



Estimating the Bio-Mass Potential- Roopnagar, Punjab

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Abstract: Biomass has enormous potential for power generation in India. Punjab state is one of the major agriculture production state of India which has great biomass availability through the whole year. More than 40Mt/y has been generated as agri-waste in the state. The present study estimates the power potential of biomass in district Roopnagar 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 944354.040 tones, which shows that the total potential available in Roopnagar district for data collected for 2014 is 246.184MW.

Keywords: Biomass, Agri-Residue, Calorific Value, Potential.

I. 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 thermochemical 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].

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 Roopnagar 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.

II. DATA COLLECTED

Through Statistical Abstract of Punjab 2014 it has been seen in Table 1 that major crops of Punjab state are Paddy wheat, sugarcane, maize cotton and rapeseeds [2]

TABLE I
MAJOR, MINOR AND INSIGNIFICANT CROP OF PUNJAB

District	Paddy	Wheat	Sugarcane	Maize	Cotton	Rapeseed	Bajra	Gram	Barley	Jowar	Sunflower
Amritsar	++	++	+	+	+	+	x	x	x	x	+
Bathinda	++	++	+	+	+	+	+	+	+	+	+
Fatehgarh Sahib	++	++	x	x	++	x	x	x	x	x	x
Firozpur	++	++	+	+	+	+	+	x	x	x	x
Gurdaspur	++	++	++	+	x	+	x	+	x	x	+
Hoshiarpur	++	++	+	+	+	+	x	x	x	x	+
Jalandhar	++	++	+	+	+	+	x	x	x	x	+
Kapurthala	++	++	++	+	x	+	x	x	x	x	+
Ludhiana	++	++	+	+	+	+	x	x	+	x	+
Mansa	++	++	+	+	++	+	+	x	+	x	x
Moga	++	++	+	+	+	+	x	x	x	x	+
Muktsar	++	++	+	+	++	+	x	+	+	x	+
Patiala	++	++	+	+	+	+	+	x	x	x	+
Rupnagar	++	++	+	+	+	+	x	+	x	+	x
Sangrur	++	++	+	+	+	+	x	+	+	x	+
Barnala	++	++	+	+	++	+	x	x	+	x	x
Fazilka	+	++	+	+	++	+	x	+	+	x	x
Pathankot	++	+	+	++	x	+	x	+	+	x	x
S.A.S. Nagar	+	++	+	+	+	+	x	x	x	x	+
S.B.S. Nagar	+	++	+	++	+	+	x	x	x	x	+
Tarn Taran	++	++	+	+	+	x	x	x	x	x	+

++: Major Crop, +: Minor Crop, x: Insignificant Crop



For study district Roopnagar is divided into 4 circles

- Ropar
- Anandpur Sahib
- Chamkaur Sahib
- Morinda

There are two main seasons of crop cycle in Punjab namely Haari and Sauni. The data collected by Agricultural Department for all the circles as of 2014 are as follows:

TABLE III
DATA OF CIRCLE ROPAR

ROPAR(haari)				Ropar(saunii)			
Sr.No	Type of agri-residue crop	Area under Crops (acres)	crop yield Quital per acre	Sr.No	Type of agri-residue crop	Area under crops(acre)	crop yield Quital per acre
1	Wheat	33048.6	25	1	paddy	19681	30
2	mustard seeds	187.72	7.3	2	maize	6530	25
3	barley (jauu)	37.05	17	3	Sugar cane	1685	285
4	pulses (masri)	83.98	3	4	pulses	79.04	9
				5	till	279.1	5

TABLE IIIII
DATA OF CIRCLE ANANDPUR SAHIB

Anandpur Saheb(haari)				Anandpur Saheb(saunii)			
Sr.No	Type of agri-residue crop	Area under crops in acres	Crop yield Quital per acre	Sr.No	Type of agri-residue crop	Area under crops(acre)	crop yield Quital per acre
1	Wheat	72319.13	25	1	paddy	17025.71	30
2	mustard seeds	185.25	7.3	2	maize	47824.14	25
3	Papolar	634.79		3	Papolar	1822.86	
4	potato	49.4	75	4	Sugar Cane	301.34	285
5	raiya	1494.35	6				
6	pulses	7.41	3				
7	grams	27.17	4				

TABLE IV
DATA OF CIRCLE MORINDA

morinda(haari)				morinda(sauni)			
Sr.No	Type of agri-residue crop	Area under crops in acres	Crop yield Quital per acre	Sr.No	Type of agri-residue crop	Area under crops(acre)	crop yield Quital per acre
1	Wheat	28096.25	25	1	paddy	30752	30
2	potato	59.28	7.3	2	maize	765.7	25
3	barley	133.38	75	3	Sugar cane	23589	285
4	raiya	7.14	6	4	pulses	71.63	9
5	pulses	9.88	3	5	till	2.47	5
6	bajra	22.23	4				

TABLE V
DATA OF CIRCLE CHAMKAUR SAHIB

Chmakaur Sahib(haari)				Chmakaur Sahib(sauni)			
Sr.No	Type of agri-residue crop	Area under crops in acres	Crop yield Quital per acre	Sr.No	Type of agri-residue crop	Area under crops(acre)	crop yield Quital per acre
1	Wheat	31640.07	25	1	paddy	22773.4	30
2	potato	93.86	75	2	maize	686.66	25
3	barley	214.89	17	3	Sugar Cane	2040.22	285
5	bajra	12.35	135	4	pulses(maah+ pulses)	59.28	9

Table II, III, IV, and V shows the area under crop and yield of crop per acre of all the circles for different crop grown in Roopnagar.

Residue production ratio is unused residue can be used for burning or other purposes. Table VI shows the different residue production ratio of different crops Sugarcane Tops and Leaves has minimum value of 0.1 and maize has maximum of 2.13 [3]



TABLE VI
DATA OF CIRCLE ANANDPUR SAHEB

S.No.	Crop name	Residue Production Ratio
1	Sugar Cane	0.1
2	Wheat	1.15
3	Pulses	1.52
4	Maize	2.13
5	Paddy Straw	1.2
6	Rice Husk	0.16
7	Potato Wine	0.4
8	Mustard	1.72
9	Barley	1.2

III. 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. Therefor total available agri-residue of crop can be determined by including total area under crop.

Now as per the quantity available of respective crop, by considering calorific value of crops total energy potential can be calculated.

Available agri-residue* calorific value= Energy potential of crop (1)

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. 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[5] (3)

Not to calculate energy potential for while year in kW
=(Net Energy in kWhr) / 8760 (4)

IV. RESULTS AND DISCUSSIONS

The biomass agri-residue available is calculated for all the circles of Roopnagar as shown in Table VII, and VIII.

TABLE VII
AGRI-RESIDUE OF ROPAR

S.no	Name of crop	Area under crops(acre)	Residue production ratio(RPR)	crop yield Quintal per acre	residue per acer in Quintals	total agri residue available
1	paddy straw	19680.96	1.2	30	36	70851456
2	paddy husk	19680.96	0.16	30	4.8	9446860.8
3	maize	6530.37	2.13	25	53.25	34774220.25
4	Sugar Cane	1684.54	0.1	285	28.5	4800939
5	Pulses	79.04	1.52	9	13.68	108126.72
6	Wheat	33048.6	1.15	25	28.75	95014725
7	Mustard	187.72	1.72	7.3	12.556	235701.232
8	Barley	37.05	1.2	17	20.4	75582
9	Pulses	83.98	1.52	3	4.56	38294.88

Similarly the by taking RPR in account Total agro-residue of Anandpur Sahib, Morinda and Chamkaur Sahib is shown in Table VIII

TABLE VIII
AGRI-RESIDUE OF ROPAR

S.no	Name of crop	Area under crop of Anandpur Sahib	Total agri residue available in Quintals	Area under crop of Morinda	Total agri residue available in Quintals	Area under crop of Chamkaur Sahib	Total agri residue available in Quintals
1	paddy straw	17025.71	61292556	30751.5	110705400	22773.4	81984240
2	paddy husk	17025.71	8172340.8	30751.5	14760720	22773.4	10931232
3	maize	47824.14	254663545.5	765.7	4077352.5	686.66	4291625
4	Sugar Cane	301.34	858819	23588.85	67228222.5	2040.22	17443881
5	Pulses 1	0	0	71.63	116040.6	59.28	101368.8
6	Wheat	72319.13	207917498.8	28096.25	80776718.75	31640.07	0
7	Mustard	185.25	90803899.63	0	0	0	0
8	Barley	0	0	133.38	272095.2	214.89	438375.6
9	Pulses 2	83.98	38294.88	9.88	4505.28	0	0
10	potato	49.4	148200	49.4	148200	93.86	281580
TOTAL		623895154.6		278089254.8		115472302.4	

Table no. VII and VIII shows the Total agri-residue available in all the district of Roopnagar it can be seen that the argiresidue is maximum at Anandpur Sahib.

Calorific value has been calculated by collecting samples and testing them on Bomb-Calorimeter available at GNDEC, NCER-Lab, Ludhiana.



TABLE IX
CALORIFIC VALUES

S.no	Crop Name	Calorific Value (kCal/Kg)
1	Sugar Cane	3239.37
2	Wheat	3421.79
3	Pulses	3692.63
4	Maize	3734.2
5	Paddy straw*	3469
6	Paddy husk*	3881
7	Potato	2927.18
8	Mustard	3375.45
9	Barley	3357.82

*Calorific Value of Paddy Straw and Paddy Husk[4]

Table IX shows the calculated calorific values of crops by Bomb-Calorimeter.

From equation (1), (2), (3) and (4) energy potential for while year is shown in Table X

TABLE X
Energy Potential Calculation of Ropar

S.no	Name of crop	Energy potential of crop (kCal)	Net useful Energy (KCal)	KWh	kW	MW
1	paddy straw	245783700864.00	98313480346	114309083.6	13048.982	13.04898215
2	paddy husk	36663266764.80	14665306706	17051352.11	1946.5014	1.946501382
3	maize	129853893257.55	51941557303	60392448.68	6894.1151	6.894115146
4	Sugar Cane	15552017768.43	6220807107	7232932.424	825.67722	0.825677217
5	Pulses	399271970.07	159708788	185693.4078	21.197878	0.021197878
6	Wheat	325120435857.75	130048E+11	151207012.3	17261.074	17.26107446
7	Mustard	795597723.55	318239089.4	370016.5893	42.239337	0.042239337
8	Barley	253790751.24	101516300.5	118033.0026	13.474087	0.013474087
9	Pulses	141408822.73	56563529.09	65766.41528	7.5075817	0.007507582
TOTAL						40.06076924

Similarly for circle Anandpur Sahib, Morinda and Chamkaur Sahib is shown in Table XI.

Table XI
Energy Potential Calculation of Anandpur Sahib, Morinda and Chamkaur Sahib

S.no	Name of crop	Energy potential of Anandpur Sahib(MW)	Energy potential of Morinda (MW)	Energy potential of Chamkaue Sahib(MW)
1	paddy straw	11.288	20.389	15.099
2	paddy husk	1.684	3.041	2.252
3	maize	50.488	0.808	0.851
4	Sugar Cane	0.148	11.562	3.000
5	Pulses 1	0.000	0.023	0.020
6	Wheat	37.772	14.674	16.525
7	Mustard	16.273	0	0
8	Barley	0	0.049	0.078
9	Pulses 2	0.008	0.001	0
10	potato	0.023	0.023	0.044
TOTAL		117.683	50.571	37.870

Table XI shows the total energy potential of the available agri-residue as it can be seen that the energy potential is maximum at Anandpur Sahib i.e. 117.683MW and minimum at Chamkaur Sahib i.e. 37.870MW.

V. CONCLUSION

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 Roopnagar district for data collected for 2014 is 246.184MW. The available energy can be utilized in a sustainable and environment friendly manner, mostly to overcome the energy shortages in Punjab.

ACKNOWLEDGMENT

The authors are grateful to the Director, GNDEC, Ludhiana, and Dr. Y.S. Brar, Department of Electrical Engg., GNDEC, Ludhiana, for providing facilities for the testing of crop samples and Dilbag Singh agriculture officer district Roopnagar, Punjab for helping in field data collection.

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