International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 03 Issue: 04 | Apr-2016 www.irjet.net p-ISSN: 2395-0072

Energy Requirement for Paddy Production in Chandrapur District of Maharashtra

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Abstract – *Efficient use of the energy is important for increasing production, productivity and competitiveness of agriculture. The assessment of the energy requirements of different input and output for paddy cultivation in Chandrapur district was carried out. The results revealed that net energy, specific energy, energy efficiency, energy productivity and water productivity for paddy cultivation was found to be 84058.50 MJ/ha, 5.40 MJ/kg, 5.65%, 0.185 kg/MJ and 2.58 kg/m^3 respectively. Fertilizer (43.41%) contributed highest share of input energy. Straw (51.82%) contributed highest share of output energy. The contribution of indirect energy (73.13%) was higher than that of direct energy (26.87%). Nonrenewable energy (78.14%) shared more than renewable energy (21.86%).*

Key Words: *Paddy, Energy equivalent, energy indices, energy sources*

1. INTRODUCTION

Energy is one of the most valuable inputs in crop production. It is invested in various forms such as mechanical power (farm machines), human labour, animal draft, chemical fertilizer, pesticides, herbicides etc. The amount of energy used in agricultural production, processing and distribution should be significantly higher in order 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. It was realized that crop yields and food supplies are directly linked to energy. To achieve higher agricultural yields, more and more energy inputs like fertilizers, pesticides, tractors, threshers, tillage implements and high yielding varieties of seed are used.

Paddy is the second important crop of Maharashtra cultivated over 15.03 lakh hectares, which constituted 19.60 per cent of the total area under cereal crops (76.67 lakh hectares) with an average production of about 25.93 lakh tonnes. The average productivity of the state was 1.73 t/ha for the year 2015-16. In the Maharashtra state, paddy is grown in various districts with varying extent. Paddy is an important crop in six districts of Nagpur division (the districts of Nagpur, Gondia, Gadchiroli, Chandrapur, Bhandara and Wardha), which alone reports 50 percent of the State's paddy area. Paddy is Cultivated in Chandrapur 1.37 lakh hectares with a production of about 1.13 lakh tonnes and average productivity of 0.82 t/ha. Energy analysis is necessary for efficient management of scare resources for improved agricultural production.

2. METHODOLOGY

The studies were conducted with a view to find the energy requirement for paddy crop production at the existing level of technology. Three tehsils of Chandrapur district, Warora, Chimur and Brampuri were selected. 6 villages and 10 paddy growers were randomly selected. The survey method was used as a tool for data collection to study energy consumption pattern.

Source wise energy consumption was calculated which included all kinds of inputs e. g. power sources, (human and mechanical) fertilizers, chemicals, manures, seed, irrigation and diesel as well as output e. g. yield in terms of grain and straw. Each agricultural input was divided into direct and indirect energy sources. The direct energy sources included human labour, diesel fuel and electricity whereas indirect energy sources were seed, fertilizers, chemicals, machinery and water. On the other hand, renewable energy included human labour, manure and seed while nonrenewable energy included machinery, chemicals, fertilizers and diesel fuel. Human labours converted into energy units by multiplying the number of total human labours with working hours. The output of paddy yield in the form of grain and straw (kg/ha) was converted into energy units. The physical units of input and output energy were converted into energy units by using the respective energy equivalent. The relation between energy inflows and outflows was studied by different energy indices.

$$\text{Energy efficiency} = \frac{\text{Total energy output (MJ/ha)}}{\text{Total Energy input (MJ/ha)}}$$

$$\text{Energy productivity} = \frac{\text{Grain yield (kg/ha)}}{\text{Total energy input (MJ/ha)}}$$

Total energy input (MJ/ha)

Specific energy = -------------------------------------
Grain yield (kg/ha)

Grain yield (kg/ha)
Water productivity = --
Amount of water applied (m^3/ha)

Net energy = output energy – Input energy

3. RESULTS AND DISCUSSION

The different types of energy according to sources required for the particular operation were evaluated also the share of different types of input output energy is furnished in table 1. Total input and output energy were 18066.50 and 102125.90 MJ/ha respectively. The highest energy used in paddy production contributed to fertilizer which accounted was about 7843.85 MJ/ha (43.41%) of total input energy consumption. The mechanical energy utilization was also significant for seedbed preparation, threshing and transportation and it was 3573.9 MJ/ha (19.78%). The use of human energy (2320.64 MJ/ha) for broadcasting, transportation, spraying and harvesting was quite less than mechanical energy as machineries were adopted for various operations. There is further scope of developing matching implements and machinery suitable for animal and mechanical power use will further enhance the efficient utilization of energy and costly inputs.

Table -1: Energy Utilization for Paddy production

Sr. No.	Energy sources	Unit per ha.	Energy Coefficient (MJ/unit)	Total energy equivalent (MJ/ha)	Percent
	INPUT				
1.	Human labour (h)	1184	1.96	2320.64	12.85
2.	Machinery (h)	57	62.70	3573.9	19.78
3.	Seed (kg)	50	14.70	735	4.07
4.	Fertilizer (kg)				
	a) N	100	60.60	6060	33.54
	b) P	50	11.10	555	3.07
	c) K	50	6.70	335	1.85
5.	Manure (qtl)	2950	0.303	893.85	4.95
6.	Plant protection	1.21	199	240.79	1.33
7.	Irrigation (m^3)	1299	0.63	818.37	4.53
8.	Diesel (l)	45	56.31	2533.95	14.03
	Total energy input (MJ/ha)			**18066.50**	**100**
	OUTPUT				
1.	Main produce	3347	14.7	49200.9	48.18
2.	By product	4234	12.50	52925	51.82
	Total energy output (MJ/ha)			**102125.90**	**100**

There were two major outcomes, grain and straw. It was found that straw energy (52925 MJ/ha) was more than grain energy (49200.9 MJ/ha) due to low yield. The energy indices were calculated and given in table 2. It was found that net energy was 84058.50MJ/ha. The energy needed per kg production that is specific energy was 5.40 MJ/kg. The energy efficiency, energy productivity and water productivity were observed to be 5.65%, 0.185 kg/MJ and 2.58 kg/m^3 respectively.

Table – 2: Energy indices in Paddy production

Sr.	Energy indices	Energy
1.	Net energy (MJ/ha)	84058.50
2.	Specific energy	5.40
3.	Energy efficiency (%)	5.65
4.	Energy productivity	0.185
5.	Water productivity	2.58

Table – 3: Total energy input for paddy

Sr. no.	Type of energy	Total Energy equivalent	Percent
1.	Direct energy	4854.59	26.87
2.	Indirect energy	13211.91	73.13
3.	Renewable energy	3949.49	21.86
4.	Nonrenewable	14117.01	78.14

Energy utilized by direct, indirect, renewable and nonrenewable sources were calculated and is shown in table 3 and fig 1. It was revealed that contribution of input energy was 15.03%, whereas output energy was 84.97%. The contribution of direct energy 26.87% was less than indirect energy 73.87% also same in terms of renewable energy (21.86%) and nonrenewable energy (78.14%).

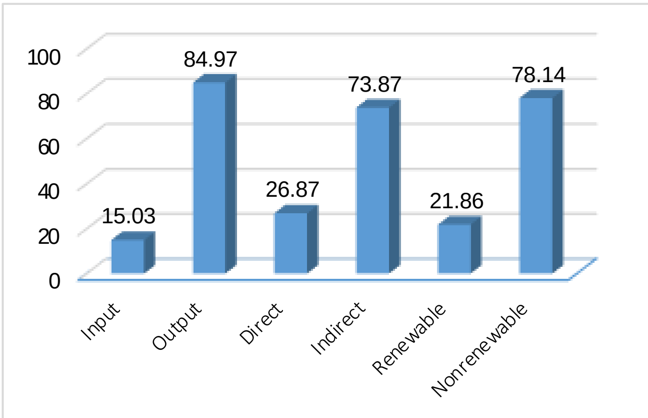

Chart – 1: Total energy contribution in paddy production

4. CONCLUSION

The paddy cultivation practices in Chandrapur district were poorly mechanized. It was due to small land holding, less availability of machinery and difficulty to use and repair of machinery. There is scope and need to moderate technologies for decreasing high amount of energy usage in paddy production, which reduce human drudgery and increase the net profit.

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