International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 9, September- 2014

Scheduling and Optimizing Mixture of Agri-Residues for Power Generation from Biomass

Gurpartap Singh Saggar[1], Khushdeep Singh[2]
[1]M.Tech student, Guru Nanak Dev Engg College Ludhiana, India
[2]Professor, Guru Nanak Dev Engg College Ludhiana, India

***Abstract*— For a developing country like India, Energy is most important resource in economic growth. India. In this paper, an investigation of agri-residues (rice and wheat straw) has been conducted in blocks Ludhiana I and Ludhiana II of district Ludhiana, Punjab. Regression analysis in MATLAB has been applied for analysis of load consumption data and scheduling of energy generated by power plant is done using simplex method in MATLAB along with obtaining optimum mixtures of agri-residues. The optimized mixture of 67.66% of rice is used for peak off-load months generating 66.63 MW Electric Power and 32.34% of rice is used along with wheat for peak on-load months generating 78.30 MW Electric Power.**

***Keywords*— Regression analysis, MATLAB, Biomass, Peak on-load months, Peak off-load months, Agri-residues, Energy**

INTRODUCTION

The perception of an energy plan for a rural municipal by making use of native accessible resources to meet electrical and other energy necessities has been revisited over the years. A lot of this may be indebted to slow but continuous rise in awareness among countries. The assessment of Biomass supplies is confounded by several ways in which biomass is generated and utilized primarily biomass is composed of remains from agricultural and societal deeds. India is 5th largest producer and third largest consumer of energy.With only 1.6% of geographical area of the country, Punjab produces 22% of wheat, 10% of rice and 13% of cotton majorly. There are two major agricultural crops in the state “Rabi”(winter crop) and “Kharif” (summer crop). The major crops grown during Rabi season are Wheat, Arhar, Sunflower, and Cotton while during Kharif seasons are Paddy, Bajra, Jowar and Sugarcane. A crop is considered major if its crop area fraction is 10% or above of the total cultivated area. A crop is considered minor if its crop area fraction is 2.5% or above. Crops that do not qualify either as major or minor are considered as “Insignificant Crops”. In this study survey is conducted for *Rabi* crop (wheat) and *kharif* crop (rice) in blocks Ludhiana I and Ludhiana II of district Ludhiana, Punjab. Block Ludhiana I consists of total 59 villages with total land area of 82463 acres consisting of 42830 acres of land under cultivation. Block Ludhiana II consists of total 178 villages with total land area of 129337 acres out which 95143 acres land is under cultivation. The areas under investigation have great potential of 1.36440e+12 Kcal.

Regression analysis stands in recognizing relationships amongst variables and uses these relationships to sort predictions. This technique can be used to recognize the line or curve that is responsible for the best fit through a set of data points. This line or curve can recognize a pattern in data, like linear or parabolic.
Here in this work, curve fitting tool box of MATLAB has been used in which particularly non-linear regression analysis is conducted for investigating the data and generate best curve for the problem. The polynomial models in non-linear regression analysis have been considered in this work.
Polynomial models for curves are given by:-

$$y = \sum_{i=1}^{n+1} P_i x^{n+1-i}$$

Where $n+1$ is the order of the polynomial$n$ is the degree of the polynomial. The order gives the number of coefficients to be fit, and the degree gives the highest power of predictor variable. Polynomials are expressed in terms of their degree. For e.g.

$$y = P_1x^3 + P_2x^2 + P_3x + P_4$$

Allocation & Analysis of Load consumption data in MATLAB

The load consumption data is plotted using MATLAB programming. Table I shows month-wise load consumption data of the area under consideration. Fig 1 shows plotting of the data in Table I using MATLAB. By investigating the traced pattern, Peak off-load months include Jan- April, Nov and Dec whereas peak on-load months include May-Oct.

TABLE I Load consumption data month-wise

S.NO	MONTH	LOAD (MW)
1	January	2850.0786
2	February	2934.1463
3	March	3179.2682
4	April	2987.8048
5	May	3300.5365
6	June	3894.909
7	July	3646.3414
8	August	3564.634
9	September	3560.9761
10	October	3369.5121
11	November	3123.1707
12	December	3182.9268

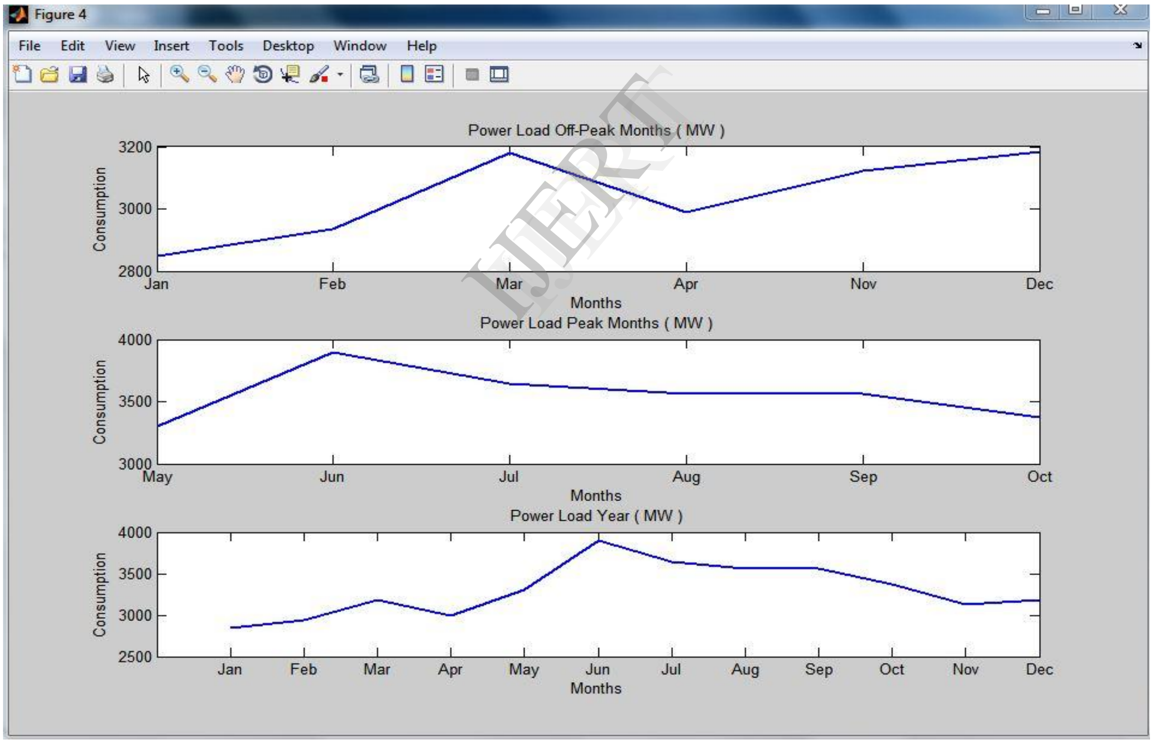

FIG I Analysis of Load Consumption Data by Tracing in MATLAB

Curve Fitting by Regression analysis in MATLAB

The equations obtained from regression analysis for peak off-load months data is expressed as:-

$$y = 4.1x^4 - 46.7x^3 + 153.7x^2 - 51.0x + 2780$$

The equation obtained from regression analysis for peak on-load month's data is expressed as:-

$$y = -26.6x^4 + 399.9x^3 - 2118.2x^2 + 4526.3 + 522.8$$

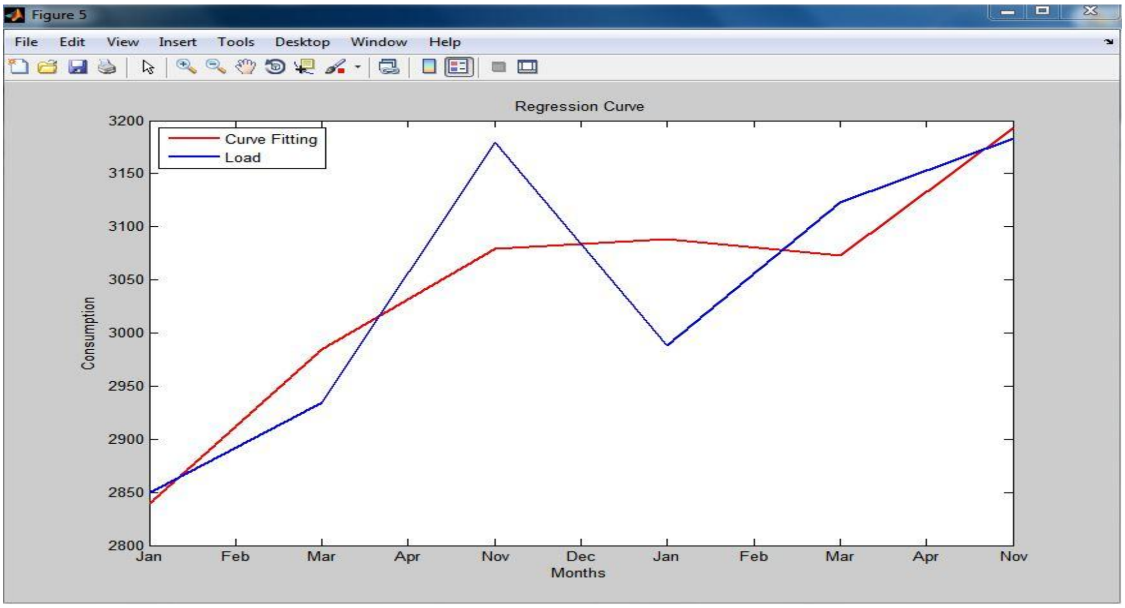

FIG II Curve fitting by using Regression Analysis for Peak off-load Months

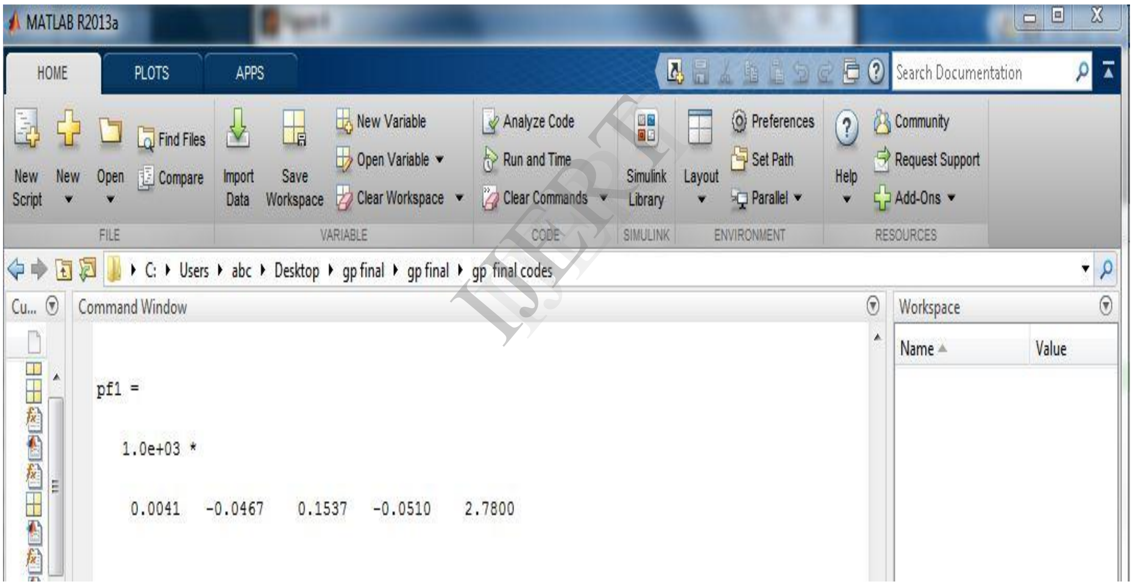

FIG III Polynomial function by Regression Analysis for Peak off-load Months

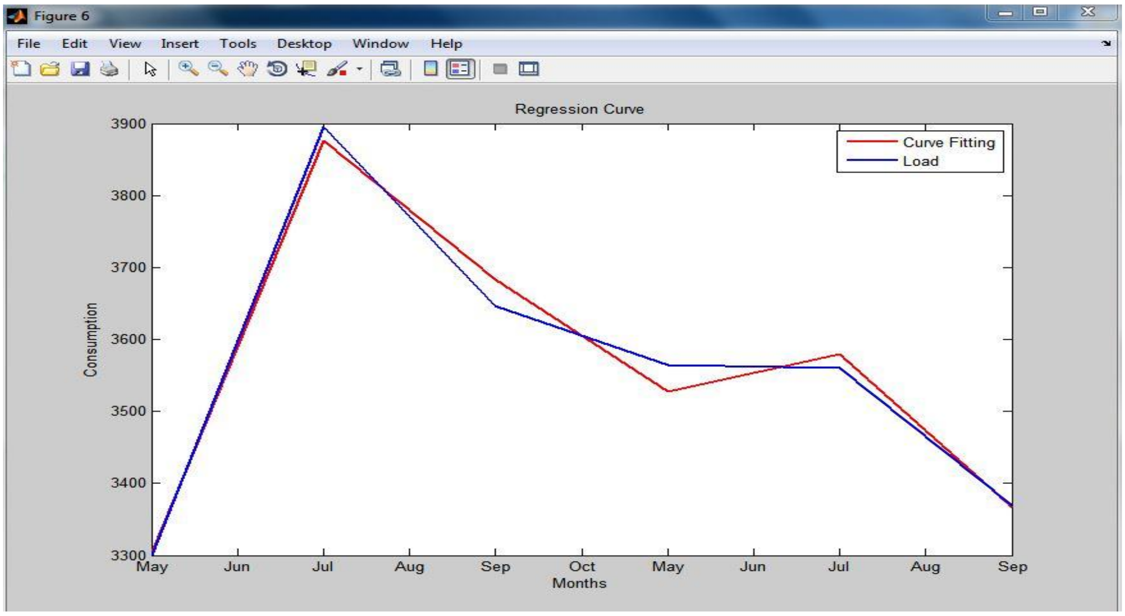

FIG IV Curve fitting by using Regression Analysis for Peak on-load Months

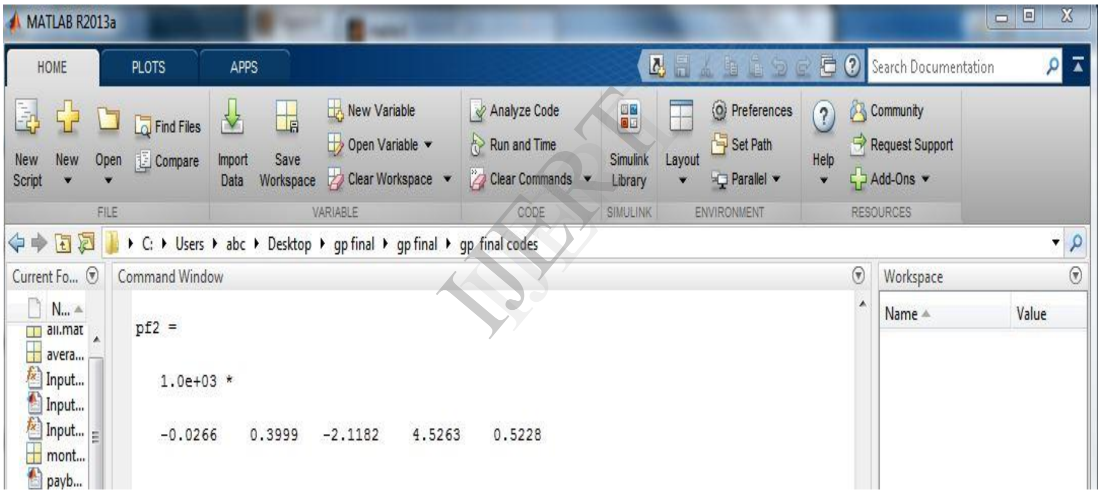

FIG V Polynomial function by Regression Analysis for Peak on-load Months

Calculations using MATLAB

Total agri-residue of wheat is 109624350 kg with capacity of generating potential 4.3465e+11 Kcal and that of rice is 278540640 kg with capacity of generatingpotential 9.2974e+11 Kcal.

Let

k= sum of peak off-loads (MW)

m= sum of peak on-loads(MW)

n= total load (MW)

x= amount of k present in n

y= amount of m present in n

p_1= total potential of wheat(Kcal)

p_2= total potential of rice (Kcal)

P= total potential for a year (Kcal)

r = potential of rice used for peak off-load months (Kcal)

s = potential of mixture of rice and wheat used for peak on-load months (Kcal)

p_2'= potential of rice for peak on-load months (Kcal)

G.C.V_w = calorific value of wheat (Kcal/kg)

$G.C.V_R$ = calorific value of rice (Kcal/kg)

δ = power generated for peak off-loads months (MW)

Δ = power generated for peak on-load months (MW)

$l_1, l_2, l_3, l_4, l_5, l_6$ = percentages of load shared by months jan, feb, mar, apr, nov, dec respectively of k

$d_1, d_2, d_3, d_4, d_5, d_6$ = percentages of load shared by months may, june , july, august, sept, oct respectively of m

$$k = \sum_{i=1}^{6} a_i = 18257.3954\text{MW} \quad (1)$$

$$m = \sum_{i=1}^{6} b_i = 21336.9092\text{MW} \quad (2)$$

$$n = k + m = 39594.3046 \quad \text{MW} \quad (3)$$

$$x\% = 0.46111657 \quad (4)$$

$$y\% = 0.538888343 \quad (5)$$

$$p_1 = 4.346548363e + 11\text{Kcal} \quad (6)$$

$$p_2 = 9.297486014e + 11 \quad \text{Kcal} \quad (7)$$

$$P = p_1 + p_2 = 1.364403438e + 12\text{Kcal} \quad (8)$$

$$r = P \times x\% = 6.29149e + 11\text{Kcal} \quad (9)$$

$$s = P \times y\% = 7.3526e + 11\text{Kcal} \quad (10)$$

Now,

$$p'_2 = p_2 - r = 3.00599568e + 11\text{Kcal} \quad (11)$$

p'_2 is positive and thus proves that we have sufficient amount of rice of potential p'_2 available for mixture with wheat during peak-on load months.

$$p'_2 + p_1 = 7.3526e + 11\text{Kcal} \quad (12)$$

Equation (12) is total potential for peak on-load months obtained from mixture of rice and wheat.

$$p_2 - p'_2 = 6.29149e + 11 \text{ Kcal} \quad (13)$$

Equation (13) is total potential for peak off-load months obtained from rest of rice.

Equation (12) and (13) is equal to equation (9) and (10) respectively, thus it proves that we have used total potential effectively for peak on-load and off-load months.

- Agri-residue of rice used in mixture with wheat for peak on-load months:-

$$\frac{p'_2}{G.C.V_r} = 90055737.57 \text{ kgs} \quad (14)$$

- Agri-residue of amount of rice used alone for peak off-load months:-

$$\frac{p_2 - p'_2}{G.C.V_r} = 188484902.4\text{kgs} \quad (15)$$

- Agri-residue of wheat used in mixture with rice for peak on=load months:-

$$\frac{p_1}{G.C.V_w} = 109624350 \text{ kgs} \quad (16)$$

- Total Power generated for peak off-load months:-

$$\delta = \frac{(6.29149e + 11) * 0.40 * 0.001163}{(183 * 24) * 1000}$$

$$\delta = 66.63937394 \text{ MW} \quad (17)$$

- Total power generated for peak on-load months:-

$$\Delta = \frac{(7.35261e + 11) * 0.40 * 0.001163}{(182 * 24) * 1000}$$

$$\Delta = 78.30665462 \text{ MW} \quad (18)$$

RESULTS

For peak off-load months 1884849.024 Quintals of biomass is used generating potential of 6.29149e+11 Kcal and for peak on-load months 1996800.876 Quintals of biomass is used generating potential of 7.3526e+11 Kcal. Intended for peak off-load months 67.66% of rice has been used for generating electric power of 66.6387 MW and for peak on-load months mixture of 32.34% of rice left along with wheat has been used for generating electric power of 78.3067 MW.

results

	Power Distributed	
January	10.4027	
February	10.7095	
March	11.6042	
April	10.9054	
May	12.1130	
June	14.2944	
July	13.3821	
August	13.0822	
September	13.0688	
October	12.3661	
November	11.3994	
December	11.6175	

FIG VI Scheduled Power generated Month-wise by Biomass Power Plant

CONCLUSSIONS

This study provides a new approach to Renewable technologies and their potential in district Ludhiana, Punjab in developing countries like India. This study includes scheduling Power generation from optimum mixture Biomass for peak off and peak on-load months. By use of this study Power generation of about 14500 KW could be set up in rural areas of India. Total Biomass calculated is 3881649.90 Quintals from Ludhiana block I and Ludhiana block II of district Ludhiana.Ludhiana blocks I and II can generate Power of 144.9454 MW by generating 66.6387 MW for peak off-load months and 78.3067 MW for peak on-load months.Optimal mixture is obtained by using Regression Analysis i.e. 67.66% of rice has been used for generating electric power of 66.6387 MW and 32.34% of rice is used along with wheat for peak on-load months to generate Electric power of 78.3067 MW.Per unit cost generation of Biomass Power Plant is Rs 4.76/KWh.Energy generated by Biomass Power Plant would have less adverse effects on environmental conditions than that generate by plants using Fossil fuels.

REFERENCES

[1] Ahiduzzaman, Islam, (2012) "Assessment of rice husk energy use for green Electricity Generation in Bangladesh, *Institute of Electrical and Electronic Engineers*, 2012.

[2] Homem, Florentino, (2010) "Optimal Energy Generation with Biomass of Sugarcane Hravest", *Transmission and Distribution Conference IEEE*, pp 653-658, 2010.

[3] Jain, Raman, Srinivas, (2010) "Sustainable Energy Plan for an Indian Village", *International conference on Power System technology*, IEEE, pp 1-8, 2010.

[4] Kun, Jun, Ping, (2011) "A study on the bioenergy crop production function of land used in China" *International Conference on Intelligent Computation Technology and Automation*,pp 11-14, 2011.

[5] Librenti, Ceotto (2010) "Biomass chis and Energy contents of dedicated lignocellulose crops, Biomass and Wsate, pp 8-13, 2010.

[6] Lonia, Badhai, (2005) "*Studies in techno-economic aspects of power generation from afri-waste in India*", Ph.D Thesis, Thapar university, Patiala, India, June 2005.

[7] Mcconkey, Kulshreshtha, (2012) "Bioenergy production potential on marginal land in Canada", *Institute of Electrical and Electronic Engineers*, 2012.

[8] Rafi, Jamil, (2011) "Energy potential & Generation through IRES in city of Faridabad-India", *IEEE Global Humanitarian Technology conference*, pp 238-241, 2011.

[9] Reddy, Sanke (2003) "Biomass for Power Energy Generation, 2003

[10] Shastre, Arechavala, (2013) "Evaluation of the environmental Sustainability of the use of straw for Electricity production", *International conference on Renewable energy research and applications*,pp 722-727, 2013.

[11] Wang, Huang, (2010) "Assessment of Biomass Energy Production Potential in China", *Institute of Electrical and Electronic Engineers*, 2010.

[12] Weigou, Guanghui, (2011) "Status of Biomass Power generation and its Solution in the country", International Conference on Advance Power System Automation and Protection", pp 157-161, 2011.