SWITCH ON FOUNDATION

ENSURING ENERGY SECURITY IN TEA GARDENS

www.SwitchON.org.in

- Founded in 2008, the **Environment Conservation Society** (ECS), also known as SwitchON Foundation, has been actively offering sustainable solutions for the vulnerable Indian population. With a commitment to **clean energy**, climate-resilient agriculture, and sustainable cities, ECS is working towards creating opportunities for 10 million people by 2030, promoting equitable growth through innovative business models and technologies.

- Central to its efforts is the CRA-DRE (**Integrating Climate Resilient Agriculture with Distributed Renewable Energy**) program, where ECS integrates renewable energy solutions with climate-resilient farming practices within a Farm-to-Fork ecosystem. This program focuses on the collectivization of producers, enhancing their capabilities in value addition to primary produce, and establishing robust market linkages.

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List of Acronyms

AIF	– Agriculture Infra Financing
CBI	– Community Based Institution
CSO	– Civil Society Organization
CSR	– Corporate Social Responsibility
CTC	– Crush Tear and Curl
DDUGKY	– Deen Dayal Upadhyaya Grameen Kaushalya Yojana
DIC	– District Industries Centre
DRE	– Decentralized Renewable Energy
FGD	– Focus Group Discussion
FPO	– Farmer Producer Organization
FSSM	– Financial Support Scheme for Mechanization
GPDP	– Gram Panchayat Development Plan
KII	– Key Informant Interview
LPG	– Liquified Petroleum Gas
MLA LAD	– Member of Legislative Assembly Local Area Development Scheme
MOFP	– Ministry of Food Processing
NAIFF	– National Agriculture Infra Financing Facility
NGO	– Non-Government Organization
OBC	– Other Backward Class
O & M	– Operation and Maintenance
PHC	– Primary Health Centre
PMKSY	– Pradhan Mantri Krishi Sinchayee Yojana
PRI	– Panchayati Raj Institution
SC	– Scheduled Caste
ST	– Scheduled Tribe
STG	– Small Tea Grower
SWOT	– Strength Weakness Opportunity Threat
TDPS	– Tea Development and Promotion Scheme
TGW	– Tea Garden Worker
USPC	– Universal Solar Pump Controller

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Executive Summary

SwitchON Foundation, with the support of Oak Foundation proposes to implement a project to improve energy security in the Tea Gardens of North Bengal. The proposed project will be implemented among 2500 Small Tea Growers and 2500 Tea Garden Workers in Jalpaiguri, Kalimpong, and Darjeeling, where many tea gardens are in remote, off-grid areas with unreliable electricity. DRE solutions, like solar power have the potential to mitigate many of the energy security challenges faced by tea garden communities and thereby improve their lives. DRE systems can also improve livelihoods by creating new job opportunities and contribute to local economic development.

The proposed project has the following **objectives:**

1. Enhance awareness about DRE solutions among all stakeholders
2. Facilitate an ecosystem for DRE solutions and their associated value chains to ensure access of tea garden communities to schemes, credit, technology, market and
3. Improve uptake of DRE solutions by tea garden communities through capacity and skill development

In the preparatory phase to this project, in-depth research was conducted comprising of 4 components:
1. Baseline Study to document baseline living standards, livelihoods, and awareness of DRE technologies.
2. Need Assessment to understand community and stakeholder perceptions of energy needs that can improve living standards and livelihoods.
3. Market Analysis for identifying renewable energy technologies based on availability, cost, and maintenance and
4. Scoping Study for mapping relevant schemes and the scope of linking identified needs with potential DRE solutions, as well as leveraging resource through government and non-government stakeholders.

A **mixed-methods approach**, combining quantitative and qualitative techniques was used to evaluate key indicators. Quantitative data was collected through ***household surveys*** among 550 respondents from tea garden communities to assess socio-economic factors, energy use, livelihood strategies, and awareness. Qualitative data included ***literature reviews, 21 key informant interviews, 26 focus group discussions with 301 participants, and resource mapping***. A multi-stage sampling approach ensured diverse representation from Darjeeling, Kalimpong, and Jalpaiguri. Data analysis involved coding qualitative data with QDA Miner lite and manual methods, while quantitative data was analysed using KOBO Toolbox and Excel for statistical and visual presentation. Findings were integrated and validated through triangulation for a comprehensive understanding. The key findings of the research are presented under five main sections:

- Awareness, Engagement and Resource Utilization among Tea Garden Communities
- Energy Security and Energy Requirement of Tea Garden Communities
- Viability and Potential of deploying DRE solutions
- Opportunities and Challenges in implementing DRE technologies
- Future Pathways

Key Findings of the Research

Awareness, Engagement and Resource Utilization among Tea Garden Communities

- 81.64% of the respondents are not even aware about the existence of DRE lighting. Less than 0.5% respondents have knowledge of schemes or financing options. Consequently, adoption of DRE lighting is very low at 0.18%.

- 97% of the respondents are not involved in any livelihood enhancement or diversification plan and 91% are not aware of any sustainable livelihood practices. This indicates a scope for both awareness generation and creation of alternate livelihood opportunities for the tea garden communities.

- 61% of youth are educated beyond grade ten. 44% of the youth are unemployed and only 15% youth are employed in non-tea related occupations. All these together denote a scope for upskilling of unemployed and underemployed youth in alternate livelihoods.

- Despite the promise of multiple benefits that can be accrued by adopting DRE based technologies, there is 0% uptake of solar devices like cooker, pumps, sprinklers, and sprayers. Even the generally more popular solar lighting has only 0.18% adoption. In addition to lack of awareness about the technology, the FGDs also revealed affordability constraints, lack of knowledge about credit options and institutions as well as perceived risks about breakdown and maintenance. All of these issues need to be addressed by the project in order to increase the adoption.

- 46.89% women are engaged in livelihood value chains. This provides a positive base to work on and increase women's participation in future. There is considerable variation in women's participation across the 3 districts and subsets (STGs and TGWs) indicating a need for a context specific intervention plan.

- 86% of the respondents shared that their families do not have any representatives in Community Based Institutions (CBIs). More than 95% of the respondents shared that CBIs are not rendering any help with respect to customer, technology, and scheme linkage. The only aspect where CBIs were rendering slightly better facilitation was in finance/bank linkage as stated by 10% of respondents. The data reveals a need for improvement in both constitution and functioning of CBIs. The CBIs also need capacity building and handholding in order to serve the needs of the communities better.

- The FGDs also revealed a potential role for STG associations and CBIs to engage with systems and structures that regulate and control prices so as to secure a better price deal for small farmers who are currently being impacted unfavourably.

Energy Security and Energy Requirements of Tea Garden Communities

- 39% of population did not have lighting that covered all parts of the house. The areas unlit include the backyard where bathrooms are located which compromises the safety of women and girls.

- Power cuts are a common occurrence in all 3 areas surveyed with variation in duration (1 to 10 hours) and population affected (30% to 83%). It is typically longer in the hills and during monsoons and storms.

- In case of power cuts and for non-lit areas of the house the most popularly used lighting sources are candles/firewood accounting for 57%, followed by battery-charged emergency lamps at 32% and kerosene lamps at 11%. There was no mention of solar lights usage in the survey or FGDs.

- The lack of adequate lighting at the household level, and public spaces creates several risks for tea garden communities including that of human animal conflict. It also reduces the hours of productive work and causes inconvenience to the tea garden communities. Alternate off grid sources of energy can be a viable solution for all these problems.

- Water scarcity is a major challenge in the hilly districts of Darjeeling (88.46%) and Kalimpong (97.14%) where the entire tea garden communities are dependent on tap water and also face issues with time of supply, maintenance, and servicing.

- As per the survey, 32% of the irrigation is done with rain water, 40% with groundwater and 10% with river water both drawn out with electric pumps. From the survey, FGDs and KIIs it is understood that the farmer's annual expenditure towards irrigation is quite high, either by diesel or by electric pumping. There is scope for transiting from electronic/fossil fuel pumps to solar pumps and also installing new pumps with grid and solar power in these regions.

- LPG is the primary cooking fuel among 78.37% STGs, 54.4% permanent TGWs and 29.35% temporary TGWs. Firewood or charcoal is the primary cooking fuel among 69.56% temporary TGWs, 44.8% permanent TGWs and 21.63% STGs. The annual expenditure on LPG as cooking fuel is around Rs 9000, making it challenging for the community to afford. Firewood emits particulate matter and contributes to indoor air pollution and global warming. Switching to solar cookers can be an answer to all these problems.

Viability and Potential of deploying DRE solutions

The market driver for DRE solutions includes the energy challenges due to limited grid infrastructure, government support through subsidies and policies, long term cost effectiveness and environmental concerns of non-renewable sources. The market challenges include the high investment and upfront costs, technological barriers, and operational and maintenance challenges. The market segmentation is in the form of the solar PV systems, biomass energy and mini hydel projects. This research and the proposed project will however limit itself to the solar solutions.

The DRE solutions though nascent currently, show promising growth potential and are applicable equally to STGs and TGWs. There are multiple stakeholders and initiatives from government to non-government which give the project sufficient opportunities for collaboration. There are several promising financing mechanisms and models that can be leveraged by the proposed project. The DRE (solar) solutions are relevant for domestic, livelihood, agriculture, and agro processing needs. The solutions are economically viable

and there are financing options available and some solutions like solar cookers when they replace firewood/charcoal, even have the potential to improve health and safety. There is a clear cost benefit to be accrued by the farmers if they transition to solar pumps as it will result in tangible savings from cut down of diesel/ electricity costs.

Many of the solutions be it at the household level or for agriculture/irrigation are being supported by a multitude of government schemes like PM Surya Ghar Muft Bijli Yojana, Aloshree, Jal Dharo Jal Bharo, PMKSY, NAIFF, FSSM, TDPS, DDUGKY and Anandadhara. Awareness generation on the schemes is not being addressed by the government but is something that is already being done by SwitchOn and can be strengthened further.

These solutions can enhance efficiency and sustainability in many sectors, but some areas require additional research and feasibility analysis. There are green job opportunities that can materialize by transitioning to organic farming, developing, and managing agroforestry, through installation and maintenance of solar gadgets and devices, and ecotourism in the tea gardens.

Opportunities and Challenges in implementing DRE technologies

- The strengths of adopting DRE technologies and solutions include their availability, economic benefits, its amenability to community participation/ownership and the presence of agencies that can provide training on them.

- The weaknesses in adopting DRE technologies and solutions include the present lack of awareness and technical skills, inadequate physical infrastructure, and the financial constraints.

- The opportunities that can be availed as well as created by adoption of DRE technologies and solutions include the many government schemes that can be leveraged, green jobs generation, contribution to climate change resilience and the provision of a pathway to community-based initiatives.

- The threats in adoption of DRE technologies and solutions include a range of challenges – economic, technologic, policy & regulatory and climate (extreme events).

The existing government schemes fall under six broad categories viz Roof top solar and street lighting, climate smart irrigation and water conservation, clean cooking, smart farm equipment, development of green skills and financial assistance. Some of these are for immediate intervention and others for intermediate intervention.

Future Pathways

Based on the in-depth research and contextual analysis findings, scope of intervention has been developed with activities pertaining to different stakeholders such as Tea Garden Communities (as a whole), Small Tea Growers, Tea Garden Workers, other stakeholders such as Tea Garden Management, Government Departments and PRI, Financial Institutions, Workers/ growers unions/associations, and CBO/NGOs. SwitchOn proposes to dialogue and actively engage with the different stakeholders to elicit their cooperation, support and participation in the implementation of the proposed project.

I. Introduction

1.1. About Oak Foundation

The Oak Foundation, established in 1983 by Alan M. Parker, is a philanthropic organization dedicated to supporting global initiatives in human rights, environmental conservation, child protection, and housing and homelessness. With offices in Europe, Africa, and North America, the foundation funds projects aimed at creating lasting social change. It focuses its resources on addressing significant global social and environmental issues, particularly those impacting disadvantaged communities. Through grant-making, the Oak Foundation supports initiatives that promote a safer, fairer, and more sustainable world.

1.2. The Tea Industry – Current Scenario

The Indian tea industry, ranking second globally in production, spans 51 million hectares and contributes 23% of global tea output (Tiwari and Chauhan 2016), with over 13,000 gardens producing 1,350 million kilograms of tea leaves annually. India exports tea to over 25 countries, generating USD 116 million in exports and providing livelihoods to 10 million people directly and another 10 million through related activities (Deshpande 2022). West Bengal, the second-largest tea-growing state after Assam, has 276 tea estates in North Bengal, employing around 2.5 million people (Afzal and Alam 2019). This region, including Dooars, Terai, and Darjeeling, produces 30% of India's tea (Anand and Sengupta 2023). The industry is crucial for West Bengal's economy, employing 262,426 permanent workers, predominantly women from tribal communities and other native communities speaking Nepalese. Challenges faced by tea garden workers include low wages, poor living conditions, inadequate healthcare, and limited education. Small, unorganized tea growers, producing nearly half of the total output, remain at the lower end of the value chain due to fragmented holdings.

Small tea growers encounter numerous challenges, including limited access to government schemes, technical knowledge gaps, infrastructure deficiencies, labour shortages, low green leaf prices, marketing issues, and financial constraints. These challenges result in a benefit-cost ratio of less than one, making it difficult for small growers to generate profits. DRE solutions introduced through simplified schemes and awareness programs combined with training programs that equip small tea growers with the requisite technical knowledge can be an answer to these challenges. Infrastructure

and automation support coupled with value added processing and improved access to credits and markets can significantly enhance productivity and efficiency.

Alternative livelihoods for tea workers are limited and include construction jobs, local businesses, eateries, broom making, and collecting non-timber forest products. Implementing and maintaining DRE systems can create new job opportunities in the renewable energy sector, contributing to local economic development.

Overall, DRE solutions are highly relevant and beneficial for tea gardens, offering sustainable, economic, and social advantages that can transform the industry and improve the livelihoods of tea garden workers.

2.Project Overview

2.1.Energy Security in Tea Gardens – Relevance and Rationale

The proposed project will be implemented in Jalpaiguri which is under the Dooars region, and Kalimpong and Darjeeling both of which are under the hill region. Many of the tea gardens in these places are located in remote or off-grid areas where access to conventional electricity is limited or unreliable. DRE solutions, such as solar power, can ensure a stable energy supply. Additionally, there are energy challenges related to inadequate lighting, electricity access, clean cooking solutions, and water access. Reliable energy access can improve working conditions for tea garden workers, providing adequate lighting and electricity for essential services. Access to clean energy can improve health outcomes by reducing indoor air pollution from burning fossil fuels and providing electricity for health facilities. Electrification through DRE solutions can support educational facilities and community development programs, improving the overall quality of life for tea garden workers and their families.

2.2. Specific Objectives

1. Enhanced awareness of tea garden communities and stakeholders regarding energy requirements in tea gardens and appropriate technology solutions towards enhancement of living conditions and diversified livelihood of tea garden communities.

2. Facilitating ecosystem around renewable energy solutions and associated resilient livelihood value chains to ensure access to schemes, credits, technology inputs and market (including job market) across the value chains.

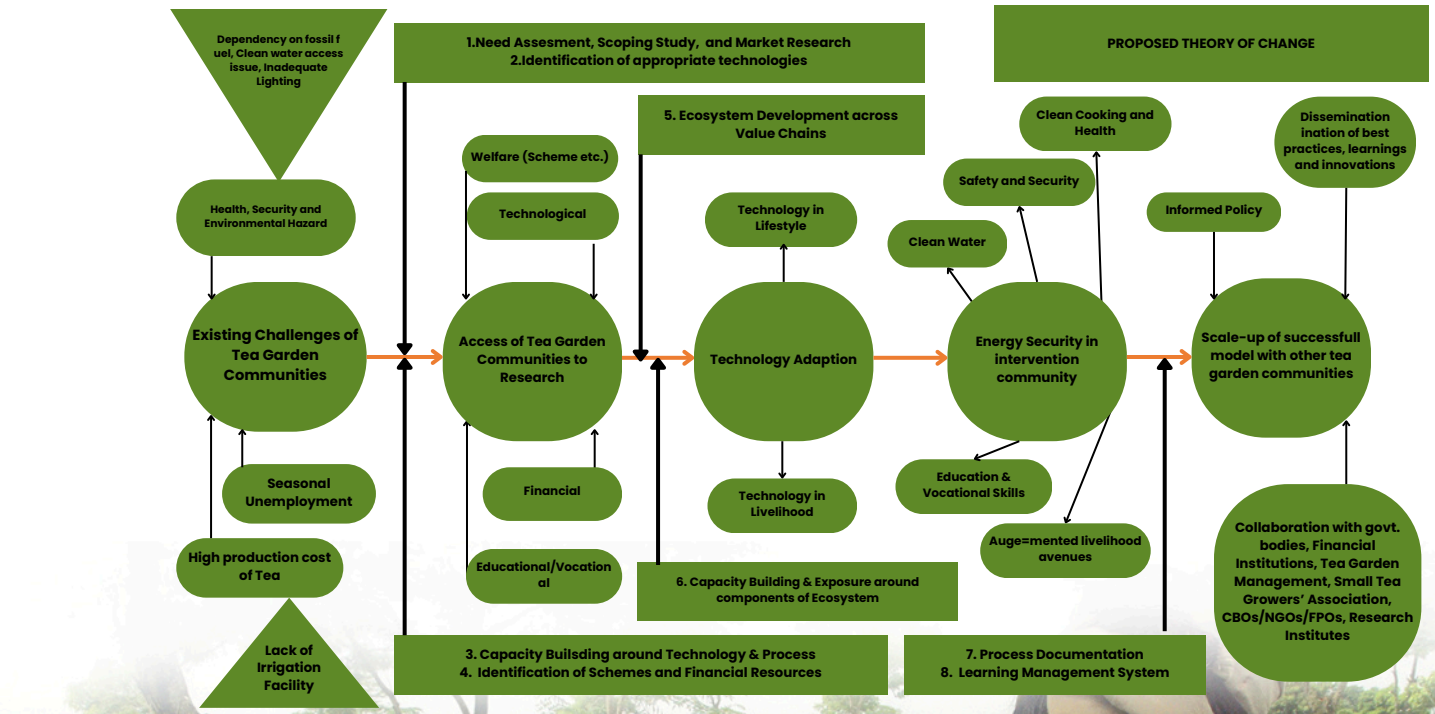
3. Improved living conditions and diversified income earning opportunities of the tea garden communities through improved access, capacity and skill development and adaptation around renewable energy solutions and associated livelihood value chains.

The Project's approach to solve the aforementioned problems involves a **four-pronged strategy**:

1. Conducting research for needs assessment,
2. Identification and sourcing of appropriate technologies,
3. Skill and capacity building around technology and process, and
4. Establishing an ecosystem that connects stakeholders across the value chain.

Proposed Coverage

2500 small tea growers and 2500 tea garden workers



3.Context Analysis and Flow of Research

3.1 Rationale for the Context Analysis - Conducting a context analysis before initiating the project on Decentralized Renewable Energy (DRE) was essential for the following reasons:

- Understanding local situations in terms of energy needs and consumption patterns of the community as well as the geographical and climatic conditions.
- Stakeholder Mapping that covers identification of all relevant stakeholders such as local communities, government bodies, NGOs, and private sector players and the degree of buy-in for the proposed project by each stakeholder.
- Assessing socio-economic factors such as the economic viability, affordability, financial sustainability and expected social impact of the DRE solutions for local users.
- Evaluating existing infrastructure and the level of energy access it provides and the degree of compatibility with new DRE systems
- Reviewing the policy and regulatory environment with regard to compliances and legal requirements as well as supportive policies which offer incentives, and subsidies for DRE solutions.
- Assessing technical feasibility pertaining to availability of renewable resources and selection of appropriate and sustainable technologies.
- Identifying potential risks and challenges that could impact the project and developing mitigation strategies
- Identifying the level of technical knowledge and capacity within the community that would in turn inform the need for training and capacity-building initiatives.
- Identifying ways to ensure efficient use of financial, human, and technical resources

3.2 Components of the Context Analysis - To gain a comprehensive understanding on all the aforesaid issues, SwitchOn designed four parts in-depth research for a thorough context analysis as follows:

Type of Research	Scope of Research
Baseline Study	Documenting Pre-Project status of Living Standard & Livelihood as well as awareness on / association with DRE technologies
Need Assessment	Energy requirement to enhance living standard and livelihood, as perceived by community itself and other stakeholders
Market Study	Identifying baskets of Renewable Energy Technologies along with availability, cost, and maintenance requirement (Techno-financial feasibility)
Scoping Analysis	Mapping applicable schemes and scope of linking assessed needs with potential DRE solution, schemes and liaison with Govt./non-Govt. Stakeholders for resource leverage

4.Research Methodology

The baseline study employed a mixed-method approach, combining quantitative and qualitative techniques to systematically assess the current status of the key indicators.

I. Quantitative Data Collection and Analysis:

Conducted through structured Household Surveys with a representative sample from tea garden communities (Tea Garden Workers and Small tea growers) to assess the socio-economic indicators, energy usage patterns, livelihood strategies, and awareness levels.

II. Qualitative Data Collection and Analysis :

This comprised of multiple components:

Desk Review:

Review of existing literature, reports, and data related to tea garden communities, renewable energy, and livelihood interventions in the study districts.

Key Informant Interviews:

with key stakeholders including tea garden workers, small tea growers, community leaders, government officials, and NGOs to understand perspectives, challenges, and opportunities.

Focus Group Discussions (FGDs):

with representatives from different segments of the tea garden communities to gather insights, perceptions, and priorities regarding energy, livelihoods, and technology adoption.

Mapping Exercise:

Mapping existing resources, infrastructure, and institutions relevant to renewable energy and livelihoods within the project area.

III. Sampling

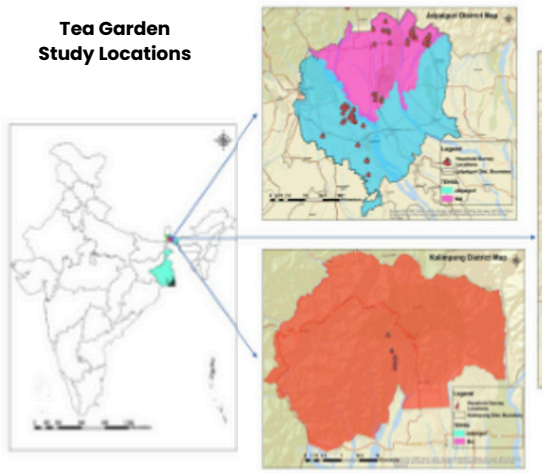
A **multi-stage sampling approach** was adopted to identify representative tea garden communities (both Tea Garden Workers and Small Tea Growers) in each of the study districts based on geographical spread, population size, and diversity of characteristics. A combination of probability and non-probability sampling techniques were used:

550 Household Interviews were conducted in Jalpaiguri, Kalimpong and Darjeeling with the Small Tea Growers (STGs) and Tea Garden Workers (TGWs) through Mobile Data Collection Tool (KOBO ToolBox).

26 FGDs were conducted with **301 participants** from the Tea Garden Community. Target specific KII Schedules were utilized for collecting information from different stakeholders. **21 KIIs** were conducted with different stakeholders, starting from Tea Garden Managements, Government officials, NGOs, Labour Unions, Tea Boards, etc.

Study Area

Tea Garden Study Locations



District	Block	Area
Jalpaiguri	Sadar	Bahadurpur , Satkhama , Manikganj , Botkabari
	Mal Bazar	Metli Area, Bagrakot Tea Garden , Raja Tea Garden , Nidam Tea Garden , Rangamati Tea Garden , Kamlai
Kalimpong	Gorubathan	Nim Basty , Dalim Basty
Darjeeling	Mirik	4 mile Area , 6 Acre Area

Field Operation

Name of the District	Category	HH Interview	No. of FGDs	No. of FGD Participants	KIIs
Jalpaiguri	Small Tea Growers (STGs)	181	4	41	
	Tea Garden Worker (TGWs)	178	15	169	
Jalpaiguri Total		**359**	**19**	**210**	
Kalimpong	Small Tea Growers (STGs)	21	3	35	
	Tea Garden Worker (TGWs)	14			
Kalimpong Total		**35**	**3**	**35**	
Darjeeling	Small Tea Growers (STGs)	6	1	13	
	Tea Garden Worker (TGWs)	150	3	43	
Darjeeling Total		**156**	**4**	**56**	
Grand Total		**550**	**26**	**301**	**21**

5.Baseline Study:

The primary objective of the baseline study was to comprehensively assess the current state and status of awareness, engagement, and resource utilization among tea garden workers and small tea growers in West Bengal's Darjeeling, Kalimpong and Jalpaiguri districts.

5.1. Key Findings

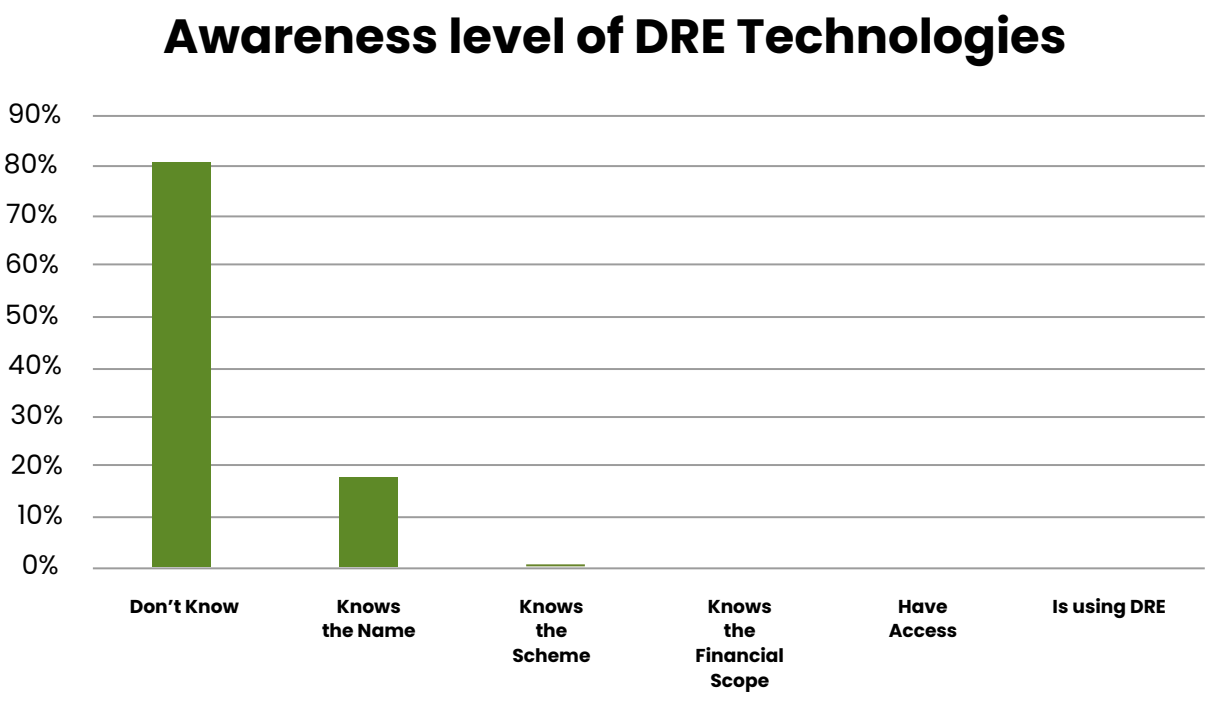
5.1.1.Level of DRE Tech awareness for lighting

- 81.64% of respondents are unaware of DRE technology for lighting. 18% are only aware of its name or existence. A negligible percentage know about specific schemes (0.36%) or funding opportunities (0.18%). Only one respondent (0.18%) reported using DRE technology for lighting.

- The data shows a significant lack of awareness about renewable energy solutions for lighting and related initiatives among the intervention community. There is also little knowledge about financial support mechanisms, and almost no adoption of renewable energy-based lighting solutions.

- District data reveals that 27.02% of respondents from Jalpaiguri know the name of DRE tech, while only 0.64% and 2.86% from Darjeeling and Kalimpong, respectively, are aware.

- FGD findings align, with few community members familiar with "solar panel" but unaware of financing options, linkages, and schemes. There is limited knowledge about Solar Lights and Solar pumps but not the technology or schemes. Few villages have solar street lights supplied by Panchayats or MLA funds.



5.1.2.Livelihood – Enhancement, Diversification and Sustainable Practices

Lack of Awareness on Sustainable Livelihood Practices: Out of 550 respondents, 499 (91%) reported having no knowledge of sustainable livelihood practices that incorporate environmental conservation, while only 51 respondents (9%) indicated awareness of such practices, showing a significant gap in understanding within the community.

Low Participation in Sustainable Livelihood Practices: Among the 550 respondents, 541 (98%) are not engaged in sustainable livelihood activities, while only 9 respondents (2%) are actively involved, reflecting a minimal level of participation in these environmentally-focused livelihood strategies.

It emerged during the FGDs that almost all the small tea growers in the hills (Darjeeling and Kalimpong) practice organic farming. Due to the market demands for organic tea, factories only accept tea grown without chemical fertilizers or pesticides and reject those which fail the regular checks. There is thus a community level thrust to maintain high standards of organic cultivation without any contamination. Despite this, communities failed to comprehend their methods as being a Sustainable Livelihood Practice indicating low awareness levels. In contrast, most small farmers, and tea gardens in the plains across Jalpaiguri utilize fertilizers and pesticides for tea and other agricultural purposes.

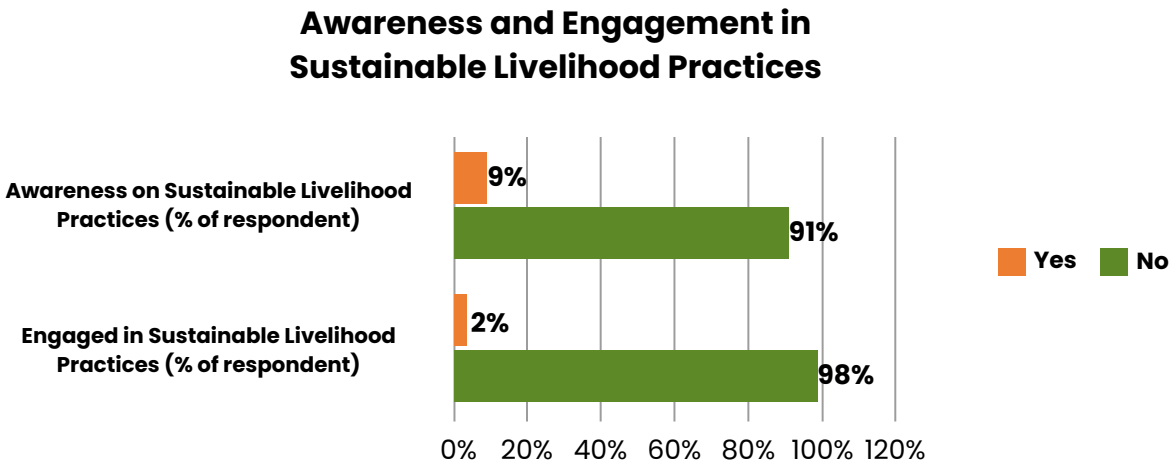


Figure 2: Awareness and engagement in sustainable Livelihood Practices

5.1.3.Status of Youth – Education and Employment

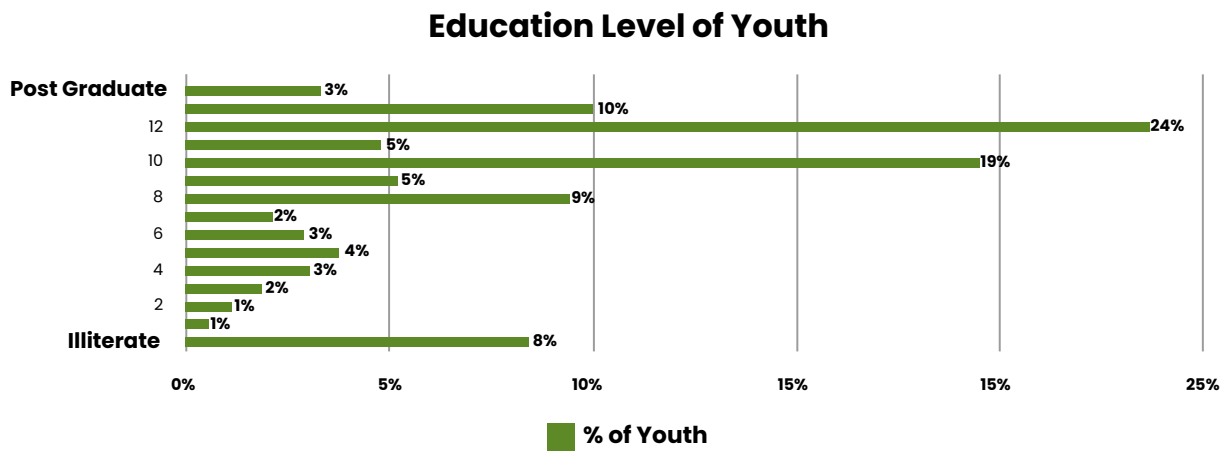
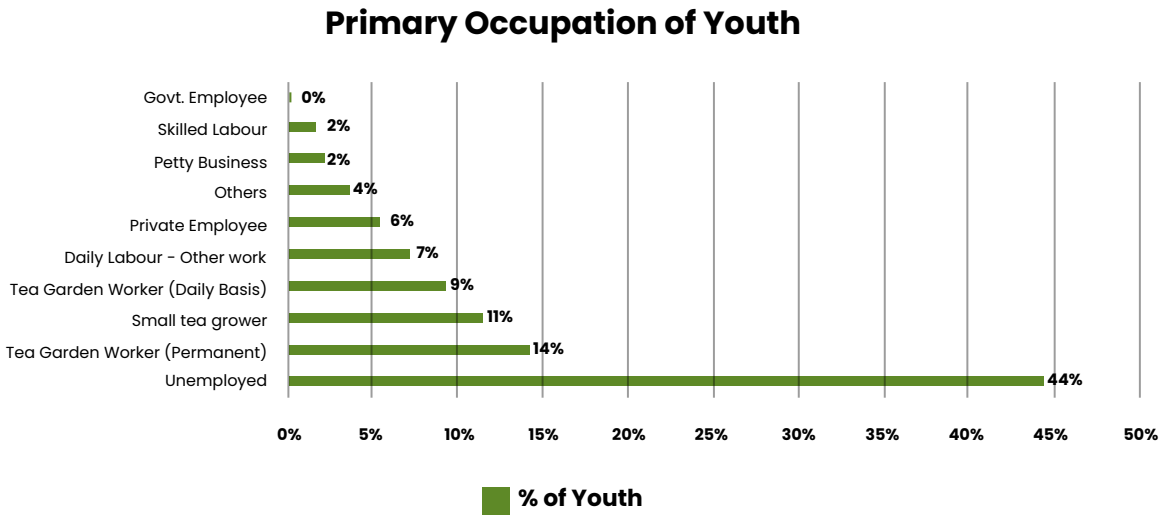


Figure 3: Youth education level

24% of youth have completed 12th grade, while 19% have completed 10th grade. 13% of youth respondents have studied beyond 12th grade, 10% of which are graduates and 3% are post graduates. Overall 61% of youth are educated beyond 10th grade.



About 8% are illiterate and 30% have been to school but have dropped before completing 10th grade. There is a greater degree of dropouts among boys at every level and is particularly pronounced after 10th and 12th grades. Secondary literature reveals that 84% of the estates have provision for schools within the estates and the rest 16% of the students have to travel to nearby schools for basic education.

-There is considerable unemployment (44%) as well as underemployment among youth as evidenced by the proportion of youth engaged in daily wage labour (9%) and petty businesses (2%). Tea garden employment, both on a permanent and daily basis, accounts for a substantial portion of youth employment, with permanent workers comprising 14% and daily wage workers comprising 9%. Additionally, about 11% of youth are engaged in small tea growing. The survey denotes the scope for upskilling of unemployed, underemployed and students.

-As for employment in non-tea-related occupations, it is limited to daily labour in other sectors (7%), private companies (6%), and skilled labour positions (2%). The data highlights the importance of diversifying employment opportunities to reduce dependency on the tea sector.

-There are notable gender disparities across occupations. For example, in tea garden workers and small tea growers, males dominate at 8% each, while females account for just 4% and 2%. In private employment, males make up 5%, compared to 2% for females. However, women are more frequently employed as daily wage laborers in tea gardens and other jobs. The percentage of unemployed males (24%) slightly exceeds that of females (20%).

5.1.4. Status of Access and Adoption of DRE Schemes, Credit and Technology

The data reveals a significant gap between the availability of various solar devices and their utilization within the intervention community. The renewable energy-based technologies, if adopted well, have the potential to transform lives and livelihoods. For instance, solar cookstoves can reduce reliance on traditional biomass fuels, mitigating indoor air pollution, reduce workload for women and reduce costs of buying fuel wood. Solar pumps/sprinklers can enhance agricultural productivity and reduce reliance on fossil fuels. Similarly solar sprayers can reduce labour requirements and increase efficiency in agricultural spraying. Despite these multiple benefits there is virtually no uptake of these solutions currently at the community level.

1.	100% no solar cookstove usage
2.	100% no solar pump/sprinkler usage
3.	100% no solar sprayer usage
4.	99.82% no solar lighting usage

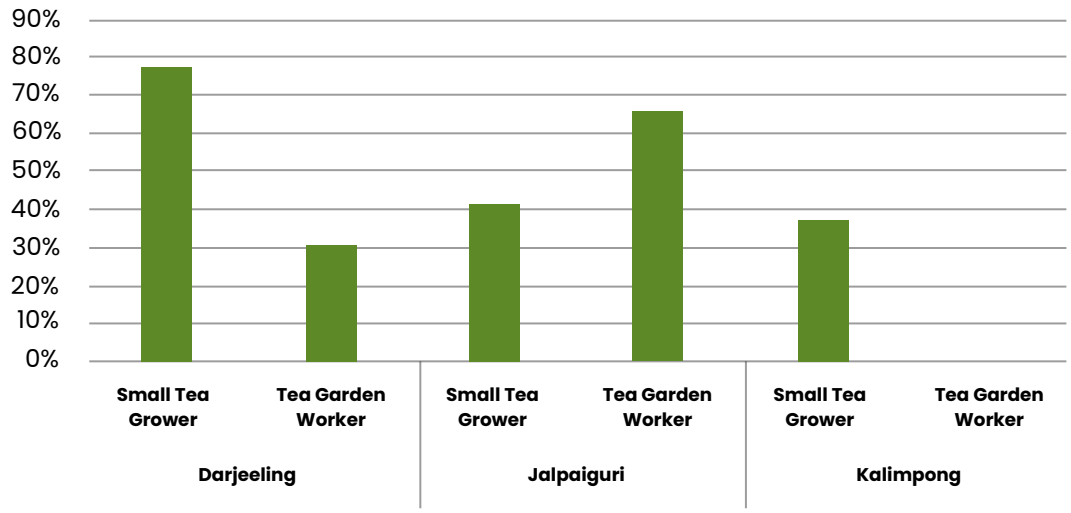
FGD findings also support the above data and further reveal that communities have no access to DRE solutions and there is also lack of awareness among them about all devices except solar lighting. Only some community members are aware of the solar street lights installed under the Panchayats and MLA LAD schemes. In addition to lack of awareness, the other barriers are affordability constraints, lack of technical knowledge or expertise, inadequate support infrastructure, and perceived risks associated with technology breakdown and maintenance. There is also a lack of awareness among community members about credit options and institutions offering credit for DRE technology and equipment.

5.1.5. Status of Women's participation in Livelihood Value Chains

The data shows that out of 546 women in the working age group, 256 are engaged in livelihood value chains which is an overall participation rate of 46.89%. This level of women's participation provides a greater scope for engaging them in future livelihood activities.

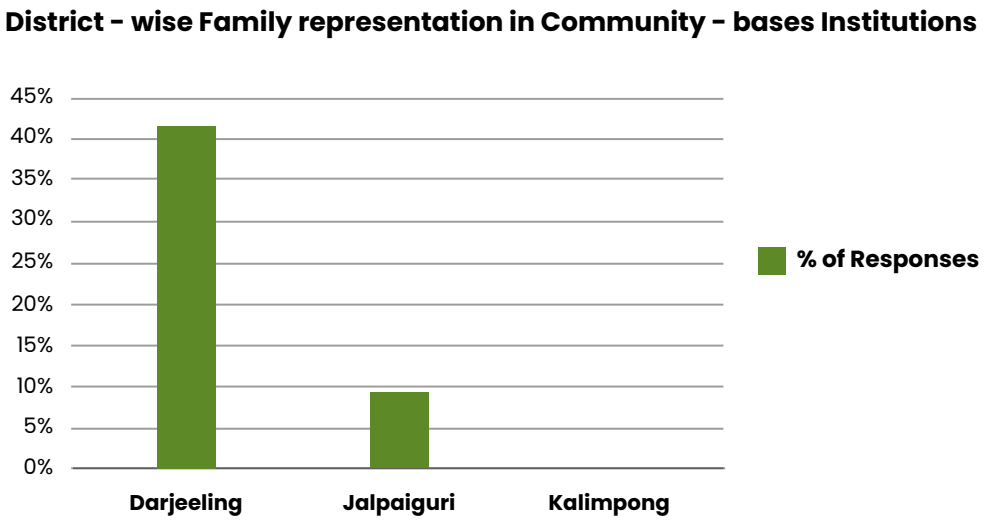
There's noticeable variation in the percentage of women working across different districts and subsets. For instance, while Darjeeling has a high percentage of women working as small tea growers (77.78%), the percentage drops significantly for Tea Garden Workers (31.13%). Jalpaiguri stands out with relatively higher percentages of women working across all subsets, Small Tea Growers (41.48%) and Tea Garden workers (65.63%). Kalimpong shows lower participation of women, particularly from Tea Garden worker's families (0.00%). This indicates a need for the implementation strategies and intervention plan to have a certain degree of context specificity for it to be successful.

Women's Workforce Participations in Different Districts



5.1.6. Community Based Institutions – Composition and Contribution

The majority of respondents (86%) indicated that their families do not have a representative in any Community Based Institutions (CBIs). This lack of direct involvement or representation within community-level organizations or institutions also restricts access to information and awareness on various DRE solutions. There is however considerable variation between districts as shown by the District Segregated data. 41.67% respondents in Darjeeling reported that a family member was part of CBI while the representation is only 3.9% in Jalpaiguri and 0% in Kalimpong.



5.1.7. Community Based Institutions – Role in customer and market linkages

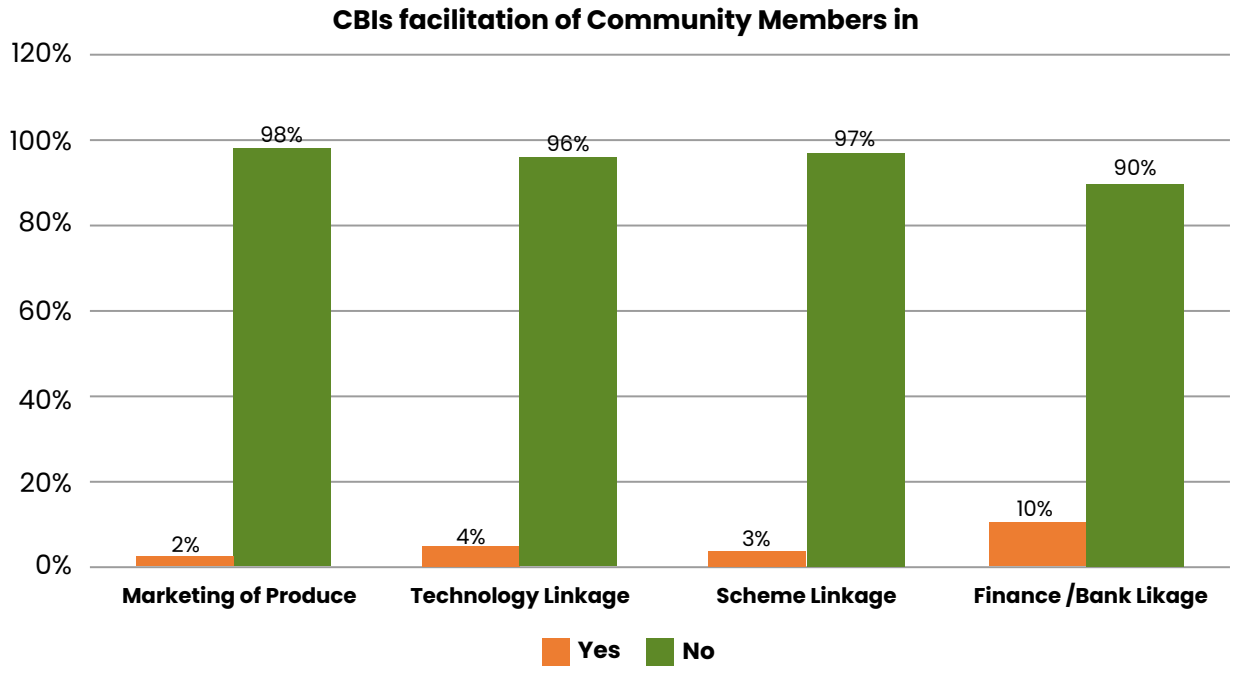


Figure 7: CBI role in customer and Market Linkage

The survey reveals that Community-Based Institutions (CBIs) play a minimal role in enhancing livelihoods, with 98% of respondents noting a lack of support in marketing produce and customer linkages, 96% citing insufficient technology access and promotion, and 97% reporting inadequate linkage to schemes and programs. Only 10% acknowledged some support in finance. Focus group discussions and key informant interviews highlight the need for capacity building in CBIs, as they primarily provide social service linkages but lack market or customer linkages. The tea industry's price setting is controlled by the Tea Board and local factories, leaving Small Tea Growers (STGs) with limited options and often forcing them to accept unfavorable prices. Training for STG associations and community institutions on engaging with these systems is essential.

5.2. Informing Policy

Existing policies such as the Plantation Labour Act and schemes by the Tea Board of India aim to regulate working conditions and provide support to tea garden workers. However, these policies do not adequately address the needs of small tea growers. While some stakeholder agencies have made efforts to adapt policies, such as providing training and subsidies for mechanized equipment to small tea growers, these initiatives are often limited in scope and reach. For instance, the implementation of subsidy schemes may face delays due to bureaucratic processes, resulting in challenges for small growers in accessing these necessary resources. There FGDs and KIIs did not reveal any instances where policies and guidelines were adapted by any of the stakeholders to facilitate seamless resource and market linkages.

In addition to the challenges outlined, there is also a significant regulatory gap regarding the classification of tea farming as agriculture in India. Despite its agricultural nature, tea farming is often not officially recognized as agriculture under Indian law. This exclusion has several implications for small tea growers and tea garden workers in these districts. Small Tea Growers fall under the purview of the Union Ministry of Commerce & Industry, leaving them ineligible for many key agricultural welfare schemes offered by the Agriculture Department. On the other hand, the Tea Board is a statutory body. It is a regulatory body attached to the Ministry of Agriculture and Farmers Welfare. Small tea Growers are however eligible for PM-KISAN scheme.

6. Needs Assessment

The primary objective of the Needs Assessment was to probe into the details of how the energy requirements are met currently and to understand current gap in energy security and energy requirement with respect to life and livelihood of tea garden communities.

Energy Mapping – Patterns in Demand (Current and Future) and Consumption		
Indicators (all in terms of energy needs)		**Interpretation**
Demography	Population density & distribution	Will reveal the rural electrification status in terms of demand, and public lighting Energy requirement changes with age (inadequate power supply influences the education of youth) Educated youth can be trained as solar technician-entrepreneurs
	Age, gender	
	Educational status	
Energy needs-Domestic	No. of houses with access to electricity for lighting	Reveals the current status of electrification in individual houses and whether there are any deficits
	No. of basic home appliances	
	Drinking water status (Quantity and quality)	Whether water needs to be pumped, if it is potable or needs filtration by electrical appliances
	Cooking	Whether cooking is being done with fuel wood, biogas, or LPG
Energy needs-Tea growers	Pumping water for irrigation	Reveals whether the source is clean energy and if it is adequate
	Heat and thermal for tea- process & packing	
Alternate livelihood (*farming other than tea gardens*)	Irrigation	Other farming needs water pumping: also if any machinery is being used for farming: processing and preserving the crops
	Farming	
	Processing and storage	
Alternate livelihood (tourism, chiseling/ crushing rocks or stones)	Lighting, home appliances	Need will vary based on the activity

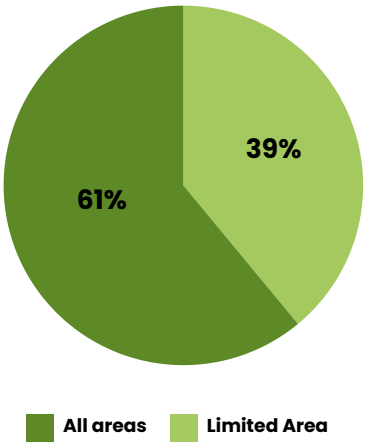
6.1. Key Findings

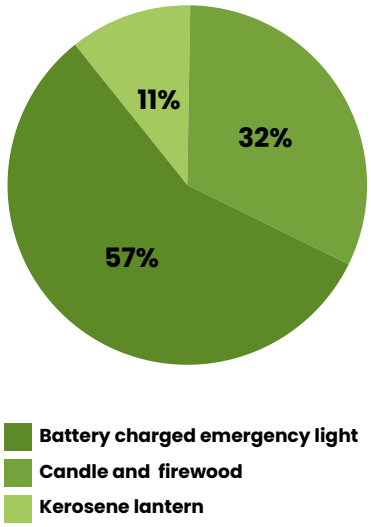
6.1.1. Electricity – Availability, Frequency of power cuts and Alternate options

The research looked into aspects such as coverage of electricity connection, lighting facilities indoors and outdoors, street lighting, and frequency of power cuts. The survey revealed that 15.60% of houses have no power in Jalpaiguri. 39% of the population lacked lighting in all parts of the houses. The parts without lighting might be in the kitchen, bathroom courtyard, etc. Lighting in the backyard is important, as many of the households have bathrooms outside. There is a safety risk to people because of proximity to forests or farmlands, which makes them prone to pest and animal attacks.

During day time Jalpaiguri faces power cuts for 1-2 hours with more than 80% on average. In the hilly regions, the power cuts occur for a longer time, 37.14% face it for 5-10 hours in Kalimpong, followed by 30.77% of Darjeeling for 2-5 hours. At night time Jalpaiguri faces the power for 1-2 hours with 83.01%. In the hills, the power cuts occur for a longer time (37.14% face it for 5-10 hours in Kalimpong, followed by 30.13% in Darjeeling for 2-5 hours).

As per the FGDs and KIIs, during the monsoon season there used to be 15-20 days long power cuts in Kalimpong, Jalpaiguri, and Darjeeling. During storms, transmission issues happen due to tree falls or transformer issues, but getting the power back takes more time due to a lack of technicians nearby, remote geographic location, communication delays, identification of the issues, etc. The same issues have been identified in other recently conducted surveys (Ahmed et al. 2015 and Afzal and Alam 2019).





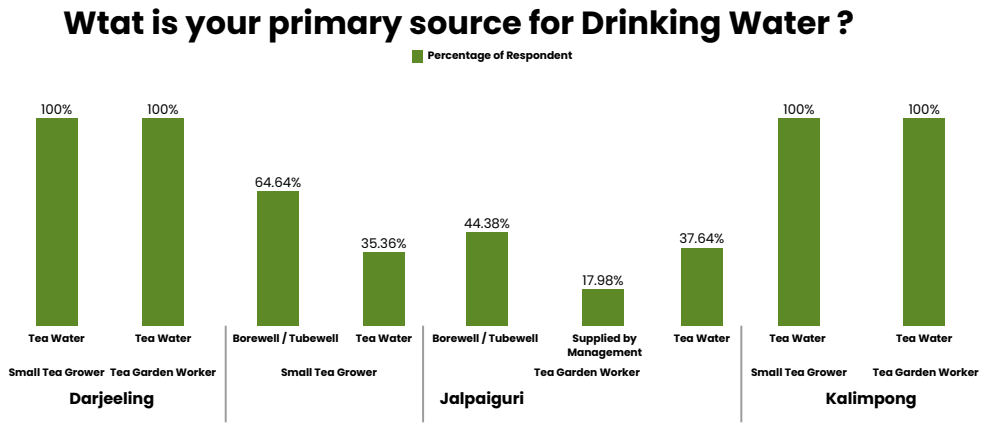
Alternate options:

In case of power cuts and for no-lit areas of the house, battery-charged lights, candles/firewood, kerosene lamps, etc are used. The most popularly used lighting sources are candles and firewood accounting for 57%, followed by battery-charged emergency lamps at 32% and kerosene lamps at 11%. Solar lights are not being used. FGDs revealed the use of mobile lights or small torches. The other surveys conducted recently also corroborate these findings and state that, during the power cuts, some families use electric charging lights, few use Kerosene lamps in households and no other alternate options are available on those days.

The FGDs revealed that there is a lack of enough lighting in the hilly regions of tea gardens. There are challenges due to attacks by wild boars and leopards and snake bites. This risk of wild animal-human conflicts prevails in the settlement colonies of workers in hilly parts of Kalimpong and Darjeeling. Precaution is important in all these places, and lighting in these regions can provide some kind of protection from such events. The group discussion also revealed that the lack of street lights on the roads leading to schools, markets, temples, PHC, govt offices, and main junctions causes inconvenience to the TGW and STG.

6.1.2.Drinking Water – Sources and Sufficiency

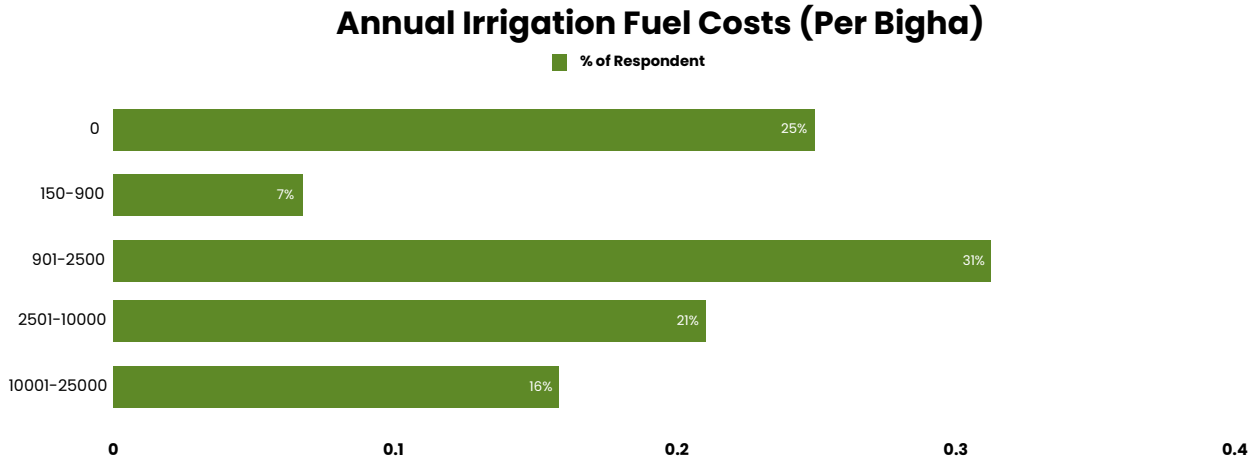
In Darjeeling and Kalimpong the source of domestic water supply for STGs and TGWs is tap water. In Jalpaiguri, 64.64% of STGs and 44.38% of the TGWs use borewells/tube wells to meet drinking water demands. Water scarcity is a major challenge in the hilly districts of Darjeeling (88.46%) and Kalimpong(97.14%).



In places where the groundwater is lifted manually, there is scope for installing pumps. There are water ATMs but the distribution is for less area and there can be more water points. Water points in the tea estates also are a requirement as the workers spend long hours in tea garden estates. Jalpaiguri and Darjeeling where the community receives tap water also face issues with time of supply, issues related to maintenance and servicing of transmission lines, lack of supply in rare cases, etc. As per the FGD findings, water scarcity occurs in few regions in the peak of summer in the districts. The tea garden sector is living in a very vulnerable condition as there is a lack of sanitation facilities, water supply, and primary healthcare centers. Previous research records revealed that there are severe water quality and quantity-related issues.

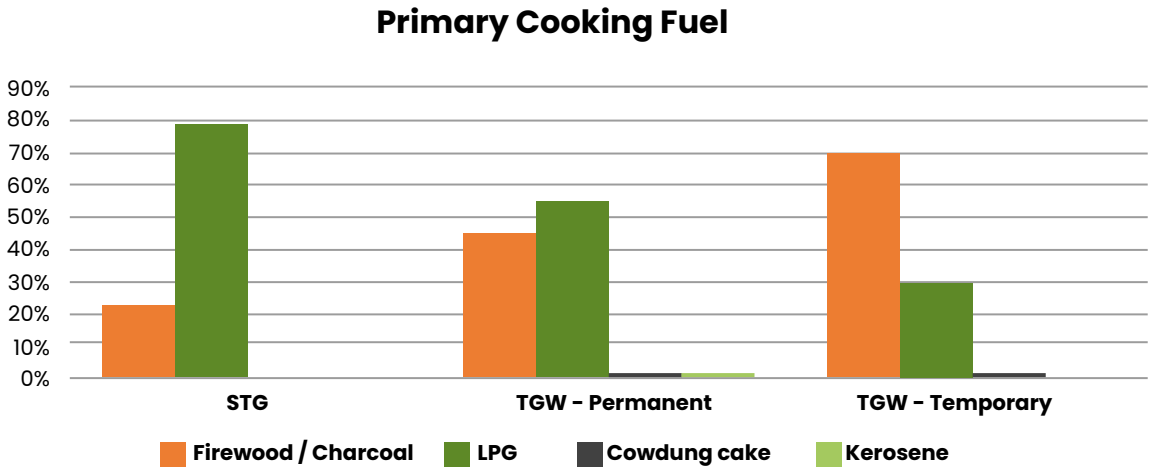
- Major sources of water include tube wells, hand pipes, and pipelines.
- Natural springs are the source of water in some of the areas.
- Gravity water is collected and used for drinking and to meet other water requirements.
- The water supply scheme of Swajaldhara is provided in five hills
- 24 in Terai and 32 in Dooars Tea estates in hilly regions of Kalimpong and Jaipalguri face severe water shortage issues, where spring water and Jhora are sources of water.
- Most of the areas have proper toilet facilities which are provided by government schemes
- Less than 15% of the population lacks proper facilities as per previous research records.

6.1.3.Water for Irrigation



Both for irrigating tea gardens and also for other farmlands, water is pumped from streams/ groundwater sources. As per the survey, 32% of the irrigation was done with rain water, 40% with groundwater and 10% with river water both drawn out with electric pumps. The survey also reveals that 16% had annual fuel costs ranging from Rs 10,001 -25,000, 21% with 2501 to 10000, 31% having 901 to 2500, and 7% from 150 to 900 INR. The annual fuel cost accounted for Rs. 20,000 for 10% of respondents, Rs. 10,000 for 11%, 2000 for 10%, and 1000 Rs for 12% of the population. As per the FGDs and KIIs, it is understood that the farmer's annual expenditure towards irrigation is quite high, either by diesel or by electric pumping. The irrigation demand in summer is soaring owing to the adverse impacts of climate change.

There is scope for transiting from electronic/fossil fuel pumps to solar pumps and also installing new pumps with grid and solar power in these regions. The survey revealed that average crop productivity is 72% in less than 1 bigha land, pointing to the major percentage of small land holdings. To conserve the groundwater resources, there is a need for rainwater harvesting structures integrated with solar pump installations. This will recharge the aquifer increasing its quantity and at the same time due to dilution, the chemical contamination (Iron, nitrates bicarbonates, etc.) is reduced.



The HH survey revealed that, in Kalimpong, Jalpaiguri, and Darjeeling the tea garden community used multiple options for cooking such as firewood, kerosene, cow dung cake, and LPG cylinders. LPG cylinders are used by 78.37% of small tea growers in the tea garden community. The remaining 21.63% of the community use Firewood/ charcoal as their cooking fuel. Among the tea garden worker community, among the permanent workers LPG cylinders are used by 54.40%, which is followed by firewood/charcoal as the second option for cooking by 44.80%.

Among the temporary workers, Firewood/charcoal is the major source of fuel for cooking, used by 69.56% and 29.35% use LPG for cooking. Most of the region has access to LPG cylinders. LPG is found to be the major fuel for cooking in Darjeeling and Jalpaiguri, with 60.9% and 60.17% respectively, followed by firewood used by 39% of the respondents in both districts. In Kalimpong, 57.14% use firewood/charcoal as the major fuel for cooking, and LPG is used by 42.86% of the respondents.

As per the FGD, the annual expenditure on cooking fuel is high, making it challenging for the community to afford. Around 9 cylinders (Rs 950 per cylinder) are used per annum as the cylinder typically lasts an average of 1.5 months, costing approximately 9000 Rs per year. In the case of firewood, though it is available free of cost in most cases, there is some kind of labour cost involved with preparing firewood. Firewood also has the drawback of emitting particulate matter, and global warming potential gases like carbon dioxide, carbon monoxide, and nitrogen oxide. In addition, sulfur oxides are also emitted which are gaseous pollutants. Indoor air pollution due to cooking with firewood can result in chronic diseases.

7.Market Analysis

7.1.Market Overview:

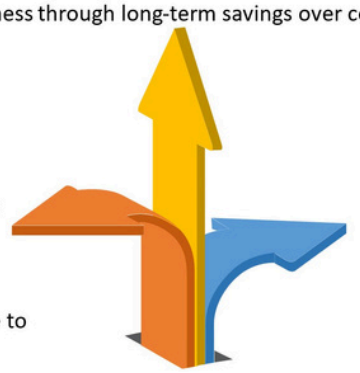
The primary objective of the Market Analysis was to evaluate the viability and potential of deploying decentralized energy solutions specially designed for the communities of small-scale tea growers and tea garden labourers in the area. In this market analysis, more focus has been given to solar-based energy sources rather than biomass, mini hydel, or wind considering the topographical and geographical features of Northern Bengal. The research carried out was based on reliable secondary data sources, based on local, central and state government data portals, agencies and departments, NGOs operating in North Bengal, reputable organizations of the tea sector like the Tea Board and different financing agencies.

Market Drivers

- Energy Access Challenges due to limited grid infrastructure which necessitates decentralized solutions,
- Government Support in the form of subsidies and policies that favour renewable energy adoption.
- Environmental Concerns that are promoting a shift towards cleaner energy alternatives
- Cost-effectiveness through long-term savings over conventional electricity.

Market Challenges

- High Initial Investment and upfront costs that deter adoption
- Technological Barriers due to Limited technical expertise and awareness
- Operational Maintenance challenges due to remoteness of locations



Market Segmentation

- Solar PV Systems that are suitable for domestic, tea sector, and agro units.
- Biomass Energy which is ideal for remote small tea processing units and residences.
- Mini Hydel Projects that can cater to local needs near riverine spots.

Scope of this research and the proposed project limited to Solar Energy only.

7.2. Current and Future Trends

Market Size and Growth The market for decentralized energy solutions in North Bengal for small tea growers and tea garden workers is currently nascent but exhibits promising growth potential. The increasing awareness of renewable energy, coupled with government initiatives, is driving the adoption of decentralized energy solutions in the region.

End-user Segments are mainly the Small Tea Growers who need reliable energy for irrigation, processing, and agricultural activities and the Tea Garden Workers who need improved living standards and productivity with energy access.

There is a **Competitive Landscape** comprising a mix of government initiatives, NGOs, and private sector players, including renewable energy companies, technology providers, financial institutions, and governmental agencies.

Regulatory Environment encompasses Government policies and regulations, including subsidies and tax credits, and promotion of investment in renewable energy infrastructure.

Market Outlook and Growth Prospects are positive with robust growth expected due to increasing energy demand, government support, and technological advancements.

Opportunities are multiple and cover factors like -

- Transition to renewable energy technologies.
- Technological advancements for cost reduction and performance improvement.
- Collaborative approaches for enhanced adoption and sustainability.

Financing Mechanisms are promising with options like Innovative financing models, such as pay-as-you-go systems and microfinance that can make decentralized energy solutions more accessible. NGOs and financial institutions can facilitate capital investment and conduct awareness training.

Relevance of Renewable Energy for the Tea Sector and Agro-processing is strong as:

- Solar systems combined with wind and biomass for heating are useful for agricultural products .
- Technical aspects include solar energy conversion methods, design considerations, and storage facilities.
- Practical solar products for domestic and livelihood needs, solar rooftop panels for home electrification, and solar-powered village infrastructure.
- Solar products for hybrid modes include solar irrigation, processing units, cold storage, lanterns, water purifiers, chargers, geysers, and room heaters.

Limitations and solutions

- Solar energy is diluted and intermittent, requiring large collection areas and storage systems.
- Sloped terrains require better energy-saving designs and installation.

Further research needed for high-quality tea processing units and detailed solar radiation distribution analysis.

7.3.Review Findings

Potential Solar-Powered Solutions and Associated Activities in various sectors or areas within tea gardens and horticulture - Some of these are solar powered irrigation in tea gardens, value added products from raw tea leaves, and preserving horticultural products. The analysis revealed that the transition to solar-powered solutions in tea gardens and horticulture presents viable options for sustainable development.

Solar irrigation systems have defined costs and available procurement options, with support from financial schemes and banks. Value-added processing units for tea and integrated farmers' units require further technical and feasibility studies to determine cost and implementation strategies. Solar cold storage for horticultural products is a promising solution for preserving produce, with microfinance available to support such initiatives. The overall conclusion is that, solar solutions can enhance efficiency and sustainability in these sectors, but some areas require additional research and feasibility analysis.

Comprehensive Market and Cost Analysis of Renewable Energy Products

At the domestic/household level it looks in to energy needs like basic electricity needs for gadgets/appliances, drinking water pumping and purification, energy for cooking, and heating in winter. At the public use level, it covers electrification of common areas in villages. The following were the major conclusions:

- **Feasibility and Economic Viability:**

  Solar PV systems for basic electricity needs and portable solar water pumps are economically viable and have microfinancing options.

- **Health and Safety:**

  Renewable products like solar cookers and biogas plants can reduce dependency on firewood and charcoal, improving health and safety.

- **Financing Gaps:**

  While some products have established financing schemes, others, especially those for heating and advanced water purification, lack economic feasibility and financing options.

- **Public Infrastructure:**

  Solar solutions for public areas like street lighting and mobile charging are cost-effective and supported by microfinancing, making them viable for remote areas.

- **Renewable Energy Adoption:**

  The research highlights the potential for increased adoption of renewable energy products in both domestic and public life, provided that appropriate financing and procurement schemes are available.

Potential Technologies for Renewable Energy (RE) solutions in the context of associated Government Schemes for different needs - Certain potential RE solutions like solar backup systems for households and lighting community spaces and tea gardens are being supported by government schemes like PM Surya Ghar Muft Bijli Yojana and Aloshree respectively. DRE awareness is not part of government schemes but is actively undertaken by SwitchON Foundation. Others like low wattage lighting households can be financed by Tea Garden Management or STGs themselves. Renewable cooking solutions like solar cookers and stoves offer a cost-effective alternative to LPG and fuelwood, with potential for significant savings for those currently spending substantial amounts on LPG.

Potential Technologies in the context of available schemes for Sustainable Agriculture and other Green Employment options

The findings are very encouraging as there are government schemes available for several critical aspects. For example, FSSM, AIF schemes for fixed pumps, Jal Dharo Jal Bharo, and PMKSY for irrigation solutions, MOFP schemes through DIC for integrated pest management, and for solar based processing units (along with NAIFF and FSSM),Tea Board Scheme (SHG/FPO), Tea Development and Promotion Scheme (TDPS)for value addition to organic tea, Anandadhara for increasing women's participation in income generation activities, DDUGKY, Minority Skill Development & Training for providing green jobs to youth. Awareness generation on DRE is not being addressed by any government scheme but can be covered by SwitchOn.

To address the high youth unemployment rate (44.33%) and the need for upskilling among tea garden workers (68.91%), particularly for female youth (42.15%), **a Framework for Green Job Opportunities** in Kalimpong, Jalpaiguri, and Darjeeling should focus on sustainable agriculture, renewable energy, and ecotourism. Sustainable agriculture can include transitioning to organic farming and agroforestry to enhance biodiversity and provide additional income. Renewable energy opportunities involve installing solar panels, biogas production, and waste management through composting and recycling.

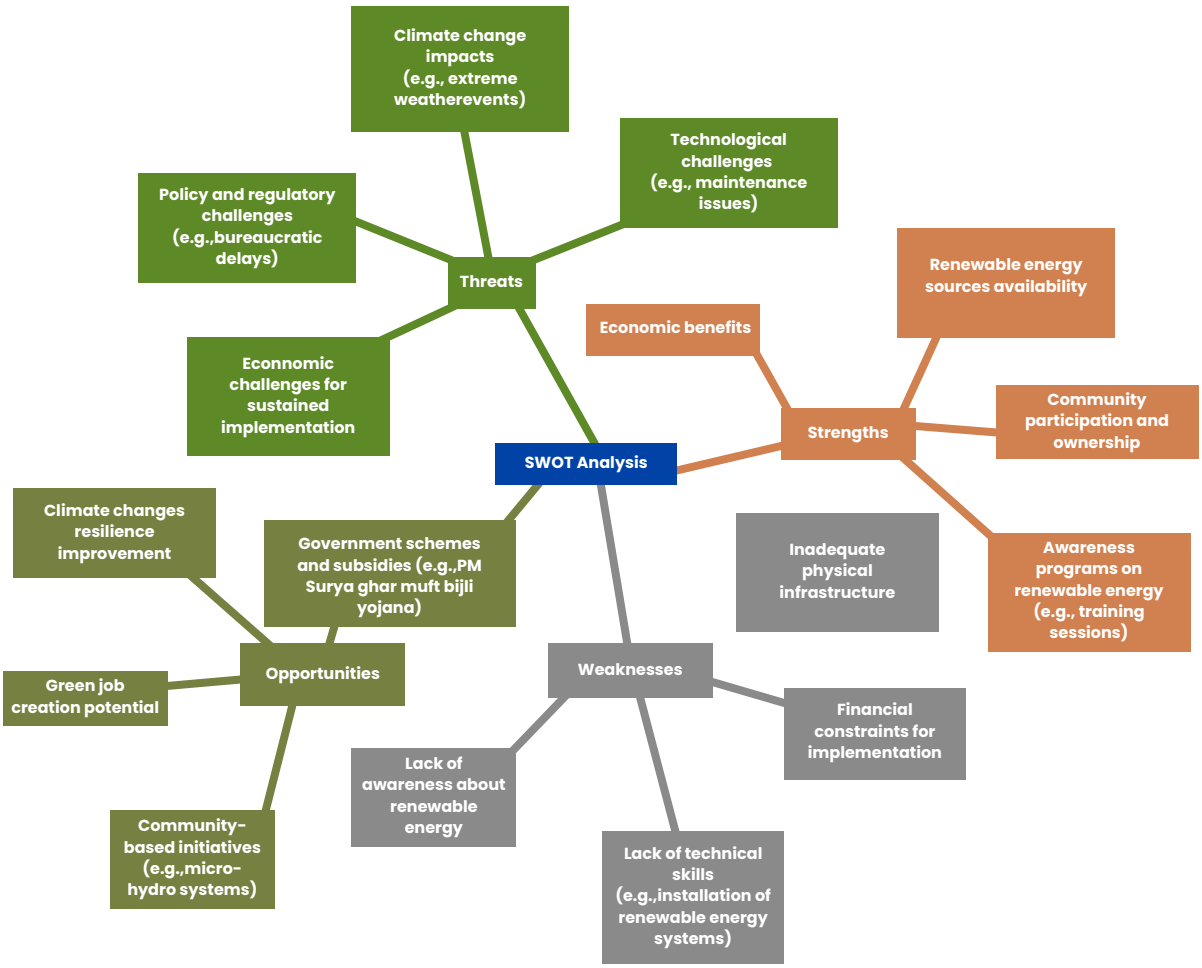
Ecotourism can generate revenue through eco-friendly tourism initiatives, such as tea garden tours and cultural experiences. Short-term goals (1-2 years) include education, training programs, feasibility studies, and pilot projects. Medium-term goals (3-5 years) involve building infrastructure and expanding successful initiatives. Long-term goals (>5 years) aim for widespread adoption of green practices to ensure sustainable economic, environmental, and social benefits.

8.Scoping Study

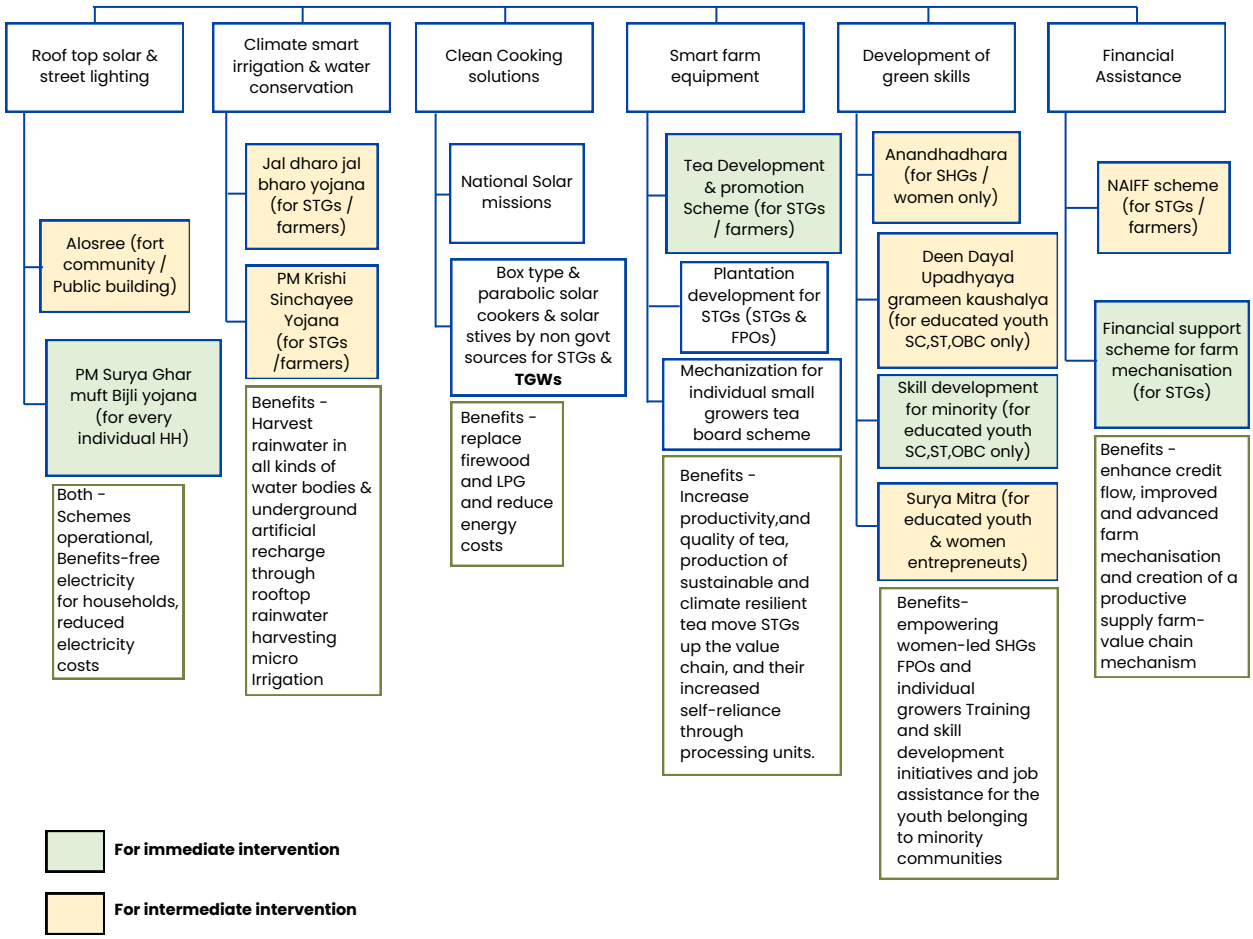
The study aims to create a comprehensive agenda that identifies challenges and opportunities for using innovative renewable energy sources to improve the sustainability and quality of life in the tea garden communities of North Bengal. The scope for the implementation of DRE technologies was explored in terms of 3 key parameters:

1. **Viability and cost effectiveness**
2. **Potential for livelihood enrichment**
3. **Efficiency and applicability**

8.1 SWOT Analysis



8.2 Scheme Mapping



Community Level Interventions

Barriers	Facilitators
• Lack of CBI involvement • Absence of community initiative for technical skill development • Lack of awareness for alternate livelihood generation • Lack of technical awareness about DRE solutions • Absence of active vendors for smart DRE solutions	• NGO (PRATHAM) facilitating vocational training • Common awareness of solar panels • Youth enthusiastic about skill development • 54.06% girls and 43.94% boys have class 10th and above education
• Lack of awareness among STGs about DRE benefits • Habitual practice of providing firewood and charcoal by tea garden communities • Out migration of youth causing labour shortage • Lack of efficient clean water supply for STGs and TGWs • Absence of strong network fort Green job creation	• Availability of PSU bank loans and NABARD schemes • Garden management's concern about schemes and subsidies • Willingness of tea garden management to install DRE solutions • STG associations interest in skill based training in agriculture • PRI leader;s interest in DRE training for panchayat heads • Panchayat annual plans facilitating DRE solutions

Barriers	Facilitators

Stakeholder Level Interventions

9. Plan of Action and Way Forward

9.1. Scope of Intervention

Based on the in-depth research and contextual analysis findings, scope of intervention has been developed with activities pertaining to different stakeholders such as Tea Garden Communities (as a whole), Small Tea Growers, Tea Garden Workers, other stakeholders such as Tea Garden Management, Government Departments and PRI, Financial Institutions, Workers/ growers unions/associations, and CBO/NGOs.

Objective- 1: Enhanced awareness of tea garden communities and stakeholders regarding energy requirements in tea gardens and appropriate technology solutions towards enhancement of living conditions and diversified livelihood of tea garden communities.

Intervention for Tea Garden Communities	Intervention for Stakeholders outside Communities
Sharing the research findings and introducing the project to communities.	Sharing the research findings and introducing the project to Govt. Departments in State and Districts, Intervention Block Offices, Intervention Panchayats, Associations of tea growers/workers, Financial Institutions (Banks, etc.), Tea Boards, community leaders, and CSOs/NGOs/FPOs.
Overall awareness of DRE technologies to solve their problems, who are the stakeholders, how this project will engage with them, and what to expect from these engagements.	Appraising relevant stakeholders about the knowledge/awareness of tea garden communities being built on DRE technologies, the expected demand for DRE solutions/devices and the support/facilitation required for meeting the demands.
Village/Community Development plan (DRE solution and livelihood enhancement) with resource convergence aspect at the smallest community unit (Tea Garden/STG village etc.) level	Communication/submission of Community Development Plans to concerned stakeholders/authorities for further resource leverage and time-bound action plan

Objective- 2: Facilitating ecosystem around renewable energy solutions and associated resilient livelihood value chains to ensure access to schemes, credits, technology inputs, and markets (including job market) across the value chains.

Intervention for Tea Garden Communities:	Intervention for Stakeholders outside Communities:
Scheme linkage for Home System, Solar Water Pumps	Common stakeholder forum with periodic meetings to learn from and support the project.
Trials/Demonstration of DRE-based environmentally viable filtration process for purifying the water coming from the step-wells	Promoting the dealer-distributor network as part of the ecosystem.
Scheme linkage for solarization of welfare institutions like schools, health centers, etc.	Organizing Technology and Buyer expo on a yearly basis
Enrollment and training of youth in Green Jobs	Documentation and dissemination of best practices and learning from the project- brochures on the project, media outreach, webinars, and workshops with stakeholders.

Intervention for Tea Garden Workers:	Intervention for Small Tea Growers:
Scheme linkage / CSR linkage for community lighting within and around Tea Gardens	Scheme linkage for introducing Smart irrigation solutions including Solar Pump and Micro-Irrigation Systems
Trial/Demonstration of renewable cooking solutions and to reduce the usage of conventional firewood/ charcoal.	Introducing the smart DRE-powered solutions (equipment like Sprayer, Insect Trap, etc.)
	Household-based livelihood enhancement/diversification planning
	Digital Knowledge Centre through Learning Management System (LMS) on mitigation of agro-technical challenges, Distributed Renewable Energy (DRE) Technologies and their application by creating videos, courses, etc.
	Promote community institutions for scale and market linkage

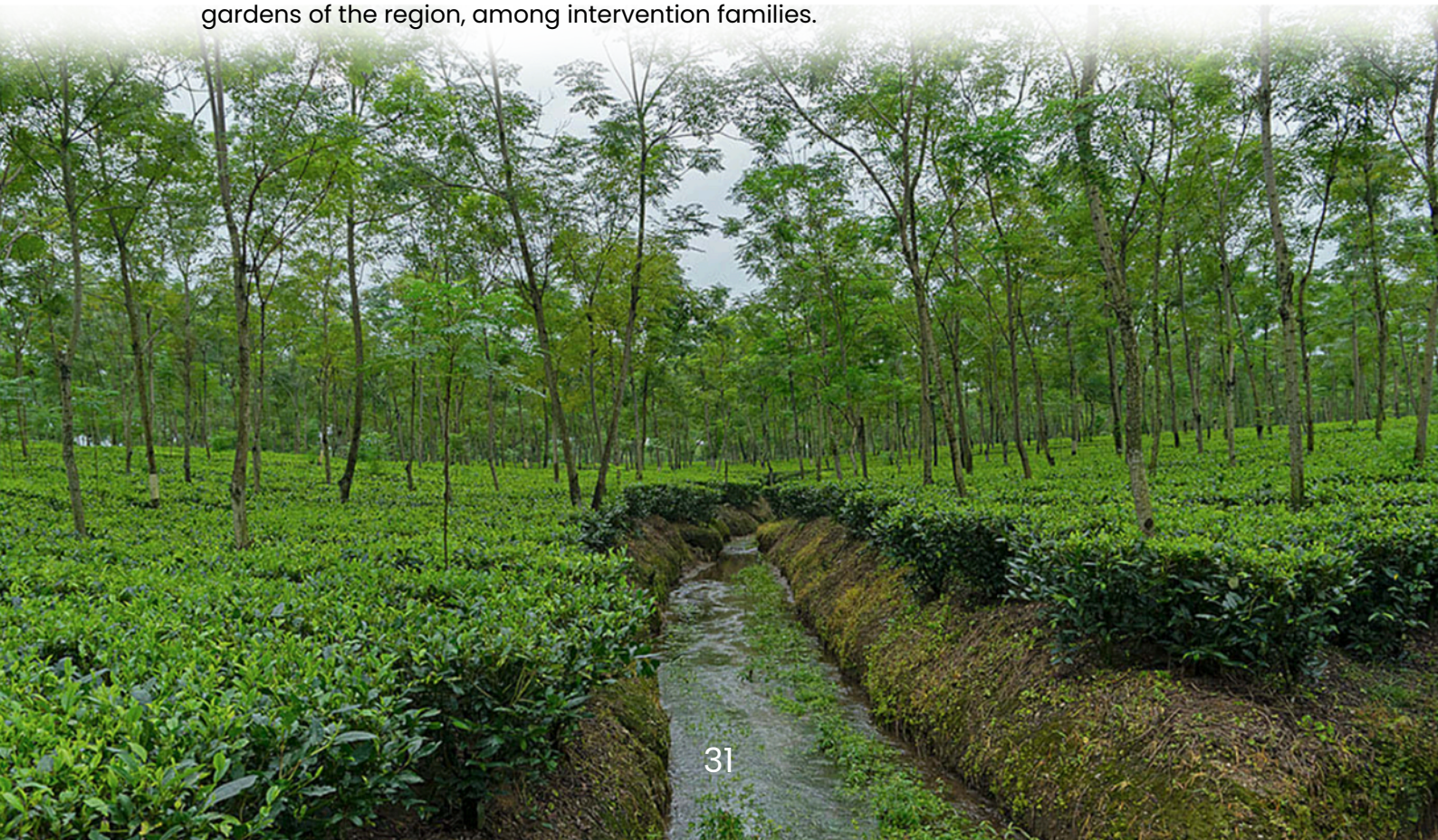
Intervention for Tea Garden Management:	Intervention for Govt. Dept. & PRI:	Intervention for Financial Institutions:	Intervention for Workers'/ Growers' Union/Association & CBOs/NGOs:
Pursue Tea Garden Management to invest in community infrastructure like streetlights and rooftop solar in schools and streets (wherever there's low penetration of Govt. schemes)	Pursue Govt. departments at the district level to issue circulars at C.D. Block offices for smooth implementation of schemes with the support of community institutions, leveraging resources through the GPDP (Gram Panchayat Development Plan) exercise.	Pursue regional bank branches to issue circulars to local branches for orientation of bank officials to financial models (including pay-back pivot) associated with RE adoption by the community.	Partnership for selection of area, deployment of community resource person, training support, and scale-up.
Informing policy at the local, regional, and national levels to facilitate seamless resource and market linkages for the replication of successful models.			

Objective- 3: Improved living conditions and diversified income-earning opportunities of the tea garden communities through improved access, capacity, and skill development and adaptation around renewable energy solutions and associated livelihood value chains.

Intervention for Tea Garden Communities:	Intervention for Stakeholders outside Communities:
Installation of DRE solutions followed by on-field support to the community on operation, maintenance, and initial troubleshooting	Formal/Informal agreements between Community Institutions and respective authorities for the sustainability of the ecosystem after the project period
Technical Training of the community on DRE solutions and livelihood value chains along with associated livelihood calendar	
Handholding support to the STG community across the livelihood value chains by utilizing infrastructure, training centers, and livelihood support centers	
Leveraging scope for placement of youth in Green Enterprises.	
Establish a mechanism of O&M at the local level, for DRE technologies	

9.2. Expected outcomes of intervention:

- Increased awareness among at least 80% of intervention families regarding the potential of renewable energy-based technology solutions to enhance their livelihood and living conditions.
- Heightened awareness among at least 60% of intervention families regarding sustainable livelihood practices, including technology, schemes, finance, and markets.
- Voluntary enrolment of at least 40% of individual households in the intervention community into the livelihood enhancement and/or diversification plan, inclusive of training and resource linkages.
- Community institutions to initiate resource linkages (schemes, finance, technology) among intervention families.
- 40% employment uptake of youth in intervention families about green jobs as a viable livelihood option within and beyond the tea garden region.
- Access (scheme, credit, technology) to and adoption of renewable energy-based technologies by at least 40% of intervention families, enhancing both living conditions and associated livelihood value chains.
- Proactive participation of at least 50% of women across the livelihood value chains embraced by intervention families.
- Community institutions as nodal points for market and customer linkages, ensuring optimal price realization.
- Informed policy/implementation guidelines adaptations by stakeholder agencies and traction towards leveraging resources for replicating successful models in other tea gardens of the region, among intervention families.

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