

Energy Use Pattern of Zero Budget Natural Farming in Rice Production in Visakhapatnam District of Andhra Pradesh State

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Authors' contributions

This work was carried out in collaboration between both authors. Author SS designed the study, collected data, performed statistical operations, managed literature searches, managed analysis of study and wrote first draft of the manuscript. Author KU designed the study. Both authors read and approved the final manuscript.

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ABSTRACT

The study examined the energy use pattern of zero budget natural farming (ZBNF) in rice production. Operation wise energy usage in rice production was calculated in this study. From the results, natural fertilizers and manures were found to be the dominant source of energy and the lowest is seed energy in rice production. The energy use efficiency shows 4.83 MJ per ha output energy utilised per 1 MJ ha⁻¹ input energy. The net energy was found to be 54645.75 MJ per hectare rice production in the study.

Keywords: Energy; efficiency; zero budget natural farming.

1. INTRODUCTION

Agriculture is an important sector in Indian economy and it is the energy consuming sector. India is one of the largest producers of rice in the world. During 2017-18, production of rice in India was 111.01 million tonnes. Andhra Pradesh state ranks 5th in rice production in India. During 2017-18 in Andhra Pradesh (AP), rice was cultivated in 22.18 lakh hectares and production and productivity were about 126.91 lakh tonnes and 5722 kg ha⁻¹ respectively. In AP, Visakhapatnam district has a rice production of 3.43 lakh tonnes in 109 thousand hectares.

In India, the rice is cultivated in different farming methods such as conventional farming, zero budget natural farming and organic farming. The energy use pattern for rice crop varied under different farming methods. The use of energy in crop production depends on the availability of energy sources and capacity of farmers. It was realized that crop yields and food supplies are directly linked to energy [1].

Zero Budget Natural Farming (ZBNF) is a set of farming methods, which has spread to various states in India (Food and Agriculture Organisation 2016). It has attained wide success in Southern India states like Karnataka and Andhra Pradesh. The father of ZBNF was Padma Shri awardee, Sh. Subhash Palekar (Wikipedia). The phrase zero budget refers to zero net cost of production of all crops. The inputs used for seed treatment and other inoculations are locally available in the form of cow dung, cow urine etc. ZBNF was initially launched in September 2015 under the Centre's Rastriya Krishi Vikas Yojana. Initially, 50 villages across 13 districts of AP state were selected for the pilot project. On June 2nd 2018, Government of Andhra Pradesh has officially launched ZBNF programme mandated by Rythu Sadhikara Samstha (RySS) (FAO 2019). The programme is financially assisted by Sustainable India Finance Facility (SIFF) set up

jointly by United Nations Environment Programme, the World Agro-forestry Centre and BNP Paribas. ZBNF involves the cultivation of crops using natural materials such as cow dung, cow urine, brown sugar etc. ZBNF includes fertilizers such as jeevamrutham, ghanajeevamrutham, beejamrutham etc., and biocides such as neemasthra, agniasthra, brahmastra [2].

Energy is invested in various forms such as mechanical power, human labour, animal draft, fertilizer, pesticides etc. The energy use can be varied from operation to operation in crop production. Ploughing consumed highest amount of energy which accounted to 20.58 per cent of the total energy utilized for all operations in paddy cultivation [3].

Sufficient availability of the right energy and its effective and efficient use are prerequisites for improved agricultural production.

2. MATERIALS AND METHODS

The present study was carried out in Visakhapatnam district of Andhra Pradesh state during 2017-18. A multi-stage random sampling was adopted for the selection of mandals, villages and farmers. In the first stage, two mandals namely, Anakapalle and Chodavaram were selected in Visakhapatnam district, as the farmers were practicing zero budget natural farming. In the second stage, two villages from each mandal were selected namely Dibbapalem and Venkupalem from Anakapalle mandal and Narsapuram and Lakshmiapuram from Chodavaram mandal. The selection was based on the maximum number of farmers practicing this farming method. In third stage, a total sample size of 77 respondents from a population size of 157 were selected based on Cochran's formula [4]. The respondents followed zero budget natural farming based on the proportional total.

Table 1. Sampling frame of respondents

S. no.	Mandals	Villages	Population size	Per cent to total population	Sample size	Per cent to total sample
1.	Anakapalle	Dibbapalem	43	27.38	21	27.38
		Venkupalem	45	28.66	22	28.66
2.	Chodavaram	Narsapuram	46	29.29	23	29.29
		Lakshmiapuram	23	14.64	11	14.64
Total			157		77	

Source: Primary data

Table 2. Energy equivalents of different inputs and outputs

S. no.	Energy source	Units	Energy equivalents (MJ)
A. Inputs			
1.	Human labour	h	1.96
	A. Man	h	1.57
	B. Woman		
2.	Animal labour	Pair- hour	10.10
	A. Bullocks		
3.	Machine labour	h	62.70
4.	Fertilizers	kg	66.44
	A. Nitrogen	kg	12.44
	B. Phosphorous	kg	11.15
	C. Potash	kg	1.20
	D. Sulphur		
7.	Organic fertilizers	kg	0.33
	Farmyard manure	kg	10.50
	Commercial compost	kg (seed)	15.90
	Green manure	L	2.98
	Bio- fertilizers		
8.	Chemicals	kg	238.00
	A. Herbicides	kg	199.00
	B. Pesticides	kg	92.00
	C. Fungicide		
9.	Bio- fungicide	L	10.10
	Bio- insecticides	L	21.60
10.	Seeds	Kg	14.70
B. Output			
	Rice	Kg	17.00

L= Litres, kg= Kilogram, h= hour; Source: Sefeedpari et al. (2012) [5], Bilalis et al. [6]

$$n_0 = \frac{Z^2 pq}{e^2}$$

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

Where,

n= sample population

N= Total population

Z = Critical value= 1.96

e = desired value of precision= 8%

p= 0.5, q= 1- 0.5 representing proportion of population for ZBNF and non-ZBNF farmers respectively

Inputs and output energy was calculated by converting the physical units of inputs and outputs into respective energy units by using appropriate energy equivalents presented in Table 2. to find out the energy use pattern.

Agriculture is not only a consumer of energy but also producer of energy in the form of output. The efficiency of energy can be calculated by the ratio of output energy to input energy.

Energy productivity= Rice output (Kg ha⁻¹)/ Energy input (MJ ha⁻¹)

Specific energy= Energy input (MJ ha⁻¹)/ Rice output (Kg ha⁻¹)

Net energy= Energy output (MJ ha⁻¹)- Energy input (MJ ha⁻¹)

Energy intensiveness= Energy input (MJ ha⁻¹)/ Cost of cultivation (Rs ha⁻¹)

Energy use efficiency= Energy output (MJ ha⁻¹)/ Energy input (MJ ha⁻¹)

3. RESULTS AND DISCUSSION

Energy use pattern of rice production in zero budget natural farming is presented in Table 3. The total operation- wise energy consumption in zero budget natural farming was 14260.50 MJ/ha. Among all the operations, natural fertilizers and manures (4708.55 MJ/ha.) consumed highest amount of energy followed by machinery (4518.00 MJ/ha.), human (2377.86 MJ/ha.), biocides (1566.96 MJ/ha.) and seed (1089.13 MJ/ha.). These findings are in line with the findings of Pradhan et al. [7] who reported

Table 3. Energy use pattern of rice production (MJ ha⁻¹)

Particulars	Zero budget natural farming (N= 77)	
	Energy (MJ/ha.)	Percentage
Inputs		
Human	2377.86	16.67
Machine	4518.00	31.68
Animal	-	-
Seed	1089.13	7.63
Natural fertilizers and manures	4708.55	33.01
Biocides	1566.96	10.98
Total	14260.5	100.00
Output		
Yield	68906.25	

Table 4. Energy indices for rice production

Parameter	ZBNF
Energy productivity (kg MJ ⁻¹)	0.31
Specific energy (MJ kg ⁻¹)	3.22
Net energy (MJ ha ⁻¹)	54645.75
Energy intensiveness (MJ Rs ⁻¹)	0.34
Energy use efficiency	4.83

that fertilizer consumed highest amount of energy in rice production.

preparation of fertilizer and biocides used under ZBNF.

From Table 4, in zero budget natural farming, the energy productivity was found to be 0.31 kg/MJ. That means 0.31kg grain output was obtained per unit energy. The specific energy was found to be 3.22 MJ/kg, which means, to produce one kg of grain output 3.22 MJ energy was consumed. The net energy was found to be 54645.75 MJ ha⁻¹ which is the difference between output and input energy. The energy intensiveness was found to be 0.34 MJ Rs⁻¹, measures energy inefficiency which indicates the cost of production. The energy use efficiency was found to be 4.83 which indicates total output per total input energy of rice production.

4. CONCLUSIONS

- The highest amount of energy consumption among all the operations in rice production was by natural fertilizers and manures and the lowest by seed energy.
- The energy use efficiency shows 4.83 MJ per ha output energy utilised per 1 MJ ha⁻¹ input energy and the net energy was found to be 54645.75 MJ per hectare.
- To save human energy, required inputs should be made available at village level through cooperative societies for

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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