International Journal of Agricultural Engineering, Vol. 3 No. 2 (October, 2010) : 257 -262

Research Paper :

Estimation of energy requirement for groundnut cultivation in Karnataka

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Accepted : ***July, 2010***

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ABSTRACT

The energy analysis made in the dry track of Karnataka indicated that cultivation of irrigated groundnut required significantly higher energy than cultivation of rain fed groundnut. Seedbed preparation, weeding, irrigation and harvesting were found to be most energy intensive operations. The rain fed groundnut required two times more renewable energy than irrigated crop. On the other hand the irrigated groundnut required three times more non-renewable energy than rain fed crop. Cultivation of rain fed groundnut was found to be more economical in terms of energy input than that of cultivating irrigated groundnut.

Key words : Groundnut, Output energy, Input energy

Indian agriculture has been experiencing a remarkable change during the last three decades with the introduction of high yielding varieties and new crop production practices. In this process, production agriculture has emerged as one of the major consumers of commercial non-renewable energy in the form of diesel, electricity, chemicals fertilizers, machineries, etc. On the other hand the relative impotence of the use of non-commercial energy sources like draught animals and organic manure is decreasing. The escalating prices of oils and other fuels, and limitations on the supply of commercial energy sources coupled with rising demands have created the need for better analysis of the energy costs and returns of various crop production systems. The quantification of energy flows in agriculture is necessary for the development of better energy management measures. This involves a methodical examination and review of the various energy inputs and outputs of the system. Rao and Singh (1981) analyzed the energy economics of cereal crops based on inputs of material and time. Singh *et al.* (1981) studied energy inputs for cultivation of paddy, cotton, maize and wheat in Punjab and found that a mechanical source was the major energy input. Devasenapathy *et al.* (1989) studied energy required for sorghum crop and observed that irrigation consumed about 60 per cent of the total energy input. The impact of implements on the energy use pattern of dry land farms was studied in Tamil Nadu and found that the use of improved implements reduced the bullock energy and increased the speed of operation (Rajeswaran *et al.*, 1990). Farming systems with high energy intensity showed higher yields over low energy intensity (Dash and Das, 2000).

The agro-climatic conditions of Karnataka State permit to grow all types of crops under rain fed and irrigated conditions. Although there are many crops grown in the eastern dry track of Karnataka with an annual rainfall less than 900 mm, groundnut is accounted for a large cultivated area both under rain fed and irrigation. The small and marginal farmers cultivate nearly 60 per cent of the total cultivable land. Draught animals are the major power source available on the farm followed by women labour for rising crops. The available energy input is about 0.34 kW/ha compared to the all India average of 0.50 kW/ha. The groundnut cultivation in Karnataka is depended on rain fall and time bound operation and most of the farmers are still following traditional methods of crop cultivation using limited energy inputs.

METHODOLOGY

The study was carried out at Hariyabbe village in Hiriyur taluk of Chitradurga District in Karnataka, to study the energy requirement for the production of groundnut. The magnitude of production of *Kharif* crops was used as the main criterion in the selected village for the study. A list of farm holdings of the entire village was prepared and classified into four categories; marginal farmers (MF), small farmers (SF), medium size farmers (MSF), and large farmers (LF) having land holdings <1, 1- 2, 2-4 and 4 ha and above, respectively. The farming operations were carried out mainly by human and animal power using indigenous implements and hand tools. The families were selected on a random basis in each category of farmers. The information on use of direct energy (human, animal, diesel, electricity, etc.) and indirect energy (seed, farm

yard manure, chemicals, fertilizers, machinery, etc.) was collected during *Kharif* seasons through structured questionnaire for cultivation of groundnut crop starting from seedbed preparation to harvest and post harvest operations. The questionnaire included all aspects of inputs supplied to the crop, machinery, human and animal power used for various farm operations and the yield obtained. The data were analyzed to find out the operation wise and source wise energy requirement on unit area basis. The energy outputs were estimated on the basis of average yield (kg/ha). The yield of the by-product (haulm) of groundnut was estimated on the basis of plant component. The output / input energy ratio was calculated by dividing the total output energy of the product (pods + haulm) by total input for crop production using the energy coefficients (Singh *et al.*, 1987). The specific energy requirement per unit of production was estimated by dividing energy input by pod output.

RESULTS AND DISCUSSION

The operation wise energy used for cultivation of rain fed and irrigated groundnut is presented in Table 1. The total energy used from seed preparation to post harvest operations for cultivation of groundnut in rain fed conditions varied from 2129.56 to 2398.89 MJ/ha. It was lowest for the medium size farmers and highest for the large farmers. On the other hand, this energy component varied from 3425.19 to 4037.45 MJ/ha in irrigated groundnut. The energy input was lowest by the marginal farmers (MF) and highest by the large farmer (LF). Further it was observed that the total energy (Table 2) for the irrigated groundnut was significantly (2.6 times) higher than that for the crop grown in rain fed. This was because of higher energy used for irrigating the crop and subsequent increase in weeding, fertilizing, and intercultivation, harvesting, transportation and post harvest operations. Fig. 2 shows that seedbed preparation in rain fed crop consumed maximum energy (34.14%) followed by weeding and intercultivation operations (19.77 %), harvest (16.59 %)and post harvest (11.48 %). This was due to the fact that more human power was used in these operations compared to other operations. Rain fed groundnut did not require any energy input for irrigating the crop. In case of irrigated groundnut, irrigation accounted for maximum energy of 26.74% followed by weeding and intercultural, harvest and post harvest operations. Seedbed preparation and weeding and Intercultivation, harvest and post harvest operations were the second most energy consuming operations for both rain fed and irrigated crops, since in traditional agriculture, more human power was used for these operations. The contribution of energy from varies sources is presented

Table1 : Operation wise energy consumption (MJ/ha) for cultivation of rain fed and irrigated groundnut by different categories of farmers in Karnataka

Operations	Rainfed cultivation of groundnut					Irrigated cultivation of groundnut				
	MF	SF	MSF	LF	Mean	MF	SF	MSF	LF	Mean
Seed bed preparation	739.68 (34.73)	760.58 (35.22)	734.50 (33.59)	794.85 (33.13)	757.40 (34.14)	1139.68 (33.27)	1220.58 (32.68	1194.50 (30.38)	1284.85 (31.82)	1209.90 (31.99)
Sowing	238.65 (11.21)	258.62 (11.98)	248.65 (11.37)	260.86 (10.87)	251.70 (11.34)	238.65 (6.97)	258.62 (6.92	248.65 (6.32)	260.86 (6.46)	251.70 (6.65)
Fertilizer application	25.65 (1.20)	30.85 (1.43)	42.36 (1.94)	75.62 (3.15)	43.62 (1.97)	25.65 (0.75)	30.85 (0.83	42.36 (1.08)	75.62 (1.87)	43.62 (1.15)
Irrigation	-	-	-	-	-	795.63 (23.23)	1015.23 (27.18	1185.63 (30.15)	1048.56 (25.97)	1011.26 (26.74)
Weeding and intercultivation	450.85 (21.17)	425.25 (19.69)	412.34 (18.86)	465.78 (19.42)	438.56 (19.77)	450.85 (13.16)	425.25 (11.39	412.34 (10.49)	465.78 (11.54)	438.56 (11.59)
Harvesting	350.65 (16.47)	360.54 (16.69)	385.64 (17.64)	375.45 (15.65)	368.07 (16.59)	350.65 (10.24)	360.54 (9.65	385.64 (17.64)	375.45) (9.30	368.07 (9.73)
Transportation	65.46 (3.07)	85.29 (3.95)	116.53 (5.33)	150.68 (6.28)	104.49 (4.71)	65.46 (1.91)	85.29 (2.28	116.53 (2.96)	150.68 (6.28)	104.49 (2.76)
Post harvest operations	258.62 (12.14)	238.53 (11.04)	246.32 (11.27)	275.65 (11.49)	254.78 (11.48)	358.62 (10.47)	338.53 (9.06	346.32 (8.81)	375.65 (9.30)	354.78 (9.38)
Total energy	2129.56 (100)	2159.66 (100)	2186.34 (100)	2398.89 (100)	2218.61 (100)	3425.19 (100)	3734.89 (100)	3931.97 (100)	4037.45 (100)	3782.38 (100)

Note: Figures in parentesis are percentages of total operation wise energy

Table 2 : Source wise energy consumption (MJ/ha) for cultivation of rain fed and irrigated groundnut by different categories of farmers in Karnataka

Source	Rainfed cultivation of groundnut					Irrigated cultivation of groundnut				
	MF	SF	MSF	LF	Mean	MF	SF	MSF	LF	Mean
Human	238.86 (10.09)	224.75 (8.13)	238.48 (8.04)	214.57 (8.34)	229.17 (8.59	650.25 (11.35	612.34 (9.10)	648.95 (8.43)	457.61 (5.60)	592.29 (8.36)
Animal	842.65 (35.59)	830.67 (30.05)	890.49 (30.03	452.15 (17.58)	753.99 (28.27	429.67 (8.48	485.57 (7.18)	483.28 (4.65)	358 (4.38)	439.13 (6.20)
Farm machinery	50.54 (2.13)	60.28 (2.18)	57.68 (1.95)	130.64 (5.08)	74.79 (2.80	78.65 (1.37	95.67 (1.42)	127.62 (1.66)	158.38 (1.94)	115.08 (1.62)
Diesel	185.62 (7.84)	248.67 (9.00)	298.57 (10.07)	324.96 (12.63)	264.46 (9.91	245.89 (4.29	345.67 (5.14)	549.52 (7.14)	786.31 (9.62)	481.85 (6.80)
Electricity	-	-	-	-	-	1458.62 (25.46	1425.31 (21.18)	1451.83 (18.86)	1456.78 (17.82)	1448.14 (20.45)
Farm yard manure	750 (31.68)	800 (28.94)	850 (28.67)	800 (31.10)	800.00 (29.99	1050 (18.33)	1250 (18.58)	1450 (48.90)	1580 (19.33)	1332.50 (18.81)
Chemical fertilizer	150 (6.34)	450 (16.28)	480 (16.19)	500 (19.44)	395.00 (14.81	1685.65 (29.42)	2384.65 (35.44)	2856.95 (37.11)	3248.48 (39.73)	2543.93 (35.92)
Seed	150 (6.34)	150 (5.43)	150 (5.06)	150 (5.83)	150.00 (5.62)	130 (2.27)	130 (1.93)	130 (1.69)	130 (1.59)	130.00 (1.84)
Total energy	2367.67 (100)	2764.37 (100)	2965.22 (100)	2572.32 (100)	2667.40 (100	5728.73 (100)	6729.21 (100)	7698.15 (100)	8175.56 (100)	7082.91 (100)

Note: Figures in parentesis are percentages of total source wise energy

in Table 1. for the four categories of farmers. The total energy input was in the range of 2129.56 to 2398.89 MJ/ha and 3425.19 to 4037.45 MJ /ha for rain fed and irrigated crops, respectively. In both cases, the total energy was lowest for the marginal farmers because of their low economic status to provide timely energy inputs compared to the other better-off farmers. Interestingly, their specific energy used was nevertheless lower and their output-input ratio was higher than those of the other farmers (Table 2 and 3). From Fig. 1, it could be seen that the energy input through farmyard manure was maximum (29.99 %) followed by animal power (28.27%). This was probably because the farmers were not prepared to take risk in applying chemical fertilizer due its possible ill effect

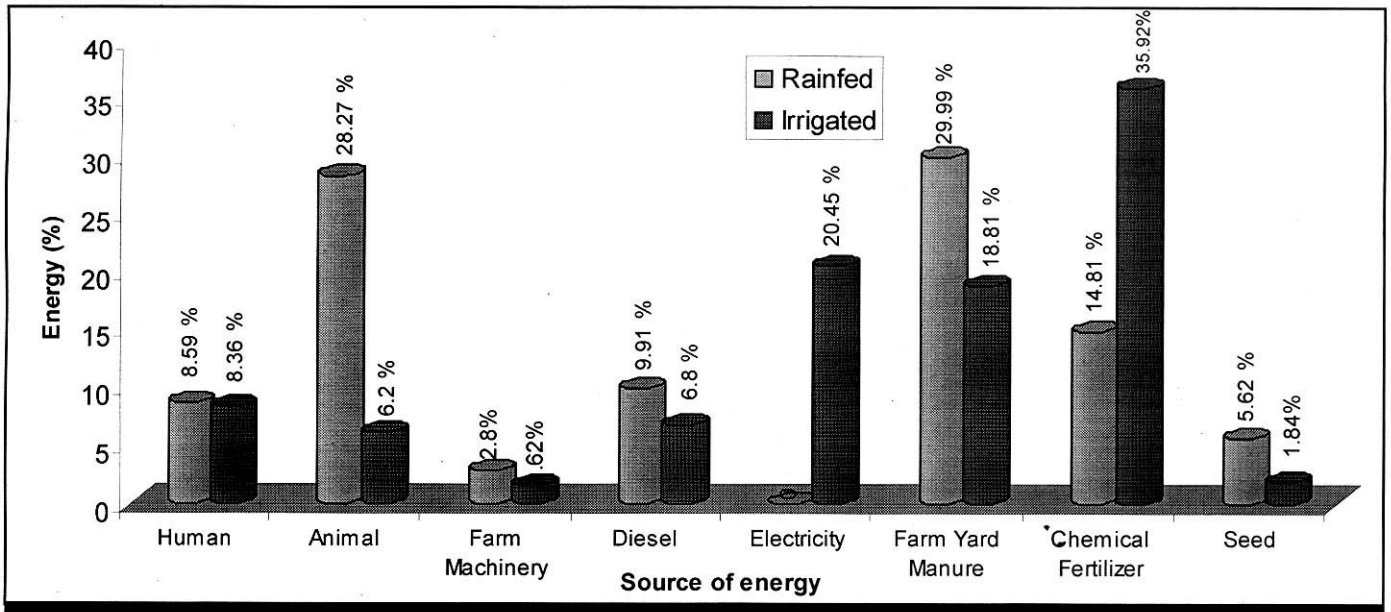

Fig. 1 : Sourcewise energy consuption for cultivation of rainfed and irrigated groundnut

Table 3 : Grain yield and output input energy ratio for cultivation of rain fed and irrigated groundnut by different categories of farmers in Karnataka

Operations	Rainfed cultivation of groundnut					Irrigated cultivation of groundnut				
	MF	SF	MSF	LF	Mean	MF	SF	MSF	LF	Mean
Pod yield (kg/ha)	800.00	850.00	950.00	950.00	887.50	1650.00	1750.00	1800.00	1850.00	1762.50
Haulm yield (Kg/ha)	1100.00	1200.00	1350.00	1350.00	1250.00	1700.00	1950.00	2000.00	2100.00	1937.50
Output energy from pod (MJ/ha)	11200.00	11900.00	13300.00	13300.00	12425.00	23100.00	24500.00	25200.00	25900.00	24675.00
Output energy from haulm (MJ/ha)	8800.00	9600.00	10800.00	10800.00	10000.00	13600.00	15600.00	16000.00	16800.00	15500.00
Total output energy (MJ/ha)	20000.00	21500.00	24100.00	24100.00	22425.00	36700.00	40100.00	41200.00	42700.00	40175.00
Renewable energy (MJ/ha)	1981.51	2005.42	2128.97	1616.72	1933.16	2259.92	2477.91	2712.23	2525.61	2493.92
	(83.69)	(72.55)	(71.80)	(62.85)	(72.47)	(39.45)	(36.82)	(35.23)	(30.89)	(35.21)
Non renewable energy	386.16	758.95	836.25	955.60	734.24	3468.81	4251.30	4985.92	5649.95	4589.00
(MJ/ha)	(16.31)	(27.45)	(28.20)	(37.15)	(27.53)	(60.55)	(63.18)	(64.77)	(69.11)	(64.79)
Total input energy (MJ/ha)	2367.67	2764.37	2965.22	2572.32	2667.40	5728.73	6729.21	7698.15	8175.56	7082.91
Direct renewable energy	1081.51	1055.42	1128.97	666.72	983.16	1079.92	1097.91	1132.23	815.61	1031.42
(MJ/ha)	(45.68)	(38.18)	(38.07)	(25.92)	(36.86)	(18.85)	(16.32)	(14.71)	(9.98)	(14.56)
Direct non renewable	185.62	248.67	298.57	324.96	264.46	1704.51	1770.98	2001.35	2243.09	1929.98
energy (MJ/ha)	(7.84)	(9.00)	(10.07)	(12.63)	(9.91)	(29.75)	(26.32)	(26.00)	(27.44)	(27.25)
Indirect renewable energy	900.00	950.00	1000.00	950.00	950.00	1180.00	1380.00	1580.00	1710.00	1462.50
(MJ/ha)	(38.01)	(34.37)	(33.72)	(36.93)	(35.62)	(20.60)	(20.51)	(20.52)	(20.92)	(20.65)
Indirect non renewable	200.54	510.28	537.68	630.64	469.79	1764.30	2480.32	2984.57	3406.86	2659.01
energy (MJ/ha)	(8.47)	(18.46)	(18.13)	(24.52)	(17.61)	(30.80)	(36.86)	(38.77)	(41.67)	(37.54)
Total output-input energy ratio	8.45	7.78	8.13	9.37	8.41	7.24	6.49	5.87	5.76	6.34
Specific energy (MJ/ha)	2.96	3.25	3.12	2.71	3.01	3.47	3.85	4.28	4.42	4.00

Note: Figures in parentesis are percentages of total input energy.

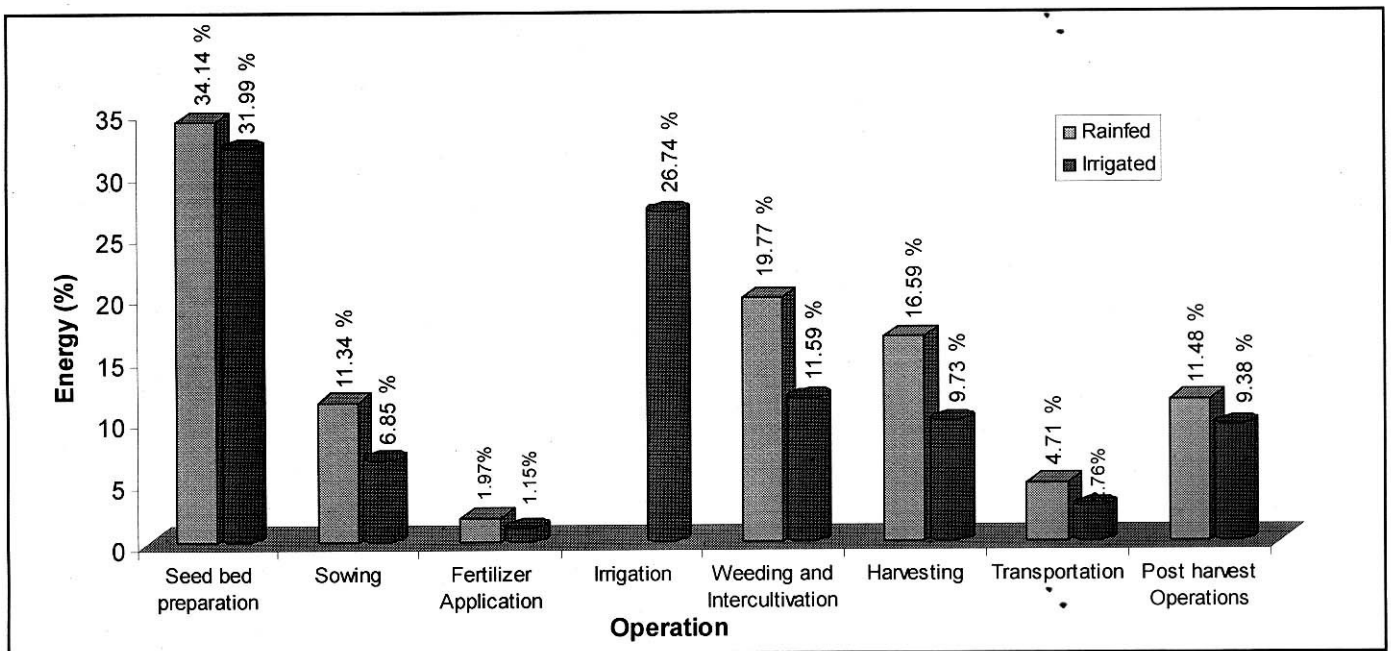

Fig. 2 : Operationwise energy consuption for cultivation of rainfed and irrigated groundnut

in case the rain did not received on time. On the other hand, the energy input through chemical fertilizer was higher (35.92%) for the irrigated crop (Fig. 1) followed by the electrical energy (20.45%). The reason for higher energy input through chemical fertilizer was due to the availability of assured irrigation to raise the crop. The grain yields ranged between 800-950 kg/ha and 1650-1850 kg/ha for rain fed and irrigated crops, respectively (Table 3). The output- input energy ratio varied from 7.78 to 9.37 for the rain fed crop. Further, the output-input energy ratio was higher for the rain fed as well as for irrigated crops with respect to all the categories of farmers at low specific energy input per unit of production. Groundnut cultivation required 35.21 per cent energy from the renewable sources and 64.79 per cent from non-renewable sources for the irrigated crop where as in rain fed condition it required 72.47 per cent energy from the renewable sources and 27.53 per cent from non-renewable sources. Similar energy consumption was also observed in the case of direct renewable (human and animal), direct non-renewable (diesel and electricity), indirect renewable (seed and farmyard manure) and indirect non-renewable (chemicals, fertilizers and machinery) energy sources. The probable reasons for recording higher per cent of nonrenewable sources under irrigated conditions may the pressure on irrigation facilities and subsequent use of fertilizers. On the other hand the use of higher percentage of renewable sources of energy under rain fed groundnut may be cheaper and easier. Further, it could be seen that the production of groundnut required 3.01 MJ of energy to produce 1kg of grain under rain fed conditions compared to 4 MJ under irrigated conditions.

Conclusion:

Total operation wise energy used was nearly double for irrigated groundnut than that of rain fed groundnut. The output-input ratio was low in irrigated groundnut indicating for planning better irrigation systems. Irrigation was the most energy intensive operation. In rain fed cultivation seedbed preparation, weeding and intercultivation, harvest and post harvest operations were found to be most energy intensive operations. Cultivation of groundnut was found to be more economical in terms of energy input under rain fed cultivation than that of irrigated cultivation.

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