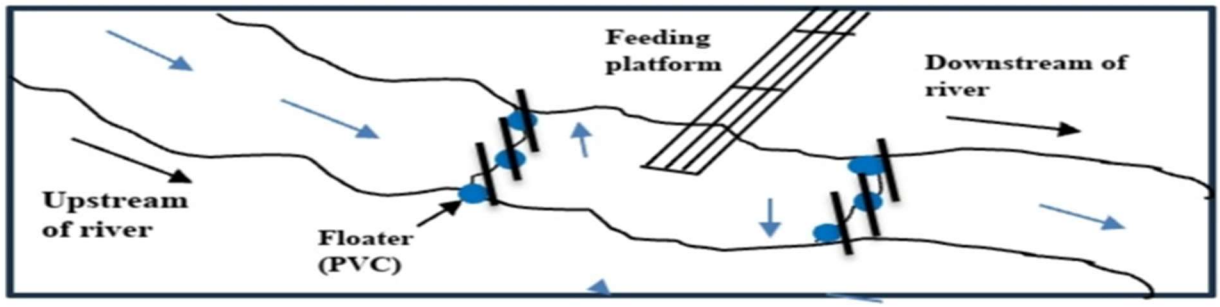
Value-Added Fish Products Training Programme at Tanda village.

Value-Added Fish Products Training Programme at Tanda village, Bhopal.

Value-Added Fish Products Training Programme at Tanda village, Bhopal (MP).

7. Replicability and Local Resource Utilization:

The river pen culture model introduced in this project is easily replicable in other water bodies with similar ecological characteristics. Its reliance on local resources, indigenous species and community labor makes it a scalable model for rural aquaculture development. Empowering women with knowledge, resources and access to markets the project successfully laid the foundation for self-sustaining, community-based aquaculture livelihoods. Its integrated, eco-friendly approach ensures that the benefits will extend well beyond the project duration, contributing to rural economic growth, food security, and environmental conservation in Phanda Block and surrounding areas.



Adjustable river pen culture diagram & technique.

Floaters (empty PVC drum)

Only two sides of the pen were enclosed the upstream and downstream sides of the Ajnal river. There will be two rows of barriers: one upstream and one downstream, extending across the entire width of the river.

Exposure Visits Programme for Women Self-Help Groups of Sankal, Tanda and Bilkhiriya villages.

Women Self-Help Groups of Sankal, Tanda, and Bilkhiriya villages.

Exposure Visits Programme for Women Self-Help Groups of Sankal, Tanda and Bilkhiriya villages.

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Exposure Visits to the Betwa River Pen Culture Unit at Dumel in Obedullaganj Block of Raisen District, Madhya Pradesh.

Exposure Visits to the Betwa River Pen Culture Unit at Dumel in Obedullaganj Block of Raisen District, Madhya Prades

(11). Project Area and Target Population:

i). Project Location and Implementation in Ajnal River Pen Culture of Phanda Block, Bhopal.

The innovative **Ajnal River pen culture project** was successfully implemented in the Phanda Block of Bhopal District, Madhya Pradesh, across three villages: Narohna Sankal, Tanda, and Bilkhiriya. This initiative aimed at empowering women through sustainable aquaculture practices, specifically focusing on pen culture technology. Five women Self-Help Groups (SHGs) were the primary beneficiaries of this project, which sought to enhance their livelihoods and promote sustainable development in the region.

ii). Strategic Village Selection

The villages of Sankal, Tanda, and Bilkhiriya were selected for their unique potential for Ajnal river pen fish culture and the community's openness to adopting innovative pen culture practices. The selection process was guided by the following considerations:

1. **River Pen Fish Culture Potential:**
    - These villages are located near the Ajnal River, offering ideal conditions for pen culture due to the river's clean water, steady flow, and abundant natural resources. These factors made it possible to establish effective and sustainable fish farming operations.
2. **Community Engagement:**
    - The women in these communities, organized into five SHGs, were highly receptive to the introduction of new farming techniques. Their willingness to engage with and adopt the river pen culture technology was critical to the success of the project, ensuring active participation and long-term sustainability.

iii). Implementation of River Pen Culture Technology

The project involved setting up one river pen culture unit, which have now become fully operational and are producing fish crops. The implementation process included the following key steps:

1. **Construction of Pen Culture Unit:**
    - One pen culture unit was constructed in the Ajnal River, strategically placed to take full advantage of the river's natural flow and resources. The pens were built using materials sourced locally, ensuring both cost-effectiveness and sustainability. The design of these pens allowed for the natural exchange of water while keeping the fish contained, providing an ideal environment for aquaculture.
2. **Training and Capacity Building:**
    - Comprehensive training sessions were conducted for the women SHGs to equip them with the necessary skills for managing the pen culture units. This included training on pen construction, fish stocking, feeding, and maintenance, ensuring that the women were fully prepared to operate the units effectively.

3. **Ongoing Support and Monitoring:**
    - To ensure the success of the project, continuous support and monitoring were provided. Technical experts regularly visited the sites to offer guidance and address any challenges faced by the SHGs. This ongoing support played a vital role in the successful operation of the pen culture units.

iv). Achievements and Impact

The implementation of the Ajnal River pen culture project has resulted in several significant outcomes:

1. **Sustainable Fish Production:**
    - One river pen culture unit have become fully operational and are actively producing fish. This success marks a significant achievement in sustainable aquaculture for the region, providing a reliable source of income for the women SHGs involved.
2. **Economic Empowerment:**
    - By generating a stable income through fish farming, the project has empowered the women SHGs economically. The income generated from the sale of fish has contributed to the financial independence of the women and improved the overall economic conditions of their households.
3. **Environmental Sustainability:**
    - The project has been implemented with a strong emphasis on environmental sustainability. The use of natural resources has been carefully managed to ensure that the aquaculture practices do not harm the local ecosystem. This approach has set a standard for future aquaculture projects in the region.
4. **Model for Future Development:**
    - The success of the Ajnal River pen culture project serves as a model for similar initiatives in other regions. The combination of strategic location selection, community engagement, and sustainable practices has proven to be an effective approach to rural development and economic empowerment.

The Ajnal River pen culture project in the Phanda Block of Bhopal District has demonstrated the potential of innovative aquaculture practices to empower local communities and promote sustainable development. Through the successful implementation of four river pen culture units, the project has provided the women SHGs with a viable and sustainable source of income, while also contributing to environmental conservation. The project's success highlights the importance of community engagement and strategic planning in achieving long-term development goals.

v). Current Operation and Output:

The pen fish culture units in the Ajnal River are currently operational and thriving. The units are populated with fish species such as Murrel, Indian Major Carps, including Rohu, Catla, and Mrigal. These species were selected for their resilience, compatibility with the local climate and

market demand. The output from these units is not only meeting local consumption needs but also generating surplus for sale, contributing to the local economy.

vi). Community Involvement and Benefits:

- **Community Engagement:**

The project has been a collaborative effort, with significant involvement from local residents. The community received training in system maintenance, fish care, and harvesting techniques, empowering them to independently manage the units. This involvement has fostered a strong sense of ownership and pride in the project.

- **Skill Development:**

The training provided has equipped community members with valuable skills, enabling them to manage not just the pen culture units but also to explore other aquaculture or business ventures.

- **Economic and Educational Impact:**

The pen fish culture units have become educational hubs, demonstrating sustainable farming practices. They have created job opportunities and stimulated the local economy through the sale of surplus fish. Consequently, the community has experienced improved food security, better nutrition, and increased economic stability.

vii). Future Prospects:
The success of the initial pen fish culture units presents a strong foundation for future expansion. There is growing interest in replicating this model in other villages and scaling up existing units. With continued support and community engagement, the project aims to enhance the resilience and self-sufficiency of the local food system. Additionally, it serves as a model for sustainable aquaculture practices in similar regions, promising a more prosperous future for the area.

viii). Target Population and Training Initiatives:

- **Beneficiary Engagement:**

The project targeted 150 women beneficiaries through five Self-Help Groups (SHGs) from the villages of Narohna Sankal, Tanda, and Bilkhiriya. Each SHG consisted of 30 members, including women farmers, unemployed youth, and other community members interested in pen fish culture with agri-based integrated aquaculture as a viable livelihood.

- **Inclusive Approach:**

The inclusive approach ensured that a broad spectrum of the community benefited from the project's training and resources. This strategy was pivotal in achieving the project's objectives of poverty alleviation and economic empowerment.

ix). Engagement with Women Self-Help Groups:

- **Strategic Involvement:**

The project strategically engaged with five women SHGs, recognizing these groups as effective platforms for community development. Each SHG was selected based on their interest in sustainable agriculture and their potential to benefit from pen culture technology.

- **Introduction to Pen Culture Technology:**

The members were introduced to river pen fish culture, emphasizing its advantages in water conservation, fish production, and sustainable farming practices.

x). Focus on Diverse Beneficiaries:

The project specifically targeted women farmers seeking to diversify their income sources, unemployed youth looking for new career opportunities, and other community members interested in sustainable pen fish culture practices. By involving these groups, the project aimed to address various social and economic challenges, such as unemployment and food insecurity. Women farmers, in particular, benefited from learning a new method of farming that requires less water and land compared to traditional aquaculture, offering a sustainable alternative in the face of changing environmental conditions.

Unemployed youth were given a unique opportunity to gain valuable skills in a growing field, opening up new avenues for employment and entrepreneurship. The training empowered these young individuals to start their own pen fish aquaculture ventures, potentially leading to job creation and economic growth within their communities. Other community members, including women and marginalized groups, were also included, ensuring broad-based participation and equitable access to the project's benefits.

xi). Outcomes and Community Impact:

The training and support provided to the SHGs resulted in a well-prepared cohort of pen aquaculture practitioners. These newly trained individuals are now capable of managing their river pen systems, contributing to local food production, and generating income through the sale of fishes. The project's impact extends beyond the immediate economic benefits; it also fosters a culture of innovation and sustainability in the community.

The initiative has led to increased awareness of sustainable aquaculture and the potential of pen fish culture to improve livelihoods. The successful implementation of the systems in these villages serves as a model for other communities, encouraging wider adoption of this technology. Furthermore, the project's focus on training and capacity building has strengthened community cohesion and resilience, as members work together towards a common goal of sustainable development.

xii). Community Empowerment and Future Prospects:

The shift towards river pen culture not only addresses immediate water and economic challenges but also promotes long-term sustainability and community empowerment. As community members become more self-sufficient and less reliant on external water sources and markets, they gain greater control over their livelihoods and future. This empowerment fosters a culture of innovation and resilience within river pen fish farming, encouraging further exploration of sustainable practices and technology.

(12). On-Site Demonstration:

Live demonstrations were conducted to show practical application of eco-friendly pen culture techniques:

- Construction and installation of fish pens.
- Fish stocking and feeding with natural inputs.
- Water quality monitoring techniques.

These activities provided real-time, practical insights and boosted participants confidence and competence.

(i) Number of trainees who adopted livelihood activity after training programme:

150, women trainees have successfully adopted river pen culture with integrated aquaculture practices as their livelihood activity, showcasing the tangible impact of the training program in empowering them with the skills and knowledge to engage in sustainable integrated fish farming. Their transition from trainees to practitioners reflects the effectiveness of the program in promoting economic independence and fostering community-based entrepreneurship.

(ii) Number of trainees who received financial support from SHGs:
Number of Trainees: 128 women trainees.

Bank Linkage: ***Punjab National Bank, Bilkhiriya Branch, Bhopal Madhya Pradesh.***

Names of Women Self-Help Groups (10 SHGs) that received bank loans after the training programme:

(a***) Vaishnavi Swyam Sahayta Samooh***

(b) Dharti Ajivika Swa Sahayta Samooh

(c) Durga Ajivika Svam Sahayta Samooh

(d) Tulshi Ajivika Swyam Sahayta Samooh

(e) Mahamaya Aajeevika Swayam Sahayta Samuh

(f) Aasha Ajivika Swam Sahayta Samooh

(g) Maha Laxmi Aajivika Svam Sahayta Samooh Narohna,

(h) Devi Ajivikka Swa Sahayta Samuh

(i) Laxmi Aajivika Svam Sahayta Samooh Tanda

(j) Saraswati Aajivika Svam Sahayta Samooh Tanda.

A total of 10 Women Self-Help Groups received bank loans after completing the training programme.

(iii) Value-Added Fish Products Training Programme:
A two-day training programme on the preparation of value-added fish products was held from 8th to 9th June 2025 in Tanda village, located in the Narohna Sankal Panchayat of Phanda Block, Bhopal, Madhya Pradesh. The training was conducted through a joint collaboration between the ***Department of Zoology and Applied Aquaculture, Barkatullah University, Bhopal*** and the ***Society for Environmental Conservation (SEC), Bhopal*.** This initiative is an extension of the ongoing River Pen Fish Culture Project. A total of 33 trainees participated in the programme, including members of the ***Dharti Aajeevika Swa Sahayata Samooh*** and other local trainees.

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- Fish cutlets
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- Fish fingers
- Fish sausages
- Fish fillets
- Fish cakes
- Smoked Fish
- Fish soup

These products have strong market potential due to their enhanced taste, shelf life and convenience for consumers.

(iv) Outcomes:

- **Skill Development & Technology Adoption**: All five SHG members acquired hands-on experience and technical know-how in managing integrated river pen culture systems.
- **Economic Empowerment**: The program facilitated livelihood generation, with an

estimated average annual benefit of Rs. *20,83,800/- and per SHG Rs.2,08,380/-,*

- **Sustainable Practices**: Emphasis on organic inputs, zero water exchange, and eco-friendly approaches promoted long-term environmental sustainability.
- **Community Development**: Women became role models within their communities, encouraging others to adopt similar sustainable livelihood models. The project also contributed to food security and local economic resilience.
- **Social Impact**: Beyond income, the initiative improved women's socio-economic status, reduced malnutrition among stakeholders, and promoted self-reliance and entrepreneurship.

(13). Project Implementation and Phases:

Phase I: Initial Setup and Mobilization (2 Months) This phase focused on establishing the foundation for the project:

- **Community Interaction and Income Generation Program:** Initial meetings and workshops were held to introduce the concept of river pen fish culture and its potential benefits. The emphasis was on engaging the women in the community and explaining the project's objectives.
- **Procurement and Setup:** Essential materials and equipment for river pen aquaculture demonstrations and training were acquired. The infrastructure for pen culture, including training centers, was also set up.
- **Mobilization and Group Discussions:** Efforts were made to mobilize the target population through group discussions, highlighting the benefits of pen culture and encouraging participation.
- **Curriculum Development:** Experts were consulted to finalize the training schedule and course content.
    - **Total Trainees:** 150 women
    - **Training Duration:** 10 days per session
    - **Total Sessions:** 5, with 30 participants per session

Phase II: Demonstration and Training Activities (9 Months) This phase involved practical training and demonstration activities:

- **Hands-On Training:** Focused on practical skills in pen aquaculture, including fish seed management, feeding, and marketing.
    - **Training Batches:** 5 batches of 30 trainees, each with 10-day sessions.
    - **Training Schedule:** 6-hour sessions daily, with a 15-day gap between batches.
- **Project Implementation Strategies:**
    - **Livelihood Mapping:** Selected and trained SHGs for livelihood activities.
    - **Enterprise Development:** Trained farmers in pen culture and encouraged infrastructure development.
    - **Refresher Training:** Two-day refresher courses were conducted for each Women's Self-Help Group.

- **Exposure Visits:** Organized visits to successful river pen fish farms and markets.
- **Follow-Up Support:** Provided ongoing mentoring and support post-training.

Phase III: Post-Training Support (1 Month) This final phase provided necessary support to ensure the sustainability of the project:

- **Financial Assistance:** Facilitated loans and financial support through NABARD, banks, and government agencies.
- **Market Linkages:** Developed strategies for selling fish through local markets and established networks.
- **Payment Systems:** Ensured secure transactions through banks and online platforms.
- **NABARD Support:** Leveraged LEDP to promote entrepreneurship and create sustainable business ventures.

(14). Outcomes and Achievements:

The project has delivered measurable and transformative outcomes. By strategically mobilizing 150 women across the villages of Narohna Sankal, Tanda, and Bilkhiriya into five functional Self-Help Groups (SHGs), the project created a robust foundation for economic empowerment, capacity building, and sustainable livelihood generation.

i). Economic Empowerment:

One of the most significant achievements of the project has been the enhancement of economic opportunities for rural women who were previously marginalized or engaged in low-income activities. The women were trained in pen culture techniques—a relatively low-cost and high-yield aquaculture practice which enabled them to become self-reliant income earners. With increased access to resources and market linkages, many beneficiaries have begun generating regular income to support their families, thereby achieving greater financial autonomy and improving household economic security.

ii). Enhanced Livelihoods:

The adoption of innovative river pen culture techniques allowed the beneficiaries to significantly enhance the productivity of available aquatic resources. The integration of practices such as the use of periphyton and azolla for natural feeding not only reduced operational costs but also improved fish health and yield. This diversification of income sources has contributed to greater livelihood stability, making the women's earnings less vulnerable to agricultural uncertainties or seasonal employment fluctuations.

iii). Community Development and Social Cohesion:

The formation of SHGs fostered unity, collective action, and shared responsibility among the participants. These groups have become social and economic platforms that encourage collaborative decision-making and peer-to-peer learning. This has strengthened community ties and created a support system where women are not only growing economically but also socially.

The group-based model has empowered women to voice their opinions, engage in leadership roles and take part in community development activities beyond aquaculture.

iv). Capacity Building and Skill Development:

The project focused extensively on equipping participants with both theoretical knowledge and practical skills related to pen culture and integrated aquaculture. Training modules covered a range of topics, including site selection, enclosure design, water quality management, species selection, feeding practices, harvesting techniques, and record-keeping. Follow-up refresher training and on-ground demonstrations further reinforced their confidence and technical expertise. As a result, these women are now capable of independently managing pen culture units and mentoring others in their community.

v). Promotion of Environmentally Sustainable Practices:

Environmental sustainability was a core component of the project. By promoting eco-friendly techniques such as the use of natural feed like azolla and periphyton the project minimized the ecological footprint of aquaculture activities. The design of pen culture units ensured the natural flow of water, which helped maintain oxygen levels and supported the ecological balance of the river system. Moreover, beneficiaries were educated about the importance of conserving aquatic biodiversity and maintaining water quality, fostering an ethic of environmental responsibility.

vi). Scalability and Replication Potential:

The success of this initiative has demonstrated that river-based pen culture is a viable and scalable livelihood option for rural women. Its low-cost setup, minimal environmental impact, and adaptability to various freshwater bodies make it an attractive model for replication. The project has already sparked interest among neighboring communities and local authorities, paving the way for the development of similar initiatives across other blocks and districts in Madhya Pradesh and beyond.

Achievements:

Through a well-structured implementation strategy that combined technical training, resource mobilization, and institutional support, the project has profoundly impacted the socio-economic landscape of the participating villages. It has successfully empowered women to transition from economic dependency to self-sufficiency, improved household nutrition through fish consumption, promoted sustainable resource use, and enhanced local resilience. This model now stands as a testament to how targeted interventions, when aligned with community needs and environmental considerations, can bring about inclusive and sustainable rural development.

Entrepreneurship and Skill Development:

Entrepreneurship and skill development programs were implemented with a focus on empowering women entrepreneurs, particularly those organized in Self-Help Groups (SHGs). Five women SHG entrepreneurs played a key role in this initiative, having been trained in river

pen fish culture techniques and fish production. The development and dissemination of innovative river pen fish culture technology utilizing harvested monsoon and rainwater, organic fertilizers, and avoiding the use of chemicals, antibiotics, and no water exchange has received widespread recognition. This sustainable and eco-friendly approach has proven to be a comprehensive technology package well-suited for women community entrepreneurs. It not only enhances their technical skills but also promotes self-reliance, contributing to both livelihood generation and community development through effective fish farming and marketing strategies.

(15). Ajnal River Pen Culture Unit Operational Cost:

(i) Fish seed rearing in Pen Culture for Ist Crop:

Sl. No.	Items	Qnt.	Unit cost Rs/-	Amount (for 1 Pen)
A. Capital cost				
	Total			**1,56,500/-**
B. Operational cost				
1	Fish seeds fingerlings (60-70 mm) including packing & transport (approx..).	40000	2/-	80,000/-
2	Poultry manure / Fertilizer etc.	500 kg	10/-per kg	5,000/-
3	Fish feed	450 kg	50/-	22,500/-
4	Lime	3900 kg.	10/-	39,000/-
5	Miscellaneous expenses			1,200/-
	Total			**1,47,700/-**
	Grand Total: A+B			**3,04,200/-**
	Benefit			
	After 7–8 months of culture, approximately 90,000 murrel fish are expected to reach an average weight of 750–800 grams each. Taking into account an estimated 10% mortality rate, around 80,000 fish are expected to reach marketable (table) size. **Expected Yield and Income:** *Number of marketable fish: 80,000* *Average weight per fish: 750 grams* *Total harvest: 80,000 × 750 g = 60,000 kg* *Market price: Rs. 300 per kg*	**60000**	**300/-**	**18,00,000/-**
	Assuming benefit for SHGs.			**14,95,800/-**

Fish seed rearing in Pen Culture for Ist Crop:

Total expenditure: Rs. 3,04,200/-. Total Income: Rs. 18,00,000 – 3.04,200= Rs. 14,95,800/-

Additional Agricultural and Aquaculture-Based Income:

S. N	Particulars	Production & Rate	Total Amoun
1	Paddy crop cultivation	15 quintals x Rs. 3,400 per quintal	51,000/-
2	Wheat crop cultivation	20 quintals x Rs. 2,400 per quintal	48,000/-
3	Bean (Legume) or Dolichos crop	25 quintals x Rs. 4,000 per quintal	1,00,000/-

4	Horticulture and Floriculture: Marigold flower farming	5 quintals x Rs. 4,000 per quintal	20,000/-	
5	Fruit-bearing trees (Banana, Papaya)	6 quintals x Rs. 4,000 per quintal	24,000/-	
6	Poultry Farming System: Egg production from 10 hens annually	2,500–3,000 eggs @ Rs. 10 per egg	30,000/-	
7	Chicken sales from 10 hens annually	10 x Rs. 1,500 per chicken	15,000/-	
8	Cattle Farming System: Milk production from 5-6 cows	5,000 kg per year x Rs. 50 per kg.	2,50,000/-	
9	Goat Farming System: 10 goats producing 20 kids per year	20 x Rs. 2,500 per kid	50,000/-	
	Total Income from Pond		**5,88,000/-**	

Total Annual Income: Rs. 51,000 + 48,000 + 1,00,000 + 20,000 + 24,000 + 30,000 + 15,000 + 2,50,000 + 50,000 = Rs. 5,88,000 (With the integration of the pen culture system) = ***Rs. 14,95,800 + Rs. 5,88,000 = Rs. 20,83,800/-.***

Expected Benefit: ***Each Self-Help Group (SHG) is expected to earn an annual profit of approximately Rs. 2,08,380/-, with each beneficiary receiving around Rs. 20,838/-.***

(16). Future Prospects and Sustainability:

The project demonstrated the viability of river pen fish culture as a self-sustaining aquaculture model. The trained beneficiaries are now equipped to independently manage and expand their pen culture setups, ensuring continuous income generation. The formation of SHGs provides a structured approach to marketing and scaling operations, promising long-term sustainability. The project has established a strong foundation for long-term success and sustainability. Moving forward, several key factors will contribute to the future prospects and continued impact of this initiative:

1. **Scalability and Expansion:** Given the success of the initial project, there is significant potential to scale up pen culture practices to other villages and communities within the Phanda Block and beyond. This expansion could increase the number of beneficiaries and further amplify the economic benefits for women across the region.
2. **Continuous Training and Skill Development:** To ensure the sustained success of the project, ongoing training and skill development programs will be essential. This will help the women stay updated with the latest advancements in pen culture techniques, ensuring they can continue to improve productivity and maintain the quality of their operations.
3. **Market Linkages and Financial Support:** Establishing strong market linkages for the sale of fish and other aquatic products is crucial for the long-term viability of the project. Additionally, providing access to financial support, such as microcredit or cooperative banking services, will enable the women to invest in their enterprises and expand their operations.
4. **Strengthening SHG Networks:** Continued support for the Self-Help Groups (SHGs) is vital for fostering collaboration, knowledge sharing, and collective bargaining power. Strengthening these networks will ensure that the women can collectively address challenges, access resources, and advocate for their needs.

5. **Environmental Sustainability:** Maintaining environmentally sustainable practices is key to the long-term health of the Ajnal River ecosystem and the success of pen culture activities. Regular monitoring of environmental impacts, along with the promotion of eco-friendly techniques, will help preserve the natural resources that the women depend on for their livelihoods.
6. **Community Involvement and Ownership:** Encouraging broader community involvement and fostering a sense of ownership among the participants will contribute to the sustainability of the project. By involving local stakeholders in decision-making and project management, the initiative can become more resilient and adaptable to changing circumstances.
7. **Policy Support and Advocacy:** Engaging with local government bodies and policymakers to secure ongoing support and favorable policies for pen culture practices will be crucial. Advocacy efforts can help ensure that the project receives the necessary backing and resources to thrive in the long term.

By focusing on these future prospects and sustainability strategies, the project has the potential to continue making a meaningful difference in the lives of women in the Phanda Block, while also serving as a model for similar initiatives in other regions.

(17). Challenges and Lessons Learned:

While the project was largely successful, several challenges were encountered:

- **Initial Resistance:** There was some initial resistance from the community due to unfamiliarity with pen culture practices. However, this was overcome through targeted awareness campaigns and demonstrations of the benefits.
- **Environmental Factors:** Variability in water levels and quality posed challenges at times, requiring adaptive management strategies to maintain optimal conditions for fish farming.
- **Market Fluctuations:** Fluctuations in market demand and prices for fish affected the income of the beneficiaries. The project team addressed this by exploring additional market linkages and diversifying the species of fish stocked.

Lessons Learned:

- The importance of community involvement and buy-in from the outset cannot be overstated. Early engagement and continuous communication with the community are crucial for the success of similar projects.
- Capacity building and continuous training are essential to ensure that beneficiaries can adapt to challenges and sustain their activities independently.
- Environmental monitoring and adaptive management strategies are vital to overcoming the challenges posed by natural variability in river pen aquaculture projects.

(18). Conclusion:

The project stands as a landmark initiative in the realm of sustainable rural development and gender-focused economic transformation. Its successful implementation has not only met but also exceeded its intended objectives namely, economic empowerment, environmental sustainability, community engagement, and skill development leaving a lasting impact on the lives of 150

women and their surrounding communities.

At the core of this initiative was the promotion of low-cost, eco-friendly pen culture technology, a method ideally suited to the natural aquatic conditions of the Ajnal River Dam. By establishing five well-organized Self-Help Groups (SHGs) across the villages of Narohna Sankal, Tanda, and Bilkhiriya, the project empowered local women with the knowledge, confidence, and tools necessary to engage in profitable fish farming. Many of these women had limited economic opportunities prior to the intervention but have since transitioned into skilled aquaculture entrepreneurs through a combination of theoretical training and practical experience.

The adoption of innovative and sustainable practices such as the use of periphyton and azolla as alternative natural feed further amplified the project's impact by reducing dependence on commercial inputs and promoting ecological balance. These methods not only ensured cost-efficiency but also contributed to improved fish health and water quality, underscoring the project's commitment to long-term environmental stewardship.

A significant milestone in the project was the successful organization of the Group Monitoring Workshop (GMW) in Sankal village. This event served as a pivotal platform for participatory learning, inter-group collaboration, and the demonstration of integrated aquaculture practices. The participation of district-level officials, technical experts, and a broad spectrum of rural women fostered strong institutional support and reinforced the project's scalability and relevance.

Beyond tangible outcomes such as increased household incomes, improved nutritional standards, and the formation of micro-enterprises the project catalyzed a significant shift in community dynamics. Women who were once marginalized from mainstream economic activities have emerged as leaders, decision-makers, and contributors to local food security. Their success stories now serve as powerful examples, inspiring neighboring communities to adopt similar models.

In this project illustrates how the fusion of traditional knowledge, scientific innovation, and grassroots participation can foster resilient, inclusive, and sustainable development. It offers a replicable blueprint for aquaculture-based livelihood generation across similar regions and reaffirms the vital role of women as agents of transformative change in rural India. With the strong foundation laid by this initiative, there is immense potential for scaling and institutionalizing such interventions throughout Madhya Pradesh and beyond towards a future that is equitable, self-reliant and environmentally sustainable.

(19). Future Recommendations:

- **Scaling Up:** Expand pen culture practices to other suitable regions within Madhya Pradesh and beyond to benefit more rural communities and enhance livelihood opportunities on a larger scale.
- **Continuous Support:** Ensure ongoing technical guidance, refresher training, and institutional support to Self-Help Groups (SHGs) to maintain and strengthen project outcomes over time.
- **Exploring New Markets:** Facilitate access to broader market linkages, including domestic and potential export channels, to maximize income generation and economic

resilience for women entrepreneurs.

- **Environmental Monitoring:** Implement regular environmental assessments to track water quality, fish health, and ecosystem impacts, ensuring that aquaculture practices remain sustainable and ecologically balanced.
- **Diversification of Activities:** Encourage integration of complementary activities such as horticulture, livestock, or value-added fish processing to increase income streams and resource utilization efficiency.
- **Access to Finance:** Promote linkages with microfinance institutions, banks, and government schemes to improve financial access for SHGs and support the expansion of their aquaculture enterprises.

This project stands as a model for community-driven, sustainable development initiatives, and its success offers valuable insights for future endeavors aimed at livelihood generation and women's empowerment in rural areas.

(20). Acknowledgments:

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Project Report Submitted by:

Dr. Brijesh Sharma (President, **SEC**)
Principal Investigator
Society for Environmental Conservation (SEC).
Add: D-41, Shahenshah Garden, Bhopal
Email: secbrij@yahoo.co.in & brijesh.sa9425@gmail.com
Phone: 0755-2590829, 9425392638.

Mr. Aman Sharma
Co-Investigator
Society for Environmental Conservation (SEC).
Add: D-41, Shahenshah Garden, Bhopal
Email: secbrij@yahoo.co.in