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ESTIMATING THE BIO-MASS POTENTIAL AND FEASIBILITY OF POWER GENERATION AT DISTRICT FATEHGARH SAHIB, PUNJAB

Harcharan Singh[1], Kuljinder Singh[2], Manjeet Singh[3]

[1]Student, Dept. Of Electrical Engineering & Desh Bhagat University, Punjab, India
[2]Assistant Professor, Dept. Of Electrical Engineering & Desh Bhagat University, Punjab, India
[3]Assistant Professor, Dept. Of Electrical Engineering & Chandigarh University, Punjab, India

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Abstract - *Biomass is renewable energy source for use power generation. India is a farming country. So the large amount of argi residue available India. More than 40Mt/y has been generated as agri-waste in the state. Punjab is a part of this large scale of available agri residue. The present study estimates the power potential of biomass in district fatehgarh sahib of Punjab including Paddy straw as well as different type of crops which are grown in the district and can be used for power generation. Availability of unused agricultural biomass evaluated in present study is 6257204.652 Quintals, which shows that the total potential available in fatehgarh sahib district for data collected for 2018-19 is 115.0141731 MW.*

Key Words: Biomass, Agri-Residue, Calorific Value, Potential in MW

1. INTRODUCTION

Biomass is capable renewable energy resource which can be used in the form of solid, liquid and gaseous fuel. Biomass can be converted into either heat energy or electrical or energy carriers like charcoal, oil, or gas using both thermo chemical and biochemical conversion methods. Combustion is the most developed and frequently applied process used for solid biomass fuels because of its cheap cost and high reliability. During combustion, the biomass first loses its moisture at temperatures up to 100°C, using heat from other particles that release their heat value [1].India is a forming country. So the large amount of agri residue available in India .and the many of the villages are are used agri residue or forest residue for power and domestic are for cooking purpose. Biomass power plants which involves direct combustion of biofuel i.e. agri-residue use travel grade burner which is very much suitable for burning biomass. Collected agri-residue is supplied to burner and it transfer heat while burning to boiler thus steam is produced which then supplied to steam turbine. Steam turbine is coupled with the alternator which produces electricity. Most of the power plants in Punjab uses Paddy straw as a base-fuel for power-production. The purpose of the present study is to estimate the power potential of biomass in district fatehgarh sahib of Punjab including Paddy straw as well as different type of crops which are grown in the district and can be used for power production.

1.1 Data Collected

Through Statistical Abstract of Punjab 2018-19 it has been seen in Table 1 that major crops of Punjab state are Paddy wheat, sugarcane, barley, potato and rapeseeds [2]

For study district fatehgarh sahib is divided into 5 circles

1. Bassi pathana
2. Sirhind
3. Amloh
4. khera
5. khamanno

There are two main seasons of crop cycle in Punjab namely Haari and Sauni. The data collected by Agricultural Department for all the circles in district fatehgarh sahib as of 2018-19 are as follows:

TABLE -1: DATA COLLECTION OF CIRLCE 1 BASSI PATHANA

BASSI PATHANA (RABBI) [SEASON 1]				BASSI PATHANA (KHARIF) [SEASON 2]			
S. no	**Type of gri-residue crop**	**Area under Crops (acres)**	**crop yield per acre (in Quintals)**	**S. no**	**Type of gri-residue crop**	**Area under Crops (acres)**	**crop yield per acre (in Quintals)**
1	Wheat	14991	25	1	paddy	14531	30
2	Rai/Sarson/mustard seeds	142	7.3	2	maize	25	25
3	Barley(jau u)	26	17	3	sugarcane leaves and trash (gnna)	565	285
4	Cabbage	43	16.29	4	Cabbage	183	16.29

TABLE -2: DATA COLLECTION OF CIRCLE 2 AMLOH

AMLOH (RABBI) [SEASON 1]				AMLOH (KHARIF) [SEASON 2]			
S. no	**Type of gri-residue crop**	**Area under Crops (acres)**	**crop yield per acre (in Quintals)**	**S. no**	**Type of gri-residue crop**	**Area under Crops (acres)**	**crop yield per acre (in Quintals)**
1	Wheat	16642	25	1	paddy	19528	30
2	Rai/Sarson /mustard seeds	79	7.3	2	maize	32	25
3	potato	3455	75	3	sugarcane leaves and trash	519	285
4	Barley	82	17	4	Bajra	927	35

TABLE -3: DATA COLLECCTION OF CIRCLE 3 SIRHIND

SIRHIND (RABBI) [SEASON 1]				SIRHIND (KHARIF) [SEASON 2]			
S.no	**Type of agri-residue crop**	**Area under crops in acres**	**Crop yield Quintal per acre**	**S.no**	**Type of agri-residue crop**	**Area under crops(acre)**	**crop yield Quintal per acre**
1	Wheat	21958	25	1	paddy	22124	30
2	potato	98	7.3	2	maize	51	25
3	Barley	15	17	3	sugarcane leaves and trash	436	285

TABLE -4: DATA COLLECTION OF CIRCLE 4 KHAMANNO

KHAMANNO (RABBI) [SEASON 1]				KHAMANNO (KHARIF) [SEASON 2]			
S.no	**Type of agri-residue crop**	**Area under crops in acres**	**Crop yield Quintal per acre**	**S.no**	**Type of agri-residue crop**	**Area under crops(acre)**	**crop yield Quintal per acre**
1	Wheat	14487	25	1	paddy	14315	30
2	potato	292	75	2	maize	71	25
3	barley	144	17	3	sugarcane leaves and trash	1023	285
4	-	-	-	4	Bajra	301	35

Table no. 5 shows the data of circle 5 place at khera for season 1 and season 2.

TABLE -5: DATA COLLECTION OF CIRCLE 5 KHERA

KHERA (RABBI) [SEASON 1]				KHERA (KHARIF) [SEASON 2]			
S.no	**Type of agri-residue crop**	**Area under crops in acres**	**Crop yield Quintal per acre**	**S.no**	**Type of agri-residue crop**	**Area under crops(acre)**	**crop yield Quintal per acre**
1	Wheat	16286	25	1	paddy	15873	30
2	potato	43	75	2	maize	65	25
3	barley	29	17	3	sugarcane leaves and trash	448	285

According to the available data quantity of agri-residue available per acre can be determined by:

1. Total agri-residue= Residue per acre (in Quintals)* Area under crops(in acres)
2. Residue per acre (in Quintals)= Residue generation ratio*crop yield per acre(in Quintals)
3. Residue formation ratio(RGR) of a crop-: Source[19]
4. Crop yield per acre (in Quintals)-:Source[Agriculture officer]
5. Area under crops(in acres)-:Source[Agriculture officer]

TABLE -6: RESIDUE GENERATION RATIO VALUE OF ALL CROPS

S. no	Crop Name	Residue generation ratio values
1	sugarcane leaves and trash	0.1
2	Wheat	1.15
3	Pulses	1.52
4	Maize	2.13

5	paddy straw	1.20
6	paddy husk	0.16
7	Potato	0.4
8	Mustard	1.72
9	Barley	1.2

TABLE -7: CALCULATION OF TOTAL AGRI RESIDUE AVALABE IN BASSI PATHANA

S.no	Name of crop	Area under crops(acre)	Residue production ratio(RPR)	crop yield Quintal per acre	residue per acer in tonne	total agri residue available for this season(in tonne)
1	paddy straw	14531	1.2	30	3.6	52311.6
2	paddy husk	14531	0.16	30	0.48	6974.88
3	maize	25	2.13	25	5.325	133.125
4	Sugar Cane	565	0.1	285	2.85	1610.25
5	Barley	26	1.2	17	2.04	53.04
6	Wheat	14991	1.15	25	2.875	43099.125
7	Mustard	142	1.72	7.3	1.2556	178.2952
8	paddy straw	14531	1.2	30	3.6	52311.6
	TOTAL					104360.3152

Similarly the by taking RPR in account Total agro-residue of Sirhind, Amloh, Khera, Khamanno is shown in Table 7.

DIRECT BIOMASS COMBUSTION: In this study used direct combustion method for biomass power generation because it's easy working, handling and economical in cost. In the whole over the World approximate 90 % of biomass is used as a energy source by using this technique of biomass combustion in biomass power plants. The most significant thing is that availability of bio-fuel ant its transportation cost put the strong influence on the size and economics of the project .it is only because when the transportation distance of the bio fuel increase, the transportation cost increases.

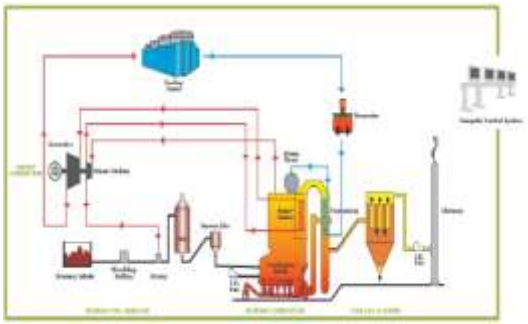

Fig -1: Direct Biomass Combustion

PROPOSED METHODOLOGY

According to the available data quantity of agri residue available per acre can be determined by multiplying the yield per acre to residue production ratio. Therefore total available agri-residue of crop can be determined by including total area under crop. For the Scheduling of biomass based power generation firstly we have to calculate biomass based power generated from each and every crop in all the circles of district Fatehgarh sahib as per the process mentioned below:

Now as per the quantity of agri-residue available of the respective crop and by considering calorific value of all the selected crops total energy potential can be calculated as under:

Available agri-residue* calorific value= Energy potential of crop .....(1)
Biomass power plants which involves direct combustion of bio-fuel i.e. agri-residue use travel grade burner which is very much suitable for burning biomass. The calculated energy potential can be converted to power potential:

Energy potential (kCal)*Generation factor(40%)= Net useful Energy..(2)
Now conversion of kCal to kWhr:
Net useful Energy*0.0011627= Net Energy in kWhr[21].....(3)
Now to calculate energy potential for whole year in kW
Net-EnergyinkWhr)/ 8760 KW (4)
By using equations 1.2,3 and 4 we can calculate biomass base power generated from each and every crop in a circle 1, circle 2, circle 3, circle 4 and circle 5 of district Fatehgarh sahib

TABLE -8: CALORIFIC VALUE Kcal/kg

S.no	Crop Name	Calorific Values kCal/kg	Source
1	sugarcane leaves and trash	3239.37	BOMB CALORIMETER
2	wheat	3421.79	BOMB CALORIMETER
3	maize	3734.2	BOMB CALORIMETER
4	paddy straw*[20]	3469	[20]
5	paddy husk*[20]	3881	[20]
6	potato	2927.18	BOMB CALORIMETER
7	mustard	3375.45	BOMB CALORIMETER
8	barley	3357.82	BOMB CALORIMETER

Calorific value has been calculated by collecting samples and testing them on Bomb-Calorimeter available at GNDEC, NCER-Lab, Ludhiana.
Calculating the power in all five circle in district in fatehgarh sahib
From equation (1), (2), (3) and (4) energy potential for while year is shown in Table 10

TABLE -9: CROP WISE TOTAL AGRI RESIDUE AVALABLE IN ALL CIRLCE OF DISTRICT FATEHAGARH SAHIB

S.No	Name of crop	BAASI PATHANA	SIRHIND	AMLOH	KHERA	KHAMANNO	Crop wise Total Agri-Residue in tonne
1	paddy straw	52311.6	79646.4	70300.8	57142.8	233501.6	415469
2	paddy husk	6974.88	10619.52	9373.44	7619.04	33050.96	59230.7
3	maize	133.125	271.575	170.4	406.25	1158.625	1873.5
4	Sugar Cane	1610.25	1242.6	1479.15	3830.4	15710.05	22673.5
5	Barley	53.04	30.6	167.28	59.16	574.74	855.72
6	Wheat	43099.125	63129.25	47845.75	46822.25	181613.05	321576
7	potato	0	294	10365	129	11379.8	21883.6
8	Mustard	178.2952	0	0	0	178.2952	356.59
		104360.32	155233.945	139701.82	116008.9	477167.1202	843919

RESULTS AND DISCUSSIONS

Biomass agri-residue available is calculated for all the circles of fatehgarh sahib as shown in Table 9. Table 7 agri-residue of Bassi Pathana Similarly for Sirhind, Amloh, Khera, Khamanno is shown in Table 7. Table 9 shows the Total agri-residue available in all the district of Fatehgarh sahib it can be seen that the argi residue is maximum at Khamanno and minimum at Khera.

TABLE -10: ENERGY POTENTION CALCULATION OF CIRCLE 1 BASSI PATHANA

S.no	Name of crop	Energy potential of crop (kCal)	Net useful Energy kCal	Net Energy in kWhr	KW	MW
1	paddy straw	181468940400.00	72587576160	84397574.8	9634.426347	9.63442635
2	paddy husk	27069509280.00	10827803712	12589487.38	1437.156093	1.43715609
3	maize	497115375.00	198846150	231198.4186	26.39251354	0.02639251
4	Sugar Cane	5216195542.50	2086478217	2425948.223	276.9347286	0.27693473
5	Barley	178098772.80	71239509.12	82830.17725	9.455499687	0.0094555
6	Wheat	147476154933.75	58990461974	68588210.14	7829.704353	7.82970435
7	Mustard	601826532.84	240730613.1	279897.4839	31.95176757	0.03195177
Total		362507840836.89	145003136334.76	168595146.6	19246.0213	19.2460213

Similarly for circle Sirhind, Amloh, Khera and khamanno is shown in Table 9.

TABLE -11: ENERGY POTENTIAL CALCULATION FROM ALL CIRCLE IN FATEHGARH SAHIB

S.NO	NAME OF THE CROP WHOSE AGRI RESIDUE HAS BEEN USED	CIRCLE 1 POTENTIAL (MW)	CIRCLE 2 POTENTIAL (MW)	CIRCLE 3 POTENTIAL (MW)	CIRCLE 4 POTENTIAL (MW)	CIRCLE 5 POTENTIAL (MW)	TOTAL POTENTIAL (MW)
1	paddy straw	9.63442635	14.6687804	12.94756574	10.5242068	9.491212797	57.26619209
2	paddy husk	1.43715609	2.1881248	1.931373215	1.56988361	1.415793096	8.542330811
3	maize	0.02639251	0.05384073	0.033782417	0.08054053	0.087975045	0.282531232
4	Sugar Cane	0.27693473	0.21370538	0.25438783	0.65876155	1.504270234	2.908059724
5	Barley	0.0094555	0.0054551	0.029821191	0.01054652	0.052368921	0.107647232
6	Wheat	7.82970435	11.4685243	8.692011197	8.50607465	7.566468346	44.06278284
7	potato	0	0.04568991	1.610802494	0.02004761	0.136137287	1.812677301
8	Mustard	0.03195177	0	0	0	0	0.03195177
Total		19.2460213	28.64412062	25.49974408	21.37006127	20.25422573	
		Total power in MW at District Fatehgarh sahib					115.014173

Table 11 shows the total energy potential of the available agri-residue as it can be seen that the energy potential is maximum at Sirhind i.e. 28.64412062 MW and minimum at Bassi pathana i.e. 19.2460213 MW. Total energy production in the district fatehgarh sahib is 115.014173 MW.

CONCLUSIONS

The state of Punjab has plenty of agricultural biomass, which can extend energy generation. Availability of unused agricultural biomass evaluated in present study shows that the total potential available in Fatehgarh district sahib district for data collected for 2018-19 is 115.014173 MW. The available energy can be utilized in a sustainable and environment friendly manner, mostly to overcome the energy shortages in Punjab.

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BIOGRAPHIES

My name is Harcharan Singh. I am pursuing M. Tech. from Desh Bhagat University, Punjab in Electrical Engineering. Also working as Lab Instructor in Chandigarh University, Mohali, Punjab.