Resource use pattern, efficiency and constraints in onion production: a special reference to Haveri district, Karnataka, India

ABSTRACT

Aim: To study and examine the resource use pattern, resource use efficiency and different production and marketing constraints faced by the onion growers in Haveri district of Karnataka.

Study design: A multistage random sampling technique was adopted for the selection of villages and sample respondents in the study area. Fifty farmers each from both Ranebennur and Haveri taluks were contacted using a random sampling procedure for the collection of data on the production of onion

Place and Duration of Study: Primary data on onion production were collected from two major onion-producing taluks *viz.*, Ranebennur and Haveri for the period 2022-23.

Methodology: Cobb-Douglas production function and Garret ranking technique were used to analyse resource use efficiency and constraints in onion production.

Results: It is that the allocative efficiency ratio exceeded unity for expenditure on plant protection chemicals (21.03) and human labour (3.60). This observation indicated an under-utilization of these resources, suggesting that enhancing their application could increase the yield. Conversely, the efficiency for seed and FYM was slightly lesser than unity and was negative for fertilizer input, suggesting the over-utilization of these resources. Under production constraints, high seed costs ranked first with a mean score of 72.5, while price fluctuation earned the highest mean score of 70.71 among marketing constraints.

KEYWORDS: Production function, Allocative efficiency,Resource use pattern, Garrett ranking technique, Constraints

INTRODUCTION

India ranks second globally in terms of onion area and production, boasting an extensive area of 15.42 lakh hectares and a production volume of 254.72 lakh tonnes during 2023-24 (Anon, 2023). Other prominent onion-producing countries include China, Nigeria, Indonesia, Bangladesh, Pakistan, Sudan, Vietnam, Egypt, and Uganda. The major onion-growing states in India are Maharashtra, Orissa, Karnataka, Uttar Pradesh, Gujarat, Bihar, and Andhra Pradesh. Maharashtra serves as the primary supplier of onions to other states in India

(Ghulghule*et al*., 2008). In onion cultivation, Karnataka secures the second position in terms of cultivation area and the fourth position in onion production.

High price variability in primary products impacts both producers and consumers, leading to spillover effects across sectors and contributing to inflation. Among agricultural products, onion prices exhibit greater volatility compared to other vegetables due to low price elasticity, income elasticity, and inherently unstable production. Market inefficiencies, stock hoarding (as reported by the Competition Commission of India in 2012), weak supply chains, and trader cartels further contribute to price fluctuations. The surge in prices began in 1998 due to reduced production caused by drought in major producing states. Simultaneously, the high international demand for Indian onions prompted the Government of India to introduce a Minimum Export Price (MEP) policy to regulate and promote onion exports(Gummagolmath*et al.,* 2020).

However, onion production fluctuates from year to year, leading to price hikes that cause discomfort among consumers. Middlemen take undue advantage of this situation, exploiting both producers and consumers (Baraker*et al.*, 2021). Despite the efforts made by extension agencies and scientists to realize the potential of onion cultivation, productivity has stagnated over time. This stagnation can be attributed to traditional cultivation practices, the prevalence of local varieties, inadequate support facilities, and significant market price fluctuations, rendering onion cultivation unprofitable. In light of these challenges, this study aims to investigate resource efficiency and constraints faced by onion farmers in the Haveri district of Karnataka

METHODOLOGY

Sampling design

The onion crop is purposively selected as per cent contribution to the area is higher among all vegetable crops in the Haveri district. Further, two leading taluks of Haveri district were selected based on the area dominance for onion, *viz.*, Haveri and Ranebennur for the period 2022-23. A multistage random sampling technique was adopted for the selection of villages and sample respondents in the study area. Fifty farmers each from both taluks were contacted using a random sampling procedure for the collection of primary data on the production of onion.

Nature and source of data

Data from the sample farmers using a pre-tested structured interview schedule through the personal interview method were collected onland holdings, livestock, farm inventory, farm assets, input use, yield,price of onion, constraints in production and marketing etc**.** The data were collected purely based on the memory of the respondents.

Resource use efficiency

Resource use efficiency in onion cultivation was studied by fitting the Cobb-Douglas type of production function to the farm-level data.

The following per-acreCobb-Douglas type of production function was specified for the estimation of production coefficients to assess the efficiency of resources [10].

$Y= a\, X_1^{b1}\, X_2^{b2}\, X_3^{b3}\, X_4^{b4} X_5^{b}{}_5\, e_u$...................... (1)

The equation (8) was converted into the logarithmic form for the estimation of the parameters.

$\ln Y= \ln a+b_1\ln X_1+b_2\ln X_2+b_3\ln X_3+b_4\ln X_4+b_5\ln X_5+u$……….(2)

Geometric mean level of inputs and output

To work out the Marginal value product (MVP) from each input, the Marginal Product (MP) and price of output (Py) were used. The MP was calculated using the production function estimates (bi) and the ratio of the Geometric Mean (GM) level of output and input. The MVP was then compared with the Marginal Factor Cost (MFC) of the respective input to estimate the efficiency of the resource used.

Allocative Efficiency

Marginal Value Product (MVP): The estimated coefficients were used to compute the MVP. By studying the marginal value product of factors of production, we can assess their relative importance. Marginal Value Product of X_i, the i^{th} input is estimated by the following formula,

$$MVP = b_i * \frac{G.M.\ (Y)}{G.\ M.\ (X_i)}$$

G.M. (Y) and G.M. (X_i) represent the geometric means of output and input respectively and b_i is the regression co- efficient of i^{th} input.

The model was estimated as follows,

r = MVP/MFC

Where, r = efficiency ratio

MVP = Marginal value product of variable input

MFC = Marginal factor cost (price per unit input)

Based on economic theory, a firm maximizes profits with regards to resource use when the ratio of the marginal return to the opportunity cost is one. The values are interpreted thus,

If AE is <1; resource is excessively used or over utilized (no scope to increase the use) hence, decreasing the quantity use of resource increases profits.

If AE > 1; resource is under used or being underutilized (there is a scope to increase the use) hence, increasing its rate of use will increase profit level.

If AE = 1; it shows the resource is efficiently used, that is optimum utilization of resource hence the point of profit maximization.

Garrett ranking technique

Garrett ranking technique was used to analyze the constraints in onion cultivation and marketing. Different authors (Prakash and Venkataramana, 2023) and (Chaithra and Shivalingaiah, 2023) have used the same tool to assess risk in maize cultivation and constraints in adopting programmes implemented under the Dharmasthala Rural Development Project.

The respondents were asked to rank (in the order of severity) the pre-listed constraints and these ranks were converted to scores by referring to Garret table.

The order of the merit given by the respondents was changed into ranks by using the formula,

$$\text{Percent position} = \frac{100(Rij - 0.50)}{Nj}$$

Where,

R_{ij}= Rank given for i^{th} item by j^{th} individual

N_j= Number of items ranked by j^{th} individual

The percentage distribution of each rank has been transformed into scores using the tables provided by Garret and Woodwarth (1969). Subsequently, the individual scores of respondents were aggregated for each factor. The sum of the scores was then divided by the total number of respondents who contributed scores. By applying this method to all factors, mean scores were obtained and used for ranking. This ranking was guided by the principle that factors, benefits, and problems with higher scores held greater significance to the farmer.

RESULTS AND DISCUSSION

Input use pattern in onion cultivation

The average input use pattern for onion cultivation across a one-acre area has been estimated and presented in Table 1. The input use pattern for onion cultivation illustrates the quantities of various resources employed. An average of 6.45 kilograms of seeds were used, alongside 35.4 man-days of human labour, one pair-day of bullock labour and two hours of machine labour. For soil enrichment, 5.25 metric tons of (FYM) were utilized. Additionally, chemical fertilizerscomprise 92.65 kilograms of urea, 52.88 kilograms of (DAP) and 50.28

kilograms of (MOP). (PPC) incur an expense of ₹ 2,349, and the amount spent on irrigation water was₹ 887.36.

Table 1: Input use pattern in onion cultivation **(per acre)**

Sl. No.	Inputs	Units	Quantity/Value
1	Seeds	kg	6.45
2	Human labour	Man-days	35.40
3	Bullock labour	Pair day	0.92
4	Machine labour	hrs.	2.00
5	FYM	tonnes	5.25
6	Urea	Kg	92.65
7	DAP	Kg	52.88
8	MOP	Kg	50.28
9	PPC	₹	2,349
10	Irrigation water	₹	887

Operation-wise labour use pattern in onion cultivation

Theaverage labouruse pattern across various stages of onion cultivation in the Haveri district has been estimated and presented in Fig 1. For land preparation, an average of 3.9 (18%) man-days oflabourers are involved. Broadcasting and sowing require 1 (3%) man-day and 1(3%)bullocklabour day, respectively, while FYM application necessitates 4.4 (11%) man-days. Chemical fertilizer application and PPC application each require 1.4 (4%) and 4 (10%) man-days, respectively. Weeding demands 7.01 (18%) man-days, and irrigation requires 2.55 (7%) man-days. The most labour-intensive operation is harvesting, which consumes 11.07 (29%) man-days. For each acre of onion cultivation, a total of 35.4 (100%) man-days, 1 bullock labour day, and 2 machine labour days are needed to complete these essential agricultural tasks.

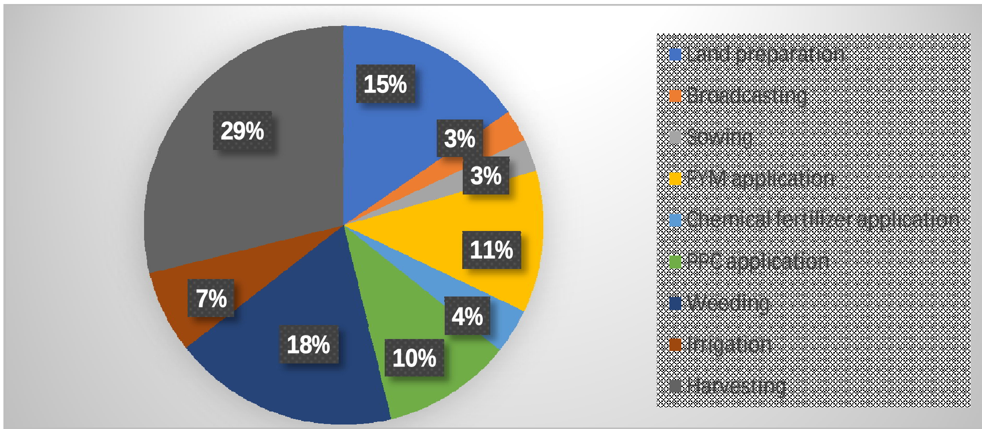

Fig.1: Operation-wise labour use pattern in onion cultivation

Resource use efficiency in onion cultivation

Production function estimates for onion cultivation

The Cobb-Douglas type of production function was used to estimate the parameters for various resources used in onion cultivation. The study revealed that the co-efficient for FYM (0.04), PPC (0.60) and human labour (0.62) were found to be positive and statistically significant indicating their positive contribution to the onion cultivation in the study area.

For every one per cent increase in FYM, the yield increased by 0.04 per cent from the geometric mean level. For every one per cent increase in PPC, the yield increased by 0.60 per cent from geometric mean level. For every one per cent increase in human labour, the yield increased by 0.62 per cent from geometric mean level. While, variables like seed (0.08), and fertilizer (-0.01) was found to be statistically non-significant(Table 2).

The coefficient of multiple determination (R^2) was 0.88, which means that the variables included in the model explained 88per cent of the variation in onioncultivation. The F-value was found to be 924.51which indicates the model was significant at a one per cent probability level. Moreover, the sum of elasticities was slightly higher than unity (1.33), indicating that onion cultivators were experiencing increasing returns to scale. This implies that if the usage of all the factors (independent variables) is increased by one per cent, the yield would increase by 1.33per cent.

Table 2: Production function estimates for onion cultivation (per acre)

Sl. No.	Particulars	Parameters	Coefficient	t value
1	No. of observations	N	100	-
2	Seed	X_1	0.08^{NS}	1.08
3	Fertilizer	X_2	-0.01^{NS}	-0.18
4	FYM	X_3	0.04^{**}	2.37

5	PPC	X_4	0.60***	4.40
6	Human labour	X_5	0.62***	5.14
7	R^2	R^2	0.88	-
8	Adjusted R^2	$\bar{R}^2$	0.87	-
9	Returns to scale	$\sum_{bi}$	1.33	-
10	F-value	924.51***		

Note: *** & ** indicates significance level at 0.01 & 0.05 level; NS: Non-significant

Resource use efficiency in onion cultivation

The study analyzed the efficiency of resources used in onion cultivation using the parameters estimated using the Cobb-Douglas type of production function and results are presented in Table 3. It could be observed from the results presented in the table that the allocative efficiency ratio exceeded unity for expenditureon plant protection chemicals (21.03) and human labour (3.60). This observation indicated an underutilization of these resources and the results found are in line with the study conducted by Bana *etal.*,2021 and Kantariya*et al.*, 2018where most of the resources were under-utilized during onion production [2][8], suggesting that enhancing their application could lead to increased yields. Conversely, the efficiency for seed and FYM was slightly lesser than unity and was negative for fertilizer inputs,suggesting the overutilization of these resources. Consequently, there was a necessity to curtail the usage of these inputs to optimize returns from onion cultivation.Thus, the hypothesis of overutilization of chemical fertilisers was accepted while the hypothesis of overutilization of other resources like human labour and plant protection chemicals was rejected as these two resources were found to be under-utilized on the sample onion farms. **Table 3: Resource use efficiency in onion cultivation**

(per acre)

Sl. No.	Particulars	bi	GM	MPP	MVP	MFC	AE
1	Seed	0.08NS	6.37	0.54	985.24	1185.75	0.83
2	Fertilizer	-0.01NS	190.50	0.00	-2.96	15.02	-0.17
3	FYM	0.04**	4.81	0.37	681.84	1600.00	0.43
4	Expenditure on PPC	0.60***	2347.56	0.01	21.03	1.00	21.03

5	Human labour	0.62^{***}	35.33	0.79	1439.91	400.00	3.60

Note: bi: Production elasticity coefficient, GM: Geometric mean, MVP: Marginal Value Product, MPP: Marginal Physical Product, MFC: Marginal Factor Cost and AE: Allocative Efficiency = MVP/MFC, NS: Non-Significant

Constraints faced by onion growers during production and marketing

Production constraints

The sample farmers were asked to rank the constraints faced during the production, finance, and marketing of onion. Notably, high seed costs rank highest with a mean score of 72.5 ranking at (I), followed by limited awareness about improved onion varieties (67.82). Scarce labour availability (57), while challenges in curing and drying techniques (46.56). The educational level of farmers (36.79), and inadequate irrigation facilities score (27.24), landing in sixth place. These constraints collectively highlight the complex challenges onion growers must navigate for successful cultivation, also the authors Kumar et al., 2020 [9] found the same line of results in the case of high seed cost as production constraints in onion cultivation in Nuh district of Haryana (Table 4).

Table 4: Production constraints faced by onion growers in the Haveri district

Sl. No.	Particulars	Garett mean score	Rank
1	High seed cost	72.5	I
2	Lack of knowledge about improved varieties	67.82	II
3	Lack of availability of labour	57	III
4	Lack of knowledge about curing and drying of onion	46.56	IV
5	Lack of awareness about scientific cultivation of onion	36.79	V
6	Inadequate irrigation facilities	27.24	VI

Marketing constraints

Onion growers face a variety of formidable marketing constraints that impact their operations. The most prominent challenge was the substantial price volatility, which earned the highest mean score of 70.71, ranking as the primary concern (I). Additionally, growers contend with insufficient remunerative pricing with a mean score of(60.5). High commission charges imposed by agents (52.15), compounding marketing complexities. Distribution (40.83)and the lack of accessible market information (24.74). Collectively, these constraints underline the intricate hurdles onion growers face within the marketing landscape. The above results conform with the findings reported by Baraker*et al.*,2021 and Shivam *et al.*, 2023[3][11] where production and marketing constraints faced by onion growers were ranked from more serious to less serious (Table 5).

Table 5:Marketing constraints faced by onion growers in the Haveri district

Sl. No.	Particulars	Garett mean score	Rank
1	High price fluctuations	70.71	I
2	Lack of remunerative price	60.5	II
3	High commission charges by commission agents	52.15	III
4	High transportation costs	40.83	IV
5	Non-availability of market information	24.74	V

CONCLUSION

Resource utilization exhibited efficiencies beyond unity for plant protection chemicals (21.03) and human labour (3.60), implying the underutilization of these resources. Conversely, seed efficiency was slightly below unity, while fertilizers and farm yard manure demonstrated efficiencies below unity, indicating overutilization.

Production-related challenges include the high cost of seeds and a lack of awareness about improved onion varieties. On the marketing front, onion growers face the dual challenges of dealing with substantial price fluctuations and a dearth of remunerative prices.

POLICY RECOMMENDATIONS

- For better resource use efficiency, there is a need to strengthenthe extension network at the grassroots level, particularly RaithaSampark Kendra (RSK)and sensitize Agro agencies to extend better technical support and facilitate the optimization of resource use in onion production through timely training activities.
- Addressing productionand marketing constraints for onion growers in the Haveri district requiresthe dissemination of new agricultural practices and enchasing existing market linkages would benefit all the stakeholders.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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