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Energy utilization pattern by farming community in Pusa and Kalyanpur block of Samastipur district

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■ **ABSTRACT :** The energy is the primary source of livelihood all over the world. The significant resources of energy were found to be wood, liquefied petroleum gas (LPG), diesel/petrol and electricity in Pusa as well as in Kalyanpur block. Wood was found with a higher per cent of yearly energy availability in the study area. Energy availability per capita was higher in Kalyanpur block as compared to Pusa block. More than 50% consumption of energy takes place in cooking and heating both blocks of the study area.Total energy consumed (MJ) varied from 15974.10 to 21137.40 and 20763.60 to 30711.90 in Pusa and Kalyanpur block, respectively. The total energy consumption / Energy consumed per ha (118832.60/ 21782.40 MJ) was higher in Kalyanpur block as compared to Pusa block,The significant proportion of energy consumed in seedbed preparation (about 50%). In Pusa block and Kalyanpur block, major proportion of energy was consumed in seedbed preparation was 50.20% and 48.21% followed by 25.61% and 21.00% for threshing, 21.64% and 27.82% was for irrigation, 1.15% and 0.99% for harvesting, 0.92% and 0.80% for showing and transplanting and 0.45% and 1.15% for intercultural operation, respectively.This paper aims to analyse present energy utilization resources in the selected area and to evaluate energy utilization pattern in theselected area.

■ **KEY WORDS :** Energy consumption, Calorific value, Mechanization, Per capita availability

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Mechanization refers to the interjection of machinery between men and materials handled by them. In agriculture, materials are soil, water, environment, seed, fertilizer, pesticides, growth regulators, irrigation, agricultural produce and by-products such as food grains, oilseeds, fruits and vegetables, cotton, sugarcane, jute and kenaf and other cash crops, milk, meat, eggs, fish etc. There is the scope of mechanization in every unit operation of production agriculture, post-harvest and agro-processing, and rural living (Uhlin, 1998).

Indian Government is giving more attention to Bihar's agriculture considering its highly fertile soils. If farming is done with modern technologies, then Bihar will be the state to feed the most of the population.

In the state of Bihar, agriculture assumes much more significance is because 89 per cent people are dependent for the livelihood. Indian agriculture is now faced with second generation problems on account of resource degradation, low input efficiency, and leading farm income.As there is no scope to increase the net cultivated area, the future requirement has to meet

through mechanization in improvement in productivity and input use efficiency. Equipment for tillage, sowing, irrigation, plant protection and threshing have been widely accepted among the farmers and power is needed on the farm for operating this equipment or implements (Carter, 1994). Energy is one the most valuable inputs in agricultural production. The per capita consumption of electrical energy in the country has been estimated to be 610 kWh per person, which is quite low as compared to the world average of 2400 kWh (Joon *et al.*, 2009). However, rural energy need fell under altogether different categories and classified as energy for cottage industries, rural home management, production agriculture, and processing (Parikh *et al.*, 2000).

The energy needs for rural home management has been estimated to be 66- 80% of the total energy for the rural sector (Rao and Reddy, 2007). The remainder is utilized for agricultural production. It is estimated that 35-40% of biomass is utilized for animal feed and the remainderis used as energy source by direct combustion. Rural cooking and agro-processing are predominantly fuelled by biomass. Utilization of solar energy, biogas, and biomass-based gasifiers, wind energy and mini and micro hydel power plants are being promoted on a large scale for industrial, agricultural and domestic use. Draught animals are capable of providing useful work output for 1500 working hours per annum; they are used for only 600 hours per annum. Mechanical power has emerged as the leading motive power for most of the farm operations.

Almost all the operations of seedbed preparation are carried out by mechanical power using tractors and power tiller. Production of tractors in the country begin in 1960, and now it is the world leader. Even with this phenomenon increased in the population of tractors, only 18-19 % of the cultivated land is covered. 'The amount of energy used in agricultural production, processing, and distribution should be significantly high to feed the expanding population and to meet other social and economic goals. Sufficient availability of the right energy and its effective and efficient use are prerequisites for improved agricultural production. Power available to the farms is thus a reflection of the trend of mechanization (Collins and Duffield, 2005). The study has brought out beneficial information on the availability of different resources, use pattern of different power sources, energy used a pattern for different farm activities in the farms as well as domestic usage in the study area.

METHODOLOGY

Study area :

The study was conducted in Pusa and Kalyanpur block of Samastipur district situated in agroclimatic zone-I. The district Samastipur is located between latitude 24° 30' to 25° 20'N and longitude 83° 14' to 83° 20' E. The Pusa block is situated above 52.99 m of mean sea level, 25°59' N latitude and 85°48'E longitudes.

Source : krishi.bih.nic.in

Fig. A : Map of Samastipur district

Survey questionnaire :

To achieve the various information on energy utilization pattern, a detailed survey performa was prepared. The performa was developed to provide necessary information regarding owner details, utilization of agricultural implements, power sources used, a number of an hour used, the area covered, type of energy resources and energy consumption. The survey performa was filled up by objectives of the study. Most of the farmers have low education level, and they did not keep records at all. Therefore, the required information was collected from the standard questionnaire.

Sampling procedure :

The present study was confined to Pusa and Kalyanpur Block of Samastipur district situated in agroclimatic zone-I. A survey was conducted in randomly selected six farmers from every five villages of above block. The details of farmers surveyed for getting the information about utilization agricultural implements, power sources used a number of an hour used, the area covered, type of energy resources and energy consumption are presented in Table A and B.

Table A : Land holding distribution in the study area

Category	Size of holding (ha)	Number of farmer surveyed in Pusa block	Number of farmer surveyed in Kalyanpur block
Marginal	below 1	3(10%)	3(10%)
Small	1 - 2	6(20%)	8(27%)
Semi medium	2 - 4	14(47%)	12(40%)
Medium	4 - 10	7(23%)	7(23%)
Large	above 10	0(0%)	0(0%)
Total		30 (100%)	30 (100%)

Parameters considered for study :

Calorific value :

Heat content per unit mass /volume is said to be calorific value. The calorific value of different fuels has been presented in Table B.

Table B : Calorific value of different fuels

Sr. No.	Name of fuel	Calorific value
1.	Wood	16.8 MJ/kg
2.	LPG	46.1 MJ/kg
3.	Petrol	34.6 MJ/L
4.	Diesel	38.6 MJ/L

The power of one person has been taken 0.05kW.

Energy consumption (E_c) :

It is obtained by multiplying fuel consumption and its calorific value and expressed as

$$E_c = C_V \times F_c \quad (1)$$

where,

E_C = Energy consumption

C_V = Calorific value

F_c = Fuel consumption

Energy consumption (E_c) may also be calculated by the following expression

$$E_c = P \times t \quad (2)$$

where P= Power and t =Time

■ RESULTS AND DISCUSSION

In the study area, an attempt has been made to find out the energy utilization pattern by farming community. The results have been discussed with emphasis upon the status of farmers and energy availability from different resources, energy utilization pattern for various farming activities, and energy utilization pattern for domestic usage. The results have been presentedunder the following heads:

Status of land holding of the surveyed farmers :

The survey was carried out in Mahmada, Birauli, Bathua, Dighra and Jagdishpur villages of Pusa block and Gorai, Balha, Bakhtiyarpur, Dumrawa and Simari villages of Kalyanpur block presented in Table 1.

It is clear from the table that 47%, 23%, 20%, 10% of the surveyed farmers came under the categories of semi-medium, medium, small and marginal category, respectively in Pusa block (Fig 1a), whereas 40%, 27%, 23% and 10% of the surveyed farmers came under the categories of semi-medium, small, medium and marginal, respectively in Kalyanpur block (Fig 1b)

This table also indicates that the farmers under large category were nil. It might be due to small landholding size in the study area.

Table 1 : Status of surveyed farmers in study area

Name of blocks	Name of village	Categories of surveyed farmers				
		Marginal (< 1 ha)	Small (1-2 ha)	Semi-medium (2-4 ha)	Medium (4-10 ha)	Large (>10 ha)
Pusa	Mahmada	1	0	4	1	0
	Birauli	1	2	1	2	0
	Bathua	1	0	4	1	0
	Dighra	0	2	2	2	0
	Jagdishpur	0	2	3	1	0
	Total	3 (10%)	6(20%)	14(47%)	7(23%)	0(0%)
Kalyanpur	Gorai	0	3	2	1	0
	Balha	0	1	3	2	0
	Baktiyarpur	1	1	2	2	0
	Dumrawa	1	2	2	1	0
	Simari	1	1	3	1	0
	Total	3(10%)	8(27%)	12(40%)	7(23%)	0(0%)

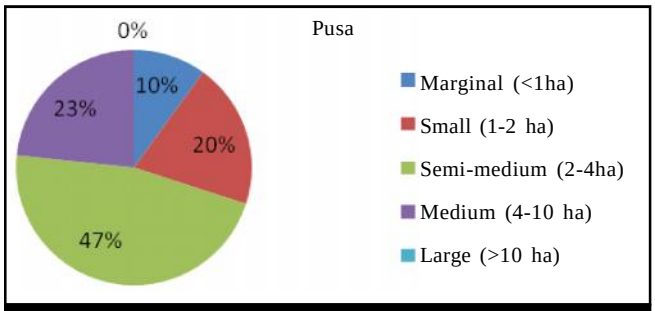

Fig. 1 (a) : Status of surveyed farmers in Pusa block

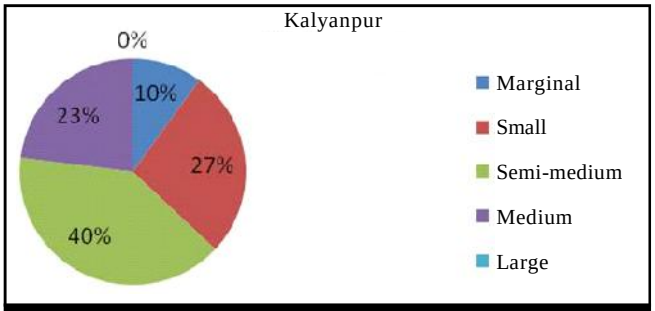

Fig. 1 (b) : Status of surveyed farmers in Kalyanpur block

Energy availability from different resources :

Yearly energy availability from different resources, in the studyarea, has been presented in Table 2. The major resources of energy were found to be wood, liquefied petroleum gas (LPG), Diesel, Petrol and Electricity in the study area. Although the percentage utilization of coal and kerosene were negligible due to the availability of LPG and electricity respectively in the study area. The use of renewable energy resources was also negligible in the study area due to lack of technical awareness.

Yearly energy availability from different resources shown in Table 2 indicates that the pattern of utilization of energy resources was almost same in Pusa and Kalyanpur Block of the study area. The highest utilization energy resources was wood>diesel/petrol> LPG> electricity> muscle power. It is also evident that the maximum per cent of yearly energy availability in Pusa Block was found to be 1162014MJ from wood, which is 47.40 per cent of total energy availability, whereas in Kalyanpur block the maximum yearly energy availability was found to be 965790 MJ from wood, which is 40.21 per cent of total energy availability.

Energy utilization pattern for domestic usage :

Energy utilization pattern for domestic usages in cooking and heating, feeding, lighting, transportation, and water lifting in the study area is presented in Table 3. It is clear from the table that per capita energy availability varied from 12935.6 to 218014.77 MJ and 11993.59 to

Table 2 : Yearly energy availability from different resources in the study area

Name of village	Yearly energy availability from different resources (MJ)						Total available energy (MJ)
	Wood	LPG	Diesel	Petrol	Electricity	Muscle power	
Pusa block							
Mahmada	242214	31421	102398.5	133037	5715.82	3426.29	518212.6
Birauli	223818	28803.28	68848.97	114872	5190.26	3493.25	445025.7
Bathua	223818	31421.76	103470.3	112450	4986.63	3260.53	479407.2
Dighra	260610	28148.66	136647.8	136670	5361.06	4153.49	571591.0
Jagdispur	211554	33385.62	96262.72	88230	4398.32	3054.96	436885.6
Total	1162014	153180.32	507628.29	585259	25652.09	17388.52	2451122.2
Mean	232402.8	30636.064	101525.658	117051.8	5130.418	3477.704	490224.44
Per cent	47.40	6.24	20.71	23.87	1.04	00.71	
Kalyanpur block							
Gorai	156366	36004.1	136323.7	116775	4730.4	3527.11	453726.3
Balha	202356	32076.38	148517.4	124420	4901.22	3899.38	516170.3
Baktiyarpur	226884	30112.52	121622.7	115910	4782.96	4843.81	504155.9
Dumrawa	193158	32076.38	123099.3	99994	28221.5	3345.69	479894.8
Simari	187026	34694.86	122267.4	95842	4835.52	3294.86	447960.6
Total	965790	164964.24	651830.5	552941	47471.6	18910.85	2401908.2
Mean	193158	32992.848	130366.1	110588.2	9494.32	3782.17	480381.64
Per cent	40.21	6.86	27.14	23.02	01.97	0.79	

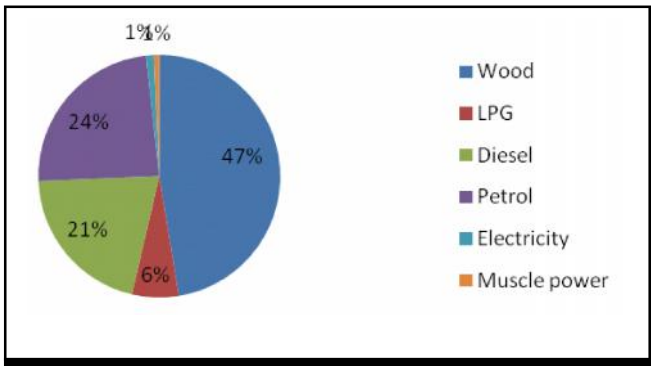

Fig. 2 (a) : Energy availability from different resources in Pusa block

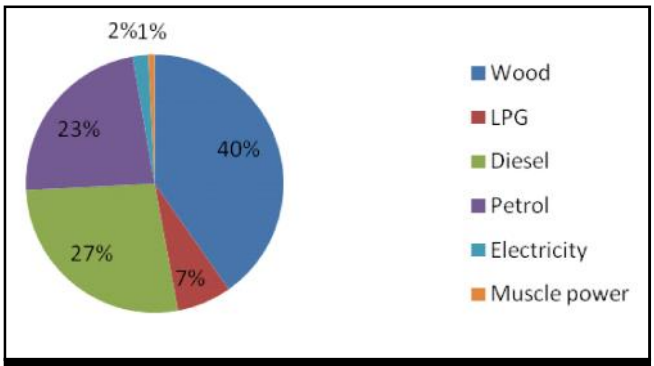

Fig. 2 (b) : Energy availability from different resources in Kalyanpur block

29812.36 MJ in Pusa and Kalyanpur block, respectively. Total available energy (3033112.3 MJ) was high in Kalyanpur block as compared to Pusa block (2328561 MJ). It is also clear that the energy consumption pattern in domestic activities in Pusa and Kalyanpur Block is same. The highest consumption takes place in cooking and heating followed by transportation, feeding, and lighting. Energy consumption for water lifting was nil.

Per cent energy consumption of domestic activities in Pusa and Kalyanpur block presented in Fig 3 a and b indicates more than 50% consumption of energy takes place in cooking and heating because of cooking and heating is carried out daily. In Pusa block transportation consumes 25.13% of total energy whereas in Kalyanpur Block it was 18.34%. In the same way, feeding consumed 23.1 and 13.45 % respectively in Pusa and Kalyanpur block.

Energy utilization pattern for various farming activities :

Energy utilization pattern for various farming activities has been presented in Table 4 which reveals that total energy consumed (MJ) was varied from 15974.1 to 21137.4 and 20763.6 to 30711.9 in Pusa and Kalyanpur block, respectively. It is also clear that energy consumed (MJ/ha) varied from 3013.9 to 3988.1 and

Table 3 : Status of energy utilization pattern for domestic usage

Name of village	No. of persons	Yearly energy consumption for domestic activities(MJ)					Total available energy (MJ)	Energy availability per capita (MJ)
		Cooking and heating	Feeding	Lighting	Transportation	Water lifting		
Pusa Block								
Mahmada	43	322390.5	95046	5715.9	133037	0	556232.4	12935.63721
Birauli	31	241209	107310	5189.54	114872	0	468611.5	15116.50129
Bathua	35	303547	102442	4986.63	112450	0	523460.6	14956.018
Dighra	30	278808	119574	5361.12	136670	0	540443.1	18014.77067
Jagdishpur	36	323158	113442	5098.42	88230	0	529964.4	14721.23389
Total	175	1178962	537814	26351.67	585259	0	2328561	13306.06383
Average		196493.6	89635.66	4391.95	97543.16	0	388064.4	2661.212766
Per cent		50.63	23.1	1.13	25.13	0		
Kalyanpur Block								
Gorai	35	842176.2	79716	4730.4	116775	0	1043432.6	29812.36
Balha	35	313297.8	82782	4901.22	128020	0	529036.02	15115.31486
Baktiyarpur	31	295230.8	104244	4782.96	115910	0	520198.76	16780.60516
Dumrawa	36	256661.9	70518	4559.47	99994	0	431769.37	11993.59361
Simari	34	337496	70518	4835.52	95792	0	508675.52	14961.04471
Total	171	2044863	407778	23809.57	556491	0	3033112.3	17737.49865
Average		340810.5	67963	3968.26	92748.5	0	505490.21	3547.499731
Per cent		67.42	13.45	0.79	18.34	0		

4205.6 to 4417.8 in Pusa and Kalyanpur block, respectively. The total energy consumption / Energy consumed per ha (118832.6/ 21782.4 MJ) was higher in Kalyanpur block as compared to Pusa block; It might be

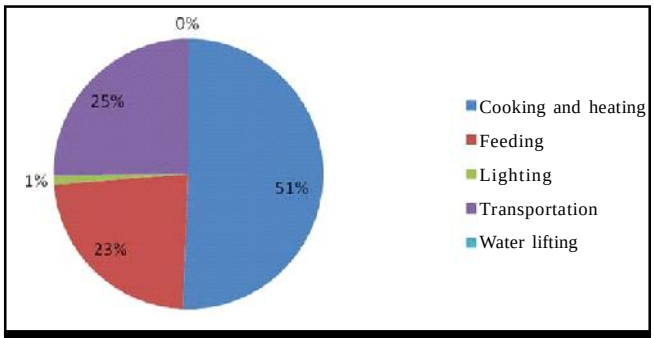

Fig. 3 (a) : Energy utilization pattern for domestic usage in Pusa block

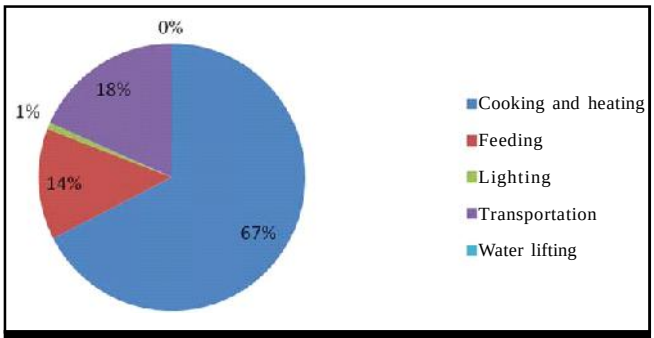

Fig. 3 (b) : Energy utilization pattern for domestic usage in Kalyanpur block

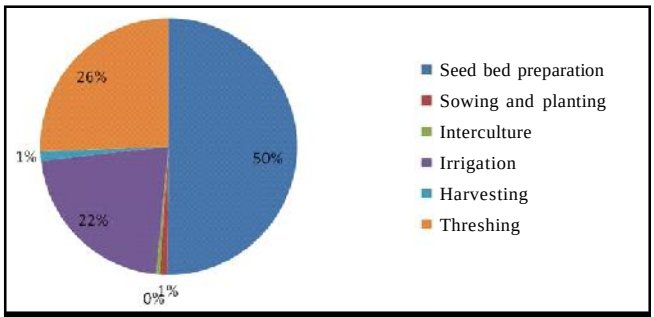

Fig. 4 (a) : Energy utilization pattern for various farming activities in Pusa block

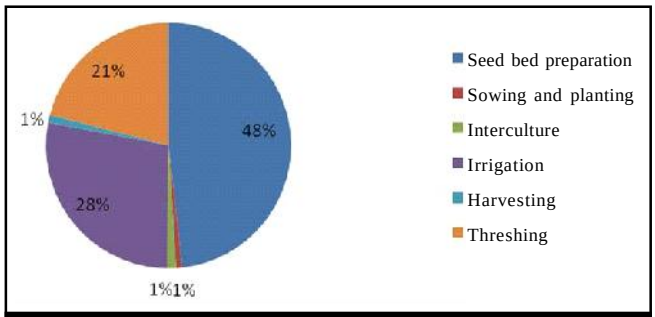

Fig. 4 (b) : Energy utilization pattern for various farming activities in Kalyanpur block

Table 4 : Energy consumption pattern for various farming activities

Name of village	Yearly activities- wise energy consumption(MJ)						Total energy consumed (MJ)	Net sown area(ha)	Energy consumed (MJ/ha)
	Seed bed preparation	Sowing and planting	Intercultural	Irrigation	Harvesting	Threshing			
Pusa block									
Mahmada	9755.8	180.1	92.7	4473.7	216.4	6418.4	21137.4	5.3	3988.1
Birauli	9748.3	184.1	87.7	4271.9	226.7	5148.1	19667.1	5.5	3575.8
Bathua	9552.0	166.2	87.5	3402.1	211.8	4522.4	17942.3	5.2	3450.4
Dighra	11768.2	217.1	106.0	5349.9	270.2	5755.2	23466.9	6.2	3784.9
Jagdishpur	8473.6	156.01	77.0	3759.5	205.2	3302.5	15974.1	5.3	3013.9
Total	49298.1	903.7	451.2	21257.3	1130.5	25146.9	98187.9	27.5	17813.4
Mean	9859.6	180.7	90.2	4251.4	226.1	5029.3	19637.5	5.5	3562.6
Per cent	50.20	0.92	0.45	21.64	1.15	25.61	100		
Kalyanpur block									
Gorai	9535	160.9	83.8	5983.6	202.7	4797.5	20763.6	4.7	4417.8
Balha	11727.6	200.2	104.4	7770.8	248.9	5350.7	25402.7	5.8	4379.7
Baktiyarpur	15753.3	250.8	127.3	7279.9	313.5	6985.7	30711.0	7.3	4206.9
Dumrawa	9976.1	173.6	964.3	6055.6	211.6	3647.0	21028.4	5	4205.6
Simari	10300.4	169.2	92.6	5975.2	209.0	4180.3	20926.9	4.9	4270.7
Total	57292.5	954.8	1372.5	33065.3	1185.7	24961.4	118832.6	27.5	21782.4
Mean	11458.58	190.9	274.5	6613.0	237.1	4992.2	23766.5	5.5	4356.4
Per cent	48.21	0.80	1.15	27.82	0.99	21.00	100		

due to more irrigation applied in Kalyanpur block than Pusa block.

Fig 4 a and b display the proportion of energy consumption in different agricultural activities. The significant proportion of energy consumed in Pusa block was in seedbed preparation (50.20%) followed by threshing (25.61%), irrigation (21.64%), harvesting (1.15%), showing and transplanting (0.92%) and intercultural operation (0.45%). In Kalyanpur block significant proportion of energy consumed in Pusa block was in seedbed preparation (48.21%) followed by irrigation (27.82%), threshing (21.00%), intercultural operation (1.15%), harvesting (0.99%) and showing and transplanting (0.80%). It may be due to seedbed preparation has been done by using atractor-drawn implement in both blocks.

Conclusion :

The following primary conclusions were drawn from the study area:

– The significant energy resources were found to be wood, liquefied petroleum gas (LPG), Diesel/ Petrol and Electricity in the study area.

– Wood was found with a higher per cent of yearly energy availability in Pusa as well as in Kalyanpur block.

– Per capita, energy availability was higher in Kalyanpur block as compared to Pusa block.

– More than 50% consumption of energy takes place in cooking and heating both blocks of the study area.

– Total energy consumed (MJ) varied from 15974.1 to 21137.4 and 20763,6 to 30711,9 in Pusa and Kalyanpur block, respectively.

– The total energy consumption / Energy consumed per ha(118832,6/ 21782,4 MJ) was higher in Kalyanpur block as compared to Pusa block,

– The significant proportion of energy consumed in seedbed preparation (about 50%).

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