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THE ASSESSMENT OF POTENTIAL ELECTRICITY PRODUCTION FROM SURPLUS CROP RESIDUES IN THE SON RIVER WATERSHED

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Abstract: *The article explores potential energy production quantity from surplus crop resides in the son river watershed. A special focus on the agricultural regions of the Son watershed through an analysis of the real potential of surplus crop residues resource. The emphasis on residues energy greatly significant in current practices and future expectation. The United Nations Development Programme, for example, refers to sustainable development as a fundamental question of our generation's development, which challenges the aspiration to enlighten humanity's collective journey towards a better future. National and international development agencies whose actions are commonly combined in the context of the development of clean renewable energy under the sustainable and clean development mechanism goals. These concerns are based on consensus among scientific and development approaches that global climate change triggers profound shifts in power/energy resources associated with ecological systems that will significant transformation in local and global environment. The most serious impacts of fossil fuel are generally seen to be concentrated among the world's poor and especially those living in the global south. The article also attempts to emphasize the importance of regional perspective and production of crop residue quantities. Crop -based residues resource has several distinct advantages such as wide periodically availability that puts it ahead among the renewable energy options.*

Key words: Residues, Agriculture, Sustainable, Electricity.

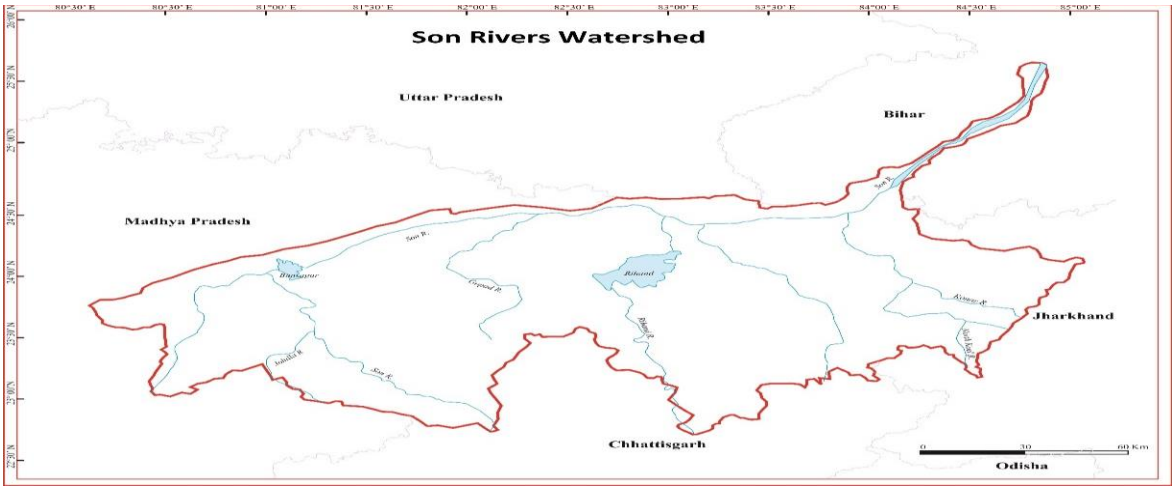
Introduction

Today, renewable energy is becoming a key question in the sustainable development goals. In this scenario, surplus crop residue becomes a kind of natural biomass resource for renewable energy. Residues is the most important source of renewable energy in the current scenario due to its periodic regional availability and the generation of heat and electricity from various applications at different scales. Residues such as products used as fuel for direct heating or as a result of their conversion into gas and electricity. Residues has relied on regional agricultural productivity so, diversion of surplus residues into electricity generation is a sustainable development initiative. The residues produced in cultivated land so, the collection, processing, marketing and ultimate residues use are highly unorganized. There need an organised process of production, processing and marketing using residues for energy conversion, the result would be highly beneficial for regional people. Residues energy really builds modern stands and illustrates how its science and technology innovations are coupled. The residues treatment uses at the same time is increasingly the same amount, it is quite sustainable. It would be an appropriate approach for sustainable development. Residues modelling and residue commercial innovation may provide opportunities for clean and sustainable energy. It is good, if we achieved solutions that are really a path beyond the present affordability levels and then calmly allow the complete supply chain. It's a small set of things that have to happen between managing residue to generate electricity and delivering electricity to local populations.

Study Region

The Son River is a major tributary to the Ganga River and joined by the south on its right bank. The Son watershed is generally referred to as the sub-basin of the Ganges basin. The total catchment area of the basin is 71,259 sq. kms. The River Son originated in Amarkantak, a locality in the Anuppur district of Madhya Pradesh. It is joined by the main tributaries of the south on the right bank. The main tributaries are the Johilla, Kunehar, Rihand, Kanhar and Koel rivers. The river flows about 784 km, crossing Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Bihar and Jharkhand. The confluence of the River Son with River Ganga is upstream of Patna at Sonpur. The Son watershed extends from 80°25' E to 84°51' E of longitude to 23°10' N at 25°42' N of latitude. The Tropic of Cancer crosses the watershed.

Figure 01: Son Rivers Watershed Area



Sources: River Basin of Atlas India, government of India & Ministry of Water Resources 2012

Objective

The research explores the potential quantity of surplus crop residues for electricity generation in the Son watershed.

Databases and Methodology

Data Source

The primary data source and secondary data source have been used. Primary survey was carried out from households which mainly based on agricultural farmland activities spread over 10 villages in the two districts of Bihar lying in the Son watershed during 2012-2013. Information of potential residues electricity production estimation observed from power plants located in the study area. Stakeholders such as farm workers, brick kiln workers and mill workers were also interviewed to understand waste collection and different uses.

Primary Data

Primary data were collected through field surveys with a focus on agricultural yield household units. The selection criteria for the village are the production of crop residues quantity in yield area and the use of surplus residues for the production of electricity through an electricity plant established in the two districts located in Bihar. The sample size was restricted to 200 farmer-respondents in the 10 villages out of 1432 in the two districts. The selection of the farmers interviewed corresponds to their agricultural activities that last ten years in the village. The random area sampling frame methodology chosen for selection of 20 yield area from each village. The crop residue inventory involves the measurement of both crop yields and crop residues, to allow the development of residue-yield ratio estimators as well as area-based estimates of residue yields. A questionnaire was prepared and respondents interviewed regarding the residues production quantities and consumption in different field.

Secondary Data Collection

Secondary data was collected from the different Government Institutions such as directorate of agricultural statistics, government of Bihar 2010-11, Jharkhand agricultural offtake allocation and procurement report section 2010-11, directorate of agriculture: government of Madhya Pradesh 2010-11, directorate of economics and statistics: government of Chhattisgarh 2010-11, agricultural statistics, government of Uttar Pradesh 2010-11 and directorate of economics and statistics government of India 2010-11.Before going into the field survey, we know about two types of techniques[1] of residues estimating, which depend on the end use of the data produced by these methods. The expected power potential of residues is calculated. If each plant that operates for 365 days and 24 hours, the value of the plant or PLF expenditure is calculated and estimated at 0.8. The expenditure value of the plant or PLF may differ from plant to plant, so it may change. In such a case, the average value was taken into consideration for the calculation. It is an expected estimate that shows the energy potential of residues in the context of power. The surplus residue available is divided by 1 X 365 X 24 X 0.8 to find the potential power capacity.

Result and Discussion

The research provided real facts about the quantity of surplus residues and the potential amount of electricity generation (144.87 megawatts) in the Son watershed area. As far as geographic space is concerned, residues are largely produced in the Son River watershed. The study provided an integrated picture of the outcomes in a wider context of sustainable development goals such as renewable energy/power.

Estimation of residues in Patna and Rohtas districts

The five villages were selected in the Patna district, including Lodipur, Anandpur, Sadikpur, Darweshpur-Uparwar and Katesar. Another five villages were selected for a survey in the Rohtas district. They include Mahadewa, Pokharaha Jamalpura, Chainpur, Berkap and Hurka. The topography consists of flat land alluvial plains with fertile soils.

[1] MNRE, 25 Years of Renewable Energy in India, 2008, p. 111 and Pathak and Srivastavan (ed.), Biomass Management for Energy Purpose Issues and Strategies, 2004, p. 78

Table 01: Residues Produced Per Crop Type and Each Village: 2012-13

Village	Rice straw (quintals)	Rice husk (quintals)	Wheat straw (quintals)	Gram straw (quintals)	Arhar straw (quintals)	Arhar husk (quintals)	Maize straw (quintals)
Lodipur	625.00	188.00	466.00	20.00	--	--	--
Anandpur	328.00	99.20	302.00	--	--	--	--
Sadikpur	544.00	166.90	476.00	73.00	--	--	--
Darweshpur	447.00	129.90	425.00	60.00	--	--	--
Katesar	291.00	91.68	356.00	35.00	53.00	6.05	--
Chainpur	544.00	163.80	512.00	50.00	--	--	--
Berkap	502.00	125.30	392.00	90.00	25.00	6.30	--
Hurka	397.00	101.30	411.00	--	--	--	90.00
Mahadewa	503.00	124.50	242.00	55.00	--	--	--
Jamalpura	294.00	104.95	494.00	150.00	--	--	--

Sources: Field Study Survey

Table 1 presents the total production residues for selected villages in the Son River watershed areas. It comprises the production quantities of paddy husk, paddy straw, wheat straw, gram straw, arhar straw and corn straw. The table shows that paddy residues are produced at the highest level. The estimated total residual produced from rice is 5770.55 quintals. Wheat is second with a total production of 4135 quintals and Gram contributes 533 quintals. Arhar and maize have a straw production limited to 91.3 and 45 quintals respectively.

Typical uses of residues in the villages studied were *cattle feed, domestic animal shelter and storage hut, domestic fuel, used as a fuel for small industry, material for paper making, no productive use disposal is a problem, used as a fuel for brick industry, use in cottage & food industry, burnt in the field.* There is still lots of potential to put residues for power production, as it is evident from the analysis that a major share of the residues is consumed in *Cattle feed and No Productive Use Disposal* is a problem category, which can be minimized if used in a scientific way. In the Son River watershed, domestic animals do not have a large number of grasses due to the availability of cultivated land as a high priority for agricultural practices. The economic conditions of households restrict the import of domestic animals, so domestic animals depended on large amounts of crop residues. The main fodder resource in the region is residues. Residues have traditionally been used as fodder but are not limited to about 24.5%. Table 2 showed that the typical use of crop residues in villages varies from traditional to non-traditional areas. It shows the predominant utilization of these crop residues and their amounts in each sphere. The economical aspect is also linked to their use. Under the supplementary situation small quantities of residues is used as fuel in the household and brick industry. The economics of straw treatment should not be viewed only in relation to production. Therefore, study only focus on areas of use and non-use that do not interrupt the traditional use of residues. The two categories of use were chosen for this study. One is burned in the field and the second is No productive use Disposal is a problem were taken into consideration for residues power potential and production in region. The amount for both categories is calculated in the next table.

The table shows the potential of residues in power production depending on their specific consumption values. The expected power potential of the residuals is determined. It therefore appears as a recommendation in the fields of usable power and its capacity. Through this table, we can understand that the exact value of any residues source can also be a forecast resource. Therefore, the most important aspect here is "how to use this power as potentials and what model should be used in this regard". Technological knowledge is a benefit in this context. It will help us apply it regionally. According to a study of 200 households, 46.44 kilowatts of power (electricity) can be generated. This is a very small amounts of residuals for power production. If the amount produced is higher, it is certain that the production of power will be large.

Table 02: Different Residues Utilisation Quantities in Survey Villages (Quintals): 2012-13

Typical uses of residues.	Rice straw	Rice husk	Wheat straw	Gram straw	Arhar straw	Arhar husk	Maize Straw	Total
Cattle feed	201	39	2230	110	0	12.35	0	2592.35
Domestic animal shelter and storage hut	132	120	0	45	50	0	0	347
Domestic Fuel	203	21	430	10	0	0	0	664
Used as a fuel for small Industry	105	120	260	0	0	0	0	485
Material for paper making	230	0	234	0	0	0	0	464
No productive use Disposal is a problem	1405	0	0	300	0	0	90	1795
Used as a fuel for brick Industry	234	320	0	68	0	0	0	622
Use in Cottage & food Industry	1465	606	32	0	28	0	0	2131
Burnt in the field	500	69.53	890	0	0	0	0	1459.53
Total	4475	1295.53	4076	533	78	12.35	90	10559.88

Sources: Field Study Survey

The following table highlights the surplus residuals available for potential power production. This surplus residual falls into the two categories. -Burned in the field and no productive use Disposal is a problem which are only available for power generation.

Table 03: Availability of surplus residues for Power Generation in Survey Villages: 2012-13

Residues Available for Power Generation	Rice straw	Rice husk	Wheat straw	Gram straw	Arhar straw	Arhar husk	Maize Straw
No productive use Disposal is a problem	1405	0	0	300	0	0	90
Burnt in the field	500	69.53	890	0	0	0	0
Total	1905	69.53	890	300	0	0	90

Sources: Field Study Survey

A sustainable supply of residues is a requirement for power generation. However, sources of surplus residues are highly dispersed within these villages.

Table 04: Residues for Potential Power Generation During the 2012-2013 in Survey Villages

Type of Residues	Quintal	Potential Power Capacity $\text{in Kw} = \frac{\text{Residues}}{1X365X24X0.8}$
Rice straw	1905	27.2
Rice husk	69.5	0.99
Wheat straw	890	12.7
Gram straw	300	4.28
Arhar straw	0	0.00
Arhar husk	0	0.00
Maize straw	90	1.28
		46.44

Sources: Field Study Survey

Estimation of Residues in the Son Watershed: 2010- 11

The following data provide comprehensive residues production quantity in entire Son watershed during year 2010-11. Secondary information is available at block level. The calculations were based on residue ratio, i.e., the values observed in the field study. The residues ratios obtained from field survey represent a small observation unit within Son watershed. Furthermore, data on surplus residues presented following table. Estimating surplus residues for power generation by taking into account only the residues burned in the field and No production use Disposal is a problem without productive use is an issue. The potential quantity of power generation from the surplus residues of Son watershed calculate amount is 144.87 Megawatts. This could be used for

the resident population within the Son watershed region. The study carefully examined only surplus crop residues that are used by rural populations to meet their daily needs.

Table 05: Potential Surplus Residues Available for Power Generation in the Son River Watershed (in quintal), 2010-11

Typical uses of Residues	Rice Straw	Rice Husk	Wheat Straw	Gram Straw	Arhar Straw		Arhar Husk	Maize Straw
No production use Disposal is a problem	4772664	0	590	275180	0		0	1851355
Burnt in the field	1699414	216660	1336311	0	0		0	0
	6472078	216660	1336901	275180	0		0	1851355

Sources: Field Study Survey

Conclusion

This research attempts to complete and understand estimate of residues production and its potential use in order to calculate power production quantity in the Son watershed geographical unit. The estimated power potential of the Son watershed for surplus residues is calculated about 144.87 Megawatts MW. The study found that utilisation of surplus residues to power production can be key pillar of sustainable development in the Son watershed. Residues is not a new resource because its production has been going on since the historical period but, through the technological conversion of surplus residues into any type of energy as called is biomass power. Agricultural residues in Son watershed mostly come in large quantities. Collection, processing, marketing and end-use are highly sustainable and the use of power within the same geographical unit would be beneficial. It seems that this is not only an issue of sustainable and renewable choice, but also the need to meet existing minimum regional electricity needs.

References

1. Directorate of Economics and Statistics. (2011). Agricultural Statistics Vol.III, 2000/2011. Patna: Government of India Bihar .
2. Directorate of Economics and Statistics. (2015). Agricultural statistics 2010-2011. Raipur: Government of Chhattisgarh.
3. Administrative Staff Colleges of India. (2005). Assessment of Socio Economic Impact of Biomass Power Plants. Hyderabad: Ministry of New and Renewable Energy, GOI.
4. Babu, D. (2000). Selection Installation and Financing of Biomass power Projects. New Delhi: New Delhi, Delhi: Central Board of Irrigation and Power.
5. Bhalla, A., & Reddy, A. (1994). The Technological Transformation of Rural India. London: Intermediate Technology Publication.
6. Bihar Sarakar. (2010). Krishi Diary. Patna: Krishi Vibhag Bihar Sarakar.
7. Commissioner of agriculture Production . (2011). Agricultural Statistics at a Glance 2011. Patna: Government of Bihar.
8. Different Consultants Consolidated by CGPL, Indian Institute of Science, Bangalore. (2004). Biomass Assessment Study Reports for 500 Taluka in 23 States. Ministry of New and Renewable Energy. Delhi: Ministry of New and Renewable Energy, Government of India.
9. Directorate of Agriculture. (2011). District wise Area, Production & Yield 2010/2011. Bhopal: Government of Madhya Pradesh.
10. Dutt, G., & Ravindranath, N. (1993). Biomass: Village Energy and Rural Development. New York: John Wiley and Sone.
11. Government of Jharkhand. (2015). Agricultural Off take Allocation And Procurement Report 2011. Rachi: Government of Jharkhand.
12. Pathak, B. A. (2004). Biomass Management for Energy Purpose Issues and Strategie. New Delhi: Sardar Patel Renewable Energy Research Institute.
13. Reddy, A. (1978). Studies in Biogas Technology. Bangalore: Indian Academy of Scienc.
14. Sarakar, Bihar. (2012). Krishi Diary. Patna: Krishi Vibhag Bihar Sarakar.
15. Sharma, N. (2011). Administrative Atlas Utter Pradesh: Census of India 2011. Utter Pradesh Volume I. Volume II. (2011 ed.). Lukhnow: Director of Census operation, Utter Pradesh.
16. Sinha, S. (2011). Administrative Atlas Madhya Pradesh: Census of India 2011: Madhya Pradesh (2011 ed.). Bhopal, Madhya Pradesh: Director of Census operation.