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STUDY OF ENERGY REQUIREMENT FOR MAIZE CULTIVATION IN PANCHMAHAL DISTRICT OF MIDDLE GUJARAT

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ABSTRACT

Energy analysis of crop production is essential to find out the current energy requirement as well as the future demand of energy in crop cultivation. A survey was conducted through structured questionnaire to 93 randomly selected farmers in four villages (Jakhripura, Kandach, Kankanpur and Ganagata) of talukas Godhra, Khanpur and Kalol. The raw data obtained were analyzed after converting data into energy equivalents. It was concluded that fertilizer application consumed maximum operation wise energy with a value of 7010.55 MJ/ha followed by seed bed preparation with the value of 3684.72 MJ/ha. According to source wise, chemical fertilizer consumed maximum energy, about 36.09 % of total energy consumption and then after fuel energy 22.62 % of total energy consumption. The total input energy requirement for maize production in Panchmahals district 18831.07 MJ/ha. Total output energy for maize cultivation was 83894.62 MJ/ha. Energy productivity of maize in the study area was found to be 0.25 kg/MJ. The net energy return from the cultivation of maize in Panchmahal district is 65063.55 MJ/ha

INTRODUCTION

Energy is one of the most valuable inputs in crop production. Energy needed for agricultural production is about 3% of the national energy consumption in developed countries and about 5 to 6% in developing countries (Stout, 1989). Sufficient availability of the exact energy and its effective and efficient use are prerequisites for improved agricultural production and profitability. All the farming operations in crop production require energy inputs in various forms and in varying magnitude. Efficient use of energies helps to achieve increased production and productivity and contributes to the economy, profitability and competitiveness of agriculture sustainability (Ozkan *et al.*, 2004; Singh *et al.*, 2002). Although energy consumption is increasing with time, the energy use efficiency is declining constantly (Khan & Khan, 2007). Energy analysis, therefore, is necessary for efficient management of scarce resources for improved agricultural production. It would identify production practices that are economical and effective.

Thus, it is our need to carry out energy analysis of crop production system and to establish optimum energy input at different levels of productivity prevailing in the area. In this regard, a research was aimed to assess the energy analysis of major crop of the area i.e. maize with the following objectives:

1. To collect farm operations data of maize cultivation in district Panchmahal.
2. To analyze energy involved in maize production.

MATERIALS & METHODS

The study was conducted to investigate the energy and economic analysis of maize crop grown in the Panchmahal district. The information was collected from farmers of four villages (Jakharipura, Kandach, Kankanpur and Ganagata) located in three talukas of the Panchmahal district. To conduct the research, district Panchmahal was selected as study area which is one of the highest producer districts of maize in Gujarat. The district is located in semi arid region with latitude of N 22°30’ to 23°23’ and longitude of E 73°15’ to 74°75 and at 119 m above MSL.

In the present study, the survey work was carried out to randomly selected 93 farmers in the 4 villages to know the present status of consumption of various inputs by the farmers in maize production along with the fodder and grain

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yield. To do this a structured questionnaire was prepared and compiled into a survey Performa covering all the needful information required for the energy analysis of maize crop production. The surveyed area is considered under rain fed condition.

Since, the data obtained from survey was primary data; it was difficult to obtain required information regarding energy involved in crop production directly from that data. Thus, all the data related to various operations was converted into energy requirement on unit area basis for both operation wise and source wise. Energy from inputs and outputs were calculated by converting the physical units of inputs and outputs into respective energy units by using appropriate energy equivalents to find out the energy use pattern.

Total output energy produced by maize production was calculated by adding the energy equivalents to fodder as well as maize grains which were obtained by multiplying their
Quantity per unit area to energy equivalent factors.

Total output energy = Energy from Maize grains + Energy from fodder

Energy efficiency parameters

$$\text{Energy ratio} = \frac{\text{Output energy (MJ/ha)}}{\text{Input energy (MJ/ha)}}$$

Table-1 Energy Equivalents of different parameters

$$\text{Specific energy (MJ/kg)} = \frac{\text{Input energy (MJ/ha)}}{\text{Crop yield (kg/ha)}}$$

$$\text{Energy productivity (kg/MJ)} = \frac{\text{Crop yield (kg/ha)}}{\text{Input energy (MJ/ha)}}$$

Net Energy Return (MJ/ha) = Output energy (MJ/ha) – Input energy (MJ/ha)

RESULTS & DISCUSSION

Primary data regarding various field operations of maize crop cultivation was collected through survey work in 4 villages. The data were examined and converted into energy equivalents and further analyzed to know the total input energy for both source wise and operation wise along with total output energy.

Operation wise total energy consumption

Operation wise total energy consumption was highest in fertilizer application with a value of 7010.55 MJ/ha followed by seed bed preparation (3684.72 MJ/ha) and irrigation (2495.25 MJ/ha) as in Figure-1.

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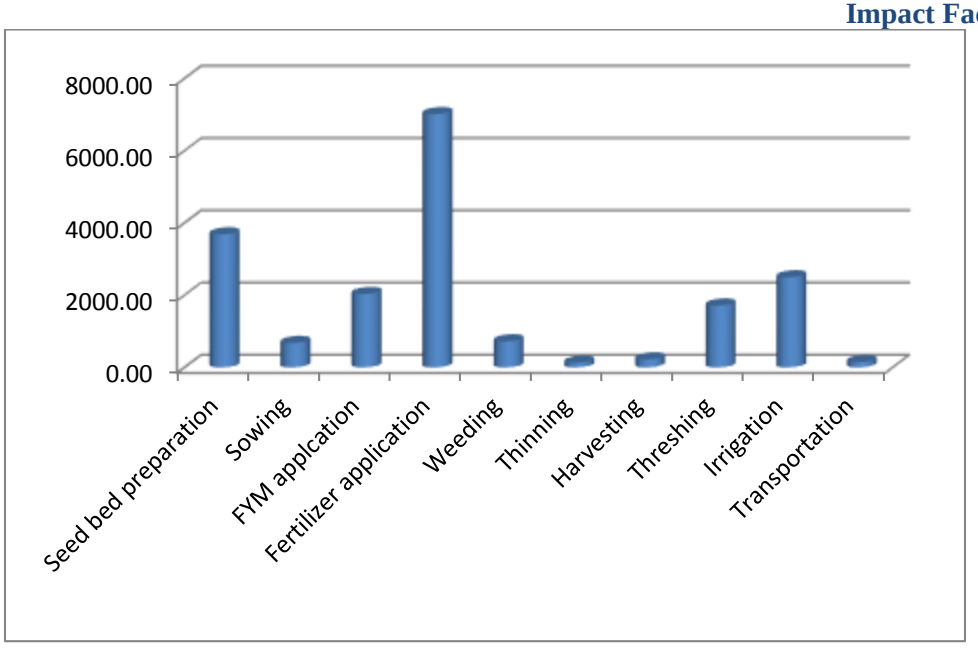

Figure-1: Operation wise total energy consumption

Total input energy

The average value of total input energy was 18831.07 MJ. Details of all sources utilized in maize production are given as follow.

Table-2 Details of source wise usage

Sources	Unit	Usage per ha	Total energy (MJ)	Percentage of total energy (%)
Human	hr	799.92	1567.83	8.33
Diesel Fuel	l	75.64	4259.13	22.62
Animal	hr	24.91	201.00	1.07
Seed	kg	23.28	342.19	1.82
FYM	kg	6485.45	1945.64	10.33
Nitrogen	kg	102.72	6225.11	33.06
Phosphate	kg	51.41	570.61	3.03
Water for Irrigation	m^3	3960.71	2495.25	13.25
Machinery	hr	18.64	1168.75	6.21
Small/stationary equipment (seed drill, sickle)	hr	547.25	55.56	0.30
TOTAL			18831.07	100.00

Total output energy

The average value of maize grain production in all the villages was 46.61 q/ha and fodder was 52.51 q/ha. Total output energy from maize production was 83894.62 MJ/ha. Out of which main produce i.e. maize contributed 68509.58 MJ/ha and rest by the fodder.

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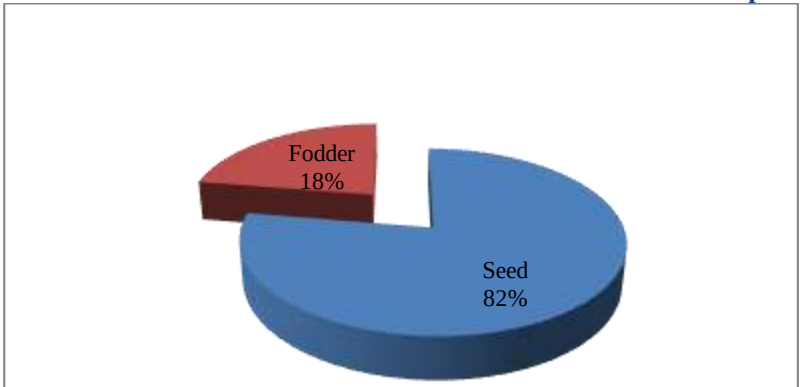

Figure- Total output energy

Energy efficiency parameters

Different energy efficiency parameters were calculated to know the usefulness of maize production in the region and to find out the relationship between input and output parameters. The values of different parameters are given in Tab1e-3.

Table-3 Different energy efficiency parameter

Parameter	Value
Energy Ratio	4.46
Specific energy	4.04 MJ/kg
Energy productivity	0.25 kg/MJ
Net Energy Return	65063.55 MJ/ha

The ratio of output to input energy for the study area was 4.46. It indicated that input energy requirement is less than the output energy from the maize production. The specific energy found to be 4.04 MJ/kg. i.e., the area under maize production requires 4.04 MJ energy for the production of one kg grain yield. Energy productivity cultivation of maize in study area found to be 0.25 kg/MJ. This indicates that one MJ of energy as inputs in various operations is required for the production of 0.25 kg of maize. The net energy return from the cultivation of maize in Panchmahal district is 65063.55 MJ/ha. This shows that there is net energy gain i.e. energy required for production is less than the energy obtained from produce.

CONCLUSIONS

Energy analysis of crop production is essential to find out the current energy requirement as well as the future demand of energy in crop cultivation. The analysis was carried and following conclusions were drawn:

- Fertilizer application consumed maximum operation wise energy with a value of 7010.55 MJ/ha.
- Among different energy sources nitrogen fertilizer energy was maximum utilized with the value of 6225.11 MJ/ha.
- The average value of total input energy requirement for maize production in Panchmahals district was 18831.07 MJ/ha
- The average value of maize grain production in all the villages was 46.61 q/ha and fodder was 52.51 q/ha.
- Total output energy for maize cultivation was 83894.62 MJ/ha. Out of which main produce i.e. maize contributed 68509.58 MJ/ha and rest by fodder.

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