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Temporal change in commercial and non-commercial energy use for rainfed sorghum in western zone of Tamil Nadu

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Abstract: Energy is critical aspect of a national development process. It is expended in agricultural operations, food processing, transportation and production of fertilizers, pesticides and farm equipments. Mechanical energy is necessary for all sorts of physical movements like soil manipulation, material input application, transportation etc. In our agriculture it is supplied by human labourers, draft animals, electric motors, diesel engines and tractors. But in earlier days it was dominated by animal power only. To assess the change in commercial and non-commercial energy use for rainfed sorghum cultivation, a study was conducted in the western zone of Tamil Nadu. Total energy utilized in the zone for rainfed sorghum cultivation was 21,76,669 GJ in 1986-87 and 11,72,986 GJ in 1997-98. The reduction in the usage of 10,03,683 GJ was mainly due to the reduction in cultivation area by 2,12,821 ha in the period. Commercial energy utilization was increased by 7.20 per cent though the area has reduced much, which is a very significant development in sorghum cultivation. *(Key words: Sorghum, Commercial energy, Non-commercial energy).*

India has been an agricultural country. Even today agriculture accounts for 25% of GDP. India attained self-sufficiency in food grain production after green revolution. Cereals like rice, wheat, sorghum and ragi are consumed largely in India. Among the cereals the sorghum is considered as poor man's food. It is considered superior to rice in terms of protein and fat contents. Starch prepared from sorghum grain is used in textile industry. Sorghum stalk is used as feeding material for cattle. The grain is used in beverage industries apart from being used for making infant food.

Development and introduction of modern agricultural technologies, supply of inputs like seeds, fertilizers and pesticides, irrigation, implements and machines increased the productivity as well as energy consumption. Studies on energy consumption pattern were carried out very little in spite of growing energy demand and depleting fossil fuel supply. This trend cannot go long forever. For the sustained agricultural production the issue of cost of production in relation to energy supply and demand has to be addressed for every crop and zone. Hence, number of studies has to be carried out periodically for crop monitoring in terms of its energy consumption pattern. In this regard a study was carried out in rainfed sorghum growing farms in the western zone of Tamil Nadu during 1986-87 and 1997-98.

Sorghum is grown in moderate rainfall areas. Even though it grows well in heavier soils, it is being grown in all types of soils. Sorghum was grown in 3,80,427 ha in 1997-98 in Tamil Nadu, while it was grown in 7,30,352 ha in 1986-87. Sorghum is being mainly grown under rainfed condition in the state and the area under this crop was 93.9 percent in 1986-87 and 85.9 percent in 1997-98 of the total Sorghum area. Total production of rainfed Sorghum was 5,61,900 tonnes in 1986-87 and 2,97,560 tonnes in 1997-98. Productivity has increased considerably from 819.4 to 910.5 kg in 11 years.

In western zone alone the crop was grown in 2.84,344 ha out of which 20,870 ha was under irrigated condition during 1997-98. However it was grown in 5,15,102 ha out of which 38,807 ha was under irrigated condition during 1986-87 (Anonymous, 1986 and 1997)

This study is aimed to provide an insight into the changing scenario of energy consumption pattern for rainfed sorghum cultivation among various categories of farms in 11 years time from 1986-87. Several sources of energy usage in terms of commercial and noncommercial energy was analysed for better policy options in the future.

Materials and Methods

In the western zone of Tamil Nadu one hundred rainfed sorghum growing farmers were

randomly selected covering all the category of farms. Energy audit was carried out on a recall basis during the years 1986-87 and 1997-98. The audit was carried out using a pre-tested questionnaire containing all the details about the farm labourers, area cultivated, inputs used, operations carried out, yield obtained etc. The collected data were converted into physical terms and analyzed. The analysis was carried out, after duly incorporating various energy equivalents given by Mittal and Dhawan in 1988. The results obtained were then grouped under commercial and non-commercial energy sources for further analysis. The commercial energy sources include fossil fuels, electricity, machineries, chemicals and fertilizers. The non-commercial energy sources include human, animal, farmyard manure and seed (Mittal and Dhawan 1988). Individual, commercial and non-commercial source-wise energy versus yield relationship is discussed after carrying out linear multiple regression analysis. Based on the results the total energy consumption for the crop in western zone during 1986-87 and 1997-98 is estimated and presented.

Results and Discussion

Consumption of commercial and non-commercial energy sources

Consumption of commercial and non-commercial energy sources of the surveyed farmers in Western zone for rain fed sorghum is presented in Table 1. From the table it is observed that the total energy consumption has reduced by nearly one percent from 4482.3 MJ ha^{-1} in 1986-87 to 4432.5 MJ ha^{-1} in 1997-98.

From the table it is observed that the commercial energy usage has increased very much by 80 per cent during 1997-98 over 1986-87. This change has emphasized the increasing dependence on commercial energy sources by all the category of farmers. The commercial energy consumption has increased to 2716.3 MJ ha^{-1} in 1997-98 from 1509.3 MJ ha^{-1} in 1986-87. However the non-commercial energy consumption has decreased to 1716.2 MJ ha^{-1} in 1997-98 from 2973.0 MJ ha^{-1} in 1986-87. This change otherwise revealed that the reduction in dependence on human, animal and farmyard manure and considerable increase in dependence on fertilizer and diesel. This increased usage of these commercial energy sources implies timely operations resulted in the increased productivity of nearly 40 percent in 1997-98.

Increase in commercial energy consumption was ranged from 735.5 MJ ha^{-1} by marginal farmers to 2386.3 MJ ha^{-1} by medium farmers in 11 years time. This clearly indicates that the higher category of farmers have the capacity to utilize these sources without any difficulties. Much change was not noticed with small category of farms in using these energy sources. It was observed that the absence of sorghum growing farmers among the large category was either due to the sub-division of land or lesser importance shown to the crop.

Higher usage of commercial energy automatically reduced the non-commercial energy consumption. The variation in non-commercial energy consumption noticed was lower in case of marginal category of farms (894.3 MJ ha^{-1}) and was higher in the case of semi-medium category of farms (1504.8 MJ ha^{-1}) during the study period. Medium category of farmers has consumed more of total energy (5548.0 MJ ha^{-1}) in 1997-98, when compared to other category of farmers. While small category of farmers has consumed more of total energy (5364.9 MJ ha^{-1}) in 1986-87, when compared to other category of farmers.

Source-wise consumption of energy

Multiple linear regression analysis was carried out for the one hundred sorghum (rainfed) growing farmers of the western zone to understand the dependability of yield in response to the use of various energy sources. The results are presented in Table 2. It could be observed from the table that human energy was significant at 5 percent level and animal energy was significant at 10 percent level and other energy sources were not significant in 1997-98.

During the year 1986-87, it was noticed that seed, fertilizers and animal sources of energy were highly significant at one percent and farmyard manure at 10 percent level. However, when all the sources of energy were added together as commercial and noncommercial energy sources,

Table 1. Category-wise commercial and non-commercial energy consumption for rainfed sorghum cultivation

Category of farm	Commercial Energy MJ ha^{-1}		Non-commercial Energy MJ ha^{-1}		Total Energy MJ ha^{-1}	
	1997-98	1986-87	1997-98	1986-87	1997-98	1986-97
Marginal	1897.8	1162.3	2113.0	3007.3	4010.8	4169.6
Small	2666.8	2438.9	1615.2	2926.0	4282.0	5364.9
Semi medium	3626.3	1518.3	1334.9	2839.7	4961.2	4358.0
Medium	3962.5	1576.2	1585.5	3002.4	5548.0	4578.6
Average	2716.3	1509.3	1716.2	2973.0	4432.5	4482.3
Yield, kg ha^{-1}					2373.0	1685.0

Anonymous, 1998.

Table 2. Source-wise linear multiple regression analysis for rainfed sorghum cultivation

Sources		1997-98			1986-87		
		Reg. co-efficient	Std. error	Sig. level	Reg. co-efficient	Std. error	Sig. level
Diesel	e_1	0.227	0.604	0.712		Not Used	
Electricity	e_2		Not Used			Not Used	
Seed	e_3	-1.614	1.433	0.258	2.295	0.705	0.003
Fertilizer	e_4	0.189	0.155	0.237	0.235	0.074	0.004
Chemicals	e_5		Not Used			Not Used	
Machinery	e_6	5.274	5.575	0.357	-0.007	0.811	0.934
Human	e_7	1.320	0.506	0.018	-0.251	0.236	0.296
Animal	e_8	1.430	0.706	0.058	1.276	0.393	0.003
Farm yard manure	e_9	-0.522	0.668	0.444	0.196	0.100	0.061
Regression Equation		$Y_1 = 0.227\ e_1 - 1.614 + 0.189\ E_4 + 5.274\ e_6 + 1.320\ e_7 + 1.430\ E_8 - 0.522\ e_9$			$Y_1 = 2.295\ e_3 + 0.235\ e_4 + 0.603\ e_5 - 0.07\ e_6 - 0.251\ e_7 + 1.276\ e_8 + 0.196\ e_9$		
R^2 Value			0.965			0.962	
Commercial Energy E_1		0.235	0.067	0.002	0.340	0.076	0.000
Non-commercial Energy, E_2		0.995	0.110	0.000	0.373	0.043	0.000
Regression Equation		$Y_2 = 0.235\ E_1 + 0.995\ E_2$			$Y_2 = 0.340\ E_1 + 0.373\ E_2$		
R^2 value			0.951			0.927	

Anonymous, 2000.

it was found out that in both the years these two sources of energy were highly significant. The regression model was fitted for both the periods and the IC value was found to be 0.965 and 0.962 in 1997-98 and 1986-87 respectively, where individual sources were considered. The 'R' value for the grouped data regression model was 0.951 and 0.927 during 1997-98 and 1986-87 respectively.

Total energy consumption for rainfed sorghum in western zone

Commercial and non-commercial energy consumption for the cultivation of rainfed sorghum in the Western zone has been estimated by multiplying the average energy consumption of each sources to the area under rainfed sorghum and the results are presented in Table 3. Total energy utilized in the zone for rainfed sorghum

Table 3. Energy Usage for Rainfed Sorghum Cultivation in Western Zone (in GJ)

S.No	Sources of Energy	1997-98 (2,63,474 ha)	1986-87 (4,76,295 ha)
	Commercial Energy		
1	Diesel	2,07,881	-
2	Fertilizer	3,88,097	4,98,681
3	Chemical 1	5,006	20,957
4	Machinery	32,144	70,968
	Total Commercial Energy	6,33,128	5,90,606
	Non-Commercial Energy		
5	Seed	87,737	1,28,600
6	Human	2,23,162	5,92,035
7	Animal	1,56,767	3,21,499
8	Farm Yard Manure	72,192	5,43,929
	Total Non-Commercial Energy	5,39,858	15,86,063
	Total energy	11,72,986	21,76,669

cultivation was 21,76,669 GJ in 1986-87 and 11,72,986 GJ in 1997-98. The reduction in the usage of 10,03,683 GJ was mainly due to the reduction in cultivation area by 2,12,821 ha in the period. The reduction in the area was mainly due to industrialization and increasing dependence on commercial energy utilization for agricultural production. Commercial energy utilization was increased by 7.20 per cent though the area has reduced much, which is a very significant development in the sorghum cultivation. More and more dependence on this energy sources automatically reduced the dependence on noncommercial energy sources. This is mainly due to reduction in the usage of human and animal energy by 3,68,873 GJ and 1,64,732 GJ respectively. Usage of farmyard manure was also reduced drastically because of reduction in the animal population and use of available manure to other commercially important crops. In order to sustain the sorghum crop cultivation, a balance must be attained between the commercial energy consumption and area cultivated.

Conclusions

Though the total energy consumption per hectare has almost remained same during the study period, an increase in the commercial energy usage up to 80 percent was observed in 1997-98, which was mainly due to more dependence on diesel and fertilizers, by all categories of farmers. The increasing dependence on commercial energy sources indirectly reduced the area under sorghum crop. A balance must be attained with regard to commercial energy usage and area cultivated for the sustained cultivation of sorghum crop. It was also noticed that majority of the individual energy sources were not significantly contributing to the yield, when grouped together as commercial and noncommercial energy sources, their effect on the yield was found to be highly significant in both the years.

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References

Anonymous. (1986). Season and crop report. Department of Economics and Statistics, Govt. of Tamil Nadu publication.

Anonymous. (1997). Season and crop report. Department of Economics and Statistics, Govt. of Tamil Nadu Publication.

Mittal, J.P. and Dhawan, K.C. (1988). Research manual on energy requirement in agricultural sector-ICAR, New Delhi.

Anonymous. (1998). Annual report of energy requirement in agricultural sector. Department of Bioenergy. College of Agricultural Engineering, Coimbatore.

Anonymous. (2000). Co-ordination committee meeting report on energy requirement in agricultural sector. Department of Bioenergy. College of Agricultural Engineering, Coimbatore.

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