P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development
Volume 7; Issue 3; March 2024; Page No. 421-424

Received: 08-01-2024
Accepted: 19-02-2024

Indexed Journal
Peer Reviewed Journal

Analyzing energy input and output dynamics in cotton production of Vikarabad District, Telangana

[1]CH Sravan Kumar and [2]K Sridhar

[1]Scientist, Department of Agriculture Engineering, AICRP on Farm Implements and Machinery, Rajendranagar, Hyderabad, Telangana, India

[2]Scientist, Department of Agronomy, Regional Agricultural Research Station, Palem, Telangana, India

DOI: https://doi.org/10.33545/26180723.2024.v7.i3e.444

Corresponding Author: CH Sravan Kumar

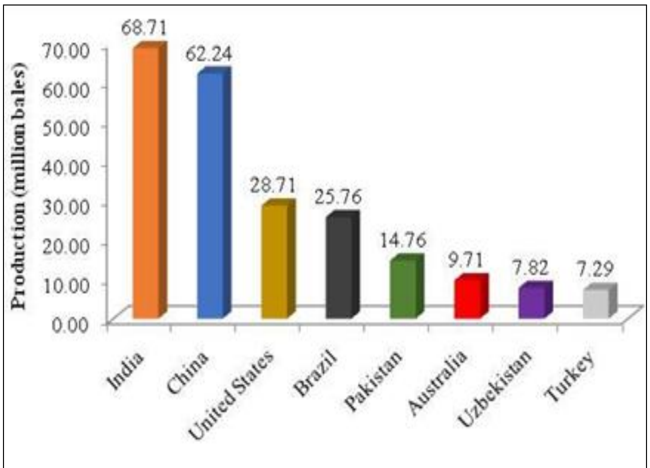
Abstract

Energy analysis (input-output) of Cotton production systems in Vikarabad district of Telangana State. Surveys conducted at the farms that cultivate Cotton in Vikarabad district, in the 2021. Sixty farms that produce Cotton were interviewed face to face**.** The results revealed that in Cotton production systems total energy input was 19289.61MJ/ha. The highest share of energy consumed was recorded for N fertilizer (31.91%) which is a nonrenewable resource. Output Energy was 32604.00 MJ/ha. Accordingly, energy efficiency (output input ratio) was 1.69, energy productivity calculated as 0.15 $KgMJ^{-1}$ and specific energy was observed as 6.5$MJKg^{-1}$, agrochemical energy ratio was 0.44% and energy intensiveness was 0.32.

Keywords: Cotton, energy use, energy productivity, specific energy, net energy

Introduction

Cotton is one of the most important fiber and a cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. Globally, the area under cotton for the year 2021-22 was 32.10 million hectares, production and productivity accounted for 257.71 million bales and 1370 kg/ha respectively. India has emerged as the largest producer of cotton in the world and occupies the first position in terms of both total area and production. Among the major cotton producing countries in the world, India occupied 1st position with 68.71 million bales (Figure 1).



Source: fas.usda.gov

Fig 1: Major cotton producing countries (2021-22)

Energy plays a pivotal role in agriculture, dating back to the era of subsistence farming. It's widely acknowledged that agricultural production correlates positively with energy input (Taheri Garavand *et al*., 2010) [15]. Reduced energy consumption in crop production translates to lower production costs, particularly in developing countries where traditional methods persist, elevating production expenses. Agriculture is a significant consumer and producer of energy. Improving energy efficiency in agricultural production involves assessing the effectiveness of methods and techniques employed. Energy usage in agriculture has surged due to population growth, dwindling arable land, and aspirations for higher living standards (Kizilaslan., 2019) [7]. The sector, like others, relies heavily on resources such as electricity, fuels, natural gas, and coke. This dependence, coupled with capital-intensive technologies, is partly fueled by relatively low energy prices compared to the resources they substitute.

Efficient energy utilization boosts production, productivity, and contributes to the economic viability and competitiveness of agriculture, especially in rural areas (Ozkan *et al*. 2007 and Singh *et al*. 2022) [11, 17] In Vikarabad district, agriculture dominates the economy, with 20 percent of the population engaged in agricultural and allied activities. The district boasts a gross cropped area of 2,61,360 hectares and 2,67,663 farm holdings.

Materials and Methods

This research was undertaken within the Vikarabad District of Telangana State, focusing on farms cultivating Cotton during the year 2021. Data for the study were gathered through face-to-face surveys conducted on sixty Cotton-producing farms in Vikarabad district. The selection of farms for the survey was determined using a simple random sampling method. The formula for this method is outlined as follows:

$$n = \frac{N \times 5^2 \quad \times}{(N-1)d^2} \frac{t^2}{+5^2 \times t^2}$$

Where,
n = the volume of sample,
s = the standard deviation,
t = the t value of the 95% confidence interval (1.96),
N = the number of farms belonging to the sampling frame and
E = the acceptable error (5% deviation)

Finally energy use efficiency, specific energy, energy productivity and net energy were determined applying standard equations (Hatirli *et al*., 2008 and Mohammad *et al*., 2010) [5, 9].

Energy use efficiency = (output energy[$MJha^{-1}$])/(input energy [$MJha^{-1}$]……………………………………… (1)

Specific energy = (input energy[$MJha^{-1}$])/(Cotton yield[$Kgha^{1}$])………………………………………..……(2)

Energy productivity=(Cotton yield[$Kgha^{-1}$])/(input energy [$MJha^{-11}$])………………………………………… (3)

Net energy= outputenergy ($MJha^{-1}$)-inputenergy ($MJha^{-1}$)…………………………………………………….... (4)

Energy intensiveness = Energy input MJ ha^{-1}/ Cost of cultivation $Rsha^{-1}$……………………………………….. (5)

Agrochemical energy ratio was calculated by applying Equations
Agrochemical energy ratio= input energy of agrochemicals ($MJha^{-1}$)/total input energy ($MJha^{-1}$)

Table 1: Energy equivalents of input and output in Cotton production systems.

Equipment /inputs	Unit	Energy equivalents	Reference
A. Inputs			
1.Human Labor	H	1.96	(Ozkan *et al*.,2004 and Yilmaz *et al*.,2005) [10, 16]
2.Machinery	h		(Erdal *et al*.,2007 and Esengun *et al*., 2007) [2, 3]
3.Diesel fuel	L	51.33	(Erdal *et al*.,2007 and Seyed *et al*., 2013) [2, 4]
4. Chemical Fertilizer	kg		
(a) Nitrogen		66.14	(Erdal *et al*.,2007 and Rafiee *et al*.,2010) [2, 12]
(b) Phosphate (P2O5)		12.44	(Erdal *et al*.,2007 and Rafiee *et al*.,2010) [2, 12]
5. FYM		0.3	(Seyed *et al*., 2013) [4]
6. Chemical		120	(Erdal *et al*.,2007 and Ozkan *et al*., 2007) [2, 11]
7.Seed	Kg	14.7	(Ozkan *et al*., 2004 and Mandal *et al*.,2002) [10, 8]
B. Output			
1. Cotton	Kg	11	(Singh 2002) [13]

Results and Discussion

The study unveiled that the average production cost per hectare of Cotton crop amounted to Rs. 60,000. Table 2 presents a breakdown of inputs utilized and outputs in Cotton production systems, along with their energy equivalents and percentages of the total energy input. Results indicated that the total energy input in Cotton production systems was 19289.61 MJ/ha. Notably, N fertilizer employed in Cotton production systems accounted for the highest share at 31.91% (see Fig. 1). Diesel fuel energy ranked second with 30.21% contribution to the total energy input. Seed, on the other hand, represented the smallest share of the total energy input at 0.07%. Additionally, the study observed a Cotton yield of 2964 kg/ha, equating to a total energy equivalent of 32604 MJ/ha. Table 3 presented the energy indicators for Cotton production systems. Notably, the energy efficiency, represented by the output-input ratio, was calculated at 1.69. The lower energy use efficiency observed in Cotton production systems can be attributed to the elevated energy inputs, particularly the consumption of N fertilizer.

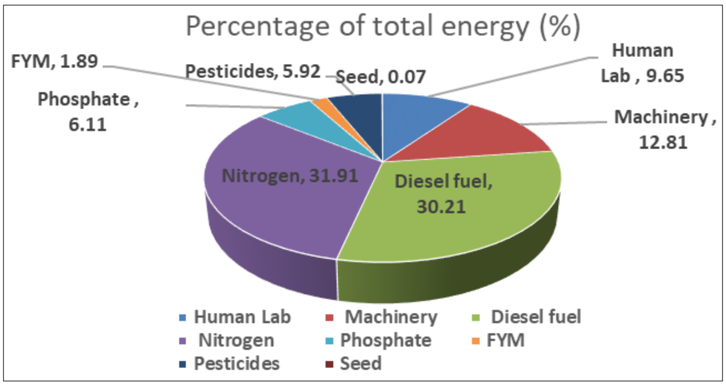


Fig 1: The share of energy inputs for Cotton production in Vikarabad District

Table 2: Energy equivalents of input and output in Cotton production systems in Vikarabad district

Quantity (input and output)	Quantity per unit area (ha)	Total energy equivalents (MJha1-)	Percentage of total energy (%)
A. Inputs			
1. Human Lab our (h)	963.3	1888.07	9.65
2. Machinery (h)	40	2508.00	12.81
3. Diesel fuel(L)	105	5912.55	30.21
4.Chemical Fertilizer(kg)			
(a) Nitrogen	252	6244.20	31.91
(b) Phosphate (P_2O_5)	94	1194.93	6.11
5.FYM	1235	370.50	1.89
6. Pesticides(kg)	9.65	1158.00	5.92
7. Seed(kg)	4	13.36	0.07
Total energy input(MJ)		19289.61	100
B. Output			
1. Cotton	2964	32604	100
Total energy output(MJ)		32604.00	100

In Cotton production systems, the energy productivity, denoting the cotton yield per energy input, was measured at 0.15 kg MJ^{-1}, while the specific energy, indicating the input energy required per unit of grain yield, stood at 6.5 MJ kg^{-1}. Put differently, for every MJ of input energy, 0.15 kg of Cotton grain was produced, or conversely, 6.5 MJ of energy was expended to yield one kilogram of grain. Furthermore, the system net energy, calculated as the output minus input, amounted to 13314.39 MJ ha^{-1}. The agrochemical energy ratio accounted for 0.44% of the input energy in Cotton production systems. Additionally, the energy intensiveness, indicating the amount of energy produced per rupee spent, was computed at 0.32 MJ Rs^{-1}, signifying that for each rupee invested, 0.32 MJ of energy could be generated.

Table 3: Indicators of energy use in Cotton production systems.

Indicators	Unit	Quantity
Inputs energy	$MJha^{-1}$	19289.61
Output energy	$MJha^{-1}$	32604.00
Cotton yield	*$Kgha^{-1}$*	2964
Energy use efficiency		1.69
Specific energy	$MJkg^{-1}$	6.5
Energy productivity	$KgMJ^{-1}$	0.15
Agrochemical Energy Ratio	%	0.44
Net energy	$MJha^{-1}$	13314.39
Energy intensiveness	$MJRs^{-1}$	0.32

Conclusion
In this study the input and output energy for Cotton production in Vikarabad District agriculture systems in of Telangana State have been investigated. That Following conclusions are drawn;
1. Total energy input and output in Cotton production systems were 19289.61 and 32604 Jha^{-1}
2. That the highest share, of input energy was reported for nitrogen fertilizer, and diesel fuel, (31.91, and 30.21%) respectively.
3. The energy use efficiency, energy productivity, specific energy, net energy of Cotton production systems were 1.69, 0.15 kg MJ^{-1}, 6.5MJ kg^{-1}, and 13314.39 $MJha^{-1}$ respectively. The energy intensiveness was 0.32 $MJRs^{-1}$

Conflict of interests: None

References
1. Demircan V, Ekinci K, Keener D, Akbolat, Ekinci. Energy and economic analysis of sweet cherry production in Turkey: a case study from Isparta province. Energy Convers Manage. 2006;47(1):1761-1769.
2. Erdal G, Esengun K, Erdal, Gunduz O. Energy use and economical analysis of sugar beet production in Tokat province of Turkey. Energy. 2007;32:35-41.
3. Esengun K, Gunduz O, Erdal G. Input-output energy analysis in dry apricot production of Turkey. Energy Convers Manage. 2007;48:592-598.
4. Tabatabaie SMH, Rafiee S, Keyhani A, Heidari MD. Energy use pattern and sensitivity analysis of energy inputs and input costs for pear production in Iran. Renew Energy. 2013;51:7-12.
5. Hatirli SA, Ozkan B, Fert C. Energy inputs and crop yield relationship in greenhouse tomato production. Renew Energy. 2008;31:427-438.
6. Khan S, Khan MA, Hanjra J, Mu. Pathways to reduce the environmental footprints of water and energy input in food production. Food Policy. 2009;34:141-149.
7. Kizilaslan H. Input-output energy analysis of cherries production in Tokat Province of Turkey. Appl Energy. 2009;86:1354-1358.
8. Mandal KG, Saha KP, Ghosh PK, Hati KM, Bandyopadhyay KK. Bioenergy and economic analysis of soybean-based crop production systems in central India. Biomass Bioenergy. 2002;23(5):337-345.
9. Mohammad A, Rafiee S, Mohtasebi SS, Rafiee H. Energy inputs-yield relationship and cost analysis of kiwifruit production in Iran. Renew Energy. 2010;35:1071-1075.
10. Ozkan B, Akcaoz H, Fert C. Energy input-output analysis in Turkish agriculture. Renew Energy. 2004;29:39-51.
11. Ozkan B, Fert C, Karadeniz CF. Energy and cost analysis for greenhouse and open field grape production and open-field grape production. Energy. 2007;32:1-4.

12. Rafiee S, Mousavi SH, Mohammadi A. Modelling and sensitivity analysis of energy inputs for apple production in Iran. Energy. 2010;35(8):3301-6.
13. Singh H, Mishra D, Nahar NM. Energy use pattern in production agriculture of a typical village in arid zone, India--part-I. Energy Convers Manag. 2002;43:2275-86.
14. Streimikiene D, Klevas V, Bubeliene J. Use of EU structural funds for sustainable energy development in new EU member states. Renew Sustain Energy Rev. 2007;116:1167-87.
15. TaheriGaravan A, Asakereh A, Haghani K. Energy elevation and economic analysis of canola production in Iran a case study: Mazandaran province. Int J Environ Sci. 2010;1(2):236-243.
16. Yilmaz I, Akcaoz H, Ozkan B. An analysis of energy use and input costs for cotton production in Turkey. Renew Energy. 2005;30(2):145-55.
17. Singh JM. On farm energy use pattern in different cropping systems in Haryana, India. Germany: Int Inst of Management, University of Flensburg, Sustainable Energy Systems and Management, Master of Science Thesis, Germany; c2002.