A CASE OF MICRO-IRRIGATION ENHANCED SOLARIZED AGRICULTURE: HOW A VILLAGE TRANSFORMED ITS LIVELIHOOD THROUGH SOLAR WATER PUMPS

BACKDROP

Kanker district, nestled in the southern reaches of **Chhattisgarh**, is a tapestry woven with rich history and diverse geography. The climate in Kanker follows the rhythm of the monsoons, with May basking in the hottest temperatures and December offering a cool respite. The average annual rainfall of 1492 mm brings life to the land, with most of the precipitation gracing the district between June and October. However, recent years have witnessed fluctuations in rainfall patterns, posing challenges for the agricultural sector.

Tribal communities form the backbone of Kanker's economy. Their deep connection with the land is evident in their primary occupation - agriculture. They also supplement their income through the collection of non-timber forest products, showcasing their knowledge of the rich biodiversity that surrounds them. Despite its potential, agriculture in Kanker faces hurdles. A significant portion of the rural population lives below the poverty line, and a large percentage of the workforce relies on marginal agriculture and related activities, often struggling with low yields and limited income.

Socio-economic factors, coupled with a low risk-taking appetite, illiteracy, limited awareness about modern technologies, and inadequate communication networks, hinder the adoption of advanced farming practices. This resistance to change translates into lower productivity, output, and overall profitability for the agricultural sector. Addressing these challenges requires a multi-faceted approach that tackles not just the technical aspects of farming but also the underlying social and educational factors. By equipping farmers with the knowledge and resources they need, Kanker can unlock the true potential of its agricultural sector and ensure a prosperous future for its residents.

AN INCENTIVE APPROACH

An end-use incentive framework represents a departure from conventional subsidy-based approaches by rewarding individuals or organizations based on the outcomes they achieve rather than the inputs they utilize. By linking financial incentives to specific results such as enhanced crop yields or water conservation, this framework encourages behavioral shifts toward sustainability. Beyond

its immediate impact on agricultural practices, such incentives have the potential to significantly contribute to social upliftment. By making sustainable technologies more accessible and appealing, raising awareness about energy efficiency and water conservation, and leveraging social influence to drive broader adoption, these frameworks can stimulate job creation, boost local economies, and foster long-term economic development.

In Chhattisgarh's Kanker district, despite the remarkable success of the state's **Saur Shakti Yojana (SSY**) which subsidized **Solar Water Pumps (SWPs)** at rates of 90-95%, certain challenges persisted due to the region's unique geography and water scarcity issues. A project supported by an international development sector organization recognized the untapped potential in this pocket and embarked on a mission to revolutionize the agricultural landscape.

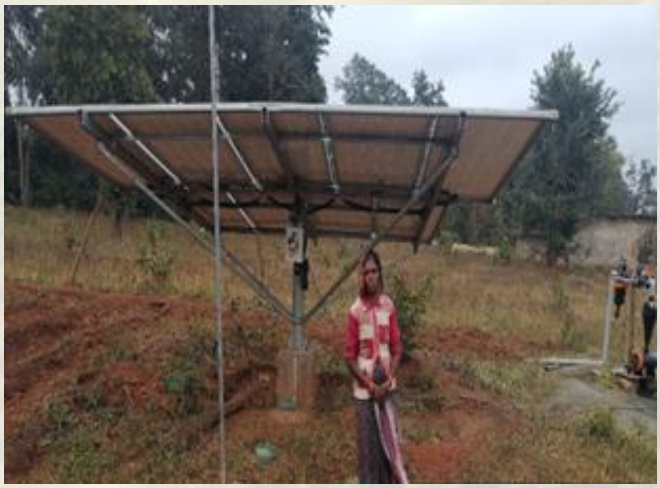


***Image**: Solar Water Pumps installed under SSY scheme*

The project handpicked 40 visionary farmers from the beneficiaries and embarked on a journey to enrich agricultural practices through the fusion of technology and traditional wisdom. Equipped with micro-irrigation systems, these farmers became pioneers of change, complementing their SWPs with innovative irrigation techniques. The introduction of the end-user incentive program further catalyzed this transformation by covering 50% of the micro-irrigation installation costs, contingent upon meeting specific performance benchmarks. This holistic approach not only unlocked the potential for higher crop yields but also heralded a new era of water conservation and resource management in Kanker.

***Image**: Installation of Drip Irrigation system under the end user incentive program*

BEHAVIOURAL MODIFICATION & TRANSFORMING SCENARIO

The villagers in the Kanker district, particularly the 40 selected farmers, experienced significant benefits from various training and social development programs. These initiatives included social campaigns, workshops, and educational messages designed to foster behavioral changes and promote the adoption of sustainable agricultural practices. The goal of these training sessions and development programs was to encourage farmers to implement environmentally friendly techniques and adopt improved farming practices, thereby

enhancing sustainability and water conservation in the region.

As a result of these efforts, the farmers began to incorporate several sustainable agricultural practices. Additionally, the farmers mixed cow dung and other organic manure into the soil at least seven days before sowing to enrich it with nutrients. Another crucial practice involved ploughing the fields to a depth of 8-9 inches to adequately prepare the land for sowing and line sowing to accommodate micro irrigation system and better management of crops growth. These practices collectively contributed to better crop management, improved soil health, and enhanced agricultural productivity, thereby promoting sustainable farming and water conservation in the region.

***Image**: Line Sowing and Crop Diversification*

In addition to installing solar water pumps and micro-irrigation systems, these farmers have adopted and transformed their farming practices to state-of-the-art standards. By integrating advanced technology with sustainable techniques, the farmers in Kanker have not only improved their agricultural output but have also set a benchmark for sustainable and efficient farming practices. This holistic approach has led to a significant transformation in the area's agricultural landscape, fostering economic growth, environmental stewardship, and social upliftment.

Many farmers in the Kanker district were previously unable to engage in farming for more than one season each year due to their reliance on rain-fed irrigation. Irregular monsoons took a heavy toll on their agricultural activities, often leading to poor yields and financial instability.

***Image**: Installation of Drip Irrigation*

The local economy could not support the cost of renting pumps, causing agriculture to suffer significantly. However, the introduction of solar water pumps and drip irrigation systems has eradicated the problem of unreliable irrigation. These advancements have enabled and facilitated farmers to undertake farming across three seasons annually.

Moreover, the push for crop diversification via the program and the mandatory cultivation of vegetables on a portion of their land has significantly contributed to increased agricultural yields and improved income levels for the farmers. By diversifying their crops, farmers can mitigate the risks associated with mono-cropping and enhance soil health, leading to more sustainable farming practices. The inclusion of vegetable cultivation ensures a

continuous and varied income stream, providing financial stability and improving the nutritional intake of the local community. A comprehensive approach has transformed the agricultural landscape in Kanker, empowering farmers to achieve greater productivity and economic resilience while promoting sustainable farming practices.

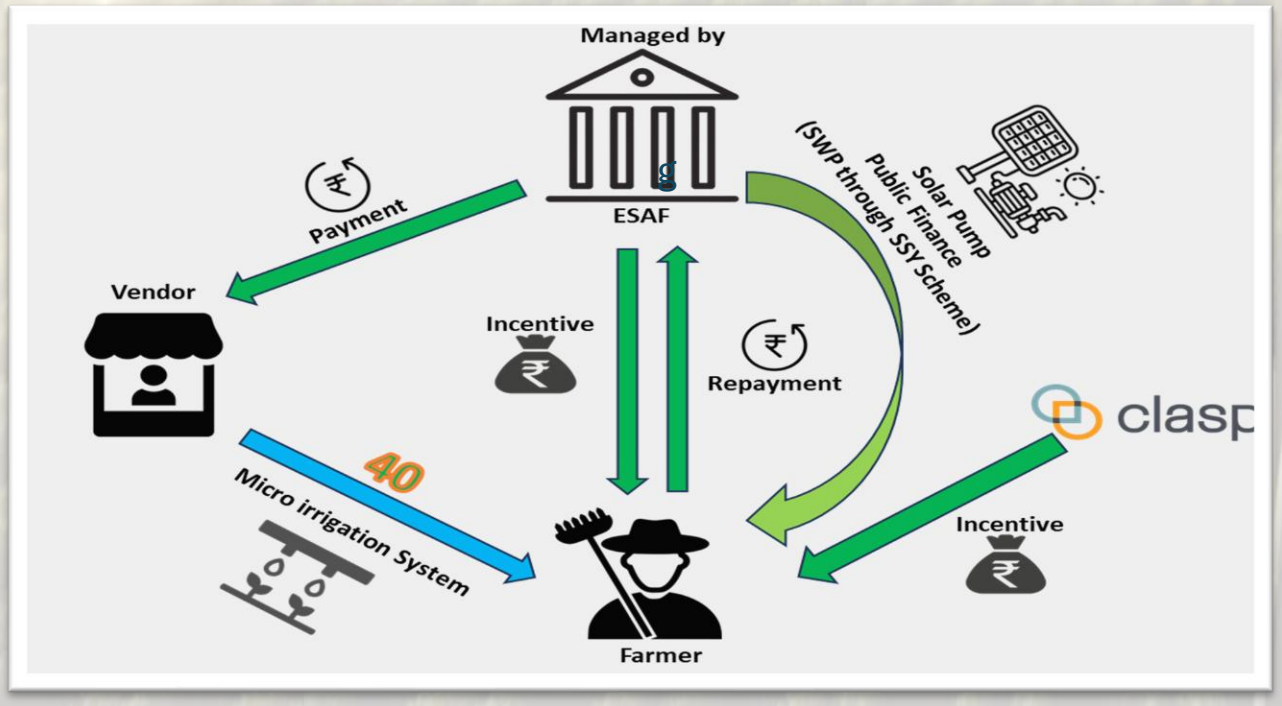
FINANCIALS OF THE CASE SCENARIO

The villagers in the area have significantly benefited from the combined support of the government and the project. This partnership exemplifies a successful collaboration between public and private financing and assistance, showcasing the power of integrated development efforts. The government provided substantial subsidies for the solar water pumps, which represent public funding. Specifically, the government mobilized approximately INR 2.92 Crores to subsidize 3 HP pumps, each costing INR 3.5 Lakhs, up to 95%. On the other hand, the project facilitated private financing for the micro-irrigation systems, mobilizing approximately INR 33 Lakhs in incentives to promote behavioral modification, the adoption of best practices, and water conservation.

For the farmers, this collaboration translated into manageable out-of-pocket expenses. Each farmer needed to pay INR 15 thousand for the subsidized solar water pump, which could be paid in two installments over a year.

This cost breaks down to INR 5 thousand per cropping season if three seasons are cultivated annually. For the micro-irrigation systems, the out-of-pocket expenses ranged from INR 20-30 thousand, depending on the farmer's performance in adopting sustainable practices and conserving water.

To alleviate the financial burden of these expenses, ESAF provided agricultural loans to farmers at very low interest rates, with a flexible payback period of 3 to 5 years. This comprehensive financial support enabled farmers to transition to more sustainable and productive agricultural practices, significantly improving their economic status and ensuring long-term benefits for the community. The combined efforts of public subsidies and private incentives have not only enhanced agricultural productivity but also fostered a culture of sustainability and resilience among the farmers.



ASSESSMENT AND IMPACTS

Demographic Impact

The project specifically targets marginal farmers, aiming to promote social upliftment and improve community standards in the area. Among the 40 beneficiary farmers, 98% fall under the Below Poverty Line (BPL) category, highlighting the economic challenges faced by this community. Additionally, 67% of these farmers are classified as marginal, underscoring their limited resources and landholdings. To further the goals of social upliftment and gender equality, the project has also ensured that 20% of the beneficiaries are women. This inclusive approach not only addresses economic disparities but also empowers female farmers, fostering a more equitable and resilient agricultural community.

Irrigation and Agriculture Impact

The installation of solar water pumps combined with micro-irrigation systems has transformed the agricultural landscape across 82 acres, allowing all 40 beneficiary farmers to cultivate crops in the Rabi, Kharif, and Zaid seasons. Previously, only 7 farmers could farm for more than two seasons due to unreliable irrigation. This has led to an 83% increase in agricultural activity. The reliable irrigation and precision of micro-irrigation systems have enabled crop diversification, including high-value and cash crops, boosting income and food security. Additionally, sustainable practices such as timely weeding, seed treatment with bio-fungicides, and using organic manure have improved soil health and crop resilience, contributing to long-term sustainability and productivity.

Cropping Pattern and Diversification of Crops

Prior to the availability of solar water pumps, the primary crops cultivated in the area were predominantly paddy and wheat. However, following the installation of solar water pumps, farmers have embraced crop diversification and adopted cash crops in multiple seasons, employing crop rotation techniques. This shift has not only increased crop yields but also improved soil conditions. The introduction of cash crops has significantly transformed the local economy, leading to a substantial increase in the annual income of farmers.

Financial Impact and Social Upliftment

On average, 0.5 acres of vegetable cultivation yields about 1 ton of produce, generating a profit of INR 12,000 to 15,000 per season per half-acre plot at local market prices. By diversifying their crops and implementing sustainable agricultural practices, farmers have achieved greater financial stability and resilience, fostering long-term economic growth in the community. Inspection and analysis reveal that the installation of solar water pumps has increased farmers' yields and profits by INR 10,000 to 12,000 per season, translating to an annual increase of INR 30,000 to 40,000 with three-season irrigation and cultivation. Previously, farmers who needed to irrigate their land outside the monsoon season had to bear the cost of pump rental and fuel, amounting to INR 5,000 to 7,000 per season. The installation of solar water pumps has eliminated these costs, further boosted farmers' incomes and enhanced their economic well-being.

Environmental Impact

The installation of 87 solar water pumps and 40 micro-irrigation systems has led to a potential reduction of 144.05 tons of CO2 emissions over the project's total lifecycle. Additionally, eliminating the need for pump rentals for irrigation has saved approximately 900 liters of diesel annually, providing energy security and independence to the local farmers. The shift away from grid electricity to solar-powered pumps has eased the workload and enhanced social security for the farmers, freeing them from the constraints of unreliable power supplies. A key aspect of the end-user incentive program is the focus on water conservation. One of the major criteria for receiving incentives was efficient water usage. With the availability of water tailored to the actual needs of the farmers, the combined use of solar water pumps and micro-irrigation systems has significantly minimized water wastage. Observations indicate that the irrigation practices followed by the farmers are well within the limits recommended by the Indian Council for Agricultural Research (ICAR) for each crop. This efficient water management has not only conserved a vital resource but has also promoted sustainable agricultural practices, thereby ensuring long-term agricultural productivity and environmental sustainability in the region.

Note: This case study has been taken from one of the recent projects managed by IIEC and supported by CLASP in India.