Framework Convention on
Climate Change

Submitting organization: **BAIF Development Research Foundation**

Description of climate action

1. ***Description of the climate action:***

   Timely irrigation is crucial for agriculture which is the primary source of income for a vast majority of rural population. About 53% of India's net sown area is irrigated, leaving the remainder reliant on rainfall1. Even for those farmers with assured irrigation facilities, lifting water from a source to the fields is a major challenge. Water lifting for domestic uses is another area that is as important as agricultural usage. The absence of water-lifting applications leads to drudgery in fetching and carrying water from a source. It also has an adverse effect on health and sanitation. Electricity supply, though highly subsidized, is largely erratic in rural areas. Fossil fuel usage for water pumping is neither economical nor sustainable. Solar energy for water lifting is a good renewable energy alternative. Being a tropical country, available solar insolation can suffice most of the requirements. However, initial cost is a hindrance which often leads the potential user to overlook the negligible operational costs. However, with the advances in technology over a period of time and various assistance schemes, the initial cost burden is gradually reducing.

   It is in the above context that BAIF initiated the promotion of this renewable energy application through various programs. The use of solar energy for irrigation can make the farmers self–reliant. While the focus has been on clean energy and sustainability, it is imperative to ensure that the intended application is efficient. Hence, efforts have also been taken to integrate solar water pumping with water conservation and use efficiency initiatives. Since the quantity of water required is drastically reduced through efficient irrigation systems, pumping capacity too can be scaled down, resulting in reduced initial costs. Shared usage among a group can be an added advantage. Mitigation potential of solar powered water lifting when compared with the conventional fossil fuel run pumps is considerable. Further, critical irrigation is also instrumental in resilience building among small holders.

2. ***Name of the policy action:***

   Solar Powered Water Lifting: De-centralized Renewable Energy for Climate Positive Action & Enhancing Living Standard.

3. ***The objective of the action:***
   The primary objective of the action is to harness renewable energy for sustainable access to irrigation and domestic usage while aligning with the Nationally Determined Contribution.

4. ***The country in which the policy was implemented:***
   India

5. ***The geographical coverage of the action:***
   National

6. ***Classification of the action (Programme, policy, or project):***
   Programme

7. ***References such as link to a website:***
   https://baif.org.in/what-we-do/solar-energy

8. ***Other relevant details about the climate action, as necessary:***
   The climate action primarily focusses on the most vulnerable section of the agrarian community – small holders & rain-fed cultivators. The sum total with the substantial scale of the collective poses a formidable dimension to the mitigation efforts.

9. ***The type of action (Adaptation, mitigation, or both):***
   Mitigation

10. ***The sector(s) targeted by the policy:***
    Agriculture; Energy

Co-benefits and assessment of co-benefits of the climate action

11. ***The area(s) for which co-benefits were monitored***
    1. Energy generation
    2. Positive effect on income
    3. Access to water.

12. ***The co-benefits that have arisen from the implementation of such climate action, including secondary co-benefits that may arise from the identified co-benefits:***
    Reference is from 392 solar pump installations by BAIF across 13 states in India covering over 12,000 households.

1. Clean, localized energy generation: It can be observed that the daily energy generation potential is 7,978 kWh, assuming five sunny hours. This results in an annual energy generation capacity of 1.91 million kWh, corresponding to the generation of about 154 kWh per household annually (considering 8 non-rainy months in a year). While the all-India per capita consumption of electricity stands at 1,255 kWh for 2022–232, rural household consumption is 724 kWh annually3. In this context, it is notable that the participants associated with the solar pump initiative are able to generate over a fifth of their consumption sustainably. This generation is substantial, particularly given that a significant proportion of rural electrified households consume less than 50 units monthly.

2. Savings on conventional fuel resources: Annual energy generation by the installed solar pumps is 1.91 million kWh. Considering the unit cost of electricity to be ₹6 per unit4, the monetary value of power generated comes to approximately ₹1.15 crore annually. When compared with the initial setup cost of about ₹8 crore (assuming ₹50,000 per hp installation cost of the solar system), the proposition does not present an attractive payback on account of the availability of highly subsidized and cheap grid power for residential/agricultural consumption. However, reliability and continuity are major issues in grid power, which justifies overlooking the apparently high opportunity cost of solar energy.

More importantly, it will be prudent to compare solar power with diesel—the next common fuel for running water-lifting applications. Taking the specific fuel consumption of diesel-driven pumps as 0.25 litres per hour per hp, the total quantity of diesel saved by adopting solar energy in BAIF's installations would be about 478,650 litres annually, worth more than ₹4.4 crore (assuming operations of 5 hours daily for 8 months in a year with the diesel price at ₹92 per litre). Therefore, the substitution of diesel pumps with solar pumps presents a viable alternative with an attractive payback of 1.8 years. Moreover, savings to the national exchequer in terms of crude oil imports and contributions to a cleaner environment are added advantages.

3. Access to water: It can be seen that 12,419 households are able to have better access to water through the lifting and conveyance of water from a source. While prime importance is for ensuring the availability of water beyond monsoon, many a time, lack of easy access becomes a crucial impeding factor. Solar pumps present a sustainable solution for the execution of decentralized water-lifting applications. Along with the focus on productive application like irrigation, access to water for domestic use is also important, covering aspects like drudgery reduction, water purification, availability at / near doorstep etc.

13. Explanation of how such co-benefits were assessed and analyzed in detail, including how the assessment accounted for, among others, different groups of

stakeholders, different types of households, gender considerations, and benefits to vulnerable groups:

The co-benefits have been assessed using empirical references by taking into consideration the participant households. Secondary data sources have been referred to for quantifying the indicators like fossil fuel consumption and energy use. Available standard references are also included for assumptions. Benefitting households have been the reference for assessment. Assessment emphasized on benefits the participants derive with the adoption of clean energy for water lifting.

14. The process, including methodology(ies) that was used and data collection, of the assessment and analysis:

Installations are across the program areas of BAIF. Data has been collected and reported by the field team from the respective locations. Each location has reported data related to installed capacity, energy generation, households covered and usage.

15. The sources of data that were used in the assessment and analysis:

Sources of data include:

Primary source: Data collected from the installation sites pertaining to installed capacity, energy generation, use and household coverage.

Secondary source: Data pertaining to average household energy consumption, specific fuel consumption.

16. The actions undertaken to promote the co-benefits, if applicable:

While the primary benefit pertains to enabling irrigation, the co-benefits such as localized clean energy generation, access to water, income augmentation and drudgery reduction are equally important from the perspective of enhanced living standard and sustainability. Promoting adoption among the intended participant group involves creating awareness about the additional benefits as compared to the conventional sources or the expected new benefits for greenfield installations. Financial assistance in the form of subsidies and grants also contributes to highlight the benefits.

17. The actions undertaken or policy/plan put in place to maximize these co-benefits, if applicable, noting the co-benefits,:

1. Promotion of shared usage for maximizing benefits and reducing the costs.
2. Availing financial assistance in the form of subsidies and grants for increasing coverage.
3. Exploring multiple usage models for enhancing the utility value.

18. The indicators that are used to monitor these co-benefits, if the implementation of these climate actions includes monitoring of co-benefits:

1. Application: It can be observed that a majority of the installations through BAIF have focused on irrigation (69% in terms of the number of installations and 70% in terms of installed capacity). It is advisable to prioritize a productive application like irrigation for such high-cost technology. The enhanced returns from the intended use should be able to pay for the cost of technology. At the same time, welfare initiatives like drinking water supply will require greater support but are important from the perspectives of equity, drudgery reduction and health.

2. Shared usage: It can be seen from BAIF's installations that in the case of irrigation, there are 2.5 households per hp on average, while there are 20 households per hp for drinking water installations and 5.2 households per hp for dual-purpose installations. Increasing shared usage for irrigation can ease the burden of the initial investment. The focus should be on enhancing shared use for irrigation. In the case of drinking water installations, intended shared use is evident. However, maintenance and free ridership issues are to be taken care of.

3. Optimal utilization: The above aspect of shared use is also linked to optimal utilization. Increasing the number of users per pump can lead to continuous harnessing of solar energy and increase the load factor of the installation. Sub-optimal utilization will result in solar pump lying idle and wastage of energy generation potential. Integration with efficient usage like drip irrigation is also required.

4. Emphasis on low-capacity installations: The average unit capacity is 4 hp, and the highest installed capacity is 20 hp for BAIF installations. In the case of a decentralized system like solar lift irrigation (LI), it is desirable to adopt an approach of promoting smaller capacity pumps for dual efficiencies—energy and water. The paradigm of "more crop per drop" should hold true for energy use as well. Farmers tend to upsize their conventional pumps to overcome variations in electricity availability. This issue no longer exists in solar LI, so the focus should be on appropriate pump capacity. Moreover, it is the economically weaker section that cannot afford higher recurring energy costs. Their requirements can be easily met through pumps of 1–5 hp capacity. Therefore, promoting the use of solar LI among smallholders is essential.

19. The challenges, barriers and lessons learned from assessing, analyzing and monitoring, as applicable, the co-benefits of climate actions:

1. Grid feeding: It is observed that all the installations are standalone units. While the main advantage of solar pumping is the flexibility in scale and de-centralization, the installations can have more utility value by leveraging their energy generation potential. The usage is generally considered for 8 months only & that too not in a continuous manner as the needs vary. Grid feeding can be a viable alternative during lean seasons and idle time. This will also result in supplementary income / additional savings for the

user/s. However, this has not been widely adopted due to the absence of a uniform policy and infrastructure issues.

2. Financial assistance: Significantly, solar pump prices have dropped to about ₹50,000 per hp. However, this is still beyond the reach of most small and marginal farmers, who require such low operational cost technologies the most. The present installations in BAIF program areas are based on a model of part grant and part contribution, with contributions ranging from 10% to 50%. It is essential to incentivize farmers for the adoption of clean energy.

Any other relevant information:

The initiative has the potential for transforming the rural economy with its immense enabling capability. At the same time, contribution to nationally determined contribution can be substantial, thereby aligning with national goals and environmental well-being. The assessment has been primarily done from the dimensions of decentralized, clean energy. Assessment of income augmentation resulting from additional season of cropping needs to be captured to understand household level livelihood changes.