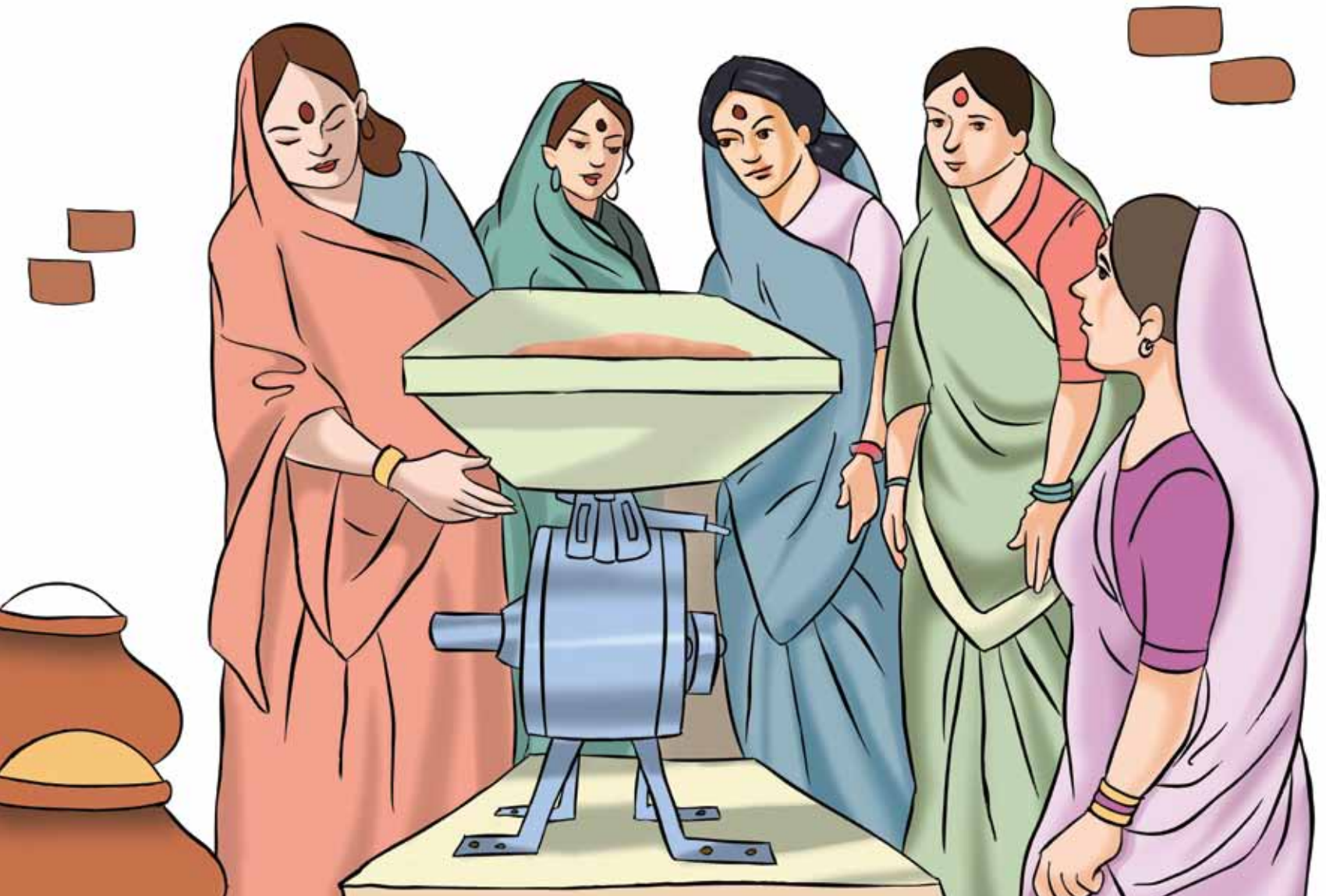


# Women Energy Cluster



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**Low Carbon Pathways**  
Sustainable Civil Society Initiatives

# Women Energy Cluster



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Embassy of Switzerland in India

## Abbreviations

BKP	Bundelkhand Knowledge Platform
BMTPC	Building Materials and Technology Promotion Council
CDM	Clean Development Mechanism
CERs	Carbon Emission Reductions
CIGs	Common Interest Groups
CRIDA	Central Research Institute for Dryland Agriculture
CSOs	Civil Society Organisations
DRDA	District Rural Development Agency
DST	Department of Science and Technology
FAO	Food and Agriculture Organisation
IARI	Indian Agricultural Research Institute
IAY	Indira Awaas Yojana
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IGFRI	Indian Grassland and Fodder Research Institute
IIVR	Indian Institute of Vegetable Research
KVKs	Krishi Vigyan Kendras
MEAL	Monitoring, Evaluation, Action and Learning
MoEF	Ministry of Environment and Forests
NABARD	National Bank for Agriculture and Rural Development
NAPCC	National Action Plan for Climate Change
NIRD	National Institute of Rural Development
NRCAF	National Research Centre for Agro-Forestry
PoADD	Programme of Activities Design Document
PoP	Package of Practices
PRA	Participatory Rural Appraisal
PRI	Panchayati Raj Institutions
RCC	Reinforced Cement Concrete
SCSI	Sustainable Civil Society Initiative to Address Global Environmental Challenges
SDC	Swiss Agency for Development and Cooperation
SORs	Schedule of Rates
SSMM	Sankalp Swashakti Mahila Mandal
TKM	TARA Karigar Mandal
TNA	Training Needs Assessment
UNFCCC	United Nations Framework Convention on Climate Change
USP	Unique Selling Proposition
VERs	Voluntary Emission Reductions
VLC	Village Level Community
WEC	Women Energy Cluster
WUA	Water Users Association

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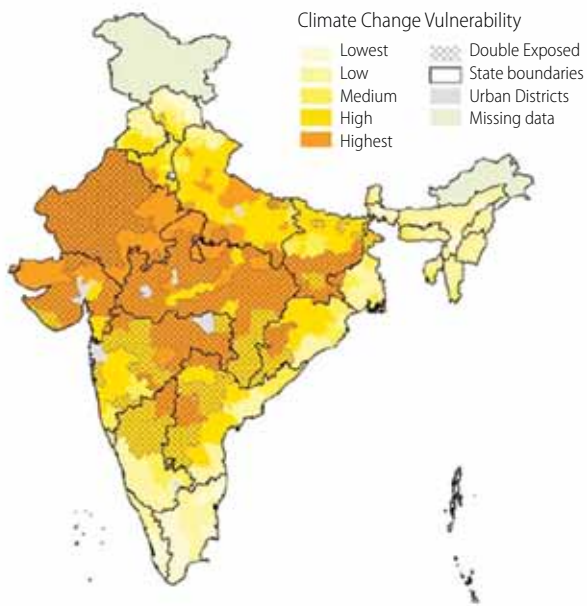
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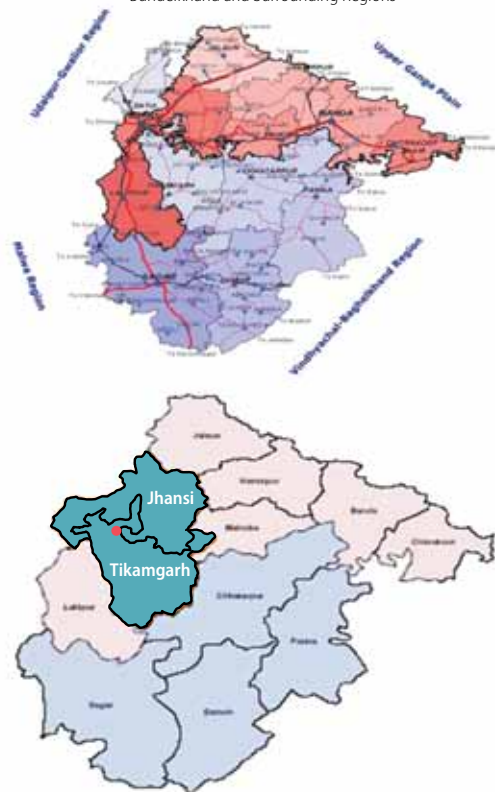
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**Fig. 1 Bundelkhand and the Project Areas**



Source: IPCC 2007  
Map not to scale

**Bundelkhand and Surrounding Regions**



Women ensure livelihood security through access to renewable energy services



## Introduction

Bundelkhand, spread over Uttar Pradesh and Madhya Pradesh in Central India, is one of the most vulnerable and drought prone regions of India. Agriculture and livestock rearing is the mainstay of the regional economy. Rainfall in the Bundelkhand region has been in the deficit to an extent of 66 per cent between 2004 and 2008. This region used to have one drought with an interval of about 16 years, which has increased to three-fold over the years between 1968 to 1992 and the past four years have witnessed continuous drought<sup>1</sup>.

The recent drought in Bundelkhand impacted 16 million people; 40 per cent farms were not sown bringing down food production by about 30 per cent while 70 per cent of ponds and tanks dried up. Rainfall has been deficient by 40-50 per cent for the last five years across the districts. This region is heavily dependent on livestock with high livestock-human ratio, but the drought impact on livestock has been severe<sup>1</sup>.

The society in Bundelkhand is mainly patriarchal in nature and the position of women here is highly marginalised. Women have limited access to resources and entitlements. While the male members of the family migrate to urban places for work, women are left behind in the villages adding further to their vulnerability. Though the Bundelkhandi women work at par with men, both on and off farm, they have minimal role and say in decision-making regarding marketing or selling of the produce. That most of them are illiterate does not do much to ameliorate the situation.

Since 2002, Development Alternatives

has been working in the villages of Tikamgarh, Datia and Jhansi districts, mobilising women into collectives of village level Self Help Groups (SHGs) that were federated as the Sankalp Swashakti Mahila Mandal (SSMM) with a current membership of more than 320 women. The women's group has been managing the Sri Ram Raja Gaushala.<sup>2</sup> The Gaushala is seen as a potential resource centre for biogas based energy for value addition to produce spices, milk, and compost. This was done to initiate activities that would generate supplementary revenue for women.

Lack of enterprises has been cited as a prime reason for the backwardness of Bundelkhand. It has also been pointed out that access to reliable and quality power is a prerequisite to establish enterprises. The Sri Ram Raja Gaushala provided a unique opportunity to address the issue of power generation. The collection pits for dung create anaerobic conditions leading to methane emissions. Methane is an important greenhouse gas with a global warming potential that is 21 times that of carbon dioxide. Proper management of dung would additionally provide benefits of saving green house gas emissions.

The purpose of involving women as the main players was to enable them to acquire stakes in natural resource management and add to their economic value thereby also improve their relative position in the society as a whole.

The Sri Ram Raja Gaushala Project is located at Orchha in Tikamgarh district of Madhya Pradesh. This report covers the activities carried over a period of 3 years from 2008 to 2011.

**Cow dung from 85 scrub cattle is the key resource to facilitate the members of the Sankalp Swashakti Mahila Mandal (SSMM) – owners of the Sri Ram Raja Gaushala to convert bioenergy into electricity for new livelihood generation.**



## The Initiative

This project aimed at reducing the vulnerability of rural communities is a part of the Sustainable Civil Society Initiative to Address Global Environmental Challenges (SCSI). The Initiative spans over 15 years' period with a long term vision to eradicate poverty and regenerate the natural resource base across 1000 villages in the region. The initiative is supported by the Swiss Agency for Development and Cooperation (SDC)/Climate Change and Development Division of the Embassy of Switzerland in India.

The other components of the initiative address the vulnerabilities of farming and infrastructure. These sectors have been identified as the ones impacted the most due to changes in the climatic regime and environmental degradation. They have also been identified as having the maximum potential to contribute to the region's development and to demonstrate reduced carbon footprints in the process. It is hoped that lessons from the Project would be useful for other comparable regions of India.



**40 members of the SSMM drawn from different self help groups have been working with Development Alternatives to explore possibilities of making the Gaushala a viable livelihood centre based on a bioenergy.**

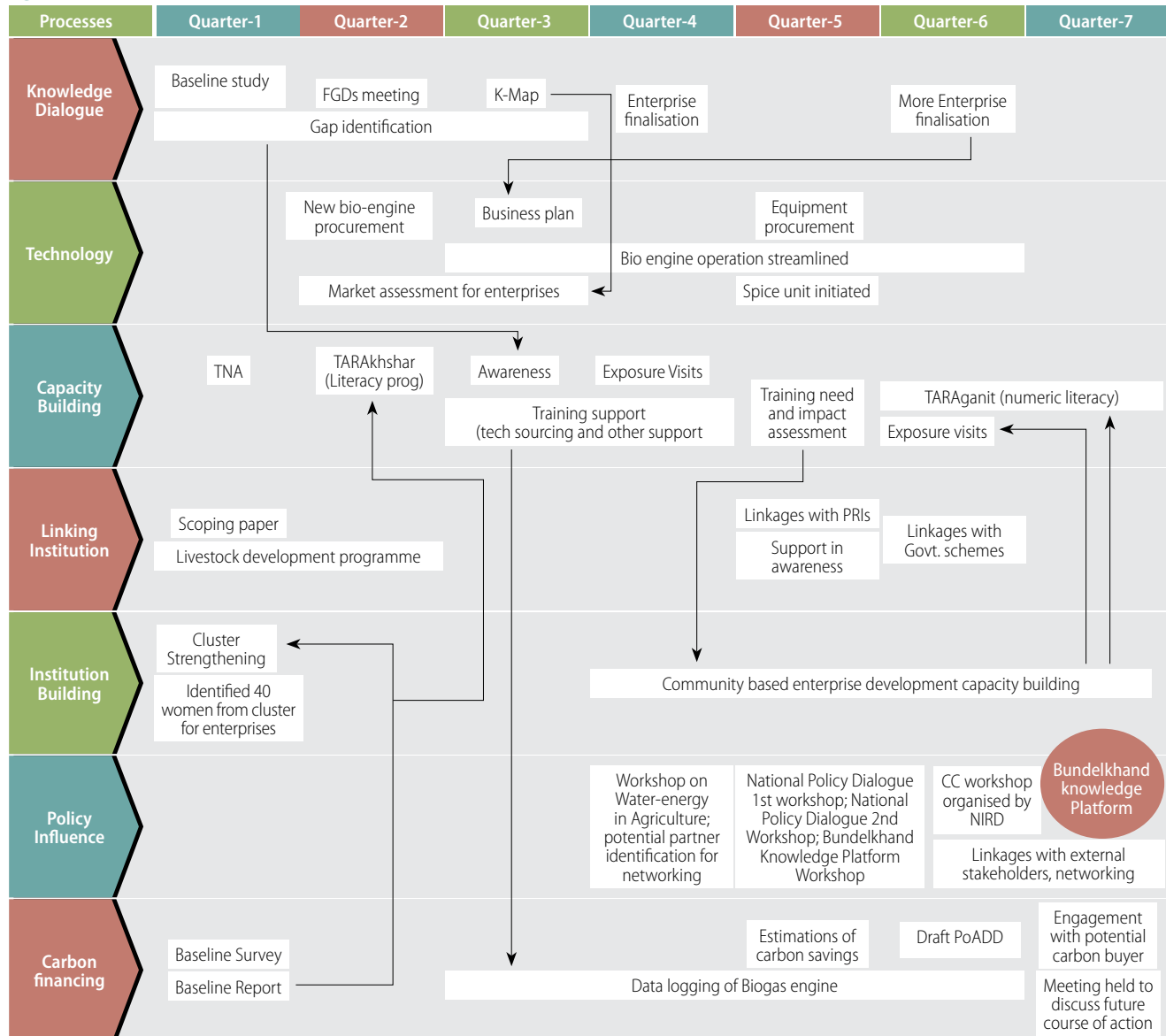


## Process and Pathways

The SCSI has a 3 pronged strategy: knowledge processes, facilitation of changes in practice and policy influence. Intensive training

and capacity building along with technical and market support strengthens the process of SCSI (Fig. 2).

Fig. 2. An Overview of the Processes







**Discussions facilitated visioning exercises which have helped women groups to articulate their dreams of economic independence. Opportunity available through the Project, tempered with practical possibilities has helped define small steps for value adding local resources and established home to market links via the Gaushala.**

### Knowledge Dialogue

The Initiative is engaged with 40 women from the SSMM, which form the Women Energy Cluster (WEC) through Focus Group Discussions (FGDs) and individual interviews attempted to understand the impacts of environmental uncertainties and economic vulnerabilities on their lives and livelihoods. Discussions helped identify capacity and resultant confidence gaps that were hindering the women from venturing into new livelihood options. During group discussions and dialogues with the women, a need for an exposure visit to build confidence in activities related to bioenergy based enterprises was felt. An exposure visit was, therefore, undertaken during which the women from the WEC met women in other parts of the country who had established their own enterprises and had moved onto the path of income security. Informed dialogue with them helped these women in confidence building. The exposure visit and subsequent visioning exercises helped women identify new options for enhancing incomes. Technical training and market support that would be required were also identified.

**Communication and Outreach:** The communication strategy focused on bringing women onto a common platform to express their needs and identify their visions and then subsequently promote their work at the Sri Ram Raja Gaushala through radio and grassroots media. In addition, communication was also directed to position the Project at the district and the state level for leveraging resources for the SSMM.

**Visioning exercise:** The Project had aimed at

economic stability of the rural women, and attempted to bridge the capacity gaps of the target group of women by providing training (and exposure visits) so that they are able to express ownership and manage the Gaushala and earn their livelihood as well. In this regard, visioning exercises were undertaken with the WEC in 2009 and 2011. Through these exercises, women were able to express their views and vision about the Sri Ram Raja Gaushala to make it more sustainable as a source of livelihood. About 50 women participated in these exercises. They first jotted down their ideas on a chart paper and were later assisted by a painter to draw them on the walls of the Gaushala campus, thus making their vision visible and prominent for themselves as well as for other stakeholders.

**Radio programmes:** Radio Bundelkhand, a community radio promoted by Development Alternatives for empowering the rural community, played an important role in making the women's group aware of the impact of the climate change and to prepare them to adopt positive changes in their behaviour. Various radio programmes such as *Safalta Ki Kahani Meri Zubani*, *Chota Kaam-Bada Munafa*, *Aas Pass* were broadcast whereas seven and six radio spots were created in 2009-2010 and 2010-2011, respectively. The team also developed messages, jingles and programmes with the SHG groups who were involved in the Sri Ram Raja Gaushala enterprises. In the first phase of Project, radio messages were designed in accordance with field requirements for the publicity of SSMM and its spice business followed by broadcasting of the success stories of WEC in the milk collection business.



**Mahila Sammelan:** Seminars have been organised on Women's Day for the past 3 years at the Sri Ram Raja Gaushala campus to create mass awareness about the trends in climate change, its impact on rural livelihood and the possible alternatives to deal with it. The events have celebrated the achievements of the SHG women and inspired them to work collectively towards their empowerment. These were aimed at making women and their families aware of various government schemes that they could benefit from. More than 1000 women participated in the event in March 2011. Local officials from the National Bank for Agriculture and Rural Development (NABARD) and line departments of the district government also participated.

### Capacity Building

**Technical Training and Support:** The capacity building of the women's group associated with the Gaushala started with basic literacy skills using a fast track system called TARAKshar<sup>3</sup>. With reading and writing skills in place, exposure visits and a series of visualisation exercises helped in building up confidence and identifying the type of enterprises that women would like to start, linked to a possibility of a regular energy source. Technical trainings consisted of learning to use and manage various equipment such as grinders, chilling plant, oil expeller etc. The operation, maintenance and management of the bio-engine were included and women could operate the system.

Initiating small enterprises including backward and forward links in the value chain

of the business was fairly easy for the farmers and artisans in other interventions as they were making changes in already established practices. For the women's cluster, however, there was a need to first understand and develop the value chains. Therefore, the Project, in association with MARTrural<sup>4</sup>, initiated a 'community based livelihood enterprise development process' specifically to address their capacities. This has included identifying the value addition that may be done to available local resources. The process started at a level with which women were comfortable and gradually progressed to higher levels of complexity such as collective management of the resources, understanding of local markets, price structures and roles of intermediary agents and setting up collective marketing etc. Visualisation of what can be done at the Sri Ram Raja Gaushala has been an ongoing process along with formal and informal group building exercises. These are enabling women to proactively plan and make decisions in terms of how they can use the resources available at the Gaushala to generate sustainable incomes and reduce their vulnerability to climate variability and drought.

### Community Institution Building

**Sankalp Swashakti Mahila Mandal:** The Sri Ram Raja Gaushala is owned and managed by the SSMM - a federation of women SHGs from 11 villages in Orchha, instituted at 3 levels. At the top is SSMM followed by Village Level Committee (VLC) at the middle level (Fig. 3). The lower level consists of SHGs. The SSMM consists of VLCs and SHGs. Each of the 11 villages has VLC.

The SSMM as the topmost organisation

**Reading and writing were identified as basic skills and stepping stones for the capacity building process. The TARAKshar an IT based fast track literacy tool in Hindi, enabled 40 women to read and write in 30 days. Basic functional literacy is being put to use to record their new skills - read what the markets have to offer and keep accounts of works.**





Capacity building has involved exposure visits to different situations. Technical activities at the Barefoot College in Tilonia, Rajasthan, women's enterprises at SEWA in Gujarat and also local markets around their villages building confidence for new economic ventures and an understanding of opportunities in the selected livelihood value chain.

basically works to strengthen the SHGs and VLCs. The WEC comprises 40 members of the SSMM from various SHGs who have indicated an interest and are actively engaged in working at the Sri Ram Raja Gaushala. Many other SHG members are associated at the village level for collective marketing of local produce not yet directly linked with the Gaushala.

**Women Energy Cluster (WEC):** A few members of the SSMM took an active interest in livelihood related activities. Out of them 40 women from different SHGs representing 4 to 5 villages in the region were identified to collectively form the WEC that would become the energy source for 4 to 5 livelihood enterprises. Each Energy Services Cluster or enterprise unit in the Gaushala is owned and managed by the women of the WEC. At present the WEC has completed the capacity

building phase. Since the enterprises are in start-up stage, they are being managed jointly by Development Alternatives and the WEC. Eventually all the enterprises will be managed by WEC. At present the WEC is involved in 5 enterprises (Table 1).

To begin with, women's resources, constraints, vulnerabilities were mapped out and linked with energy utilisation to identify the type of livelihood interventions that can be initiated with them. For example, use of dung for energy generation was identified as relevant to the women groups as they had expressed dung cake making as a 'curse' they are born to bear and had expressed a need that Gaushala should be a source of revenue and not only a social service as it is made out to be. Further, the training needs of the women were identified on the basis of their challenges and levels of literacy and capacity to undertake enterprise activity.

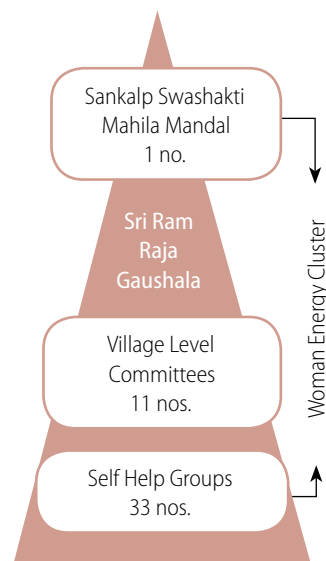
The selection of women for establishing groups was on the basis of:

- membership in SHGs associated with the SSMM;
- active participation in SSMM activities;
- willingness to run enterprises or be involved in income generation activity; and,
- stake in the various economic activities at the Sri Ram Raja Gaushala.

Assessment of women's capacities for local implementation was done on the basis of:

- understanding of importance of SHG and its functionality;
- micro enterprise development and management;
- book keeping;

**Fig. 3 Structure of Sankalp Swashakti Mahila Mandal**





**Table 1: Activities of Women Energy Cluster**

Enterprise Name	Current Status	Activities	Nature of the Enterprises
Oil Expeller	Running	Purchasing from villages, extracting the oil through processing and selling	Regular
Groundnut Decorticator	Running	Purchasing from villages, grading and selling	Regular
Milk collection	Running	Fat testing, milk purchasing from villagers, selling at dairy	Regular
Grinding Unit	Running	Purchasing from the villagers, processing, grinding and selling at village level.	Service based / irregular
Nimboli Collection	Running	Collection from the villagers, assembling and selling.	Seasonal

- livestock management;
- negotiation, marketing and selling; and,
- women's educational level.

At regular intervals women's training needs and exposure requirements were assessed by The TARA Livelihood Academy.<sup>5</sup>

### The Green Enterprise Model

**Technical Processes:** Presently there are a total of 85 cows at the Sri Ram Raja Gaushala. On an average, one cow produces 5-6 kg of cow dung per day. The obtained cow dung is mixed with water in a ratio of 1:1 and the thick mixture is fed into the digester. Inside the digester anaerobic decomposition of cow dung produces biogas. This gas then generates electricity through a gas engine which is used to run the various enterprises operated by the WEC (Fig. 4).

This following flowchart shows how the different sub-systems of Sri Ram Raja Gaushala are inter-dependent for material and energy

resources. The sub-systems of Gaushala which are currently not functional are represented by broken lines. The linkage of the Gaushala with the outside community is also shown. The Sri Ram Raja Gaushala system has material inflow from outside system (community) such as fodder, spices etc., and it provides materials to the community like vermi-compost, slurry, processed spice etc.

The enterprises run by the WEC are as follows:

**Grinding unit:** With the processing capacity of 25 kg per hour; the commonly processed spices in the grinding unit are turmeric and red chillies. The women of the WEC bring the spices, process and package them and then sell the produce in the market. This unit is currently not operational due to the seasonal nature of the enterprise, shortage of electricity and the high cost of raw material.

**Milk chilling unit:** A milk chilling unit with plant capacity of 500 litres per batch has been set up. Milk is collected in collection centres and graded on the basis of cream content and

**Active participants from the SSMM have spent many days to discuss and develop an understanding as to how they could convert the Gaushala from a charity venture to a profit centre, owned and managed by the women' group. Value addition to local resources has been a starting point.**





The dung from 85 plus scrub cows is used as a source of energy to run 5 production units including irrigation pumps. The challenge of making this system self reliant and profit making for its members remains. Right scaling, combination of different green energy sources and efficiencies in operations and strengthening management and backward and forward links with village resources and markets are required.

chilled. Currently, the milk chilling plant is not operational due to the lack of electricity for the requisite hours. However, the milk supply chain has been established and the milk collecting centres are operational.

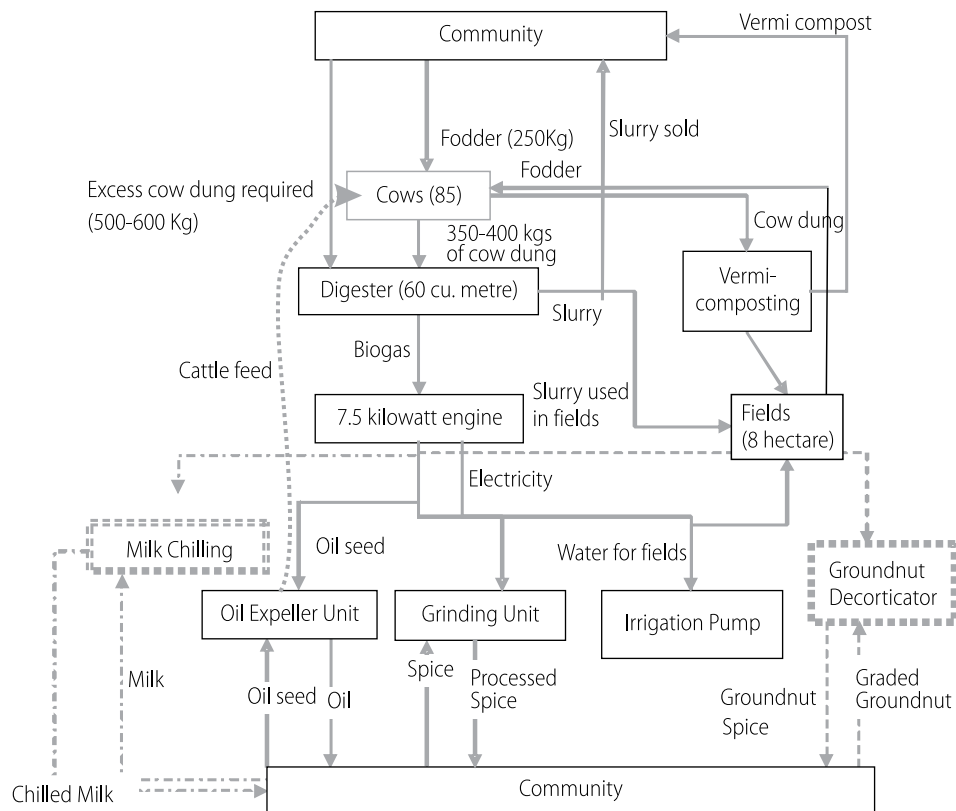
**Oil expeller unit:** The unit has a processing capacity of 7 kg per hour. The oil seeds are brought by the women of the WEC and after processing and packaging they sell them in the market. The by-products obtained in the process can be used as fodder because of their high

nutritious content.

**Groundnut decorticator:** The decorticator machine has a capacity of 50 kg per hour. Grading and sorting of the groundnut seeds through machines ensures standardised produce which fetch better prices in the market. The unit has started functioning since April 2011. This unit is operational, but not on a regular basis and to its full potential due to irregular supply of electricity.

**Irrigation pumps:** These pumps are used to water the fields which are owned by the Sri

Fig. 4 Activities of Women Energy Cluster





Ram Raja Gaushala. Water can thus be regulated resulting in better management and good agricultural production. This unit is operated regularly. On an average the irrigation pumps are run for about 1-3 hours every day. Wheat is being cultivated in 5 acres of the Gaushala. In the Rabi season of 2010-2011, 11 quintals of wheat were produced and sold, its husk adding to the fodder Green fodder *berseem* grass is produced in the Rabi season.

**Vermi-compost unit:** The vermi-compost unit uses cow dung which is broken down by earthworms. The compost making process requires 45 days. The compost obtained is used in the fields owned by the Gaushala. Cow dung which cannot be used in the biogas plant i. e., old and dry cow dung (4-5 per cent of the total cow dung) is put in the vermi compost pits specially made in the Gaushala.

**Slurry management:** Slurry is the by-product produced when biogas is produced from cow dung. It is basically a mixture of digested cow dung and water in equal proportions with very good manure properties. It is collected and used in the fields of the Sri Ram Raja Gaushala to increase productivity. From 50 to 75 per cent of the cow dung fed into the digester will form the slurry. Excess slurry can be sold to the villagers as manure at a good price. The expected price for the slurry is about 60 paise per kg. There is thus a high potential to earn revenue through sale of slurry.

**Fodder management:** Each cow is fed with an average of 2-3 kg of fodder every day, averaging to an approximate of 250 kg of fodder per day. The green fodder is obtained either from the field owned by the Gaushala or is purchased

from the market. Other ingredients which are available in particular season are mixed with the fodder, especially for the milching cows to provide them with extra nutrition. The Sri Ram Raja Gaushala has often been facing fodder crisis due to shortage and price rise in the market. For solving the same the following measures need to be put in place:

- Fodder is bought in wholesale in seasons when it is readily available so as to reduce costs;
- Machinery procured to ensure fodder compaction and conservation for longer periods to allow storage; and
- Growing green fodder in the Gaushala fields in large quantities.

**Resource and energy management:** On an average 5-6 kg of dung is obtained from each cow. This value is more for milching cows (20 kg) and lesser for the scrub cows (4-5 kg). Approximately about 400 kg of cow dung is obtained from the Sri Ram Raja Gaushala everyday. A part of it is lost while the cows go to graze the fields outside the Gaushala.

For optimum operation of the biogas engine, a minimum additional 500-600 kg of cow dung is required. Since the dung availability from the Gaushala does not meet the required quantity, dung is bought at Rs. 0.6 per kg from a nearby gaushala for optimum operation of the biogas engine costing about Rs. 300 per day. The quality of the cow dung is monitored to ensure that it is free of gravel and stones. If stones or gravel enter the plant, it can lead to choking up of the biogas plant. To prevent the same, sieves are used to remove the stones present.

**Technical training included operations and management of various production units as well as the biogas unit.**



The process of energy management has been explained with the help of Fig. 5.

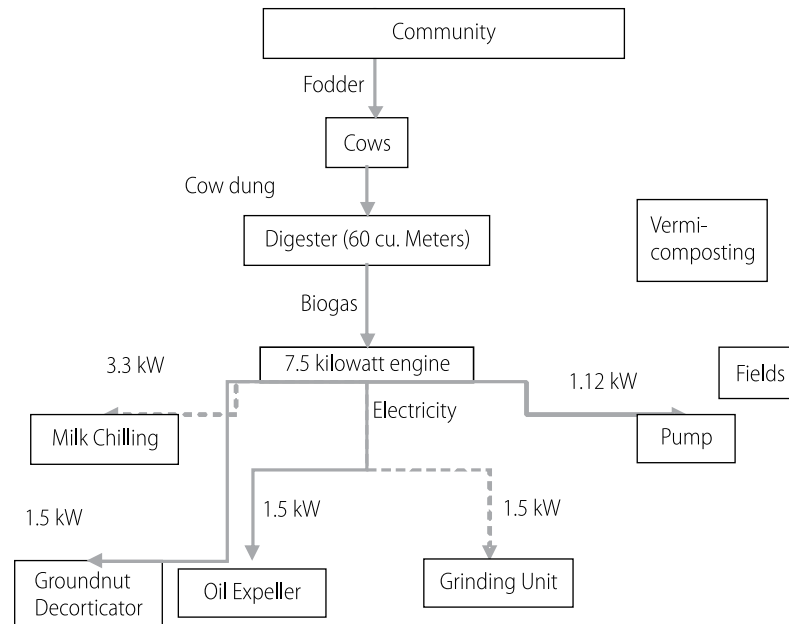
**Financial Issues:** The major components of the revenue are:

- The Sri Ram Raja Gaushala is supported by an annual grant of Rs 1.5 lakh from Madhya Pradesh Government;
- The energy generated from Gaushala plant (if sold to various enterprises) is Rs. 6.5 per unit of electricity;
- Annual rent of Rs. 2000 is taken from each unit; and
- Agricultural income from the sale of crops.

In the future, this value is expected to increase with sale of slurry and revenues from

milk. Also in future, with increased energy usage more revenue is expected from sale of electricity. With registration of the project under Clean Development Mechanism (CDM), revenue from Carbon Emission Reductions (CERs) is expected. This carbon credit could be around Rs. 28 lakh in the first year. However, a large sum of it would be required for validation and administrative costs. The rest can act as revenue for the biogas enterprise unit. This could amount to about Rs. 6 lakh. With input costs, it is expected that the biogas enterprise will accrue minimal profits in the first year as the entire supply chain for the resources and the enterprises is in the development phase.

**Fig. 5 Energy Management**



Adequate fodder for the cows is a challenge. While the bulk is purchased by SSMM, berseem grass as green fodder and the husk of wheat from the gaushala fields is also available to supplement the requirement, issues of fodder sustainability still remains.



## Outcome

Over the 3 years' period of the project, the members of WEC have attained several social and economic benefits. Once the women become part of the SHGs members they are trained in various skills such as group management, book keeping etc. The bank account of SHGs is opened after 2-3 meetings so that the regularity of the members and savings can be ensured. So far, the SHGs members have undertaken financial transactions with 5 banks. After becoming the part of a group and participating in the trainings, the women are now able to interact with each other without any hesitation and are more confident in visiting the bank to complete various bank transactions.

### Economic Benefits

Currently, no regular income has been established so far in the Sri Ram Raja Gaushala. However, collective marketing of nimboli (fruits of the neem tree), milk, groundnut, spices has ensured higher prices to the women, e.g. through collective marketing of nimboli the

women could realise higher prices of Rs. 6-7 per kg as compared to Rs. 2 per kg that they were getting earlier. Milk collection and sale of upto 300 litres per month is providing economic benefits of Rs. 3-4 per litre depending on fat content and sale of mustard oil and wheat from the Sri Ram Raja Gaushala has led to an income of Rs. 10,000 in the months of April - July 2011.

A business plan for the Gaushala has been developed, although theoretically its verification now requires the enterprise units and bioenergy unit to run to optimum capacity in the coming years.

### Emission Reduction

For the purpose of calculating methane emissions, AMS III D methodology of United Nations Framework Convention on Climate Change (UNFCCC) was followed (Table 2). The project boundary, as per AMS III D paragraph 8 is delineated by 'the physical, geographical site(s) of the livestock and manure generation

**Bioenergy from cow dung is supplementing the grid electricity at the Gaushala to run a small oil mill, grinding unit, groundnut decorticator and pumping water for agriculture. The growth in economic footprint is accompanied with reduction in the carbon footprint of the Gaushala and related economic activities as proper management of cow dung has led to methane capture and conversion.**

**Table 2: GHG Savings Calculations at the Sri Ram Raja Gaushala**

	Source	Gas	Included	Justification/Explanation
Baseline	Methane emissions due to anaerobic fermentation of manure	CO <sub>2</sub>	No	Excluded for simplification. This is conservative.
		CH <sub>4</sub>	Yes	Main emission source.
		N <sub>2</sub> O	No	Excluded for simplification. This is conservative.
Project Activity	Leakages from biogas plant	CO <sub>2</sub>	No	Excluded for simplification. This is conservative.
		CH <sub>4</sub>	No	Main emission source.
		N <sub>2</sub> O	No	Excluded for simplification. This is conservative.







Reading, writing, exposure, training and small revenues have been confidence boosters of the WEC. A path towards climate resilient growth is visualised, where women have given expression to their dreams on the walls of the Gaushala and have taken the message home to their villages. Behaviour change analysis has revealed a demand for new skills and a confidence for enhancing their stake in the Gaushala.

**Table 3: Emission Reductions**

ER y	Emission reductions in year y	3987	t CO <sub>2</sub>	Calculated
	Reductions due to manure management practices	3985	t CO <sub>2</sub>	Calculated
	Reductions due to grid displacement	2	t CO <sub>2</sub>	Calculated

and management systems and the facilities which recover and flare/combust or use methane'. It also covers treatment of manure collected from several farms in a centralised plant (for more details please refer to: <http://cdm.unfccc.int/methodologies/DB/APIHMNNKLNBU8MY8DK7TRQ9XQJJGLT/view.html>). Under this methodology the important aspects considered are outlined below.

As per approved methodology AMS IIID, the baseline scenario is the situation where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. Baseline Emissions (BE<sub>y</sub>) are calculated using the amount of the decayed waste or raw material.

Biogas plants are not commonly set up in gaushalas in this region. The dung is dumped in a deep pit and left to decompose. Due to the depth of the pit, there is no oxygen at the lower levels and anaerobic conditions are created. This gives rise to methane gas production which is directly released in the atmosphere due to lack of any mechanism to capture or destroy the gas. Thus, the baseline scenario is use of anaerobic lagoons for animal waste disposal.

In the absence of the project activity, energy needs will be met using grid electricity. Almost 70 per cent of this is sourced from fossil fuels. This leads to higher emissions which contribute to global climate change. Grid electricity supply, however, is erratic in rural India. Hence, it is supplemented with diesel based energy (Diesel Generator Sets). Thus, the electricity baseline is use of fossil fuel derived electricity. After calculations, the estimated amount of CO<sub>2</sub> emission reduction is given in Table 3.

The emission reductions due to grid displacement are miniscule i.e., less than 1 per cent of the total emission reductions even when the biogas engine is worked up to its optimum capacity. Thus it can be seen that a major part of the emission reductions is due to manure management practices which are undertaken at the Sri Ram Raja Gaushala.

### Behaviour Change

An assessment of change in behaviour, reflective of the project's impact amongst the women and other target groups was conducted towards the end of the current phase.

Some of the specific changes in the behaviour of the women assessed amongst the



experimental group (those who had received training and support under the Project, control group has not been covered under training) include: increased self-esteem (87 per cent); remaining 13 per cent said that they have earned respect from others. Nobody faced resistance in joining Gaushala. Majority of them (90 per cent) recalled that they have received training on milk chilling followed by making spices (86.7 per cent) and oil expelling (73.3 per cent). Basic education and basic maths, growing fodder and groundnut decortication has also been recalled by many (Table 4).

For 73 per cent, the training received was extremely beneficial and for remaining it was somewhat beneficial. According to 90 per cent of the women from the experimental group, many people in their village are aware of the Project. All the women who have received training have motivated other people in their village in adopting the methods of Sri Ram Raja Gaushala model. On an average, each woman motivated 18 other people.

**Table 4: Topics Covered in Training - Recalled by WEC**

	Experimental Group (%)
Basic Education	63.3
Basic Maths	63.3
Milk chilling	90.0
Running collection centre	60.0
Making spices	86.7
Growing different fodder	63.3
Groundnut decortication	53.3
Oil expelling	73.3
Biogas plants	50.0
Gaushala management	60.0
Information on market & marketing	36.7
Produce electricity	33.3
How to run an SHG	40.0
Accountancy/book keeping	23.3
Base (N)	30

**Many women who had never stepped out of their village have travelled out and come back with new knowledge and their families and village community have vastly benefitted from it.**



## Challenges

### Income Generation and Capacity Utilisation

The primary challenge is to make the Gaushala system economically rewarding. On current values, a net income of Rs. 50 per day per woman who is managing the biogas plant is achievable in 3 years from the sale of energy and potential carbon credits. This income has a possibility of doubling if sale of cow dung slurry and agricultural produce is added and the backward-forward linkages of dependent enterprises are strengthened. At present the Project benefits are inadequate to attract and retain interest of WEC and contribute significantly to their income security. A re-orientation of the business plan of the Sri Ram Raja Gaushala is thus required.

### Technological Streamlining

To ensure long term sustainability of the Project certain processes need to be put in place. Currently the biogas enterprise is facing a few technical issues. The energy requirement at the Gaushala is of 20 kWh per day with a maximum of 50 kWh. The engine despite being a 7.5 kW engine is unable to cater to this need. The engine currently operates for a period of 1-2 hours in a day. This is mainly due to the following reasons:

- Low production of biogas with low availability of cow dung (measures have been put in place to solve this issue) and leakage of gas from the current system (repairs have been carried out, but a system rehaul is required).
- The maximum load that can be borne by the engine is 6 kW despite a capacity of 7.5 kW. Engine does not perform to its full capacity. There are operational and maintenance

issues which often arise with the engine. Technological improvements are required to ensure optimum utilisation.

- The biogas produced in the digester is used to run the biogas generator. It is important that impurities (mainly moisture) in the biogas are removed before it is fed to the engine. A filter has been put in place for the same. However, the biogas produced still has traces of moisture. This is an issue which needs to be looked into.

Right scaling of the technology package is critical to the sustainability of the WEC model. To optimally run the current scale of economic operations, a regular supply of 7 kWh energy for 6 hours is required. The current technology package is not optimised with adequate back-up supports to maintain a regular energy service. Some suggestions for increasing capacity are as follows:

- The gas holding capacity can be increased by providing a biogas balloon of 30 m<sup>3</sup> capacity. This will also reduce leakage to a large extent. This arrangement would ensure continuous feed to the generator to run it comfortably for 6-8 hours.
- Increasing the biogas generator capacity to 10 kW will lead to an upgradation of the existing system which is 7.5 kW. This increased capacity will help easily feed our current requirements (minimum of 20 kWh per day and can feed more).
- A back up generator is required to meet the existing demands in case of energy shortage to ensure continuous supply of electricity to enterprises.



**Women at the Gaushala meet every month for a federation level SSMM meeting. Every Women's Day is a celebration of achievements.**



### Resource Sustainability

**Cow Dung:** Cow dung availability to run the engine at its optimum capacity needs to be assured. The following steps have been taken towards this:

- The cow dung requirement for producing each unit of electricity is very high. Currently we require approximately 30 kg of cow dung for producing 1 unit of electricity. At present, cow dung is being purchased from another gaushala. While doing so a quantity and a price check is maintained to ensure financial sustainability.
- It is being envisaged that cow dung production be internally upgraded in the Project, by increasing the number of milch cows, that can produce larger amounts of cow dung as well as contribute to income in terms of sale of milk.
- To make the process more transparent and encourage ownership among the WEC members a new strategy is underway, whereby cow dung is collected by the members of the WEC in exchange of the slurry (organic fertiliser) that will be generated.

**Fodder:** High fodder costs need urgent stepping down to ensure long term sustainability of the Project. Some suggestions that are under process include:

- Bulk purchase of fodder to augment costs. The downside would be large and long term storage facilities.
- Green fodder being used can be increased as it is grown in the Sri Ram Raja Gaushala fields.
- Innovative strategies of barter, with fodder for slurry schemes.

### Financial Sustainability

Several issues need to be addressed in terms of financial sustainability. To make the system financially viable such that the entire process can be sustained by the WEC, a business plan has been prepared. However, in the first year the enterprises did not show a profit as there was a lag vis-à-vis mechanisms and processes yet to be put in place. Apart from fodder and raw material management a backup generator needs to be purchased or an alternate renewable energy system set up. Due to varied challenges the Project is unable to provide adequate electricity to the units hampering their profitability. A detailed description of energy consumption for the current year and prediction of energy consumption for future years has been given in Table 5. While ensuring electrical supply to the enterprises, the sustainability of technical, financial and resource aspects needs to be kept in mind.

### Bioenergy for Income Generation

The current cost of electricity from biogas at the Sri Ram Raja Gaushala is approximately Rs. 13 per unit. This is being charged at a subsidised rate of Rs. 6.5 per unit yet it is unable to compete with grid electricity available at a subsidised rate of Rs. 3.2 per unit. The grid electricity neither reliable nor adequate for running any of the units to full capacity and it is subject to frequent voltage fluctuations. The other available alternative is diesel based electricity available at an exorbitant rate of Rs. 17 - Rs. 18 per unit, which in fact compares favourably in cost with



**Resource sustainability and technological right scaling remain a big challenge. The fodder, dung cycle and capacity management for bioenergy have been identified as grey areas. Technical, institutional and financial solutions will need to be redesigned. A strong base and understanding has been achieved.**

**Table 5: Energy Consumption and Prediction of Energy Consumption for Future**

Enterprise name	Units (kWh) Consumed per day in the given years					
	2011	2012	2013	2014	2015	2016
Grinding unit	0	1.5	6	7.5	9	10.5
Milk chilling unit	0	14.92	14.92	29.84	29.84	29.84
Groundnut decorticator unit	0.45	6	9	10.5	13.5	15
Flour mill	0	6.72	8.96	11.2	13.44	15.68
Oil expeller unit	0.672	6.72	8.96	11.2	13.44	15.68
Pump for agri. production	2.625	5.25	10.5	13.125	15.75	18.375
Total units consumed (per day)	3.747	32.19	58.34	83.365	94.97	105.075
Biogas required (m <sup>3</sup> )		49.57	89.84	128.38	146.25	161.82
Cow dung required (kg)		1448.02	2624.33	3750.04	4272.07	4726.63

Source: Project documents from SCSl project of Development Alternatives

bioenergy. This value can only be understood and internalised by the WEC when economic benefits from the enterprise units through increasing efficiencies and moving up in the value chain of their businesses is linked with dependence on electricity / regular energy availability. Even if the value of bio-energy 'in their control' is internalised by the WEC, the gap

between cost of generation and affordable price of biogas based energy will need to be met through development / adaptation funds till such time as profits at the Sri Ram Raja Gaushala are able to meet the gap. Theoretical business plans developed for each of the enterprise units as a whole need to be further fine-tuned as economic activity at the Gaushala increases.



**While there is a need for a continued handholding and capacity building of this unique green enterprise model, a hard look at its financial viability and strengthening its business plan will make it replicable across hundreds of community gaushalas across the region and in the country.**



**Endnotes:**

1. Report on 'Drought Mitigation Strategy for Bundelkhand region of Uttar Pradesh and Madhya Pradesh' by Dr. J.S Samra of the National Rain-Fed Areas Authority, 2008.
2. Gaushala is a shelter for stray/ scrub cows, a social enterprise supported in part by the state fund by the Gaushala Ayog, in response to the Hindu belief of cow worship. Gaushala Ayog rule allows a Gaushala to upkeep upto 50 per cent of the total number of cows as milch cows.
3. TARAKshar is an IT based pan India literacy programme for adult literacy delivered by Development Alternatives
4. MARTrural is an organisation working for sustainable livelihood creation of the rural poor which engages in finding innovative rural solutions that meet the specific requirements and fill the gap between corporate and development sectors.
5. TARA Livelihood Academy is a training arm of the Development Alternatives Group, working in the area of community training for livelihood generation, to fulfil the exact need of the target group.











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