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ESTIMATION OF POWER GENERATION POTENTIAL FROM BIOMASS PRESENT IN MELGHAT-A CASE STUDY

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Abstract: Energy is a key driver for economic development in the country. It enables greater productivity, prosperity, and living comforts. Renewable emerged as a mainstream energy source for the global community and power generation through biomass is one of them. This work presents a case study done in Melghat region to estimate the power generation potential from biomass present. The village Raksha in Melghat region is approximate 12km^2 in area which has no electricity and it is rich in biomass like teak leaves, lantana and cow dung which can be used to generate power. Lantana the shrub threatens natural habitats which is to be eradicated by government, contains good amount of calorific value, can be used for power generation. The study shows the powered required by the vilage is 2.19MWhr and power estimated through biomass is 15.92 MWhr.

Keywords: Biomass, Lantana, Teak Leaves, Energy, Calorific Value, Power Estimation.

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INTRODUCTION

The global demand for electric energy is expected to increase from about 14 billion 1TCE to 19 billion TCE by 2020. In India too, the demand for electric energy is expected to go up drastically. At present electricity production in India is based on coal, gas & hydel power. There are two implications of electricity produced in this fashion. One, electricity from these sources is not likely to meet all our country's needs. Secondly, electricity produced from these sources gets distributed around the country through a centralized grid. This grid usually does not reach many remote rural areas. In other words, the expected shortfall in electric production is likely to have a much greater impact on remote rural areas, than at other places. One way of ensuring supply of electricity to remote rural areas is to adopt the construction of small sized, decentralized generation plants that are dependent on renewable energy sources. Four such sources are already in wide use: solar, wind, micro-hydro and biomass. Of these, one of the most significant is bio-mass in light of the availability of biomass across most regions of the country. According to one estimate, it is possible that India will be able to produce 35,000 MW of electric energy, by the year 2035, using biomass. At this level of production it would not only be able to meet 9% of India's power needs, but would also replace 8 million tons of coal, and prevent 40 million tonnes of carbon emission annually. A key challenge for Biomass based power production is to ensure that the right kind, the right quality, the right amount and the right channels of procurement of biomass are available within a certain distance from the plant. Each of the above is essential for the effective and economic operation of the biomass based plants. The first point to note is that different types of gasifiers (those using different technologies such as gasification or combustion) require different kinds of biomass. The gasification based biomass based power plants utilize hard wood, Lantana while combustion based power plants can utilize all the raw material such as agri-residues, hard wood, Lantana. Consequently, the location of gasifiers has to be in line with the kind of biomass available in that location. Secondly, the right quality of biomass is necessary in order to increase the efficiency of these plants. The right quality of biomass is the one that has high calorific value. The high calorific value based biomass is used directly in gasification in the power plant. Biomass with low calorific value will not be effective in a gasification based power plant. However, the calorific value of biomass can be enhanced by briquetting. Thus briquetting is an alternative method for assuring right quality of biomass. Briquetting, though, adds to the current cost.

1.1 PROFILE OF THE VILLAGE

Raksha is a small Village/hamlet in Chikhaldara Taluka in Amravati District of Maharashtra State, India. It comes under Raksha Panchayath. It belongs to Vidarbha region. It belongs to Amravati Division. It is located 81 KM towards North from District head quarters Amravati. 628 KM from State capital Mumbai Raksha Pin code is 444708 and postal head office is Nandgaon Khandeshwar. Raksha is surrounded by Achalpur Taluka towards East , Anjangaon S Taluka towards South ,Bhainsdehi Taluka towards East , Akot Taluka towards South . Achalpur , Amravati ,Morshi ,Murtijapur are the nearby Cities to Raksha. Total area of Raksha is 1200 hectares. Raksha is a medium size village located in Chikhaldara of Amravati district, Maharashtra with total 49 families residing. The Raksha village has population of 300 pepole. As per constitution of India and Panchyati Raaj Act, Raksha village is administrated by Sarpanch (Head of Village) who is elected representative of village.

1.2 AGRICULTURAL AND BIOMASS SCENARIO

The agricultural scenario in the village is not so good due to less rainfall and no irrigation facility. The only crop that grows is wheat(4-5 quintals) and chickpeas i.e channa(2-3 quintals) which is sufficient only for them and the crop residues are used to feed cows and buffalo. The village is surrounded with teak trees which provides teak leaves which is rich in calorific value. There is also a growth of shrub lantana a type of weed which affects the inhabitants there, with disease but this shrub has good amount of calorific value. With these biomass the village is rich in cattle field so a good amount of cattle dung can be extracted as biomass.

1.3 POWER SCENARIO

The village Raksha is a underdeveloped village with no facility of electricity as it is in interiors the government cannot reach them. There are almost 49 semi built houses with one or two rooms and one school. The village is provided with only two solar street lights .At present the village demands minimum 2MWhr to 3MWhr power.

2. OBJECTIVE

The main objective of this case study is to estimate the power required by the village and to estimate the power that can be generated through the biomass present in the village.

3.METHODS

The first step to estimate the data for power generation is field surveys based on household and direct interview methods. A baseline questionnaire was made and a survey was conducted in the village and all information regarding the village like agriculture, population, houses, occupation, school, biomass available was gathered. After collecting the data power required by the village was calculated and the biomass available in the village was estimated .Then the calorific values of all the biomass present was found and the estimation was made how much power can be generated through the available biomass.

4. RESULTS AND DICUSSIONS

4.1. POWER REQUIRED BY THE VILLAGE

After the survey it was found that there are 49 houses and one school where electricity is needed. Therefore approximate 100 bulbs will be required.

1 bulb requires = 15 watts of energy

requirement of power per day will be for 4 hrs

∴energy required for 100 bulbs in one day = 4 X 15 X100

= 6000 Whr/day

Hence power required in one year will be = 6000 X 365

= 2190000 Whr

Therefore power required by the village for 1 whole year will be 2.190 MWhr

4.2 BIOMASS AVAILABLE AND THEIR CALORIFIC VALUES

The crops grown in the village is only wheat and chickpeas where it is only sufficient for the villagers therefore the crop residues are also less and is utilized in cattle field .So no crop residues are used as biomass. The region is rich in teak tress and the village is surrounded by the teak trees. the leaves fallen from the tree i.e the teak leaves is enough in quantity and has a good calorific value.

Amount of teak leaves collected in one day in 12km^2 land = 36.56 Kg

∴ Amount of teak leaves collected in one year in 12km^2 land = 13344.4 kg

Lantana locally known as *kukurkundu* is a shrub is grown in this area. Their common names are shrub verbenas or lantanas. Some species are invasive, and are considered to be noxious weeds. The spread of lantana is aided by the fact that their leaves are poisonous to most animals and thus avoided by herbivores, and it causes lots of diseases to the inhabitants staying there. But it's wood contains calorific value for combustion and is highly combustible and can be used as a biomass. otherwise since it is affecting the environment the government wants to eradicate it so can be used as biomass for generation.

Amount of lantana collected in one day in 12Km^2 land = 28 Kg

∴ Amount of lantana collected in one year in 12km^2 land = 10220 kg

The village has approximate 150 cows. As we know cow dung is one of the best biomass with great calorific value cow dung is also used as biomass for power generation. the people in village sell these cow dung. So this being their occupation only one fourth amount of cow dung can be used as the biomass for power generation. It is estimated that one cow produce an average of 3 kg of dried dung per day, of which some part is dropped while grazing and only the balance is retrieved by owners which may be approximate up to 1.5 kg.[1] so for 110 cows amount of cow dung will be produced in one year is 60.22 tons, of which only one fourth is available as biomass. Amount of cow dung available in one year = 15056.25 kg

4.3CALORIFIC VALUES OF BIOMASS

The air dried biomass samples were crushed into powders and then processed for their proximate and ultimate analysis and calorific value determination.

SR.NO	COMPONENT	FIXED CARBON	VOLATILE MATTER	ASH	CALORIFIC VALUE
1	TEAK LEAVES	8.88 -9.21%	77.32-77.88%	17.27 -18.08%	11.7 MJ/kg
2	LANTANA	11.90%	20.80%	67.30%	7.68 MJ/kg
3	COW DUNG	74.31%	43.10%	19.57%	15.9 MJ/kg

The calorific value of the teak leaves is found to be 11.78 MJ/kg [2]

The calorific value of the lantana is found to be 7.687 MJ/kg [3].

The calorific value of the cow dung is found to be 15.91 MJ/kg [4].

4.4 ENERGY AND POWER GENERATION CALCULATION

Total energy contents and power generation structure from biomass

SR.NO	COMPONENT	CALORIFIC VALUE (MJ/kg)	BIOMASS AVAILABLE (kg)	ENERGY VALUE (MJ)	POWER PRODUCED (KWhr)
1	TEAK LEAVES	11.78	13344.4	157197.032	44015.16
2	LANTANA	7.687	10220	78561.14	21997.11
3	COW DUNG	15.91	15056.25	239544.93	67072.58

Energy calculations:

Total power can be produced = 44015.16 + 21997.11+ 67072.58

= 133084 KWhr

= 133.084MWhr

Assumptions:

• Conversion efficiency of wood fuelled thermal generators = 30 %

• Overall efficiency of the power plant = 40 %

Energy value of the total utilizable biomass obtained at 30% efficiency of generation

= 133.084 MWhr x 0.30

= 39.92 MWhr

Power generation at 85 % overall efficiency = 39.92 MWhr x 0.40 = 15.952 MWhr

5. CONCLUSION

1. The power required for the village is calculated to be 2.190 MWhr

2. The biomass present and available for power generation are teak leaves , lantana and cow dung.

3. The power produced by teak leaves is 44015.16 KWhr , by lantana is 21997.11 KWhr and by cow dung is 67072.58 KWhr

4. Total power can be produced through these biomass is 15.952 MWhr.

5. Thus power to be generated is more than required and can be further used as cooking material.

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