Mitigation And Adaptation Information Network For Sustainable Communities

KNOWLEDGE BASE FOR DECENTRALIZED RENEWABLE ENERGY IN INDIA

Decision Support System for Decentralized Renewable Energy

A Manual

Supported

UNEP GRID ARENDAL
Environmental Knowledge for Change

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Disclaimer: The decision support system has been prepared by Development Alternatives and the data used for its preparation is project specific.

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SECTION – A

1. Introduction

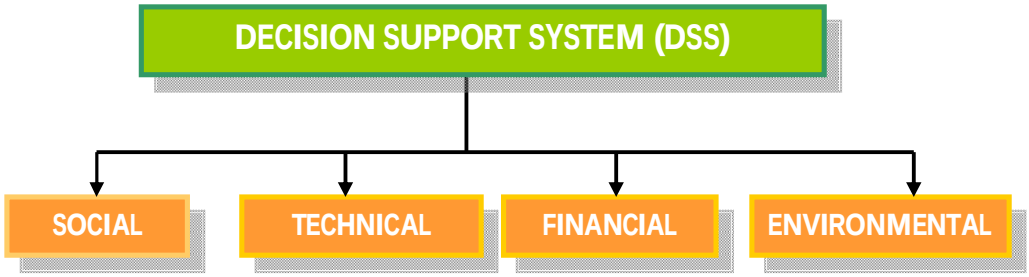
In generic terms *'**Decision Support System (DSS)** is a tool that facilitates the process of decision making by breaking down a complex problem into simple components.'*

Development Alternatives with support from UNEP/GRID – Arendal has developed the current **'Knowledge Base on Decentralized Renewable Energy (DRE) in India'**. One of the key components of this is a 'Decision Support System (DSS)' on Decentralized Renewable Energy (DRE).

The DSS is an Information and Communication Technology (ICT) based tool and will provide need based information on technical, social, financial and environmental aspects of DRE technology options to help decision makers in taking informed decisions.

1.1 Components of DSS

- **Social:** The social component is evaluated through the *'Social Assessment'* sheet. It helps the decision makers assess community readiness to set up the DRE plant and accordingly suggests different delivery models on DRE plants namely 'Village level' and 'Group level' DRE initiatives.
- **Technical:** The technical component is evaluated through the *'Resource Assessment'* and *'Demand Estimation'* sheets. Resource assessment considers mainly two types of resources i.e. crop residue and wood collected by villagers and helps in supply side assessment. Demand Estimation helps us assess the current and future load demands of the villagers. Thus the technical component provides the technical details mainly the capacity of the DRE plant to be installed**.**
- **Financial:** The financial component is inbuilt in the *'Resource Assessment'* and *'Demand Estimation'* sheets and it gives an estimate of the total capital cost of the DRE plant, the costs to be incurred after plant commissioning for five years (includes operation & maintenance costs, personnel costs, equipment & infrastructure costs and raw material costs) and a fund gap analysis.
- **Environmental:** The environmental component is also in built in the *'Resource Assessment'* and *'Demand Estimation'* sheets and gives the expected reduction in carbon emissions in kg CO_2 per year (due to installation of DRE plant).



1.2 Target Group

- Communities (PRI members, Farmers etc)
- Entrepreneurs
- NGOs
- Funding agencies
- Policy makers

1.3 Applicability

The present version of DSS is a prototype i.e. has been designed for taking decisions only related to one technology (biomass based DRE solutions). It is well suited for DRE plants in semi arid regions of India and small scale DRE plants i.e. plants with a scale up to 1 MW as the assumptions have been taken for the same.

1.4 Way Forward

This is the first version and a prototype of the DSS tool and will be developed further to include more parameters in order to make it more robust.

SECTION – B

1. How to Use the DSS

This section gives you the step wise procedure of how to use the web based Decision Support System for Decentralized Renewable Energy.

1.1 Social Assessment

Through the social assessment sheet we have tried to assess the readiness of the community to set up a DRE plant. For this we have identified six indicators which have been provided in the sheet. The user is supposed to give ranks against these indicators depending on the performance of his village. Depending on the ranks given by the user, the DSS will do the calculations to provide a score, on the basis of which the user can decide which delivery model will be more preferable for the specific village.

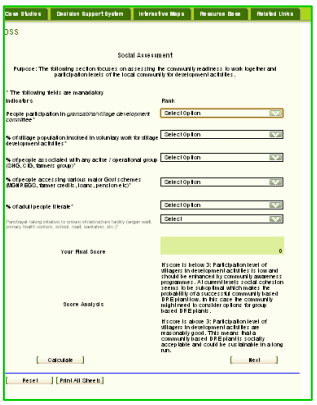
Delivery Model is a model followed to carry out execution of the project. The two delivery models considered here are Village level DRE plant and Group Level DRE plant. The 'Village Assessment' sheet gives an analysis of the village level DRE plant delivery model. In this model the DRE plant will be owned and managed by the community, and will serve the needs of the community as per their demands and their priority. The 'Group Assessment' sheet gives an analysis of the group level DRE plant delivery model. In this model the DRE plant will be owned and managed by the common interest group, and will serve the needs of the common interest group. We have considered two CIGs- Farmers group and Entrepreneurs group (Please refer Section B, 1.5 for further details).

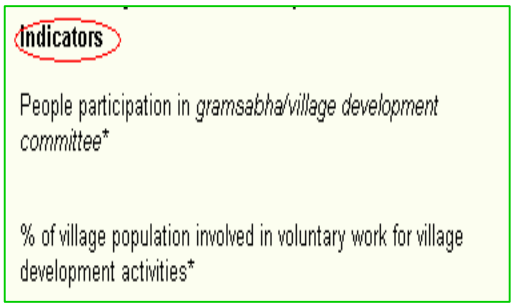
Purpose: To assess the community readiness to work together and participation levels of the local community for development activities (in this case DRE solutions).

Steps: For Social Assessment complete the following steps:

1. Read the **'Indicator'** given on the left hand side of the sheet.

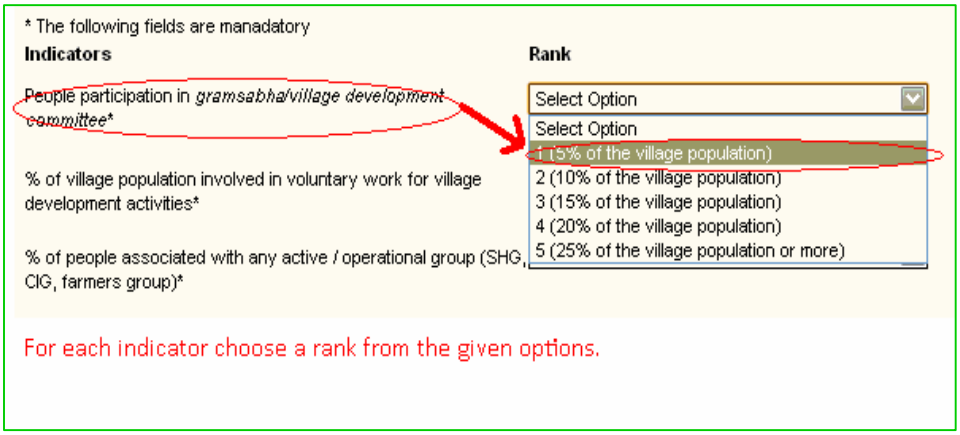
Social Assessment Sheet



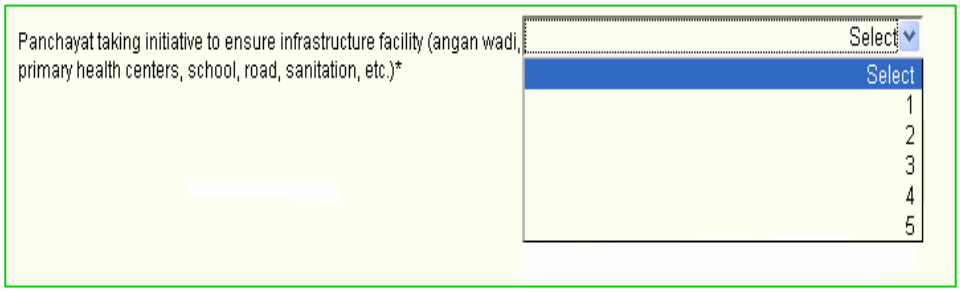


2. Under ranks column click on **'Select Option'** corresponding to the concerned indicator. 5 options will be provided in a scroll down format. The ranks are provides as a percentage of the number of people in the village for the first 5 indicators.

   For e.g.: For the indicator – 'People participation in gramsabha/village development committee' , if there are about 10 people in your village who take part in this activity, then you have to choose the corresponding rank (equivalent to the % of population under consideration). To calculate the % of population do the following; for a village of population 200, 5% of the village population would be 10 villagers i.e. 5/100*200=10. In this case you choose Rank 1 which corresponds to 5% of the village population.

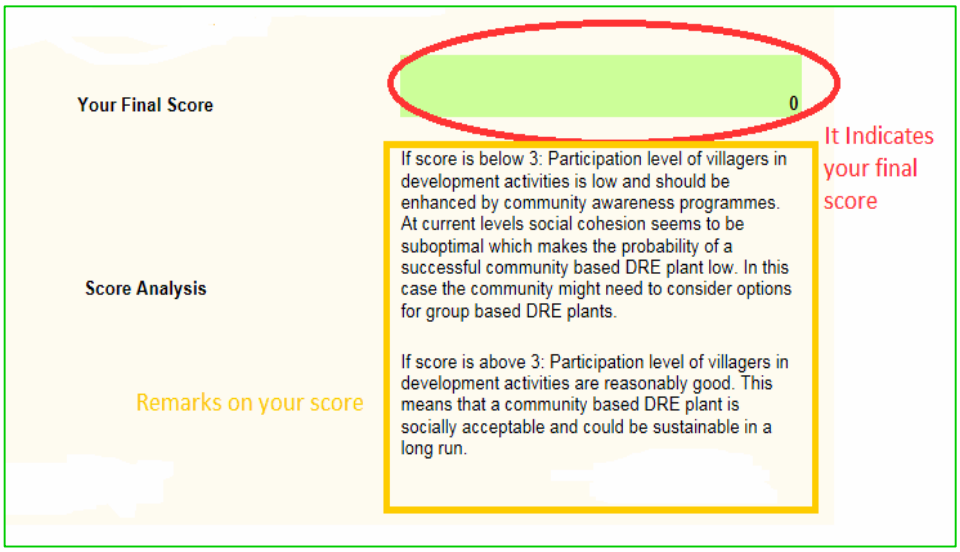


3. For the 6th indicator – 'Panchayat taking initiative to ensure infrastructure facility (angan wadi, primary health centers, school, road, sanitation, etc.)' click on **'Select'** on the right hand side and you will get options of ranks from 1 to 5. Give a rank from 1-5 depending on the Panchayat performance in the village in terms of setting up infrastructure facilities for the village. This can be indicated by the current community infrastructure available in the village, which has been set up with help of the Panchayat Raj Institution (PRI) members.

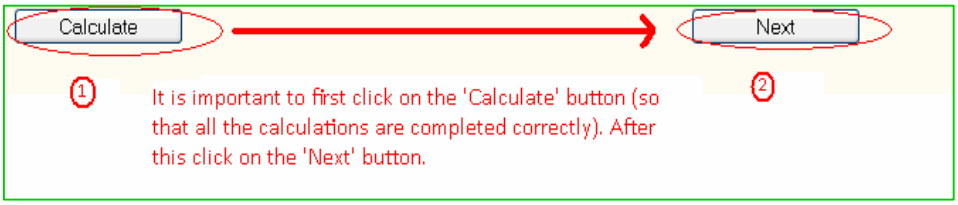


4. Please click on the **'Calculate'** button. This will ensure that all the calculations are done correctly.

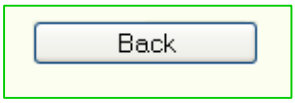
5. Based on your indicator's ranks, your final score will be calculated and represented as **'Your Final Score'**. The interpretation of the score is provided in the sheet as **'Score Analysis'**.



6. Please click on the **'Calculate'** button. It is mandatory to click on 'Calculate' before you click on the 'Next' button to ensure that all the calculations are done correctly. After this click on the **'Next'** button.

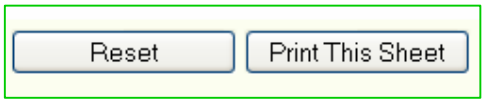


7. The **'Back'** button will take you to the previous sheet (with filled input values) in case you wish to change any input value in the previous sheet.



8. If you wish to change or modify all the input values, click on the **'Reset'** button. This will reset the entire calculator (i.e. all the input values are replaced by their initial default values i.e. 0 or blank) and then you can modify the input values. Then click on **'Calculate'** button.

9. If you wish to print the current DSS sheet please click on the **'Print This Sheet'** button.



1.2 Resource Assessment

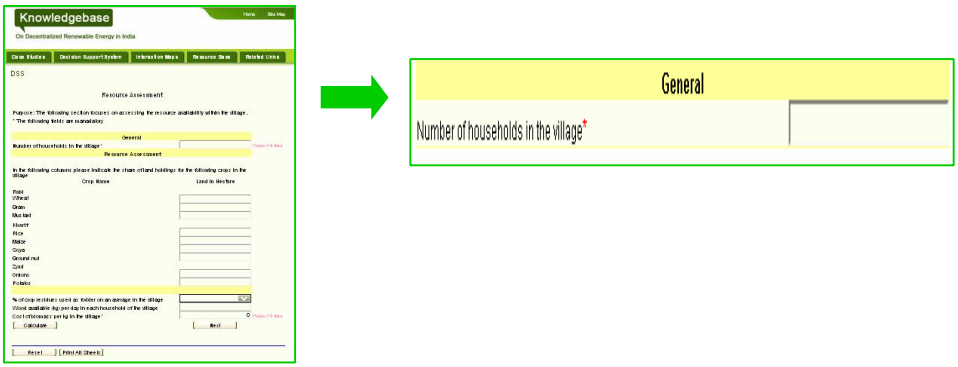
Through the resource assessment sheet, the DSS does a supply side assessment for the DRE plant. Mainly two resources will be assessed in this sheet namely 'crop residue' available in the village and 'wood' available per household. These act as raw material for the biomass based DRE plant and hence will be calculated based on the below mentioned steps.

Purpose: To assess the resource availability within the village.

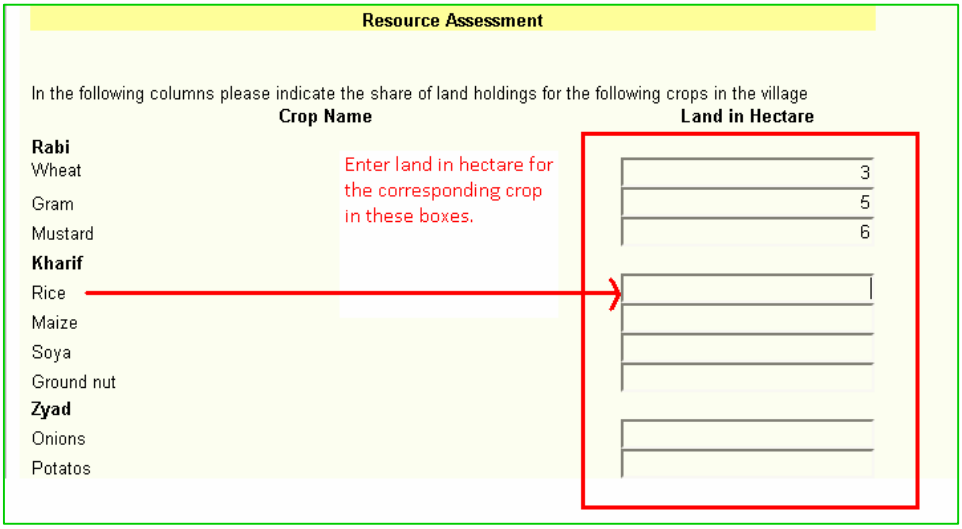
Steps: For Resource Assessment complete the following steps:

1. Under **'General'** tab enter number of households in the village ranging from 5 to 500. This is a mandatory field.

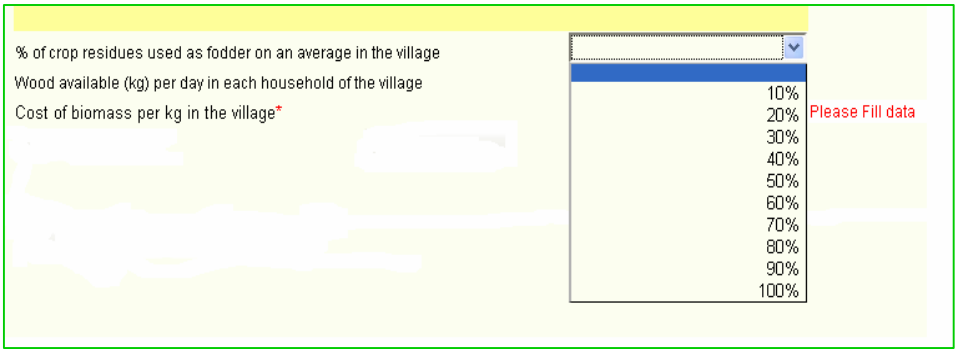
Resource Assessment Sheet



2. In **'Resource Assessment'** tab enter the share of land holdings (in hectares) for the different type of crops in the village. Size of the land holding under one crop can be a minimum of 0 hectare to a maximum of 1000 hectares.

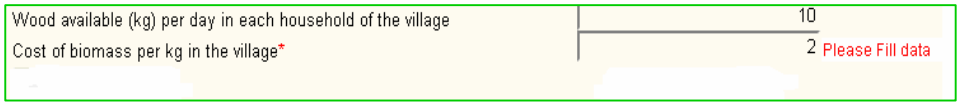


3. Now enter the '**% of crop residues used as fodder on an average in the village'** which can be ranging from 10% to 100%.

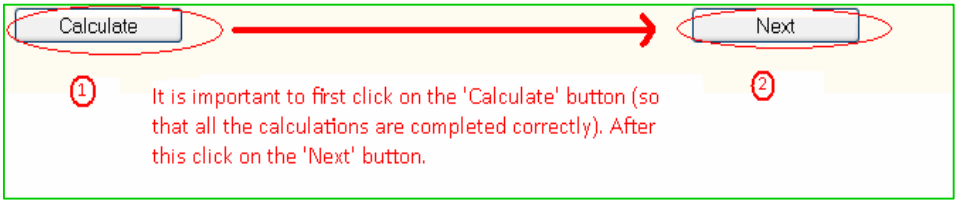


4. Now enter **'the wood available in kg per day in each household of the village** with a minimum of 1kg to a maximum of 100kg.

5. In the next tab **'cost of biomass per kg in the village'** should be entered. The cost per kg can lie between Rs. 0 to Rs. 50. This is a mandatory field.



6. Please click on the **'Calculate'** button. It is mandatory to click on 'Calculate' before you click on the 'Next' button to ensure that all the calculations are done correctly. After this click on the **'Next'** button.



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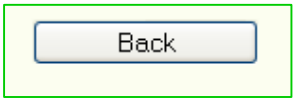

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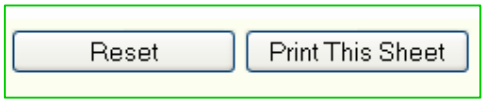


Short Note

- If the land holding in hectare for a particular crop is 0, please mention the same.

1.3 Demand Estimation

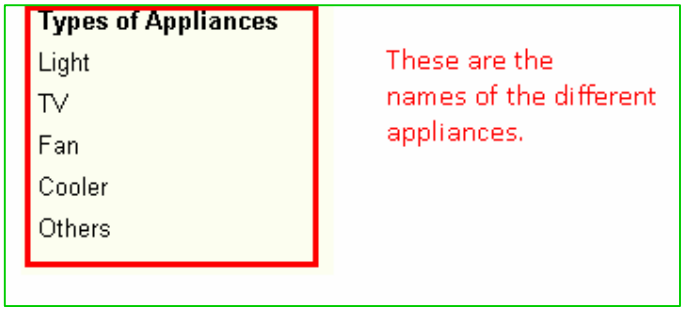
Through the demand estimation sheet the DSS does a does a demand side assessment for the DRE plant. Mainly three loads will be assessed in this sheet namely domestic load, enterprise load and farming load. Under each category the user has to fill the number of appliances, their power rating (KW or HP) and their average hours of usage. Also a priority of the load demand need has been taken to ensure that the DRE plant serves the users load demands.

Purpose: To determine the load demand in the specific village

Steps: To estimate demand follow the steps given below:

1. **Domestic Load**

   a. Under the domestic tab various appliances are listed you have to enter the **'No of appliances', 'Power wattage of appliance'** and **'Average daily hours of use'**. The following instructions will make it more clear



- **Lights**: If you are not sure of number of light appliances in the village you can approximate them by taking 2 per household i.e. Total no of Light Appliances= Total No of Households*2. For e.g. in a village with 200 households the total no of light appliances= 200*2=400.

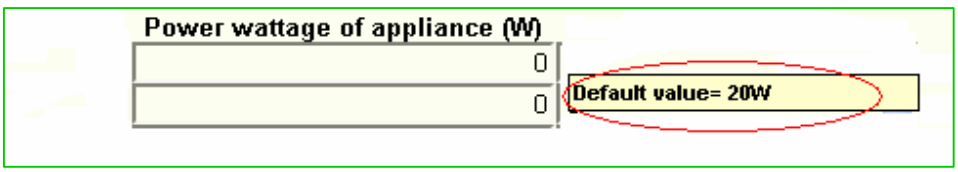
- **TV**: Enter number of TV sets in the village or this can be approximated by assuming 1 per household. i.e. Total no of TV sets= Total No of Households*1. For e.g. in a village with 200 households the total no of TV sets= 200*1=200.

- **Fan**: Enter number of fans in the village or this can be approximated by assuming 2 fans per household. i.e. Total no of fans= Total No of Households*2. For e.g. in a village with 200 households the total no of fans= 200*2=400.

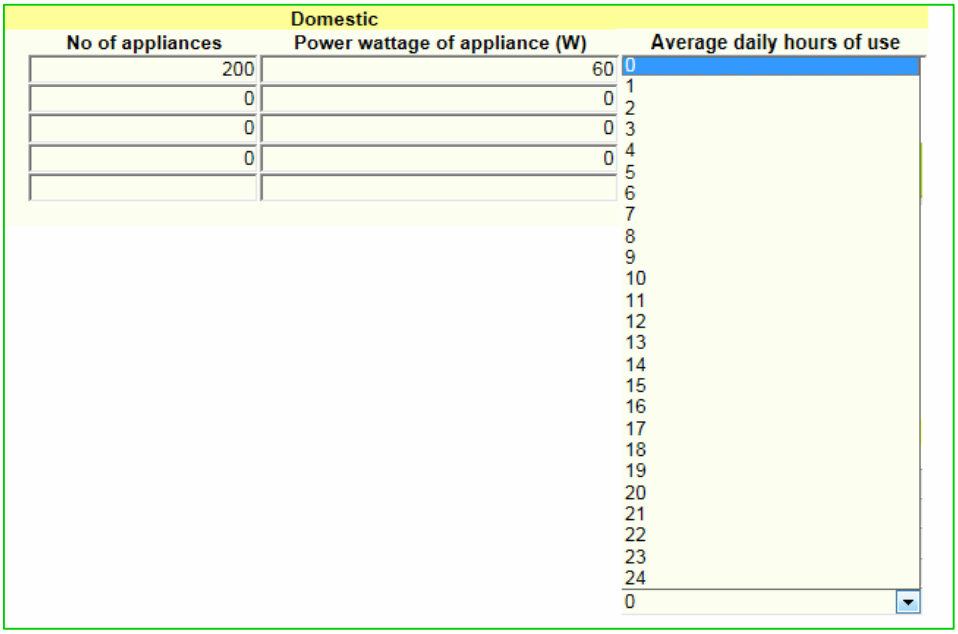
- **Cooler**: Enter number of coolers in the village or this can be approximated by assuming 1 cooler per household i.e. Total no of coolers= Total No of Households*1. For e.g. in a village with 200 households the total no of coolers= 200*1=200.

- **Others**: Enter the data for any other appliance used for domestic purposes which have not already been mentioned.

   b. **Power wattage of appliance (W):** Enter the W power ratings of the appliances. If you do not know the value, then enter the default value which can be obtained by placing the cursor over the required box.



c. **Average daily hours of use:** Enter the average usage hours of the appliance per household in a day in the village. It can be chosen from the scroll down list.

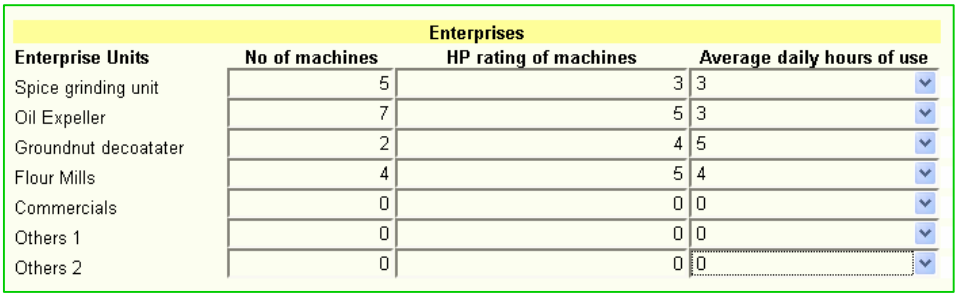


Short Note

- It is essential to fill all the columns in this section. If there is no value to be filled in then you must place 0 in that cell/box.

2. Enterprises Load

a. Under the Enterprises tab various enterprise units have been listed. You have to enter **'No of appliances', 'Power wattage of appliance (HP)'** and **'Average daily hours of use'** (Similar to the *'Domestic'* tab).

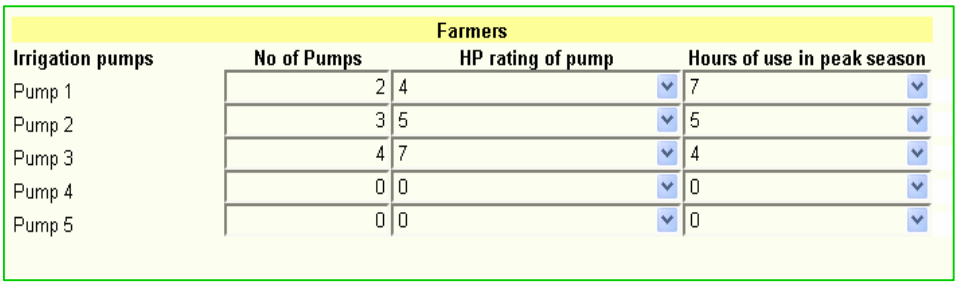


Short Notes

- In the sheet, 'Others 1' and 'Others 2' refer to the enterprise units present in the village other than the ones mentioned here.
- Power ratings must be entered in Horse Power (HP).

3. Farming Load

a. In farming tab types of pumps are listed in **'Irrigation pumps'** column. You have to enter their number (0-500), their rated capacity in horse power (0-10 hp) and their hours of use in peak season (Similar to the *'Domestic'* tab).



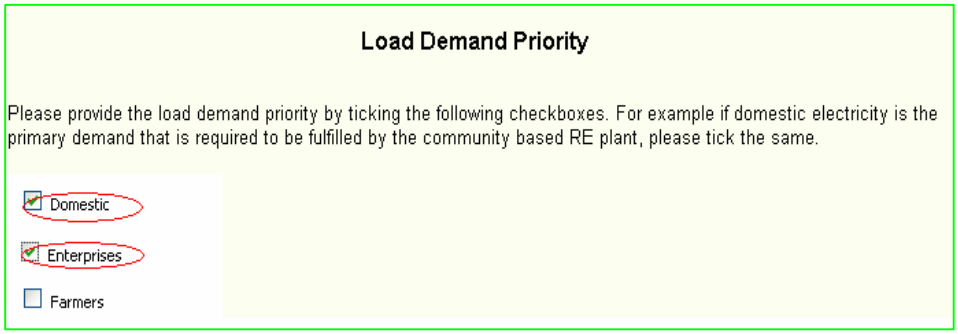
Farmers

Irrigation pumps	No of Pumps	HP rating of pump	Hours of use in peak season
Pump 1	2	4	7
Pump 2	3	5	5
Pump 3	4	7	4
Pump 4	0	0	0
Pump 5	0	0	0

Short Notes

- In this sheet 'Pump 1', 'Pump 2', 'Pump 3', 'Pump 4', 'Pump 5' represent pumps of different ratings (in Horse Power) which may be present in the village.
- Power ratings must be entered in Horse Power (HP).

4. Please give your **'Load Demand Priority'** by clicking on the required check boxes. For e.g. if domestic and enterprise load are the demand that requires to be fulfilled by the DRE plant click on the same. You can select either one or two or all three options but please note that at least one option should be selected. Please note that this is a mandatory field.

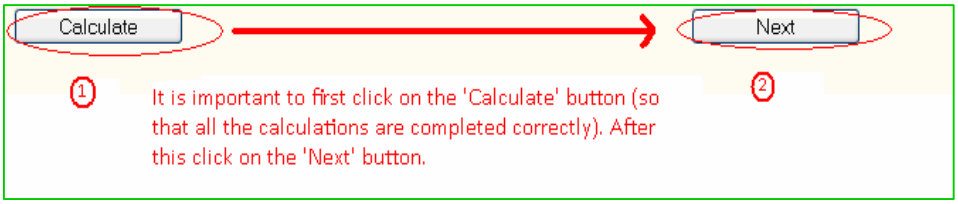


Short Note

- Even though the **'Load Demand Priority**' selected by the user may be only for one or two or all three options (i.e. Domestic, Enterprises, Farmers), it is essential to fill the entire 'Demand Estimation Sheet' with input values given under the 'Domestic' tab, 'Enterprises' tab and 'Farmers' tab.

Domestic			
Types of Appliances	**No of appliances**	**Power wattage of appliance (W)**	**Average daily hours of use**
Light	400	20	6
TV	200	80	3
Enterprises			
Enterprise Units	**No of machines**	**HP rating of machines**	**Average daily hours of use**
Spice grinding unit	5	3	3
Oil Expeller	7	5	3
Farmers			
Irrigation pumps	**No of Pumps**	**HP rating of pump**	**Hours of use in peak season**
Pump 1	2	4	7
Pump 2	3	5	5

5. Please click on the **'Calculate'** button. It is mandatory to click on 'Calculate' before you click on the 'Next' button to ensure that all the calculations are done correctly. After this click on the **'Next'** button.



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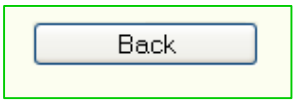
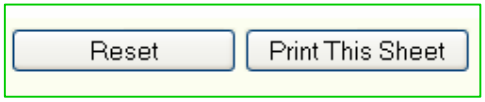


7. If you wish to change or modify all the input values, click on the **'Reset'** button. This will reset the entire calculator (i.e. all the input values are replaced by their initial default values i.e. 0 or blank) and then you can modify the input values. Then click on **'Calculate'** button.

8. If you wish to print the current DSS sheet please click on the **'Print This Sheet'** button.



Important Notes

For correct results please ensure the following:

- Please fill all the mandatory fields compulsorily.
- An error will pop up if values entered by you are not in the acceptable range or in case certain input values which are compulsory have not been filled by you. In this case please make the changes required.
- In the 'Demand Estimation Sheet'
  - It is mandatory to fill all the columns (number of appliances/machines/pumps, power (W or HP) rating for the same and also the average hours of usage) for a single type of appliance/ enterprise/ pump.
  - It is compulsory to tick at least one and a maximum of 3 check boxes in the **'Load Demand Priority'** section.

1.4 Interpretation of the Output Sheet - 1

This is an output sheet- **'Village Level Assessment'** sheet which provides details of the village level DRE plant delivery model which serves village level demands as per priority of the users.

Purpose: To provide an overview of the technical, financial and environmental aspects of the DRE power plant which serves village level demands.

Steps: The output sheet can be interpreted (read) using the following steps:

1. **Gasifier Capacity:** On the basis of the **'Demand Estimation'** and **'Load Demand Priority'** of the village, minimum and maximum **'Gasifier Capacity'** (installed capacity) will be calculated.

Gasifier Capacity		
Maximum Capacity	75	Kw
Minimum Capacity	50	Kw

2. **Biomass Availability:** The **'Biomass Availability'** denotes whether the biomass quantity available within the village is sufficient for the DRE plant (based on the supply and demand requirement in the village level DRE plant). It gives the biomass required in the first year after commissioning for the DRE plant to function optimally.

Biomass Availability	
The biomass available in the village is not sufficient to operate a community based RE plant. Alternative arrangements are made to ensure timely availability of raw materials.	
Biomass required in kgs (for the first year after commissioning)	2,312

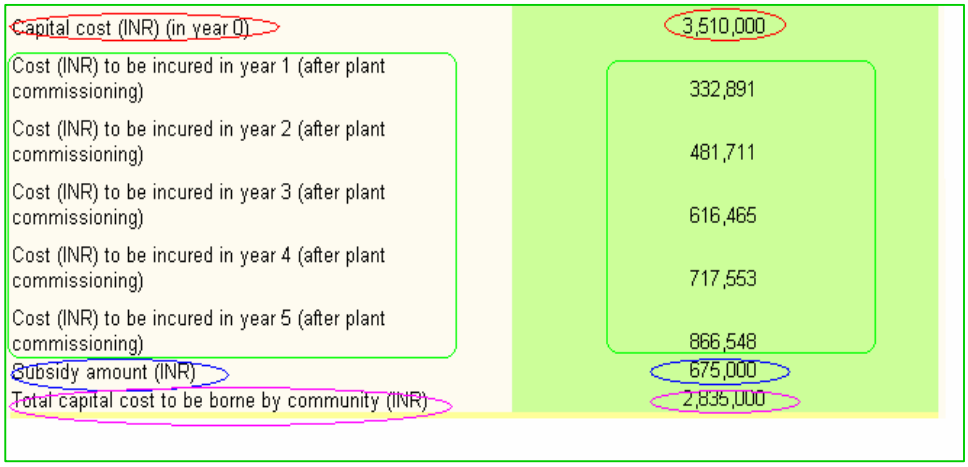
3. **Financial Analysis:** In the '**Financial Analysis**' tab it provides the costs that a community based biomass plant will incur at various stages of the project.

- Capital cost is the cost of power generating unit in year 0 (that is before commissioning) is provided. It has been considered as INR 78,000 per Kw for biomass based RE plants as per DDG guidelines for village electrification.

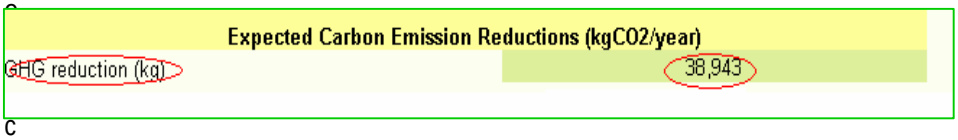
- Then the cost incurred for 5 years (after commissioning of the plant) is provided. This includes operation & maintenance costs, personnel costs, equipment & infrastructure costs and raw material (biomass) costs.

- Further an estimate of the subsidy given by the government is considered. This includes only the Central Financial Assistance given by the MNRE for off grid biomass programmes in rural areas for Indian states (not Special Category States i.e. NE Region, Sikkim, J&K, HP & Uttaranchal).

- In the last row the total capital cost to be borne by community in year 0 (in INR) is given. A fund gap analysis has been done based on the capital cost in year 0 and the subsidy given by the government (Central Financial Assistance).

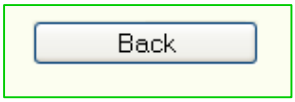


4. **Expected Carbon Emission Reductions (kgCO2/year):** This provides the expected r



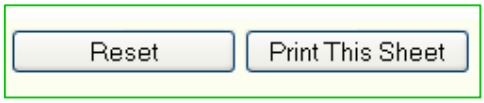
c
tion in carbon emissions in kg CO_2 per year.

5. The **'Back'** button will take you to the previous sheet (with filled input values) in case you wish to change any input value in the previous sheet.



6. If you wish to change or modify all the input values, click on the **'Reset'** button. This will reset the entire calculator (i.e. all the input values are replaced by their initial default values i.e. 0 or blank) and then you can modify the input values. Then click on **'Calculate'** button.

7. If you wish to print the current DSS sheet please click on the **'Print This Sheet'** button.



1.5 Interpretation of the Output Sheet - 2

The *'Group Level Assessment'* sheet, an output sheet, provides an analysis of the group level DRE plant delivery model details of the DRE plant which serves group

level demands. These have smaller capacities and lesser investments as they are focused to serve the needs of the particular group with common interest. These groups are also termed as Common Interest Groups (CIGs). In present version of the DSS we have considered 2 types of CIGs:

- Farmers Group- Under this a farmers' Common Interest Group (CIG) owns and manages the DRE power plant which provides energy to meet the irrigation related demand. CIG, in this case, can be formed by the like minded farmers with in a village having similar investment and management capacity.
- Entrepreneurs Group- Under this an entrepreneur's Common Interest Group (CIG) owns and manages the DRE power plant which provides energy to meet the enterprise related demand like to operate a flour mill, spice mill, groundnut decorticator etc. CIG, in this case, can be formed by the like minded entrepreneurs of the proposed village, who have similar investment and management capacity.

Purpose: To provide an overview of the technical, financial and environmental aspects of the DRE power plant which serves group level demands.

Steps: To interpret the *'Group Level Assessment* -output sheet please refer to the steps mentioned above under the '*Village Level Assessment'* - output sheet.

ANNEX

1. Definitions

I. Rabi- The crops that are sown in the winter season are called rabi crops.
II. Kharif- The crops that are sown in the rainy season are called kharif crops.
III. Zyad- In between the rabi and kharif seasons, there is a short season during the summer months- March to June known as the Zyad (Zaid) season.
IV. Crop residue- Crop residue is plant material remaining after harvesting, including leaves, stalks, roots.
V. Installed capacity- It is the theoretical annual production capacity of a power plant, whereas the effective capacity is a plant's actual optimal annual production capacity, which can be 10–20% less than installed capacity.
VI. Capital cost (Generic definition) - Costs incurred on the purchase of land, buildings, construction and equipment to be used in the production of goods or the rendering of services, in other words, the total cost needed to bring a project to a commercially operable status.
VII. Plant commissioning- The process during which the power plant after having been constructed, is approved for operation.
VIII. Subsidy- A benefit given by the government to groups or individuals in the business or economic sector usually in the form of a cash payment or tax reduction. The subsidy is usually given to remove some type of burden and is often considered to be in the interest of the public.
IX. GHG Green House Gases- A gas that contributes to the greenhouse effect by absorbing infrared radiation, e.g. carbon dioxide and chlorofluorocarbons.

2. Acronyms

SHG	Self Help Groups
CIG	Common Interest Group
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee
GHG	Green House Gases