

Village selection for Cool Village Power



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For more information

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Contents

Executive Summary	v
Introduction.....	1
Project background	1
Methodology.....	1
Post-harvest management and biomass supply in India.....	2
Framework for site selection.....	5
Interaction with district horticulture officers (DHO) and non-governmental organizations (NGO) in the identified states	5
Haryana	6
Himachal Pradesh.....	6
Madhya Pradesh	6
Punjab	6
Uttarakhand.....	6
Uttar Pradesh.....	7
West Bengal	7
Shortlisting of state.....	7
Visits to the villages and interaction with farmers and members of panchayat and site finalisation.....	8
Visit to villages and interaction	8
Site finalisation	10
Implementation strategy	16
Pre-installation phase	16
Installation phase	17
Post-installation phase	17
Conclusion.....	18
Appendix: Information collected from DHOs in various states	19
Appendix: Letter of support from NGO and village.....	27

Executive summary

This report details out the basic premise and methodology followed to select the village site for TERI-CSIRO collaborative project titled “Cool Village Power” supported by AusAID. This project aims to equip a rural village in India with a facility which converts woody biomass into;

1. Electricity; and
2. Cool storage for horticultural produce.

After reviewing the current status of post-harvest management and biomass availability in India, a set of criteria were formulated to shortlist the possible states; these are as follows

- a. Produce available at the location, and need for cold storage
- b. Electricity demand at the location
- c. Accessibility of the location
- d. Land and water availability at the location
- e. Support from NGO at the location
- f. Outlook of the panchayat¹ and the farmers at the location
- g. Support of the district (read DHO) authorities at the location

This was supplemented with the interactions with the district horticulture officers and the non-governmental organisations leading to identification of a set of villages.

Visits were undertaken to these villages to meet the farmers, the local elected representatives and village community at large. On the basis of information gathered from these meetings and after evaluating them against the pre-set criteria for the success of the project, final selection was made.

The site for the project has been located at Basantpur (District: Sitapur, State: Uttar Pradesh)

¹ Panchayats are elected local self-governments at the village or small town level in India, http://en.wikipedia.org/wiki/Gram_panchayat accessed on 22 November 2011.

Introduction

Project background

While India's agricultural production base is quite strong, wastage of agricultural produce is massive. It is estimated that, due to a lack of proper storage and transit facilities, about 22% of agricultural produce, especially fruit and vegetables, is spoiled. The wastage in fruit and vegetables is estimated to be worth about Rs.330 billion (US\$ 7.3 billion)¹.

India and other developing countries which are predominantly agriculture-based economies have tremendous growth potential with respect to rural-based food processing. However, poor infrastructure, including the lack of integrated cooling facilities (cold chain), has retarded the growth of the food processing industry. The Ministry of Food Processing in India has identified refrigeration and cold storage facilities as the weakest link in the whole value chain.

The Energy and Resources Institute (TERI), India and Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia are conducting collaborative research as part of a project entitled "Cool Village Power", funded by AusAID.

The project combines CSIRO's sorption refrigeration expertise with TERI's biomass utilisation experience to develop and demonstrate an integrated village electrification and cold storage facility.

As a result of this project, a rural village in India will be equipped and trained to use a facility which converts woody biomass into;

- (1) Electricity; and
- (2) Cool storage for horticultural produce.

In a hot country like India, the importance of refrigeration can hardly be over-emphasized. 70% of the Indian population, of over 1.1 billion, is engaged in agriculture, and the contribution of agricultural output amounts to around 40% of the national income. The country is producing in excess of 150 million tonnes of fruits and vegetables per annum².

Successful demonstration of the proposed system, in this project, will highlight a pathway for poverty alleviation in rural communities through reduced food spoilage and the provision of electricity for micro-enterprise.

This report describes a detail analysis, which was undertaken for identification of potential site for installation of system to validate the proposed electrification and community cool storage concept. The report concludes by recommending the more appropriate site for installation of cool village power project by considering all possible criteria.

Methodology

The overall methodology adopted for selection of the village for project implementation has been covered in detail in the following sections. The key steps for village identification were as follows:

1. Literature survey of the post-harvest management and biomass supply in India

¹ "Vision, Strategy and Action Plan for Food Processing Industries in India", prepared by Rabo India Finance Pvt. Ltd. For Ministry of Food Processing industries, Government of India, April 2005

² Ministry of Food Processing industries, Government of India

2. Identifying the desired set of conditions and issues to be addressed during village selection
3. Shortlisting of States
4. Interaction with district horticulture officers (DHO) and non-governmental organizations in these states (NGO)
5. Visits to the shortlisted villages, and interaction with farmers and members of Panchayat.
6. Comparison of the villages and final selection.

Post-harvest management and biomass supply in India

A literature survey was performed to identify key horticultural produce in the different regions of India. Apart from identifying suitable produce as per cool storage temperature, the availability of biomass resources and climate conditions in different parts of India were studied. This study has been reported as part of the “Applications constraint document” prepared for the project. Two key tables (Table 1 and Table 2) showing the major crops and biomass resource are reproduced below.

Table 1 A detailed list of key produce grown in different regions of India

Agro-climatic zones	States	Significant crops
Western Himalayan Region	Himachal Pradesh (HP), Jammu and Kashmir (J&K), Uttarakhand	Kharif (maize, paddy, bajra, black gram, til, great millet, potato, jowar, millet, soybean); Rabi (wheat, rai, barseem, Bengal gram, mustard, colicosa, barley, lentil); Zaid (chari, potato, turmeric, cucumber, pumpkin, onion, bhatt - black soybean, gaihath); peas, sugarcane, mango, orange, lemon, apple, ginger
Eastern Himalayan Region	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, West Bengal (WB)	Kharif (paddy, sali, sisal, common millet, ginger, maize, brinjal, sesame); Rabi (potato, mustard, cabbage, cauliflower, tomato, wheat, boro paddy); Zaid (paddy, jute, til, boro paddy, jute, betel leaves); tea, betel leaves, sugarcane and banana, mango, sugarcane, pineapple
Lower Gangetic Plains Region	WB	Kharif (paddy); Rabi (mustard, wheat, potato, boro paddy); Zaid (til, boro paddy, jute, betel leaves); mango, sugarcane
Middle Gangetic Plains Region	Uttar Pradesh (UP), Bihar	Kharif (paddy, maize, jowar, black gram, bajra, red gram,); Rabi (wheat, Bengal gram, pea, potato, green gram, paddy, black gram, chickling); Zaid (black gram, green gram, onion); sugarcane, oilseeds, tobacco, jute, litchi
Upper Gangetic Plains Region	UP	Kharif (paddy, maize, jowar, black gram, bajra, red gram, ground nut); Rabi (wheat, mustard, Bengal gram, pea, potato); Zaid (black gram, green gram, onion); sugarcane, red gram
Trans-Gangetic Plains Region	Chandigarh, Punjab, Haryana, Delhi &	Kharif (paddy, maize jowar, bajra, paddy, cotton, black gram, green gram, soybean, groundnut); Rabi

Agro-climatic zones	States	Significant crops
	Rajasthan	(wheat, barley, mustard, barseem, sunflower, potato, Bengal gram); Zaid (green gram, bajra, jowar); sugarcane
Eastern Plateau and Hills Region	Chhattisgarh, Jharkhand, MP, Maharashtra, Orissa, WB	Kharif (maize, arhar, paddy, soybean, great millet, black gram, Bengal gram, lentil, green gram); Rabi (wheat, potato, tomato, mustard, pea, linseed, green, paddy, black gram, chickling, boro paddy); Zaid (onion, brinjal, til, boro paddy, jute, betal leaves); sugarcane, mango
Central Plateau and Hills Region	MP, Rajasthan, UP	Kharif (jowar, maize, arhar, paddy, soybean, great millet, black gram, lentil, green gram, groundnut, bajra, red gram); Rabi (wheat, potato, tomato, mustard, pea, linseed, Bengal gram, pea); Zaid (onion, brinjal, black gram, green gram); sugarcane, red gram
Western Plateau and Hills Region	Maharashtra, MP	Kharif (maize, arhar, paddy, soybean, great millet, black gram, lentil, green gram, jowar cotton, oilseeds, red gram, bajra); Rabi (wheat, potato, tomato, mustard, pea, linseed, Bengal gram, jowar, other vegetables); Zaid (onion, brinjal, chillies, groundnut); sugarcane, lemon, sapota, banana, mango, orange

Table 2 A detailed list of availability of biomass in different states of India¹

State	Biomass Surplus (kT/yr.)	Biomass Class
Andhra Pradesh	3484.4	Forest & wasteland
	6956.4	Agro
Arunachal Pradesh	74.5	Agro
	6045.3	Forest & wasteland
Assam	2424.2	Forest & wasteland
	2346.9	Agro
Bihar	831.9	Forest & wasteland
	5147.2	Agro
Chhattisgarh	2127.9	Agro
	9065.8	Forest & wasteland
Goa	119.3	Forest & wasteland
	161.4	Agro
Gujarat	9085.5	Agro
	8251.8	Forest & wasteland
Haryana	259.6	Forest & wasteland
	11342.9	Agro
Himachal Pradesh	1034.7	Agro
	2016.0	Forest & wasteland
Jammu & Kashmir	279.6	Agro

¹ Biomass Resource Atlas of India, IISc, <http://lab.cgpl.iisc.ernet.in/atlas/Tables/Tables.aspx>, accessed on 22 November, 2011

State	Biomass Surplus (kT/yr.)	Biomass Class
	7564.7	Forest & wasteland
Jharkhand	890.0	Agro
	3249.8	Forest & wasteland
Karnataka	6600.8	Forest & wasteland
	9027.2	Agro
Kerala	1429.1	Forest & wasteland
	6352.1	Agro
Madhya Pradesh	12271.2	Forest & wasteland
	10329.3	Agro
Maharashtra	12440.4	Forest & wasteland
	14789.6	Agro
Manipur	114.4	Agro
	834.2	Forest & wasteland
Meghalaya	91.6	Agro
	1125.6	Forest & wasteland
Mizoram	8.5	Agro
	1050.0	Forest & wasteland
Nagaland	85.2	Agro
	556.9	Forest & wasteland
Orissa	6084.8	Forest & wasteland
	3676.8	Agro
Punjab	263.0	Forest & wasteland
	24842.9	Agro
Rajasthan	6297.5	Forest & wasteland
	8645.7	Agro
Sikkim	17.8	Agro
	350.8	Forest & wasteland
Tamil Nadu	3070.6	Forest & wasteland
	8900.0	Agro
Tripura	21.1	Agro
	683.4	Forest & wasteland
Uttar Pradesh	3672.0	Forest & wasteland
	13737.9	Agro
Uttaranchal	638.4	Agro
	3055.3	Forest & wasteland
West Bengal	949.0	Forest & wasteland
	4301.5	Agro
Total	249074.0	

The literature survey helped to identify the current status of biomass availability in India (at state level), as well as to zero down on the produce, which can be stored (subject to temperatures constrained by the sorption cooling technology)

Framework for site selection

A decision-support framework was devised based on the key factors, which would influence the site selection, wherein each factor was assigned certain weightage. These key factors are classified in three categories, namely

1. Logistical
 - a. Produce available at the location
 - b. Accessibility of the location
2. Technical
 - a. Electricity demand at the location
 - b. Land availability at the location
 - c. Water availability at the location
3. Social
 - a. Support from NGO at the location
 - b. Outlook of the panchayat and the farmers at the location
 - c. Support of the district (read DHO) authorities at the location

This being the first grass-root level project; it was decided to consider the states closer to Delhi as possible candidates, from the logistic point of view. Thus, the states which were analysed were – Haryana, Himachal Pradesh, Madhya Pradesh, Punjab, Uttarakhand and Uttar Pradesh. Later West Bengal was also included in the study as it is one of the priority states of AusAID, the other being Uttar Pradesh.

The next section discusses in detail the interaction with the DHO and NGO in these states.

Interaction with district horticulture officers (DHO) and non-governmental organizations (NGO) in the identified states

As part of the site selection, installation and operation of the system, a long term association of local body is desired. Thus, to narrow down at district level, it was decided to gather more information from the DHO in the respective areas. From its experience in field work TERI has a wide network and a vast experience in working with the NGOs in many of these regions. The interaction with these NGOs was used to supplement the information gathered from the DHOs. The District Horticulture Officer's and local NGO's active in these states were identified and were contacted for information regarding agricultural produce, electricity status, and availability of wooden biomass etc.in the identified regions. A summary of these interactions is presented in Table 3.

Table 3 Summary of DHOs/NGOs contacted in different states

S. No.	State	Name of DHOs/NGOs contacted		Total no. of DHOs/NGOs contacted	
		DHO	NGO	DHO	NGO
1	Haryana	Kurukshetra, Ambala, Karnal, Panipat, Panchkula, Kaithal, Jind, Hisar, Bhiwani, Fatehabad, Rewari, Sirsa, Mewat, Palwal, Yamuna Nagar	Lighting a Billion Lives (TERI)	15	1
2	Himachal Pradesh	Sirmaur	NA	1	Nil
3	Madhya Pradesh	Morena	NA	1	Nil
4	Punjab	Ropar, Sangrur	NA	2	Nil

S. No.	State	Name of DHOs/NGOs contacted	Total no. of DHOs/NGOs contacted
5	Uttarakhand	NA Society for Rural Technology, Sri Jagdamba Samithi	Nil 2
6	Uttar Pradesh	Ghaziabad, Gautam Buddha Nagar, Mathura, Meerut, Bijnor, Kanshiram Nagar, Badaun, Bulandshahr, Aligarh, Agra, Moradabad, Etah, Mainpuri, Saharanpur, Muzaffarnagar, Sitapur	Saumya Chauhan Memorial Welfare Association, Humana people to people India & PACE 15 3
7	West Bengal	NA TERI, Purba Dwarakapur Sebyan Sangha	Nil 2

The information collected from the DHOs has been tabulated and presented in Appendix 1. Following is the summary of state level interactions

Haryana

After contacting the DHOs and NGOs in the state of Haryana it was observed that;

- Response from DHOs was positive and cooperative
- There is a problem of getting cheap woody biomass in Haryana¹
- Most of the villages of contacted districts in Haryana are electrified.

Himachal Pradesh

In Sirmaur (the only district in Himachal Pradesh close to Delhi) it was observed that there is lack of cold storage in Rajgarh area of Sinour District but this area is electrified.

Madhya Pradesh

In the state of Madhya Pradesh it was observed that production of horticulture produce is not significantly high.

Punjab

The DHO contacted was not very supportive; additionally the cold storages already available are able to cater to most of the demand.

Uttarakhand

In Uttarakhand, it was observed that

- The NGO (Shri Jagadamba Samiti) was supportive, and have already been operating a cold storage in community model.
- There was need for more cold storage units, and also surplus available of biomass.
- However this area is already electrified.

¹ Information was also collected about some of the regions through divisions of TERI involved in projects at many of these locations.

Uttar Pradesh

After contacting reasonable number of DHOs and NGOs in the state of Uttar Pradesh it was observed that

- a) The contacted NGOs are active and also ready to cooperate during installation and operation of the system. The DHOs were seemed supportive to the project.
- b) Existing cold storage units don't meet the demand even though UP has largest number of cold storage units in India
- c) Many villages are not electrified.

West Bengal

In the state of West Bengal it was observed that;

- a) The contacted NGO was supportive
- b) The state horticulture department is not as organised as in the other states.

Here it is important to mention that West Bengal is much farther from TERI, New Delhi as compared to the other states, which could significantly strain the logistic and personnel support at site.

Shortlisting of state

After collecting the preliminary information from the respective DHOs and NGOs, a weighted-scale method was used to find the suitable state for installation of the project. In this method, each criterion was given a weight (minimum 1, maximum 5) and for all of these criteria a state was evaluated and given point on the scale of 1 to 5. Table 4 gives the details of state selection process. It can be seen that Uttar Pradesh scored the highest followed by Uttarakhand.

Table 4 State selection and weighing of important criterion

Information collected	Weight-age	Haryana	Himachal Pradesh	Madhya Pradesh	Punjab	Uttara-khand	Uttar Pradesh	West Bengal
Horticulture produce	5	5	5	3	3	5	5	3
Availability of woody biomass	5	1	5	3	3	5	4	3
Need for cold storage unit	4	5	5	5	3	5	4	5
Support of NGOs	3	1	1	1	1	3	5	3
Support of DHOs	2	5	1	1	1	1	3	1
Status of electricity	2	4	5	3	3	5	5	4
Nearer to Delhi	1	5	3	3	3	2	4	0.5
Total		76	88	64	56	93	96	65.5

Visits to the villages and interaction with farmers and members of panchayat and site finalisation

Visit to villages and interaction

Once the states had been analysed comparatively, it was fairly clear that Uttar Pradesh and Uttarakhand had more potential than the other states. Expanding further on TERI's ties with many of the NGOs operating in these regions (as part of TERI's campaign on "Lighting a Billion Lives") several villages were identified for site visits. The key factors influencing the selection of these villages were

- a) Experience of the NGO in the villages
- b) Accessibility of the villages

The other factors (as pointed out in "Framework for site selection") were analysed and evaluated during the visit to these villages.

Before each visit, the objective and expected outcomes of the project were explained to the NGO. The NGO in turn communicated some basic information about the project to the farmers and members of the panchayat to motivate them and allow active participation during actual village visits.

In all a total of 8 village visits were conducted in 5 different districts in the two states (Uttar Pradesh and Uttarakhand).

The information collected during these visits has been presented below in Table 5. Some common information from these villages is summarized below:

- Almost all the villages are un-electrified.
- Power supply in adjoining areas is not reliable.
- Most of the cold storages in the regions have diesel gen-sets to operate the refrigeration system.
- Generally potatoes and vegetables are grown in these areas.
- Major requirement of cold storage is from March to September.
- Almost all the Gram Panchayats² of these villages have availability of land for setting up the project.
- Wooden biomass is available in these villages.

¹ labl.teriin.org accessed on 22 November 2011

² Gram means Village in Hindi, thus Gram Panchayat is the panchayat of village. The common land in villages are under the purview their respective panchayat, hence this is the targeted land space for setting up the system in the village

Table 5 Site visit findings

S. No.	Particulars	Uttar Pradesh						Uttarakhand	
		Village - 1	Village - 2	Village - 3	Village - 4	Village - 5	Village - 6	Village - 7	Village - 8
		Manpara, Sitapur	Basantpur, Sitapur	Puranpur, Sitapur	Mubarakpur, Sitapur	Abdullahganj, Badaun	Jakhera, Kasganj	Januyan, Badaun	Vikasnagar, Dehradun
1	Distance from nearest town	10kms	5kms	3-5kms	10kms	8-10kms	8-10kms	30-35kms	20-25kms
2	Approximate distance from Delhi	450 kms	450 kms	450 kms	450 kms	220 kms	250 kms	230 kms	290 kms
3	Response from District Horticulture Officer (DHO) about the village	Positive	Positive	Positive	Positive	Positive	-	Positive	-
4	Electrification Status	No	No	Yes (3-4hrs/day)	No	Yes (4-5 hrs./d)	Yes (4-5 hrs./d)	No	Yes (7-8 hrs./d)
5	No. of Households (Approx.)	80-100	100-120	50-60	100-120	600	800	140	300
6	No of villages nearby which can benefit from the project	6 villages (Un-electrified)	4 villages (Un-electrified)	6 villages (Un-electrified)	2 villages (Un-electrified)	2 villages (Electrified)	2 villages (Electrified)	3 villages (Un-electrified)	3 villages (Electrified)
7	Availability of Panchayat Land	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
8	Cold Storage availability	3kms	5kms	5kms	10kms	30-40 Cold Storages (8-10kms)	30-40 Cold Storages (8-10kms)	30-40 Cold Storages (30-35kms)	No Cold Storages nearby
9	Rent of Cold Storage (Rs/100kg/season)	Rs. 135-140	Rs. 135-140	Rs. 135-140	Rs. 135-140	Rs. 140	Rs. 140	Rs. 140	-
10	Electricity Charges per household	No electricity	No electricity	Rs 275 / 2 months	No electricity	Rs 275 / 2 months	Rs 275 / 2 months	No electricity	Rs 210-285 / 2 months
11	Commercial entities/business present	Nil	Nil	Nil	Nil	Flour Mill, Shops	Nil	Nil	Flour Mill, Shops
12	Commercial Electricity Charges	-	-	-	-	Rs 3.75 / unit	-	-	Rs 4.10 / unit
13	Any vegetable market nearby	10kms	5kms	3-5kms	10kms	Ujhani & Local mandi every Monday & Thursday	Kasganj	Ujhani & Kasganj	Vikasnagar, Ponta Sahib & Dehradun

S.	Particulars	Uttar Pradesh				Uttarakhand			
14	Major Crops	Vegetables, Potatoes, Sugarcane, Wheat, Peas, Mustard, Grams	Vegetables, Potatoes, Sugarcane, Wheat, Peas, Mustard, Grams	Vegetables, Potatoes, Sugarcane, Wheat, Peas, Mustard, Grams	Vegetables, Potatoes, Sugarcane, Wheat, Peas, Mustard, Grams	Potatoes, Maize, Bajra, Sugarcane	Potatoes, Maze, Bajra, Sugarcane	Potatoes, Sugarcane, Vegetables	Potatoes, Sugarcane, Vegetables
15	Crops that can be stored	Potatoes, Brinjal, Tomatoes, Cauliflower, Carrot, Okra	Potatoes, Brinjal, Tomato, Cauliflower, Carrot, Okra	Potatoes, Brinjal, Tomato, Cauliflower, Carrot, Okra	Potatoes, Brinjal, Tomato, Cauliflower, Carrot, Okra	Potatoes	Potatoes	Potatoes	Potatoes, Brinjal, Tomato, Cauliflower, Carrot, Okra
16	Cost of Wooden Biomass (Rs/100kg)	Rs. 200-250	Rs. 200-250	Rs. 200-250	Rs. 200-250	400-500	400-500	400-500	300
17	Major source of wooden biomass	Eucalyptus, Neem & Agricultural wastes	Eucalyptus, Neem & Agricultural wastes	Eucalyptus, Neem & Agricultural wastes	Eucalyptus, Agricultural wastes	Eucalyptus, Agricultural wastes	Eucalyptus, Agricultural wastes	Eucalyptus, Agricultural wastes	Wood from small trees
18	Period for Cold Storage requirement	March - September	March - September	March - September	March - September	March - September	March - September	March - September	March - September (weekly storage of vegetables)

Site finalisation

For selection of the final site for setting up the project, different weightage was given to different components (important for selection) of the final site. Essentially, the ideal village should have

1. Availability of cheap woody biomass
2. A need for cold storage (i.e. horticulture produce should be grown and there should be a deficit of available cold storages)
3. Should be un-electrified
4. Land available to setup the plant
5. Should be close to New Delhi
6. The available produce should be suitable for the temperature delivered by the selected adsorption technology.

7. Should be accessible to nearby markets

Apart from these a few more factors emerged as a result of better understanding gained from the site visits

1. Number of households in the village – This is important for economic viability of the project
2. Number of nearby villages which can benefit from the project – This not only supplements the above point but also would be important in villages where enough households are not available.
3. Easy accessibility to a major city – this allows for speedy maintenance and availability of spare parts.

The comparison of the visited villages is presented in **Table 6**.

Table 6 Weighted comparisons of villages visited

S. No.	Particulars	Weight-age	Uttar Pradesh							Uttarakhand
			Village - 1	Village - 2	Village - 3	Village - 4	Village - 5	Village - 6	Village - 7	Village - 8
			Manpara, Sitapur	Basantpur, Sitapur	Puranpur, Sitapur	Mubarakpur, Sitapur	Abdullahganj, Badaun	Jakhera, Kasganj	Januyan, Badaun	Vikasnagar, Dehradun
1	Approximate distance from Delhi	2	3	3	3	3	5	5	5	4
2	Electrification Status	5	5	5	3	5	2	2	5	1
3	No. of Households (Approx.)	3	2	4	2	4	4	3	4	5
4	No of villages nearby which can benefit from the project	3	5	5	5	2	2	2	3	3
5	Availability of Panchayat Land	4	5	5	5	5	5	1	5	5
6	Requirement for Cold Storage	5	5	5	5	5	4	4	4	5
7	Accessibility to major city	4	5	5	5	5	3	3	3	4
8	Major source of wooden biomass	5	4	4	4	4	4	4	4	5
Total Points			137	143	127	134	110	91	128	123



Picture 1 Interaction with NGO and farmers at Manpara, Sitapur (Uttar Pradesh)



Picture 2 Interactions with panchayat and farmers at Abdullahganj, Badaun (Uttar Pradesh)



Picture 3 Visit to Mubarakpur, Sitapur (Uttar Pradesh)



Picture 4 Visit to Basantur, Sitapur (Uttar Pradesh)



Picture 5 Interaction with NGO and panchayat members at Puranpur, Sitapur (Uttar Pradesh)



Picture 6 Land available at Vikasnagar (Uttarakhand)



Picture 7 Villagers participating in the meeting at Jakhera, Kasganj (Uttar Pradesh)



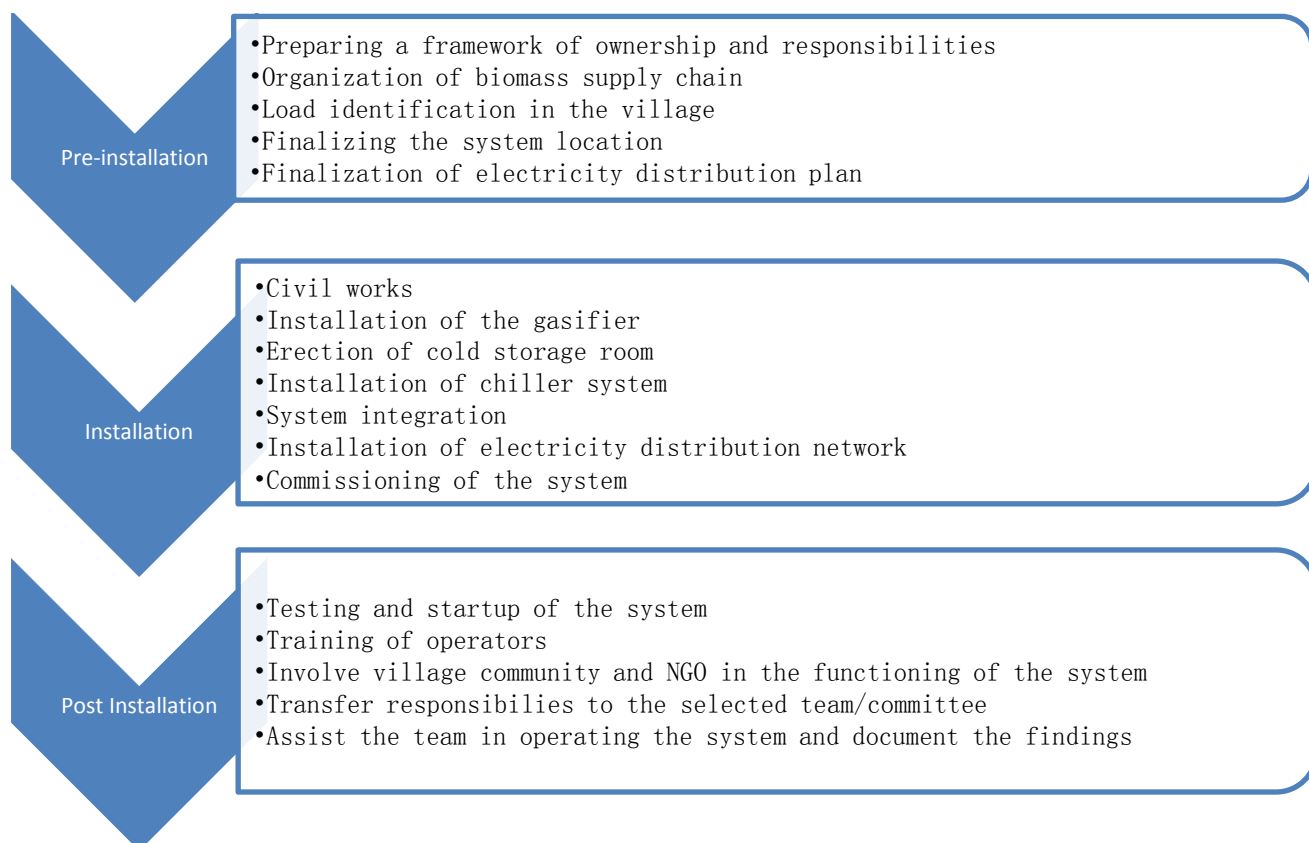
Picture 8 TERI Solar Lanterns at work - Januyana, Badaun (Uttar Pradesh)

Implementation strategy

With the selection of the potential village sites and due deliberations with the village panchayat, the project implementation can be carried out. The activities required for successful project delivery can be categorized thematically in to

1. Pre-installation phase
2. Installation phase
3. Post installation phase

Each of these has been elaborated in sections below.



Pre-installation phase

This stage focuses on laying the foundation for the installation phase. The individual activities to be accomplished are as follows

1. Preparing a framework of ownership and responsibilities

This would be the most important part of pre-installation phase. In order to make the system sustainable it is of utmost importance to involve the community, and assign them responsibilities and rights. Also the NGO involved at the village level will be an important stakeholder. It is proposed to select and empower a Village Energy Committee (VEC) which will be responsible for running the system and its operational sustainability. The Committee will be guided by TERI.

2. Organization of biomass supply chain

For uninterrupted operation of the gasifier system a reliable source of biomass supply is essential. It would be best to make use of all available resources rather than relying on any one. The available options include

- a. Bulk supply on contractual basis
- b. Energy plantation to grow wood for self-sustenance
- c. Involving villagers in biomass supply chain (fuel for electricity barter system)

3. Load identification in the village

The loads in the village will be studied and categorized. This will include:

- a. Residential/domestic loads
- b. Institutional loads – schools, primary health centre, panchayat etc.
- c. Community loads – street lights, water supply, and community centre etc.
- d. Commercial loads – cottage industries, oil and flour mill, irrigation pumps etc.

Due to lack of access to electricity there is a deficit of commercial loads in the village, thus in order to augment the revenue stream it would be necessary to plan some commercial loads. Not only would this make the system more viable but also lead to employment opportunities in the village.

4. Finalizing the system location in village

Based on the spatial distribution of the major loads and the available land options, system location would be finalized.

Finalization of electricity distribution network Once the site has been finalized, the next step would be to prepare local electricity distribution plan and finalize the optimal routing.

Installation phase

This phase comprises all installation related activities, involving the following:

1. Site preparation and civil works
2. Installation of biomass gasifier
3. Erection of cold storage chamber
4. Installation of chiller and accessories
5. Setting up electricity distribution network
6. Mechanical integration of the system
7. Electrical Integration of the system
8. Commissioning the system

Post-installation phase

This phase would involve major interaction with village committee and NGO. The processes and operational framework required for sustainable functioning of the system will be finalized in this phase.

1. Testing and start-up of the system

After commissioning, the system will be closely monitored by TERI to identify and solve any technical problems that may arise, in consultation with CSIRO. At this stage operation procedures will also be finalized.

2. Training of operators

For the system to be sustainable and replicable, it is essential to involve the village community and make available locally trained manpower. Thus TERI will train local youth

for running the system. These youth would be identified in consultation with the VEC and NGO.

3. Involve village community and NGO in the functioning of the system

Once the system operation has been sufficiently stabilized, transition to the VEC and locally trained youth for operating the system will occur, under TERI's technical back-stopping.

4. Transfer responsibilities to the selected team/committee

At a later stage, TERI will step down from its active role and system responsibilities will be transferred to the village committee.

5. Document the findings

The findings and experience of the system will be documented and shared with stakeholders for dissemination. TERI and CSIRO will make efforts to solve any glitches that may arise and try to perfect a sustainable business model.

Conclusion

It can be seen that both Village 1 and Village 2 are close competitors, in the end, however, considering (a) the commitment of NGO and (b) their strong established local relationship, Basantpur (District: Sitapur) has been finalised for system installation. However, Manpara, (District: Sitapur) has been kept as a back-up village for the project. In both of these villages, the village community and the panchayat had already expressed their willingness to have such a facility in their village and its full utilization.

Detailed list of information collected from DHOs in various states has been tabulated in the following tables (Annexure 1).

Appendix: Information collected from DHOs in various states

HARYANA

S. No.	Information collected	Kurukshetra	Ambala	Karnal	Panipat	Panchkula	Kaithal	Jind	Hisar
1	Horticulture produce	Potato, Tomato, Capsicum, Beans, Cauliflower, Carrot , Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot , Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot , Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot , Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot , Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauli flower, Carrot , Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauli flower, Carrot , Cabbage, Musk Melon, Cucumber, Bitter Gourd
2	What farmers do in case of excess production	Sell at low price	Sell at low price	Sell at low price	Sell at low price	Sell at low price	Sell at low price	Sell at low price	Sell at low price
3	Sources of getting woody biomass	Dry Tree	Dry Tree	Dry Tree	Dry Tree	Dry Tree	Dry Tree	Dry Cotton wood	Low
4	Availability of cold storage units	NA	4	1 (4 tons)	0	0	1 with capacity 3000 tons capacity	3 with the capacity of 3000 tons	A 4 tons capacity under construction
	Remarks	15th May to 20 June for storage of tomato	Positive & Invited for the Visit	Positive & Invited for the Visit	Positive & Invited for the Visit	Positive & Invited for the Visit	Positive & Invited for the Visit	Get positive response for next talk	Positive

HARYANA (Continued)

S. No.	Information collected	Bhiwani	Fatehabad	Rewari	Sirsa	Mewat	Yamuna nagar	TERI (NGO)
1	Horticulture produce	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot , Cabbage, Musk Melon, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot ,Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot ,Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Tomato, Lady finger, Guava, Cauliflower, Brinjal, Carrot, Capsicum, Carrot, Musk Melon, Bitter Gourd, Green Melon	Potato, Tomato, Lady finger, Guava, Cauliflower, Brinjal, Carrot, Capsicum, Carrot, Musk Melon, Bitter Gourd, Green Melon	Potato, Tomato
2	What farmers do in case of excess production	Sell at low price	Sell at low price	Sell at low price	Sell at low price	Sell at low price	NA	Sell at low price
3	Sources of getting woody biomass	Dry Cotton wood	Dry Cotton Wood	Dry Tree	Dry Cotton wood	Dry Cotton Wood	Dry Tree	Dry tree (available to buy)
4	Availability of cold storage units	Cold storage is available in the Mandi but the capacity is not known	1 the capacity is not known	NA	1	0	4 & the total capacity is 10,000 tonne	Nil
	Remarks	Positive & Invited to visit the office	Positive & Invite for the talk	Positive & Invited for the Visit	Positive & Invited to visit the office	Positive & Invite for the talk	Positive & Invited for the Visit	Mr. Satpal Singh, Diesel Engine Operator, TERI Gram. Mob. No. +91 8800 946 322 Region: Mewar, Rewari

Himachal Pradesh

S. No.	Information collected	Sirmaur
1	Horticulture produce	Potato, Tomato, ginger, Apple, Mango, Capsicum, Beans, Cauliflower, Carrot, Cabbage, Peas,
2	What farmers do in case of excess production	Sell at low price
3	Sources of getting woody biomass	Dry Tree & the forest area
4	Availability of cold storage units	Nil

Madhya Pradesh

S. No.	Information collected	Morena
1	Horticulture produce	Potato, Chili, Brinjal, Sweet Potato, Green Melon, Cucumber
2	What farmers do in case of excess production	Sell at low price
3	Sources of getting woody biomass	Dry Tree
4	Availability of cold storage units	8 & The total capacity is 50000 tons

Punjab

S. No.	Information collected	Ropar	Sangrur
1	Horticulture produce	NA	NA
2	What farmers do in case of excess production	They sell the perishable Vegetable in Low rate & they store the potato in the Cold storage	They sell the perishable Vegetable in Low rate & they store the potato in the Cold storage
3	Sources of getting woody biomass	Forest	
4	Availability of cold storage units	5 & the total capacity is 10000 tons, meet the requirement	NA

Uttarakhand

S. No.	Information collected	Thalisain	Kotdwar
1	Name of the NGO	Society for Rural Technology (SRT)	Saumya Chauhan Memorial Welfare Association (SCMWA)
2	Horticulture produce	Huge production of Potatoes	Potato and other vegetables
3	What farmers do in case of excess production	Sell at low price	NA
4	Sources of getting woody biomass	Forest; trees such as pine	Forest
5	Availability of cold storage units	Nil	Nil
	Remarks	Mr. Satish Kala, M.D. Society for Rural Technology (SRT) Mob. No. +91 9917 185 515	Mr. G.R. Singh Saumya Chauhan Memorial Welfare Association (SCMWA) Mob. No. +91 9412 7074 24

Uttar Pradesh

S. No.	Information collected	Ghaziabad	Gautam Buddha Nagar	Mathura	Meerut	Bijnor	Kanshiram Nagar	Badaun
1	Horticulture produce	Potato, Tomato , Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauli flower, Carrot ,Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauli flower, Carrot ,Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauli flower, Carrot ,Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauli flower, Carrot ,Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauli flower, Carrot ,Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato , Capsicum, Beans, Cauli flower, Carrot , Cabbage, Musk Melon, Cucumber, Bitter Gourd
2	What farmers do in case of excess production	Sell at the low price	Sell at the low price	Sell at the low price	Sell at the low price	Sell at the low price	Sell at the low price	Sell at the low price
3	Sources of getting woody biomass	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus
4	Availability of cold storage units	34 & the storage capacity is 131000 tons	0	32 & The total capacity is 312000 tons	25 & the total capacity is 117000 tons	11 & the total capacity is 110000 tons	11 & the total capacity is 61700 tons	54 & the capacity is not available

Uttar Pradesh (Continued)

S. No.	Information collected	Buland Shahr	Aligarh	Agra	Moradabad	Etah	Mainpuri	Saharanpur	Muzaffer Nagar
1	Horticulture produce	Potato, Tomato, Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato, Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato, Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato, Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato, Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato, Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato, Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd	Potato, Tomato, Capsicum, Beans, Cauliflower, Carrot, Cabbage, Musk Melon, Cucumber, Bitter Gourd
2	What farmers do in case of excess production	Sell at the low price	Sell at the low price	Sell at the low price	Sell at the low price	Sell at the low price	Sell at the low price	Sell at the low price	Sell at the low price
3	Sources of getting woody biomass	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus	Dry tree, Babool & the Eucalyptus
4	Availability of cold storage units	34 & the total capacity is 133000 tons	64 & the total capacity is 425000 tons	205 & the total capacity is 3.4 million tons	35 & the 251000 tons	18 & the total capacity is 1,28,360 tons	30 & The total capacity is 232000 tons	3 & the total capacity is 9 tons	22 & 115000 tons

Punjab

S. No.	Information collected	Sundarban	Sundarban
1	Name of the NGO	Purba Dwarakapur Sebayon Sangha	TERI
2	Horticulture produce	Potato, Onion, Brinjal, Chili	Potato, Onion, Brinjal, Chili
3	What farmers do in case of excess production	Sell at low price	Sell at low price
4	Sources of getting woody biomass	Dry tree from nearby (Sundarban) forest	Available woody biomass is sufficient for existing biomass gasifier plant operated by IREDA. Availability is less for any other plant.
5	Availability of cold storage units	Nil in Sundarban region	Nil in Sundarban region
	Remarks	Positive response. Mr. H.S. Rauth Mob. No. +91 9810 666 775 E-mail Id: purba72@gmail.com	Krishnapada TERI co-coordinator Mob No. +91 9903 337 097 E-mail Id: krishnapada@gmail.com

Appendix: Letter of support from NGO and village

Letter from NGO



**PARTICIPATORY ACTION *For*
COMMUNITY EMPOWERMENT**

(A Civil Society Organisation Registered under SRA - 1860, PAN, TAN, 12A & 80G5 (vi) of Income Tax, EPF Dept., FCRA)

Ref: Gen/Admn/2011/263

21.12.2011

Mr. Lovedeep Mann
Research Associate, RETA
The Energy and Resources Institute (TERI)
Darbari Seth Block, India Habitat Center
Lodhi Road, New Delhi-110003

Sub: Setting up of Biomass Gassifier unit.

Dear Sir,

Please refer to your visit to our field and the discussions with our Secretary Ms. Rajvinder Kaur regarding setting up of Biomass Gassifier with Cooling Unit in our intervention area.

We are interested to get the unit installed in our intervention area and we will be supporting you in this process.

However we would like to know as to how you will compensate for our involvement.

Looking forward to have a fruitful partnership.

Thanking you,

Yours faithfully

Sanjay Srivastava
Sr. Manager
(Programme & Administration)

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Programme Office : (II) Opp. Misrikh Pvt. Bus Stand
Sidhauri, Sitapur - 261 303

(A Civil Society Organisation Committed for People's Empowerment)

Letter from Village

सहमति पत्र

मैं ग्राम प्रधान रमेश चन्द्र ग्राम पंचायत न्यामतपुर लबरहा विकास खण्ड - पहला जनपद सीतापुर में ऐसी संस्था एवं चैस संस्था सिधौली सीतापुर के संयुक्त तत्वावधान में वैकल्पिक ऊर्जा हेतु विद्युत उत्पादन एवं कोल्ड स्टोरेज स्थापित करने के संदर्भ में संचालित होने वाली परियोजना के लिए अपनी ग्राम पंचायत की एक बीघा जमीन देने हेतु सहमति प्रदान करता हूँ तथा भविष्य में मेरी पंचायत इस युनिट की स्थापना एवं संचालन में पूरा सहयोग करेगी।

रमेश चन्द्र
ग्राम प्रधान हस्ताक्षर

नाम - रमेश चन्द्र
ग्राम पंचायत - न्यामतपुर लबरहा
विकास खण्ड - पहला
जनपद - सीतापुर, ७०१०

रमेश चन्द्र
ग्राम प्रधान
न्यामतपुर लबरहा
विकास खण्ड - पहला, सीतापुर

RENEWABLE ENERGY AT TERI

Energy–Environment Technology Development Division at TERI provides a wide array of technological solutions and technical services for the efficient utilization of resources and for harnessing renewable sources of energy. The Division’s strength lies in its ability to work closely with end-users in finding practical technological solutions to energy-related and environmental problems: from providing comprehensive distributed electricity generation solutions to remote rural communities to promoting green building concepts in the urban areas; from developing and disseminating clean technologies in numerous small and micro enterprises along with impact assessment for providing energy auditing services to large industrial units; from developing biomass gasification technology for power generation. Division’s two dedicated research areas, namely Renewable Energy Technology Applications (RETA) and Biomass Energy Technology Applications (BETA) are engaged in developing renewable energy technologies based products and their markets. These Areas focus on a range of services in various fields, such as solar photovoltaic, solar thermal, wind, biomass and renewable based hybrid systems. The thrust areas and capabilities of the Group include:

- *Renewable energy resource assessment*
- *Product development and demonstration*
- *Performance evaluation and field testing*
- *Renewable energy policy and planning*
- *Technical consultancy/ studies*
- *Regulatory interventions for renewables*
- *Project development under clean climate initiatives*
- *Distributed generation and delivery models for electricity in rural areas*
- *Training and capacity building*



The Energy and Resources Institute

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