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Resource use efficiency in organic wheat crop in Haryana state

[1]Heena, [2]Naveen Sharma, [3]Suman, [4]DP Malik and [5]Nitin Tanwar

[1, 2, 3] Faculty of Agricultural Sciences, SGT University, Gurugram, Haryana, India

[4] Department of Agricultural Economics, CCSHAU, Hisar, Haryana, India

[5] Department of Statistics, Lady Shri Ram College for Women, University of Delhi, New Delhi, Delhi, India

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Corresponding Author: Nitin Tanwar

Abstract

This study was designed to measure resource use efficiency in organic wheat production in Haryana state. In present investigation we use the Cobb-Douglas type of production function. The sample of 120 organic farmers was selected from which input-output data collected. Functional analysis of wheat crop revealed that among the seven (7) explanatory variables the coefficients of human labour, irrigation, FYM + jeevamrit and machine labour were found to be positive with significant impact on yield of organic wheat. The coefficient of organic pesticide had negative and significant effect. However, the effect of seeds and vermi-compost were found to be non-significant on organic wheat production in Haryana. The MVP to MFC for Human labour, machine labour, irrigation, vermi-compost and FYM + Jeevamrit were positive and greater than one, indicated under-utilization of these resources in organic wheat production. For organic pesticide and seeds the ratio of MVP to MFC were less than one which indicates over-utilization of these resources in organic wheat production.

Keywords: Resource, efficiency, variables

Introduction

IFOAM provided the following definition of organic agriculture: "Sustainable soil, ecosystem, and human health are all benefits of organic agriculture. Instead of using inputs with negative impacts, it relies on biological processes, biodiversity, and cycles that are tailored to local conditions. Organic farming blends science, creativity, and tradition to benefit the environment as a whole, foster just relationships, and improve everyone's quality of life."

Organic farming is a method that, to the greatest extent possible, relies on crop rotation, crop residues, animal manures, off-farm organic waste, mineral grade rock additives, and biological systems of nutrient mobilization and plant protection instead of avoiding or largely excluding the use of synthetic inputs (Such as fertilizers, pesticides, hormones, feed additives, etc.). (USDA).

"Organic agriculture is a unique production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity," according to the FAO. This is done by using on-farm agronomic, biological, and mechanical methods in place of all synthetic off-farm inputs. "Organic agriculture is a strategy of farm design and management to build an eco-system that can attain sustainable productivity without the use of artificial external inputs like chemical fertilizers and pesticides," according to NPOP, India.

It is evident from the aforementioned definitions that, philosophically speaking, organic farming refers to "farming in spirits of organic interaction" as it is envisioned by various organizations. Everything in this system is interconnected with everything else. Since organic farming involves putting farming in an integrative relationship with all important components, the foundation of organic farming is the sum of these relationships. In the 1930s, the idea of organic farming was developed in the United Kingdom, and since the 1970s, certified organic product has been readily available. Both crop and animal production as well as processed food must adhere to organic quality requirements. Organic farming practises prioritise social justice, the environment, animal welfare, and the provision of safe food. In order to maintain soil productivity and tilth, supply plant nutrients, and control insects, weeds, and other pests, organic farming systems rely, to the greatest extent possible, on crop rotation, crop residues, animal manures, legumes, green manures, farm waste, and aspects of biological pest control (Browne *et al*., 2000) [9]. IPM and INM techniques used in organic farming include the use of bio-pesticides, bio-fertilizers, and vermicompost. Crop rotation, intercropping, and green manuring are some other aspects of organic farming (Rosset, 2000) [10]. It is also referred to as biological farming, regenerative farming, bio-dynamic farming, and low input sustainable agriculture (GOI, 2001). (GOI, 2001). A variety of economic, environmental, and social advantages are provided to developing countries by the environmentally sound and sustainable agricultural system known as organic agriculture. Due to the absence of chemicals (Because of their high cost) and the use of less expensive techniques, such as biological resources instead of chemical fertilizers and pesticides, organic farming is cost-effective for farmers. In order to protect the environment and promote sustainable agriculture, emphasis was placed during the 9th five-year plan on the development of organic production in plantation crops, spices, and condiments (GOI, 2001). The tenth five-year plan has a strong emphasis on promoting and encouraging organic farming by utilising organic waste, IPM, and INM (GOI, 2003). In India, there are numerous state and commercial organisations working to promote organic farming. These include a variety of federal and state government ministries and agencies, academic institutions and research facilities, producer groups and eco-farms like OFAI, certification agencies like Indocert and Ecocert, as well as different processors and merchants. Agri Export Zones have also been designated by the federal and state governments for the export of agricultural products generally and organic products in particular in select states. Numerous facilities and incentives are being provided to boost the production and export of organic goods in these zones. Products suitable for local production and processing have been identified. The DASP is promoting biodynamic farming, compost, vermiculture, CPP, green manuring, bio-control agents, IPM, INM, ICM, and other practises throughout Uttar Pradesh and Uttarakhand (UPDASP brochure). Beginning in Rabi 2003, the Punjab Agri Export Corporation will promote organic farming in the province. About 300 farmers enrolled with the business just a few days after it was founded to request advice on how to begin organic farming. The programme prioritises farm clusters and adjacent farms, and it requests information on the farmer's land holdings, the amount of area that is intended to be used for organic farming, and the kind of crops the farmer is interested in cultivating. Nilgiris, a South Indian retailer with 50 locations, sources organic food from local growers in Bangalore (Chengappa *et al*., 2003) [11]. Similar to this, Mumbai-based IRFT purchases organic cotton and other agricultural products to sell to domestic and international customers as part of its fair trade policy to assist the rural poor (IRFT, Mumbai, Annual Report, 2002-2003). The Government of India has started a programme similar to NPOP in 2007 to promote organic farming systematically throughout the nation in project mode in designated locations. Launched was NPOP, which attempts to create national standards for organic products based on IFOAM criteria. In addition to advocacy, networking, and consulting services, ICCOA has been proposed to gather, evaluate, document, and disseminate information and knowledge on organic farming and create capacity in individuals and institutions (Kumar, *et al*., 2003) [12]. A number of initiatives have recently been launched by PKVY to support farmers' adoption of organic farming in the nation and to provide facilities for the certification of organic goods. With 1,093,288 certified organic producers, India is the country with the most organic producers in the world, making up more than 35.11 percent of all organic producers worldwide (APEDA, 2019) However, India only accounts for 2.54% (1.80 million hectares) of the total (69.80 million ha) global coverage when it comes to the area under certified organic production. India is a major exporter of organic goods to different parts of the world. Tea, pulses, sugar, basmati rice, oilseeds (Sesame and soybean), spices, cotton, medicinal plants and herbs, processed foods, and dry fruits are the main organic items exported from India. With an expanding domestic market, India is primed for stronger growth. The expansion of India's domestic markets is essential to the success of the organic movement there. India has historically practised organic farming, but the rise of contemporary scientific, input-intensive agriculture has driven it to the breaking point. But as people's concerns about the security and quality of their food, the system's long-term viability, and mounting evidence of its equal productivity have grown, organic farming has emerged as a substitute for conventional farming that not only addresses these issues but also provides a debt-free, lucrative means of subsistence. The fact that there are more organic food outlets opening up in India is evidence of the country's rising organic food consumption. Today, every supermarket and department store in India's major cities has a section for organic foods, and each major city has a huge number of organic food shops and eateries. In contrast to affluent nations, India has a very diverse pattern of organic food consumption. Customers in India favour organic jams, strawberries, tea, honey, cashew butter, and a variety of organic flours. The Indian organic food consumer does, however, require education. Many people don't understand the distinction between natural and organic food. Many consumers buy items with the label "Natural" in the mistaken belief that it means "Organic".

The ideas of technical efficiency, allocative efficiency, and environmental efficiency may all be included under a wide definition of "resource use efficiency in agriculture." An effective farmer divides up his land, labour, water, and other resources in the best possible way to maximise his profits while maintaining a sustainable level of expenses. Numerous studies, however, demonstrate that farmers frequently make inefficient use of their resources. While some farmers may obtain the highest physical output per acre at a high expense, others make the most money from each input they utilise. By using resources wisely, all enterprising farmers should logically attempt to maximise their farm returns. However, because each farmer's resources (Both qualitatively and quantitatively) and managerial effectiveness vary greatly, so do the net returns per unit of inputs used. A farmer's ability to manage risk under fluctuating weather and economic conditions, along with his access to technology, credit, markets, and other infrastructure and policy support, would also impact how efficient his farm is.

Materials and Methods

Resource use efficiency

The production of any crop or anything else per unit of the resource applied under a specific combination of soil and climatic circumstances is known as resource use efficiency (fertiliser, water, etc.). There is efficient use of resources if inputs are employed to the point when their MVP equals their price. Mathematically,

If, $MVP = P_i$

Where,

MVP = Marginal Value Productivity

P_i = Unit price of input X_i

Any deviation of MVP of variable input X_i from its unit price, may be called as the resource use inefficiency. The higher the difference between these two, the higher is the inefficient use of resource and vice-versa.

Marginal Value Productivity

When one unit of any input is added while keeping the other inputs constant, the additional output is referred to as marginal productivity. For the Cobb-Douglas production function, the marginal value productivity (MVP) of inputs X1, X2, X6 is calculated as follows.

$$MVP_i = b_i.\overline{Y} / \overline{X}$$

Where,
b_i = Estimated regression coefficient of input X_i,
$\overline{Y}$ = Geometric mean value of output,
$\overline{X}$ = Geometric mean value of input being considered.

Production function

The most typical applications of production function analysis are to evaluate crop production efficiency and to ascertain the impact of various production parameters. For instance, the Cobb- Douglas Production Function can be applied in the manner described below:

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}$$

Where,
Y = Gross Returns (Rs/ha)
X_1 = Human Labour (Rs/ha)
X_2 = Machine labour (Rs/ha)
X_3 = Seed (Rs/ha)
X_4 = FYM+ Jeevamrit (Rs/ha)
X_5 = Vermi-compost (Rs/ha)
X_6 = Irrigation (Rs/ha)
X_7 = Organic pesticide (Rs/ha)
'a' is the constant term
b_1, b_2 ……b_6 are the estimated regression coefficients in case of organic crops

Return to scale

The variation or change in productivity that results from a proportionate increase in all the input is known as returns to scale. When the rise in output during the production process is more than the increase in input, this is known as an increasing returns to scale. For instance, a farm or economy would have enjoyed increasing returns to scale if input was increased three times while output climbed three and a half times. When the proportion of output is lower than the expected increased input during the production process, a declining returns to scale occurs. Declining returns to scale, for instance, occur when input is increased three times but output is decreased two times. The formula is used to calculate the return to scale from both organic and inorganic crops using the Cobb-Douglas production function;

$$RTS = \sum b_i$$

Where,
RTS = Return to scale
b_i = regression coefficient of i^{th} variable.

The sum of b_i's indicates the nature of return to scale.
The return to scale (RTS) is explained as.
RTS<1: Decreasing return to scale.
RTS=1: Constant return to scale.
RTS>1: Increasing return to scale.

Results and Discussion

The efficiency of resource use in production of organic wheat crop was determined by the ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) of variable inputs based on the estimated regression coefficients. The coefficients from Cobb- Douglas production function were used to determine the contribution of different factors on production and to estimate the efficiency of the variable factors of production and results are presented as follows. The resource use efficiency with respect to various explanatory variables of cost of cultivation in wheat cultivated under organic conditions is worked out. Regression analysis was done using monetary term and results are presented as follows.

Input-output relationship of organic wheat cultivation in Haryana: Regression analysis of organic wheat cultivation in Haryana is presented in Table1. All explanatory variables were regressed with dependent variables in monetary value term with gross returns attained from sale of wheat produce. The results revealed that in case of organic cultivation of wheat, among the seven (7) explanatory variables the coefficients of human labour and irrigation were found to be positive with significant impact at 1 percent level on yield of organic wheat, FYM + jeevamrit had positive and significant effect at 5 percent level and machine labour had positive and significant effect at 10 percent level on wheat yield. The coefficient of organic pesticide had negative and significant effect on organic wheat production. However, the effect of seeds and vermi-compost were found to be non-significant on organic wheat production in Haryana. The sum of elasticity coefficients with 0.911 showed decreasing return to scale. A decreasing returns to scale occurs when the proportion of output is less than the desired increased input during the production process. The value of coefficient of determination (R^2) indicates that 73.25 percent of the variation in gross income in organic wheat cultivation was explained by the seven independent variables included in the model.

Table 1: Regression coefficient and standard error of organic wheat cultivation in Haryana

Variable	Coefficients	Standard error	t-value
Constant	0.464	0.066	7.030
Machine Labour	1.658***	0.893	1.856
Human Labour	0.653*	0.073	8.945
Seed	0.015	0.022	0.688
Irrigation	0.278*	0.041	6.780
FYM + Jeevamrit	0.072**	0.036	72.001
Vermi-compost	0.167	0.216	0.795
Organic pesticide	-1.932	0.836	-2.311
Return to Scale	0.911		
	Decreasing		
R^2%	73.25		

*Significance at 1 percent level, **Significance at 5 percent level, ***Significance at 10 percent level. Figures in parenthesis represent standard error

Marginal value of productivity of different inputs used in organic wheat cultivation in Haryana

In order to examine the resource use efficiency in organic wheat in Haryana, the marginal value productivity (MVP) of various inputs was worked out for regression coefficients in the estimated wheat production function. The estimated MVP of different inputs used in organic wheat is presented in table 2. The results reveal that ratio of MVP to MFC for Human labour, machine labour, irrigation, vermi-compost and FYM + Jeevamrit were positive and greater than one, indicated under-utilization of these resources in organic wheat production. It implies that higher profit could be accrued by increasing usage level of these resources. For organic pesticide and seeds the ratio of MVP to MFC were less than one which indicates over-utilization of these resources in organic wheat production.

Table 2: Marginal value of productivity (MVP) of various inputs in organic wheat cultivation in Haryana

Inputs	Organic N=30				
	MVP	MFC	r	S.E	Efficiency
Machine Labour	3.316	1.00	3.316	0.893	Under utilized
Human Labour	1.959	1.00	1.959	0.073	Under utilized
Seed	0.045	1.00	0.045	0.022	Over utilized
Irrigation	1.834	1.00	1.834	0.041	Under utilized
FYM + Jeevamrit	1.288	1.00	1.288	0.036	Under utilized
Vermicompost	1.501	1.00	1.501	0.216	Under utilized
Organic pesticide	-1.166	1.00	-1.166	-0.006	Over utilized

*Significance at 1% level, **Significance at 5% level, ***Significance at 10% level

Conclusion

Organic agriculture, as defined by various organizations, emphasizes sustainable practices that promote soil, ecosystem, and human health. It relies on biological processes and local adaptation rather than synthetic inputs, fostering a holistic approach to farming. Organic farming, historically rooted yet increasingly relevant, offers economic, environmental, and social benefits, especially in developing countries. India, with its significant organic farming initiatives, showcases both domestic and international potential. However, challenges such as resource use inefficiencies persist, highlighting the need for continuous improvement and support. Overall, organic farming represents a promising pathway towards sustainable agriculture, addressing contemporary concerns while honoring traditional wisdom and practices.

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