Full Length Research Article

© 2026, Centre for Advanced Research in Agricultural Sciences
Research Journal of Agricultural Sciences
Volume 17; Issue 03 (May–June 2026); pp 295–298

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Resource Use Efficiency in Garlic Cultivation in Baran District of Rajasthan

Gopesh Kumari*[1], P. S. Shekhawat[2], Sheela Kharkwal[3], Sonu Jain[4], Anil Singh Rawat[5] and Priyesh Ranjan[6]

[1] Ph. D. Scholar, Department of Agricultural Economics, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner - 334 006, Rajasthan, India
[2-4] Assistant Professor, Department of Agricultural Economics, Sri Karan Narendra Agriculture University, Jobner, Jaipur - 303 329, Rajasthan, India
[5] Ph. D. Scholar, Department of Agricultural Economics, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, S. K. Nagar - 385 506, Gujarat, India
[6] Ph. D. Scholar, Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur - 492 012, Chhattisgarh, India

Received: 31 Mar 2026; Revised accepted: 12 May 2026

Abstract

Efficient utilization of production resources is essential for improving productivity and profitability in garlic cultivation. The present study was conducted in Baran district of Rajasthan to examine the resource use efficiency in garlic cultivation. Primary data were collected from 80 garlic growers during the agricultural year 2023-24 through personal interview method using a structured schedule. The collected data were analyzed using Cobb-Douglas production function and marginal value product to marginal factor cost ratio for estimating resource use efficiency of major inputs in garlic cultivation. The results revealed that the coefficient of multiple determination (R^2) was 0.41, indicating that 41 per cent variation in gross returns from garlic cultivation was explained by the selected independent variables included in the model. The regression analysis showed that fertilizer, human labour and plant protection chemicals had positive association with gross returns, whereas machine labour, seed, manure and irrigation showed negative association. Resource use efficiency analysis indicated that human labour, machine labour, seed, manure and irrigation were overutilized, whereas fertilizer and plant protection chemicals were underutilized in garlic cultivation. This implies that profitability in garlic cultivation can be improved by reducing the use of overutilized inputs and increasing the use of underutilized inputs to attain optimum resource allocation. The study concluded that rational allocation of production resources can significantly enhance efficiency and profitability of garlic cultivation in the study area.

Key words: Garlic, Resource use efficiency, Cobb-Douglas production function, Marginal value product

Agriculture stands as a cornerstone of India's economy, crucially employing a significant portion of the population and making substantial contribution to the nation's economy. Agriculture plays a key role in the Indian economy, contributing about 16 per cent to the Gross Domestic Product (GDP) and supporting nearly 46 per cent of the population [1-2]. Within agriculture, horticulture has emerged as a significant domain, offering avenues for diversification, increased income, and optimized land and water usage. This sector encompasses a wide array of crops, including fruits, vegetables, flowers, spices, and medicinal plants, nurturing opportunities for multi-layer cropping and minimizing the risk of crop failure for farmers. Notably, horticulture contributed 33 per cent to India's agricultural GDP and occupies 18 per cent of the total cropped area during 2020-21 [3].

Spices constitute an important group of horticultural crops and defined as vegetable products or mixture. Thereof, free from extraneous matter, seasoning and imparting aroma in foods used for flavoring. India is known as home of spices due to wide variety of spices like black pepper, cardamom (small and large), garlic, turmeric, and ginger a large variety of tree and seed spices. Garlic (*Allium sativum* L.) is one of the most important commercial spice crops cultivated in India due to its high economic value, wide domestic consumption and export potential [4]. It is widely used in culinary preparations, food processing and traditional medicine, which makes it an important cash crop for farmers.

India, although holds second place in area and production, but the productivity of garlic is very low due to genetic and environmental factors affecting its productivity and its related traits [5]. in India, total area under Garlic cultivation was 386.83 thousand hectares with which production of 3239.45 thousand tonnes with productivity were 8.37 tonnes per hectare during 2022-23. In India, Madhya Pradesh secured first position in term of area and production of garlic which has area of 202.20 thousand hectares with production of 2085.50 thousand tonnes in 2022-23. Rajasthan has an important position in garlic production and area but the productivity is low than other states like Madhya Pradesh, Uttar Pradesh, Punjab, Gujarat, Maharashtra [6]. In Rajasthan state, area under garlic

***Correspondence to:** Gopesh Kumari, E-mail: kgopesh301@gmail.com; Tel: +91 8079026535

Citation: Kumari G, Shekhawat PS, Kharkwal S, Jain S, Rawat AS, Ranjan P. 2026. Resource use efficiency in garlic cultivation in Baran district of Rajasthan. *Res. Jr. Agril. Sci.* 17(3): 295-298.

cultivation was 62,135 hectares with a production of 385482 tonnes with productivity of 6,203 Kg/ha during the year 2022-23. Major garlic producing districts in Rajasthan are Baran, Jhalawar, Kota, Pratapgarh, Chittorgarh, Bundi etc. Baran is the largest garlic producing district with an area of 20452 hectares with a production of 116131 tonnes and productivity of 5678 during the year 2022-23 [7]. Garlic is an input-intensive crop requiring substantial use of labour, seed, irrigation, fertilizers and plant protection chemicals. The productivity and profitability of garlic largely depend upon efficient allocation and utilization of these resources. In commercial crop cultivation, merely increasing the use of inputs does not always ensure higher returns; rather, optimum use of resources is essential for maximizing output and profit. Therefore, improving resource use efficiency has become an important concern in garlic cultivation, particularly under conditions of rising input costs and limited resource availability [8]. Resource use efficiency refers to the extent to which production inputs are optimally utilized to obtain maximum possible output. In agricultural production, efficient use of resources not only improves farm profitability but also helps in reducing wastage of costly inputs and ensures sustainable production. In the case of garlic cultivation, inefficient use of resources may increase cost of production and reduce net returns, thereby affecting the economic viability of the crop [9-12]. Hence, an assessment of resource use efficiency is essential to identify whether the available resources are being utilized optimally or not.

The application of production economics, particularly the Cobb-Douglas production function, provides a useful framework to analyze the relationship between inputs and output and to assess the efficiency of resource use in crop production. Estimation of marginal value product and comparison with marginal factor cost help in determining whether a specific input is underutilized, overutilized or efficiently utilized. Such analysis is useful for suggesting appropriate adjustments in resource allocation for improving farm efficiency and profitability. In this context, the present study was undertaken to examine the resource use efficiency in garlic cultivation in Baran district of Rajasthan. The study aims to identify the efficiency status of major production inputs and suggest suitable measures for improving resource allocation in garlic cultivation.

MATERIALS AND METHODS

Sampling design

A multistage sampling design was employed for the selection of sample respondents in the study area. In the first stage, Baran district of Rajasthan was selected purposively because it is the leading garlic-producing district in the state. In the second stage, two tehsils having the highest area under garlic cultivation were selected purposively. In the third stage, two villages from each selected tehsil were chosen on the basis of higher area under garlic cultivation. In the final stage, 80 garlic growers were selected randomly from the selected villages for detailed investigation. The selected garlic growers were classified into three farm size groups on the basis of operational land holding, namely small, medium and large farmers. This classification was made to examine variations in resource use efficiency across different farm size groups. The distribution of selected farmers was made proportionately among the selected villages and farm size categories to ensure representative sampling.

Analytical framework

Resource use efficiency

A production function was fitted to the input-output data received from the entire aggregate sample farm in order to get a sense of the resource usage efficiency in crop production as a whole. The Cobb- Douglas production type of production function was fitted [13].

Production function model:

$$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} e^u$$

Where;

Y = Gross income (rupees)

a = Constant

X_1 = Value of human labour (rupees)

X_2 = Value of machine labour (rupees)

X_3 = Value of manure (rupees)

X_4 = Value of seed (rupees)

X_5 = Value of fertilizer (rupees)

X_6 = Value of Plant protection chemicals (rupees)

X_7 = Value of Irrigation (rupees)

u = error term

b_1 to b_7 are elasticity coefficient of respective inputs.

The above function was transformed into logarithmic form for estimation:

$$\text{Log } Y = \log_a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + \log_e u$$

The marginal value product (MVP) of each input was estimated using the regression coefficient to assess the relative importance of production factors. The MVP of the i^{th} input (Xi) was calculated as:

$$\text{MVP of Xi} = \text{bi} \frac{\text{Geometric mean of Y}}{\text{Geometric mean of Xi}}$$

Where;

bi = Elasticity coefficient of i^{th} variable

Y = Gross income

Xi = i^{th} independent variable

The efficiency of resource use was estimated by comparing Marginal Value Product (MVP) of each input with its Marginal Factor Cost (MFC). The ratio was computed as:

$$r \frac{MVP}{MFC}$$

Where;

r = Efficiency ratio

MVP = Marginal value product of variable inputs

MFC = Marginal factor cost, (price per unit input)

The decision rule used for interpretation was:

If $r < 1$; resource is excessively or over utilized

If $r > 1$; resource is underutilized

If $r = 1$ resource is efficiently used

RESULTS AND DISCUSSION

Resource use efficiency in garlic cultivation

Coefficient of independent variables

Resource use efficiency in garlic cultivation was analyzed by estimating the Cobb-Douglas production function using gross returns as the dependent variable and major production inputs as independent variables. The estimated regression coefficients indicate the contribution of different inputs to gross returns from garlic cultivation. The results of the production function are presented in (Table 1).

Table 1 Estimation of the Cobb-Douglas production function in garlic cultivation in Baran district of Rajasthan

S. No.	Independent variable	Coefficient	Standard error
1.	Intercept	11.64	12.03
2.	Human Labour	0.05 NS	0.91
3.	Machine Labour	-0.0003 NS	0.07
4.	Seed	-0.09 NS	0.55
5.	Manure	-0.02 NS	0.39
6.	Fertilizer	0.34*	0.32
7.	Plant protection chemical	0.01 NS	0.17
8.	Irrigation	-0.05*	0.21
9.	F Value	7.21	
10.	Coefficient of determination (R^2)	0.41	

Note: *Indicating significant at 1 per cent level of significant, NS Indicating non-significant

Cobb-Douglas production function revealed that the coefficient of determination (R^2) was 0.41, indicating that 41 per cent variation in gross returns from garlic cultivation was explained by the selected production inputs. The F-value (7.21) showed that the overall regression model was statistically significant. Among the explanatory variables, fertilizer had a positive and significant coefficient (0.34), indicating that fertilizer use positively influenced gross returns from garlic cultivation. Human labour (0.05) and plant protection chemicals (0.01) also showed positive coefficients, suggesting their favourable contribution to output, although statistically non-significant. Similar positive influence of labour and fertilizer on crop productivity was also reported by Shelke *et al*. [14] and Karthick *et al.* [15].

The coefficients of machine labour (-0.0003), seed (-0.09), manure (-0.02) and irrigation (-0.05) were negative, indicating inverse relationship with gross returns. The negative and significant coefficient of irrigation suggests that excessive irrigation reduced returns, while negative coefficients of seed and manure indicate inefficient use of these inputs. Similar findings of input inefficiency in garlic cultivation were also reported by Ahmed *et al.* [16] and Sojitra *et al.* [17]. Overall, the results indicate that fertilizer was the most productive input, whereas seed, manure and irrigation were not efficiently utilized in garlic cultivation.

Efficiency ratio of independent variables

Based on the predicted parameters in the garlic cultivation system, the efficiency ratios ("r" values) for human labour, machinery labour, seed, manure, fertilizer plant protection chemicals and irrigation are given in (Table 2).

It is evident from (Table 2) that the marginal value product to marginal factor cost ratio (MVP / MFC), i.e., the efficiency ratio (r), was greater than unity for fertilizer (99.62) and plant protection chemicals (3.45), indicating that these inputs were underutilized in garlic cultivation. This implies that an additional expenditure of one rupee on fertilizer and plant protection chemicals would increase gross returns by ₹99.62 and ₹3.45, respectively. Therefore, increased use of these inputs would improve economic efficiency and profitability. Similar findings were also reported by Ibitoye *et al*. [18] and Ali *et al*. [19].

Table 2 Efficiency ratio in garlic cultivation in Baran district of Rajasthan

S. No.	Independent variable	Coefficient	MVP	MFC	MVP / MFC (r)	Inference
1.	Human labour (₹/ha)	0.05	0.84	1	0.84	Overutilized
2.	Machine labour (₹/ha)	-0.0003	-0.01	1	-0.01	Overutilized
3.	Manure (₹/ha)	-0.02	-2.37	1	-2.37	Overutilized
4.	Seed (₹/ha)	-0.09	-0.55	1	-0.55	Overutilized
5.	Fertilizer (₹/ha)	0.34	99.62	1	99.62	Underutilized
6.	Plant protection chemical (₹/ha)	0.01	3.45	1	3.45	Underutilized
7.	Irrigation	-0.05	-5.43	1	-5.43	Overutilized

The efficiency ratio for human labour (0.84) was less than unity, while irrigation (-5.43), manure (-2.37), seed (-0.55) and machine labour (-0.01) showed negative ratios, indicating overutilization of these inputs. This suggests that additional expenditure on these resources at the existing level would reduce returns, implying inefficient allocation and excessive use. The negative efficiency ratios clearly indicate that these inputs exerted an adverse effect on output due to their use beyond optimum levels. Hence, rational adjustment in the use of labour, irrigation, manure, seed and machine labour is necessary to improve resource use efficiency in garlic cultivation [18-19].

CONCLUSION

From the aforementioned study it could be concluded that resource use efficiency in garlic cultivation was not optimal in the study area, as farmers were not allocating production inputs in the most economical manner. The estimated Cobb-Douglas production function indicated that fertilizer, human labour and plant protection chemicals contributed positively to gross returns, whereas machine labour, seed, manure and irrigation showed negative contribution to gross returns from garlic cultivation. However, the efficiency analysis revealed that these inputs were used beyond their optimum level, indicating overutilization. In contrast, fertilizers and plant protection chemicals were found to be underutilized, suggesting scope for increasing their use to improve productivity and returns. The findings clearly indicate that garlic farmers in Baran district can improve production efficiency and profitability through better resource allocation. Rational use of labour, seed and irrigation along with adequate application of fertilizers and plant protection chemicals can help in reducing unnecessary production costs and enhancing output. Therefore, improving managerial efficiency in input use is essential for achieving optimum resource utilization and increasing profitability of garlic cultivation in the study area.

LITERATURE CITED

1. Narang S. 2025. Why 46% of India's population working in the agriculture sector contributes to only 20% of the country's GDP. *International Journal for Multidisciplinary Research* 7(3): 1-9.
2. Press Information Bureau. 2025. Agriculture contributes around 16 per cent to India's GDP and supports nearly 46 per cent population. Government of India, New Delhi.
3. Department of Agriculture and Farmers' Welfare. 2021-22. Annual report 2021-22. Ministry of Agriculture and Farmers' Welfare, Government of India, New Delhi.
4. Chhetri P, Mula G, Sarkar A, Ojha S, Mondal S. 2024. Transition in production and export potential of garlic in India. *Journal of Applied Horticulture* 26(2): 148-153.
5. Bhosle SS. 2024. Review on garlic cultivation in India: Techniques, challenges, and future prospects. *Modern Phytomorphology* 18: 133-143.
6. National Horticulture Board. 2022-23. Indian horticulture database 2022-23. Ministry of Agriculture and Farmers' Welfare, Government of India, Gurgaon.
7. Department of Horticulture. 2022-23. District-wise area and production of horticultural crops in Rajasthan. Government of Rajasthan, Jaipur.
8. Cui Y, Zhang S, Dong X, Li Q, Huang Y, Meng X, Wang Y, Ye Y. 2024. Garlic-specific fertilizer improves economic and environmental outcomes in China. *Hort Science* 59(5): 605-612.
9. Chekol F, Abetie K, Sirany T. 2023. Technical efficiency of garlic production under rain fed agriculture in Northwest Ethiopia: Stochastic frontier approach. *Cogent Economics and Finance* 11(2). https://doi.org/10.1080/23322039.2023.2242177
10. Sui F, Yang Y, Zhao S. 2022. What affects the production technology of labor-intensive agricultural industries in the context of labor aging? An empirical study based on the garlic production in Lanling. *Sustainability* 14(1): 48. https://doi.org/10.3390/su14010048
11. Ahmed B, Jobdi MS, Olukosi JO. 2011. Analysis of resource use efficiency in garlic production in Kano State, Nigeria. *Nigerian Journal of Agricultural Economics* 2(1): 79-88.
12. Sojitra HP, Ardeshna NJ. 2021. Resource use efficiency and economics of garlic cultivation in Saurashtra Region of Gujarat, India. *Int. Jr. Curr. Microbiol. Applied Science* 10(10): 444-453.
13. Cobb CW, Douglas PH. 1928. A theory of production. *American Economic Review* 18(1): 139-165.
14. Shelke RD, Aher VK, Bhosale MY, Gharge SH. 2011. Resource productivity and resource use efficiency in rabi onion production. *International Journal of Commerce and Business Management* 4(2): 342-346.
15. Karthick V, Alagumani T, Amarnath JS. 2013. Resource-use efficiency and technical efficiency of turmeric production in Tamil Nadu: A stochastic frontier approach. *Agricultural Economics Research Review* 26(1): 109-114.
16. Ahmed B, Jobdi MS, Olukosi JO. 2011. Analysis of resource use efficiency in garlic production in Kano State, Nigeria. *Nigerian Journal of Agricultural Economics* 2(1): 79-88.
17. Sojitra HP, Ardeshna NJ. 2021. Resource use efficiency and economics of garlic cultivation in Saurashtra region of Gujarat, India. *International Journal of Current Microbiology and Applied Sciences* 10(10): 444-453.
18. Ibitoye SJ, Shaibu UM, Omole B. 2015. Analysis of resource use efficiency in tomato (*Solanum lycopersicum*) production in Kogi State, Nigeria. *Asian Journal of Agricultural Extension, Economics and Sociology* 6(4): 220-229.
19. Ali Q, Ashfaq M, Khan MTQ. 2016. Resource use efficiency and return to scale analysis in off-season tomato production in Punjab. *Pakistan Journal of Applied Environmental and Biological Sciences* 7(1): 11-18.