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Mathematical Analysis of Status and Scope of Renewable Energy Resources in Mungeli District of Chhattisgarh

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Abstract: With the increasing of population, the energy source demands are also increases. The amount of energy requirement is different between the countries around the world. The developed country need more energy compare to developing country. The present people are most concern about renewable energy sources because it is pollution free, simply available and less costly and more amounts exist in the earth. In this connection a survey has been carried out in a cluster of villages in Mungeli district of Chhattisgarh. The survey is based on data collected from households and village level questionnaire. The present energy consumptions in cooking, lighting agriculture and rural industry etc. have been worked out. An effort has been made to evaluate the present energy resources in the cluster and also determine the area required to install the renewable energy system. In this paper we also calculate the total requirements of renewable energy resources for aforesaid district.

Key Words: Renewable energy, Solar energy, Bio-energy.

1. Introduction:

India, today is one of the world's most attractive renewable energy markets. India's renewable power capacity is the 4th largest in the world, standing at 136 GW (Nov 2020), which is 36% of its total power capacity. India's ranking is due to the strong focus of the government on renewable energy as well as appropriate execution of renewable energy projects. Energy is considered crucial to achieve India's development ambitions, to support an expanding economy, to bring electricity to rural areas, to fuel the demand for greater mobility and to develop the infrastructure needs of an increasing population. Deloitte in a 2018 report mentions that while energy use in India has doubled since 2000, the energy consumption per capita is only around one-third of the global average and ~240 million people still have no access to electricity, indicating significant growth opportunities. As India looks to meet its energy demand on its own, which is expected to reach 15,820 TWh by 2040, renewable energy is set to play an important role. For a developing economy like India, power continues to be a valuable and essential commodity. The country is experiencing continuous surge in demand for power.1 India has prioritized

increasing the share of renewable energy (RE) based power generation capacity for several years, the installed renewable energy capacity increased by 226% in the last 5 years. Renewable energy deployment is mainly concentrated in the Southern and Western Indian states (80% of total). Several states such as Tamil Nadu (37%), Gujarat (18%) and Maharashtra (17%) have a much higher share of Renewable energy in their generation capacity mix compared to the national share.

2. **The Need for Renewable Energy:**

For thousands of years, we have relied on burning fossil fuels to get energy, however in today's world using oil, gas and coal for our needs is turning into a problem. Global climate change is one among the environmental challenges that we have ever faced for so long, and the main cause behind it is our dependence on fossil fuels. Burning coal, petroleum and fossil fuels helps in producing electricity. However it conjointly ends up in significant concentrations of pollutants in our air and water [1]. Another problem with using fossil fuels to generate energy is that there is limited quantity available. Since past few years, we are relying more and more on the world's supply of fossil fuels, and that supply is rapidly running out. As the demand for fossil fuels has increased, the cost of using them has also increased due to which each year we find ourselves with larger energy bills [3]. The answer to all of these problems is shifting to Renewable energy. Energies like solar energy, wind energy and water power are generated from natural energy sources and in contrast to fossil fuels, these sources of energy never run out. With a way lower impact on the surroundings, using renewable energy helps to protect our planet by considerably reducing the quantity of carbon emissions that we produce. By using renewable energy sources, we also reduce our dependence on fuel gas and oil reserves, which implies that we can avoid the rising value of energy bills and improve our energy security [1]. In order to preserve our planet, our wallets and our energy sources we all need to be compelled in switching to renewable energy sources and making our homes more energy efficient.

3. Advantages and Disadvantages of Renewable Energy:

Renewable energy has multiple advantages over fossil fuels. Here are some of the top benefits of using an alternative energy source:

- Renewable energy won't run out.
- Renewable energy has lower maintenance requirements.
- Renewables save money.
- Renewable energy has numerous environmental benefits.
- Renewables lower reliance on foreign energy sources.
- Renewable energy leads to cleaner water and air.

- Renewable energy creates jobs.
- Renewable energy can cut down on waste.

Renewable energy has many benefits, but it's not always sunny when it comes to renewable energy. Here are some cons of renewable energy when compared to traditional fuel sources:

- Renewable energy has high upfront costs.
- Renewable energy is intermittent.
- Renewables have storage capabilities.
- Renewable energy sources have geographic limitations.
- Renewables aren't always 100% carbon-free.

4. Present status of Renewable energy sources in India:

India is one amongst the countries with the largest production of energy from renewable sources. In the electricity sector, renewable energy accounted for 20% of the total installed power capacity (71.325 GW) as of 30 June 2018. There is a high potential for generation of renewable energy from various sources- wind, solar, biomass, small hydro and biogas. The overall potential for renewable power generation in the country as on 31.03.17 is approximately 10, 01,132MW. This comprises the solar power potential of 649342 MW (64.86%).wind power potential of 3,02,251 MW (30.19%) at 100 m hub height, SHP (small-hydro power) potential of 21,134 MW (2%), Biomass power of 18,601 MW (1.86%), 7,260 MW (0.73%) from biogas-based cogeneration in sugar mills, 2554 MW (0.26%) from waste to energy [7]. The geographic distribution of the estimated potential of renewable power as on 31.03.2016 reveals that Rajasthan has the best share of about 14% (167276 MW), followed by Gujarat with 13% share (157158 MW) and Maharashtra with 10% share (119893MW), mainly on account of solar energy potential [6].

Solar energy is the free and non-depleting power resource of energy. The solar radiation received outside the earth's atmosphere is 1367 W/m2. However, on an average, the radiation received by the planet is 800 W/m2. The planet receives billions of MW solar power daily that is way enough to fulfill the energy demand of the country. The average intensity of radiation received in India is about 200 MW/km with a geographic region of 3.287 million kilometer sq. This accounts to 657.4 million MW of solar power. However (85%) of the land is used for the agriculture and forests, (6.7%) land used for housing, (5.8%) land is either barren, snow bounded or typically inhabitable. Therefore about (12.8%) of surface area mounting to 4.413 million sq. can be used for solar power plant installations [6]. Most parts of India get ample days of sunshine a year. About 5,000 trillion kWh annually energy is incident over Indian land with most area receiving 4-7 kWh per sq. meter

per day. Hence, both solar thermal and solar photovoltaic's can effectively offer an enormous capability for solar power in India. Solar power additionally provides the flexibility to generate power on a distributed basis. It can be observed that the best annual global radiation is received in Rajasthan and northern Gujarat [8] [7].

Solar power in India is a quickly developing industry. The country's solar installed capacity reached 23 GW as on 30 June 2018. India expanded its solar-generation capacity 8 times from 2,650 MW as on 26 May 2014 to over 20 GW as on 31 January 2018. The 20 GW capacities were initially targeted for 2022 however the government achieved the target four years sooner than scheduled. The country added 3 GW of solar capacity in 2015-2016, 5 GW in 2016-2017 and over 10 GW in 2017-2018, with the average current value of solar electricity dropping to 18% below the average value of its coal-fired counterpart [8]. Also, solar products have helped to meet rural needs; by the end of 2015, just fewer than one million solar lanterns were sold out in the country, reducing the requirement for kerosene. That year, 118,700 solar home lighting systems were installed and 46,655 solar street lighting installations were provided underneath a national program; just over 1.4 million solar cookers were distributed in India [7].

5. **Power Situation in Chhattisgarh:**

Chhattisgarh has excellent power infrastructure, and is a power surplus state. With a potential to produce 50,000 MW of power, Chhattisgarh has the prospect to become the power hub of India. As of March 2011, the total installed power generation capacity for Chhattisgarh was 4,882.4 MW, which comprised of 2,199.0 MW under the state utilities, 1,831.9 under private utilities, and 851.5 MW under the Centre. Few noteworthy on-going Thermal power projects in the State include the Korba West Extension thermal power plant (TPP) (1 x 500= 500 MW) at Korba, and the Marwa TPP (2 x 500 = 1000 MW) at Janjgir- Champa. In addition, Non-conventional energy sources have been accorded very high priority. A special agency -- CREDA has been set up. Micro-Hydel power potential is also being tapped in a big way, and several projects have been identified for viable private investment. The Hasdeo Bango reservoir offers a relatively cheaper source of power generation. As on March 2012, average uninterrupted energy demand of the State is 2,732 MW and average supply has been around 2,740 MW. The current consumption pattern is 24.52 percent domestic, 4.58 percent non-domestic, 55.84 percent industrial and 14.14 agriculture (against 10 percent in 2001). Keeping its promise to reach the unreached, BPL connection holders (1.3 million connections) get 13.63 percent and beneficiaries of irrigation pump schemes (small and marginal farmers) get 14.3 percent of the power generated. For the domestic and agriculture sector, priority

has been given to electrification of BPL households, schools-hospitals, and energisation/line extension for irrigation pumps.

5.1 Chhattisgarh Renewable Energy Development Agency:

The State has placed significant emphasis on renewable energy development. CREDA is the State Nodal Agency of Ministry of New &Renewable Energy (MNRE), Government of India responsible for Deployment, and Promotion of Renewable Energy (RE) in the state. RE based power plants currently generate about 279 MW, and contribute over 5 percent to the total power generation in the State. The State Electricity Regulatory Commission (SERC) has mandated renewable purchase obligations to promote RE. Obligated entities are required to procure RE Power up to 20 percent (by 2020) of their power consumption.RE Power generation has been declared as priority sector under state industrial policy. In order to further promote RE power, the State has announced state policies for promotion of solar, wind, hydro, and biomass power projects.

5.2 Chhattisgarh Bio-fuel Development Authority" (CBDA):

Based on the state's excellent potential for production of tree borne oilseeds (TBOs) such as Pongaemia, Pinnata (Karanj) and Jatropha (Ratanjot) it was felt that there is a need for effective and coordinated management and monitoring of the activities connected with promotion of plantation, collection of seeds, extraction of bio-fuel and marketing of bio-fuel from tree borne oil seeds. As such, the State set up the CBDA for promotion of bio-fuel in January 2005.

5.3 Chhattisgarh Environment Conservation Board (CECB):

The CECB has also been playing a key recommendatory and regulatory role in the power sector. It has taken steps to ensure that the State adopts super-critical technology for all new large power plants to improving fuel burning efficiency by 1-3 percent, and making the use of high concentration slurry based disposal systems for fly ash disposal to minimize pollution and dispersal/fugitive emissions of fly ash for all new thermal power plants from 2010 onwards. The CECB also recommends the use of 'beneficiated' or washed coal in thermal power plants in the state for energy output maximization and efficiency, as well as recommending plantation and advocating the use of alternative fuels.

5.4 Chhattisgarh Sate Solar Policies:

The state govt. introduces Chhattisgarh solar policy, 2012 with the following objective

1. To encourage, develop and promote solar power generation in the state with a view of meet the growing demand for power in an environmentally and economically sustainable manner.
2. To enhance the private sector participation in solar generation.
3. To create a favorable environment for development of solar manufacturing capability within the state.
4. To contribute to long time energy and ecological security of Chhattisgarh with gradual reduction in dependence on conventional thermal energy sources such as coal.
5. To promote the Off-Grid solar application s to meet the energy needs of vulnerable section of society residing in far flung area and also to promote Stand-alone system.
6. Universlisation of access to clean energy.
7. To encourage decentralized, distribution generation system in the state.
8. To create opportunities for huge direct or indirect employment in solar generation , manufacturing and related support industries.
9. To productively utilize the available wastelands/ non-industrialized unused land for solar generation.
10. To create skilled and semi skilled human resources for the sector.
11. To encourage innovative projects pertaining to solar power generation.

6. Mungeli District of Chhattisgarh:

Mungeli is one of the newly formed districts of Chhattisgarh. Mungeli was established in January 1, 2012 and it belongs to Chhattisgarh plain zone. Mungeli is located at 22.07 0 N 81.68 0 E. It has a population of 456724. It has average elevation of 94.4 feet. Total area is about 163942 ha. In which farming land is in rabi , 89178 ha and in kharif 116094 ha. Irrigated land is 52.97% and annual rainfall is 956.13mm (288 meter). In Mungeli district no any industrial belt, there are some Jagari and sugar factory in Mungeli district. People are purely depends on agriculture and agriculture base products. They are taking the crop of Rice and sugarcane in kharif and pulses in rabi. Mungeli has three blocks namely –

1. Mungeli block with 173 villages.
2. Lormi block with 210 villages.
3. Pathariya block with 219 villages.

In this district Solar energy is resources for more applicable for renewable energy resources and some bio - gas plants are also installed.

7. Sampling and Sampling Procedure

Some plants of Mungeli district which are in working condition from the Mungeli district are selected, as per stratified random sampling procedure. Beneficiaries from village had survey falling under their different capacities of plants were installed according to their requirement. The data was collected from office (website) of CREDA, CSEB Mungeli.

Table 1.1 Data collected during survey from different resources

S. No.	Different Renewable Energy Resources	Capacity of Different Renewable Energy Resources (kw)
1.	Home Light	9.66
2.	Street Light	0.48
3.	Govt SC/ SC Hostel Boys	32.20
4.	Govt SC/ SC Hostel Girls	8
5.	District hospital Mungeli	2
6.	Solar water heater	15.457
7.	Solar hand pump	12
8.	Other Health Centre of Mungeli District	138.007
9.	Administrative building	26
10.	Educational Institute	103
11.	Solar plant for Boiga family	247
12.	Achanakmar Tiger Reserve Solar pump	37.8
13.	Solar water purifier	4.6
14.	Solar TV	0.9
15.	Solar high mast	4
16.	Solar generator	0.45
17.	Solar equipment in other commercial sector	144
18.	Biomass	5
19.	Cook stove	2
20.	Solar pump	55.2
21.	Bio-gass plant	2.83
Total		**850.584**

7.1 Cost Analysis

Comparisons between Electricity and total Renewable Energy production in Mungeli district and cost analysis are given below

(a) As the data collected from electricity office Mungeli district
Total electricity consumed =38.4crore kw (from 16 substations)
=38.4crore unit

(b) Total power generated by renewable sources in Mungeli district = 850.584kw (from Table 1.1. calculation)
Total energy produce in kwh = 850.584 x 365 x 24
= 7451115.84 kwh
= 7451115.84 unit

(c) Average price of electricity =5 Rs/unit
So cost saving by renewable sources,
= 7451115.84 x 5
= 37.255,579.2 Rs
(Three Crore Seventy Two Lakh Fifty Five Thousand Five Hundred Seventy Nine Rs)

(d) % of renewable energy to the total electricity consumed in Mungeli district

$$= \frac{7451115.84}{380400000} \times 100 = 1.95\%$$

Conclusion:

The power demand in India is continuously increasing at a high rate and India have limited power production for fulfilling the demand therefore, Research, development, production and demonstration have been carried out enthusiastically in India to seek out a possible answer to the perennial problem of power shortage for the past three decades. India has obtained the application of a variety of renewable energy technologies to be used in different sectors too. There are enough opportunities with favorable geology and geography with the huge customer base and widening gap between demand and supply. Technological advancement, suitable regulatory policies, tax rebates, efficiency improvement in consequence to R&D efforts are the few pathways to energy and environment conservation and it will make sure that these massive, clean resource bases are exploited as quickly and cost-effectively as possible. This paper offers an outline of the potential renewable energy resources in Indian context while evaluating the present status, the energy demand of the country and forecast consumption and production, with the target to evaluate and assess whether or not India can sustain its growth and its society with renewable resources. In this paper a small area of Chhattisgarh i. e. Mungeli district is chosen of the study of utilization status of renewable energy resources and found that the percentage of utilization of renewable energy is 1.95%.

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