CASE STUDY - India

Bamboo Used at Biogas, Solar within Eco-Village Developments

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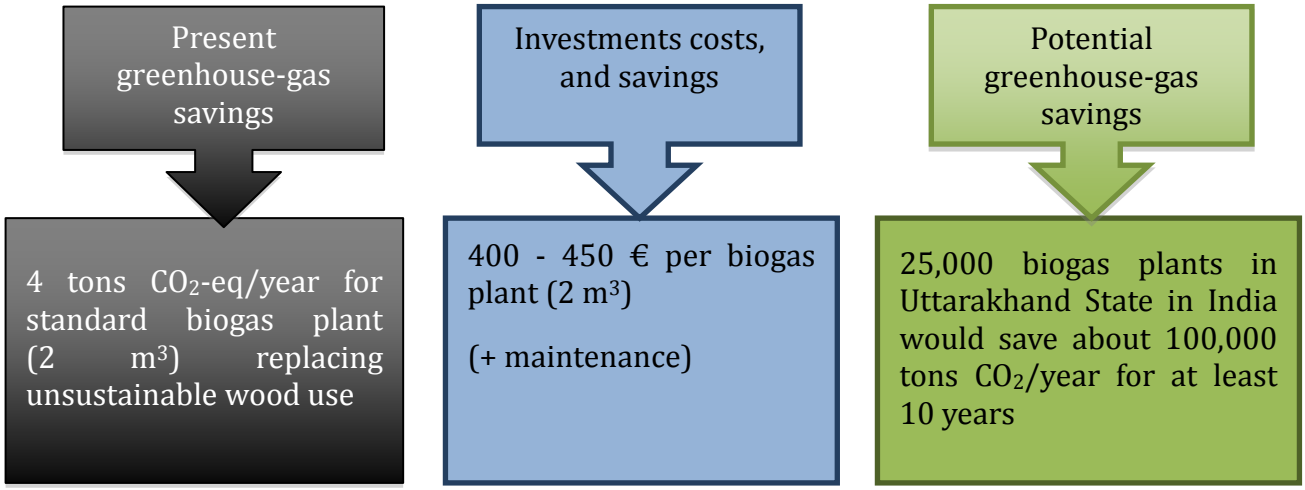
Summary

A renewable-energy based eco-village development project is a joint effort of WAFD (Women's Action For Development) and INSEDA (Integrated Sustainable Energy and Ecological Development Association) to demonstrate how several such actions at the grassroots level can effectively mitigate the negative effects of climate change. This project is based in six villages of Rani Chauri area of Tehri Garhwal district of Uttarakhand state. The project villages are situated at a height of 5,000-7,000 feet above sea level, in the Sub-Himalayan mountainous region of India, and is a prime example of promoting green community living using innovative low-carbon strategies and commonly found resources in uncommon ways.

This case study briefly discusses the processes and strategies for promotion and implementation, mainly by utilizing eco-friendly bamboo building material and renewable-energy based sustainable eco-village development (EVD) actions. It demonstrates how a large number of such local people-centered solutions can contribute effectively to low-cost, affordable solutions for climate-change mitigation. It also illustrates how this process, assisted by the capacity-building of 'end users', makes these interventions sustainable and enduring even after the withdrawal of the external agencies (NGO partners) at the conclusion of the project period. Bottom-up approaches to climate mitigation and adaptation, like the organization of receptive communities into eco-villages, helps them evolve their own responses to climate change-challenges.



I. Introduction

While policies and strategies to deal with climate-change issues are being given some urgency in global, regional and national forums, the negative impacts of these changes are already being felt amongst the most vulnerable populations of the world.

To address this issue effectively at the grass-roots level, the approaches followed by *WAFD (Women's Action For Development) and INSEDA (Integrated Sustainable Energy and Ecological Development Association)* were to take villages as the smallest units for integrated development, by implementing renewable-based, environmentally benign and eco-friendly low-cost affordable actions.

Socio-Economic impact:
Biogas and other cooking solutions reduce the need to collect firewood and yield a cleaner cooking environment as well as good fertilizer. Solar drying enables better treatment of harvests.
Water collection increases resilience to drought.

Environmental impacts:
Cooking solutions replace use of wood, which reduces overuse of forests and other trees, and thus contribute to reduce CO_2-emissions. Use of biogas sludge for fertiliser enriches soil.

The rationale of WAFD and INSEDA for choosing villages as the smallest units for interventions (especially in India) is that they are usually at the fringes of policy-making and are also the first to be impacted by climate-change effects. Village communities are also ideal for illustrating the concept of contextually appropriate, small-scale innovations for climate-change mitigation and adaptation, which can be replicated easily in other villages with appropriate modifications.

The key to success for these projects is the participation of families living in these villages. This also involves their active participation to ensure that they are trained, their capacity is built and skills up-graded so that they can be actively involved in the implementation of development activities meant for their benefit.

This project has been developed and built upon by the 8 years of experience that WAFD and INSEDA gained in implementing a joint program of eco-village development (EVD) in the state of Rajasthan in India. These EVD projects were undertaken in 12 selected villages of the Bharatpur district in Rajasthan. After learning extensively from these projects, both of the NGOs in January 2011 launched similar programs in the ecologically fragile Himalayan sub-region of India. Thus now we are having a total of about 10 years of experience in EVD programs. The first program on EVD, which lasted over a period of 8 years in 12 villages in Bharatpur was funded by the Finnish Ministry for International Cooperation (FMIC), Finland through the Students Union of the University of Jyvaskyla, Finland.

How this Case can Contribute to Climate Mitigation

This case is important to improve standard of living, but it also contributes to climate mitigation. It does so in its present form, but it could do it much more, if scaled up to national or regional levels, together with other, similar initiatives. In the table below, focus is on biogas, but solar cooking, solar drying and other solutions used in the EVD project also contribute to reduced greenhouse-gas emissions.

Present greenhouse-gas savings	A 2 m^3-capacity household biogas plant (rated to generate 2 m^3 biogas per day, when fed with 50 kg fresh cattle manure daily) saves 4 tons of CO_2-equivalent/year from avoided use of unsustainable wood, avoided LPG, avoided use of cow-dung cake for cooking, and avoided uncontrolled methane emissions.
Potential greenhouse-gas savings	If all people with animals enough and space for biogas in the Uttarakhand state had a biogas plant, a total of 25,000 biogas plants would be built, then savings would be 100,000 ton of CO_2-equivalents/year, given that alternative is unsustainable use of biomass.
Investments costs	400 - 450 €/ biogas plant (2 m^3 capacity) (+ maintenance)
Savings	Typically, one biogas plant saves 2 tons of wood or 400 kg LPG per year (If 25,000 household biogas plants of 2 m^3 capacity are installed in Uttarakhand, savings would be 50,000 tons wood or 10,000 tons LPG/year).
Resources needed for large-scale dissemination	At the present cost, it would require about 800,000,000 INR (Approx. 11,000,000 €) for 25,000 units of Grameen Bandhu biogas plants plus investment in capacity-building, administration, and post-installation follow-up services for at least 3 years. External funding required is 30-50% of this, ca. 4-6 mill. €, which would save 1 mill. tons of CO_2-eq over 10 years (given replacement of unsustainable biomass use), equal to 4-6 €/tons.

II. EVD Project in Villages Surrounding Rani Chauri in Tehri Garhwal Dist. of Uttarakhand

The EVD project in the Rani Chauri area of New Tehri district was prepared jointly by WAFD, INSEDA and ASDA (a Helsinki-based NGO) as a two-year pilot project. The preparation work was just after that the old Tehri Garhwal district headquarters had been submerged after the construction of the Tehri Dam and all the offices moved to the New Tehri district. The work was based on intensive participatory exercises with local people from the proposed target villages, and was sanctioned by the Finnish Ministry for International Cooperation (FMIC), Finland, to be implemented with effect from January 2011.

After the project was sanctioned by FMIC, WAFD & INSEDA conducted a systematic baseline survey of the target villages using two designed formats, one for the village level survey and second for the household survey in the target villages.

The baseline survey was used to create a digitized database. The detail surveys confirmed some of the important inputs given by the local people during the participatory planning of the pilot project of 2 years duration, followed by the planning, formulation and implementation of the main project of 3 years duration.

The target villages are situated at a height of 5,000 to 6000 ft. (1,500 - 2,000 m), above sea level, in two adjacent blocks (namely, Chamba and Narendra Nagar) of the New Tehri district of Uttarakhand State in the sub-Himalayan region of India.

III. Background & Reason for undertaking SEVD project in Rani Chauri (Tehri Garhwal)

1. Due to the construction of the Tehri Dam, which submerged the old Tehri Township completely, people in the target villages (located only 20 km from the dam) mentioned that:

- Weather pattern had changed and rains had become erratic as well as unpredictable, either too much or too little.
- The natural habitat of the wild animals and birds were destroyed, as a result of the submergence of many villages and forest lands in the lake, on the up-stream side of the Tehri dam. These displaced wild animals and birds then moved towards these villages, attacking destroying the standing crops of the villagers for their survival.
- Climate change has been responsible for the low yield from the traditional crops grown by them.
- Males from these village have gone to urban centers within the Uttarakhand as well as to other states for jobs.
- Women, children and older people are left in the villages, and the burden of agriculture, livestock-rearing and looking after all the work of the house, etc., falls on the women.

2. Women walk long distances to collect the firewood, fodder for animals, and water.

3. The livelihood of the women is affected, as there are no regular income-generating activities.

4. The women get low prices for their agricultural produce, as they lack the skills and resources to preserve and process the agricultural and horticultural produce for value-addition so as to increase the shelf-life, to get better market prices.

5. In view of this, WAFD and INSEDA have undertaken this project for the sustainable development of the villagers through the integration of scientific organic farming, rainwater storage, low-cost renewable energy and income-generating activities by “Promoting People Centered, Renewable Energy Based Eco-Village Development (EVD) For (i) Energy, (ii) Water and (iii) Food Security and (iv) Generating Sustainable Livelihood for Local Community.

6. In addition to the above, to demonstrate the “Local Solutions for Climate Change Mitigation”, which can be taken up by the local people, especially the women. These solutions show and teach them how to have a sustainable life style, through low-carbon, on-farm and off-farm income generation within their own villages. This is possible by using the upgraded skills they learn through the capacity-building activities of the EVD project.

IV. Overall Objective of the SEVD project

1. **The overall goals** of this renewable-energy-based eco-village development (EVD) in the existing project (in Tehri Garhwal district in Uttarakhand state) are the same as in our earlier project in Bharatpur in Rajasthan state. These are:

- To promote people-centered, renewable-energy-based sustainable village development in 6 selected villages in the Himalayan sub-region of India by integrating renewable energy as well as environmentally benign and eco-friendly low-cost affordable technologies,
- To focus on those technologies, which are simple and affordable to help in improving their lives as well as to augment their livelihoods.
- To train the target families, through capacity-building activities, for future actions for combating the negative impact of climate change, through mitigation and adaptation innovations that can be undertaken easily with their existing resources.

2. **NGO Cooperation:** The WAFD (an NGO operating at the grassroots level) and INSEDA (a socio-technical NGO operating at the national level) have been working as partners in the field of promotion of appropriate rural technology for the past about 18 years. Together, they have been involved in the implementation, transfer, demonstration and promotion of socially relevant technologies which could fit into the local social and cultural environment, rather than following a purely technology-oriented approach. Thus, they have drawn heavily on the long and practical field experience of other grassroots partner NGOs in understanding the local people and local situations in developing and transfer a technology.

3. **Bamboo:** Recognizing bamboo as one of the most eco-friendly and environmentally benign materials, for the last 18 years, INSEDA has been working in the design, development, testing, promotion of different rural technologies in partnership and close collaboration with WAFD (Women's Action for Development) in villages of Bharatpur district in Rajasthan state, and now in the villages surrounding Rani Chauri in Chamba block of New Tehri Garhwal district in Uttarakhand state. Bamboo presently is brought from neighbouring districts/states, but if large-scale implementation of this technology is taken up then it can also be grown in this district/state.

4. **Green technologies:** The main objective of working with bamboo as the building material in these two project areas which have different agro-climatic conditions (where WAFD was already operating) was to design and develop eco-friendly green technologies to provide clean cooking energy, rain-water harvesting from the rooftops of the rural houses and storage, compost units for organic agriculture, solar drying and water heating, as well as greenhouses for vegetable cultivation and nursery raising etc. At the same time, such bamboo-based technologies would be comparatively stronger, affordable, user-friendly, and would provide employment to local artisans and rural women in the project area during construction/building, after providing them appropriate training. The people would be able to use these to enhance their existing income, remove drudgery, improve their nutrition as well as quality of life.

V. Technologies Implemented in Rural Areas in Rajasthan State Uttarakhand State within the Eco-VillageDdevelopment (EVD) Project

1. Biogas plants: These are made from bamboo-reinforced cement mortar (BRCM), and provide clean cooking energy for the house, saving traditional cooking-fuels such as firewood, cow dung cakes, LPG gas etc. Biogas-production also provides excellent composted manure as a by-product to be used in kitchen gardens/fields. A 2-m^3 BRCM biogas plant built in Rani Chauri area of the project (fed daily with 50 kg cattle manure mixed with 50 liter of water) produces sufficient gas for cooking for a family of 6-8 persons and costs INR 32,000-35,000 (400 -450 €). One 2-m^3 Grameen Bandhu biogas plant would save approximately 4 tons of CO_2 equivalent/ year.

Pictures: Bamboo basket as reinforcement for cement dome for biogas, biogas plants under construction, finished biogas plant covered with soil

2. Solar Dryer: These easily portable low-cost solar dryers are made from bamboo and polyethylene for drying fruits, vegetables, spices & herbs cleanly and without traditional sources of energy. They also save time and are easy to use. The cost of this bamboo solar dryer is INR 1,500 to 1,600 (19-21 €).

Pictures: Constructing solar dryer solar dryer in use, example of dried material

3. Roof -Top Rain-Water Harvesting Unit (RWHU): The RWHUs also use eco-friendly and environmentally benign bamboo as the main building material for building bamboo-reinforced cement mortar (BRCM) storage tanks for the RWHUs to harvest (collect) and to store rainwater from the roofs during rainy seasons, thus reducing women's drudgery of carrying water over long distances. Depending on the roof area of houses, the RWHU built using BRCM tank of 1,000 liters capacity cost INR 8,000-10,000 (100- 130 €), and the 5,000 liters capacity RWHU is built for INR 30,000-35,000 for an individual rural family (400-470 €).


Pictures: Bamboo reinforcement under construction, finished water tank with tap

4. Solar water heater: These easily portable low-cost solar water heaters/dryers made from bamboo and polyethylene to heat water for a household. The cost of this bamboo solar water heater is INR 1,500-1,800 (20-24 €). It is used for taking baths or pre-heat water for cooking.

5. Composting baskets: Almost all rural areas have a problem of unsanitary conditions due to organic waste being thrown on the street corners or on open dumps. Those farmer families who don't have the required number of domestic farm animals to have enough dung for a biogas plants, or don't have enough resources to install even the smallest-capacity plant, normally dump their animal dung in pits or heaps above ground to make manure in an unhygienic manner. For such families, WAFD/INSEDA is promoting simple compost baskets. These portable compost basket units are fabricated with woven bamboo strips. They are used for making excellent composted manure from any biodegradable waste from the kitchen gardens & agricultural fields. The cost of each woven bamboo basket (I meter diameter and 1 meter height), which produces enough composted manure for 1 Nali (220 sq.yd.), comes to INR 1,400-1,600 (18-21 €). (Note: 22 Nali = 4,840 sq. yd. = 1 Acre).

Composting basket in use

6. Solar Poly Green House (SPGH) -The SPGH is fabricated using very good quality, UV-stabilized polyethylene. The comparatively low-cost SPGHs is either used at a nursery to raise high-value vegetables and fruit trees before planting in the field or, by individual families, for growing vegetables year-round for their own consumption for better nutrition or to sell. The SPGH of 2 m. width, 15 m. length & 2.5 m. height costs INR 30,000-35,000 (400-460 €).


Pictures: Polyester greenhouse from outside, and inside.

VI. Sustainability and Replication of the SEVD (Sustainable Energy based Eco-village Development) Project

Two NGOs, WAFD and INSEDA, have been implementing renewable-energy-based sustainable "Eco-village Development-EVD" projects jointly in a few selected villages in India since 2002. They serve as model "Demonstration-cum-Training Villages", for the capacity-building of NGOs and development organizations who would be interested in replicating them in their areas of operations, with appropriate modifications.

Even after the funding from the FMIC has ceased, both WAFD and INSEDA have continued their interventions in Bharatpur district. These activities involve mostly local women volunteers from those villages to disseminate their learning to other women in their villages. They hope to motivate at least 1-2 of those 12 villages to implement most of the components of EVD project using their own and other local resources for mobilization, motivation, awareness, meetings and training for women volunteers in Bharatpur, to spread the concept and project component of EVD in other villages. Thus, this project has exemplified the concept of sustainable and enduring multi-stakeholder learning.

The same approach is being followed by WAFD and INSEDA in the villages around Rani Chauri area in the Tehri Garhwal district of Uttarakhand.

VII. Analysis of the SEVD (Sustainable Energy based Eco-village Development) Project

In order to address the issues of climate change and sustainability and their effects on the day-to-day lives of the poor at the grassroots (in the villages' communities), the model that WAFD and INSEDA have adopted is that of "Eco Village Development". It is one of the successful approaches for the following reasons:

- This model *targets the village,* which is the smallest unit for interventions because in India the village communities illustrate the concept of appropriate small-scale innovations for climate-change adaptation. They can be replicated easily in other places, with appropriate modifications.
- *Focusing on developing capacities of the women leaders* and on giving them training as well as on upgrading their existing skill base, has shown that even after stopping of funding these, women can carry the program forward on their own. Our experience in Bharatpur shows that these women leaders can motivate other women in their own and surrounding villages to implement and adopt some of these components of EVD. The most common are the adoptions of organic farming and kitchen gardening. These activities give immediate results, as they can see the changes in their land, and they can get vegetables not only for their own families but to sell as extra produce to earn some money.
- *The key to success of this model is that it is easily replicable*. It is easily learned and uses simple durable technologies, with locally available material that is environmentally friendly. It also fulfills felt needs such as clean, cheap energy for cooking, storing rainwater so as to use it, drying of fruits and vegetables for future use, etc.
    - The activities have impacts on climate mitigation and adaptation. Rainwater-harvesting is measure for adapting to more erratic rainfall, while renewable energy like biogas is a mitigation measure, reducing needs for unsustainable firewood and fossil fuels, while also limiting uncontrolled methane emissions.

- To address the issues related to climate change and sustainability effectively at the grass-roots level, one of the approaches could be to take villages as the smallest units for integrated development, by implementing renewable-based, environmentally benign, and eco-friendly low-cost affordable actions. WAFD and INSEDA's rationale for choosing villages as the smallest units for interventions (especially in India) is that they are usually at the fringes of policy-making and are also the first to be impacted by climate change-effects. Village communities are also ideal for illustrating the concept of contextually appropriate, small-scale innovations for climate-change mitigation and adaptation, which can be easily replicated in other villages, with appropriate modifications.
- The key to success for these projects is the participation of families, especially women living in these villages. This involves their active participation to ensure that their capacity is built and these skills upgraded so that they can be actively involved in the implementation of development activities meant to benefit them. Thus, they will continue to implement what they have learned on a sustainable basis, even after the withdrawal of the external development agencies.