RESOURCE USE EFFICIENCY AND CONSTRAINTS IN ORGANIC Vs INORGANIC TURMERIC FARMING IN GUJARAT, India

Abstract

In organic farming MVP:MFC ratio for human labour, planting material and irrigation were -7.36, 9.82 and 43.6, respectively which indicated that human labour was over-utilized while planting material and irrigation were under-utilizedfrom the results, we can clearly see that there was ample scope of increasing organic turmeric production by decreasing the quantity of human labour and increasing the quantity of planting material and manure. In case of inorganic turmeric farming MVP:MFC ratio for human labour, planting material, fertilizer and irrigation were -6.31, 11.38, -16.67, 54.33, respectively which indicated that human labour and fertilizer were over-utilized while planting material and irrigation were under-utilized. In case of organic farmers had constrains like stem rotting in turmeric, unavailability of labour, disease management, low availability of organic manures, no alternate of FYM and farmers get low prices,there is a need for a comprehensive framework that integrates organic farming with bottom up responses, technology diffusion with reciprocal knowledge flow from farmers' institution and their local resources and innovation. While in case of inorganic turmeric farmers had constraints like labour scarcity, lack of co-operative societies, lack of technical guidance,

Key words

Organic, inorganic, turmeric, resource use efficiency

Introduction

India produces nearly the world's entire turmeric crop and consumes 80 per cent of it, with its inherent qualities and high content of the important bioactive compound curcumin, Indian turmeric is considered to be the best in the world. Erode, a city in the South Indian state of Tamil Nadu, is the world's largest producer of and the most important trading center for turmeric. It is also known as "Yellow City" "Turmeric City" or "Textile City". Sangli, a city of Maharashtra, is second only to Erode in size and importance as a production and trading site for turmeric.In India during 2019-20, about 2.54 lakh ha area was covered under turmeric (https://www.ncbi.nlm.nih.gov/books/NBK92752/).

The important turmeric growing states in India are Telangana 55,443 ha, Odisha 27,864 ha, Tamil Nadu 18,296 ha, West Bengal 17,711 ha, Karnataka 17'598 ha, Assam 16'550 ha, Maharashtra 14'511 ha and Andhra Pradesh 13,223 ha.In 2019-20 major turmeric growing districts in Gujarat are Dahod, Navsari, Surat, Panchmahal, Mahisagar*etc*. In Middle Gujarat, major turmeric producing districts were Dahod (18260 MT), Panchmahal (6627 MT), Mahisagar (6703 MT), Anand (2992 MT), Vadodara (3736 MT). https://doh.gujarat.gov.in/horticulture-census.html.

Considering these the present study was framed to compare Resource Use Efficiency and Constraints in Organic Vs Inorganic Turmeric Farming in Gujarat. Organic farming practices contribute to the conservation of biodiversity (Yadav *et al.*, 2024), reduction of greenhouse gas emissions, and overall resilience of agro-ecosystems (Baral*et al.*, 2021). Organic manures, derived from plant or animal sources, offer a holistic solution for enhancing soil fertility, improving soil structure, and promoting balanced nutrient uptake by crops (Kumar *et al.*, 2023).

Materials and Methods

The study was confined to Middle Gujarat district only.Purposive sampling technique was used to collect primary datafrom organic and inorganic turmeric farmers related to agricultural year 2020-21, from 9 districts of middle Gujarat, 4 districts were selected *i.e.,* Anand, Panchmahals, Dahod and Vadodara as they contributed around 70 per cent of turmeric production, then one taluka was directly drawn from each selected districts and from each selected taluka 2 villages were chosen. Among the villages 10 farmers was selected who grow turmeric and from that 5 farmers were selected who cultivated organic turmeric and 5 farmers were selected who cultivated inorganic turmeric, So the sample size was 80 from that 40 organic farmers were there and 40 inorganic farmers were there.

Resource Use Efficiency

Functional Analysis

Production function analysis was carried out to explore the contribution and productivity of individual inputs. The linear as well as Cobb-Douglas production functions analyses was tried to establish statistical relationship between selected inputs and gross returns of organic and conventional farming systems. Finally, the best function analysis was adopted.

The least square method was used to estimate resource-use efficiency. Before undertaking the regression analysis, zero order correlation matrixes was estimated for both the systems to test the multicollinearity amongst the input variables. The forms of linear as well as Cobb-Douglas production function to be used in the present study are as follows:

Linear: $Y = a + b_i X_i + U$

Cobb-Douglas: $Y = a.X_i^{b_i}.e^u$

Where,

Y = Gross Returns per ha

a = Intercept

X_i = Cost of independent variables (inputs) per ha

b_i = Regression coefficients of the respective variables

U/e = Random error term

The Cobb-Douglas production function was converted into log linear form and parameters (coefficients) were estimated by employing Ordinary Least Square Technique (OLS) as given below:

$$\text{Log } Y = \log a + b_i \log X_i + u \log e$$

The regression coefficients (b_i's) was tested for their significance using't' test at five percent and one percent probability levels.

$$t = \frac{b_i}{SE\ of\ b_i}$$

The overall significance of the model was also tested by using the following formula.

$$\text{F-value} = \frac{\text{Regression mean of squares}}{\text{Error mean of squares}}$$

of an input just covers its acquisition cost it is said to be used most efficiently.

Measurement of Resource use efficiency

The resource-use efficiency can be measured on the basis of marginal value productivity (MVP) and the marginal factor cost (MFC) of a particular input. To decide whether a particular input is used rationally or irrationally, its marginal value products (MVP) was computed. The MVP of a particular resource represents the additional to gross returns in value term caused by an additional one unit of that resource, while other inputs are held constant. If the MVP

The MVP is obtained by taking resources (Xi) as well as gross return (Y) at their geometric means. The formula to calculate MVP is as under.

$$MVP\ i^{th} resource = b_i \frac{\bar{y}}{\bar{x}}$$

Where,

$\bar{Y}$ = Geometric mean of the output

$\bar{x}$ = Geometric mean of ith independent variable

bi = The regression coefficient of the ith independent variable

Marginal factor cost (MFC) of the input is expressed in terms of additional money spends for providing individual input. In the present study, MFC was the average price of input used. In order to test the efficiency, the ratio MVP to the MFC for each input was computed and tested for its equality to 1 i.e., (MVPxi ÷ MFCxi) = 1. When this ratio is equal to unity indicates that the resource is efficiently used. When the ratio is more than unity implying the resource is under-utilized. When the ratio is less than unity implying the resource is over used.

Measurement of Returns to scale

The Cobb-Douglas type of production function, being a homogenous function provides a scale factor enabling one to measure the returns to scale. The estimated regression coefficients represent the production elasticity. Returns to scale was calculated by the sum of the regression coefficients of the model. If this sum is 1, then there are constant returns to scale, that is, doubling the inputs will double the output. If the sum is less than 1, there are decreasing returns to scale i.e. doubling the inputs were less than double the output. Finally, if the sum is greater than 1, there are increasing returns to scale i.e. doubling the inputs were more than double the output (Gujarati, 1995).

Constraints Faced By Farmers

Garret Ranking Technique

The Garret ranking technique was used to study the opinion of the farmers regarding the adoption of organic farming and the reason for non-adoption of the organic farming by other farmers. The per cent position of each rank was worked out by using following equation:

$$\textbf{\textit{Per cent position}} = \frac{\mathbf{100(}\boldsymbol{R_{ij}} - \mathbf{0.5)}}{\boldsymbol{N_i}}$$

Where,

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

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

The per cent position of each rank was converted into scores by referring to the table given by Garret and Woodworth (1971).

Results and Discussion

Resource Use Efficiency

Table – 1 Estimates of production function analysis of organic farmers

Sr. No	**Explanatory variables**	**Parameters**	**Organic farm**	
			Coefficients	**t-value**
	Intercept	A	-6.0566 (10.5242)	-0.5754
1	Human labour	b1	-0.1375** (0.0654)	-2.1037
2	Planting material	b2	-0.1453** (0.5831)	-2.2053
3	Tractor cost	b3	-0.3133 (0.5898)	-0.5312
4	Manure	b4	4.1844** (1.2559)	3.3317
5	Plant protection	b5	-0.9013 (5.2752)	-0.1708
6	Irrigation	b6	0.0418 (0.0877)	0.4767
7	Harvesting cost	b7	0.0316 (0.0670)	0.4718
	Coefficient of multiple determinations (R^2)		0.4989	
	F value		4.5527	
	Returns to scale Σ b_i		2.7604	

Note: Figures within the parentheses denote standard error.

* Significant at 5% level of probability **Significant at 1% level of probability

The regression coefficient for human labour was -0.1375, for manure it was 4.1844 and for planting material the regression coefficient was -0.1453. From these three variables manure showed positive as well as significant effect on gross return. Return to scale for organic farming was estimated to be 2.7604 which indicated increasing return to scale.

The ratio of MVP and MFC explains economic performance of inputs. The resource-use efficiency of significant inputs used in turmeric production in organic as well as in inorganic farms was assessed by estimating Marginal Value Productivity (MVP) and the Marginal Factor Cost (MFC). Here ratio of MVP and MFC indicates the every change in one unit of input what was the impact on output. The results are discussed below and this result is also similar with AGRESCO report, Department of Agricultural Economics,Anand Agricultural University in which they concluded that human labour, manure and irrigation charges had significant effect on production (Anonymous,2019).

Table – 2 MVP:MFC ratios on organic farms of turmeric

Sr. No.	Inputs	MVP	MFC	Organic Farms (MVP:MFC)	Remarks
1	Human labour	-7.36	1.00	-7.36	Over utilization
2	Planting material	9.82	1.00	9.82	Under utilization
3	Irrigation	43.60	1.00	43.60	Under utilization

MVP: MFC ratios were analyzed for those variables, which were found to be a significant and included in the model. In organic farming, MVP: MFC ratio of human labour was -7.36, planting material was 9.82 and irrigation was 43.60. Here, human laour was over utilization while planting material and irrigation were underutilization, we can clearly see that there was ample scope of increasing organic turmeric production by decreasing the quantity of human labour and increasing the quantity of planting material and manure.

Table – 3 Estimates of production function analysis of inorganic turmeric

Sr. No	Explanatory variables	Parameters	Inorganic farm	
			Coefficients	t-value
	Intercept	A	6.8871 (0.8247)	8.3510
1	Human labour	b1	-0.2165** (0.0700)	-3.0919
2	Tractor cost	b2	-0.2419 (0.2848)	-0.8492
3	Planting material	b3	0.1346** (0.0367)	3.6657
4	Manure cost	b4	-0.0499 (0.0348)	-1.4367
5	Fertilizer	b5	-0.0813** (0.0275)	-2.9592
6	Plant protection	b6	-0.0047	-0.1765

			(0.0268)	
7	Irrigation	b7	0.9166** (0.0671)	2.2476
8	Herbicide	b8	0.0534 (0.0309)	1.7264
9	Harvesting cost	b9	-0.0846 (0.0805)	-1.0513
	Coefficient of multiple determinations (R^2)		0.7836	
	F value		12.0678	
	Returns to scale Σb_i		0.4257	

Note: Figures within the parentheses denote standard error.
* Significant at 5% level of probability**Significant at 1% level of probability

The regression coefficient for human labour was -0.2165, for fertilizer it was -0.0813 and for planting material the regression coefficient was 0.1346 and for irrigation it was 0.9166. From these four planting material and irrigation cost showed positive as well as significant effect on gross return. Return to scale for inorganic farming was estimated to be 0.4257 which indicated constant return to scale same result was studied by Nagaraja (2011) studied carried out on coefficient of multiple determinations (R^2) indicated that 69.20 per cent and 62.10 per cent of the variation in farm income was explained by the explanatory variables and also this result was similar with AGRESCO Report, Department of Agricultural University, Anand Agricultural University (Anonymous 2019). As concluded in their report tractor charge and planting material were significant effect on production.

MVP: MFC Ratios of Inorganic Farms of Turmeric

Table – 4MVP: MFC ratios of inorganic farms of turmeric

Sr. No.	**Inputs**	**MVP**	**MFC**	**Inorganic Farms**	**Remarks**
1	Human labour	-6.31	1.00	-6.31	Over utilization
2	Panting Material	11.38	1.00	11.38	Under utilization
3	Fertilizer	-16.67	1.00	-16.67	Over utilization
4	Irrigation	54.33	1.00	54.33	Under utilization

MVP: MFC ratios for significant inputs of inorganic farming were worked out and presented in Table 4. In case of inorganic farming, MVP: MFC of human labour, planting material, fertilizer and irrigation charges were -6.31, 11.38, -16.67 and 54.33 respectively, indicated that human labour and fertilizer were overutilization while planting material and irrigation charges were underutilization, this result was similar with Tasila*et al.*(2019)and Kiruthika*et al.*(2023). They observed that MVP and MFC ratio, they observed that in case of fertilizer, weedicide, seed and farm size 0.496, -0.587, 0.144, and 4.518, respectively. From this we can be say that fertilizer, weedicide, seed were overutilization, while farm size was underutilization.

Constraints Faced by Organic and Inorganic Turmeric Farmers

Results presented in Table5 shows that stem rotting of turmeric ranked first among the major constraints faced by organic farmers followed by Unavailability of labour. Other constraints faced by organic farmers were Disease management, low availability of organic manure, No alternate of FYM, stem rotting in turmeric. These findings are also similar with Pandey and Singh (2012) and Devi *et. al.* (2020), they studied that there are a number of constraints impeding Indian farmers, especially small farm holders from adopting organic farming. Farmers' apprehension lies in non-availability of sufficient amount of organic supplements, bio-fertilizers and local market for organic produce. Additionally, lack of access to guidelines, certification and input cost coupled with capital-driven regulation by contracting firms strongly discourage small farm holders who constitute over 70 per cent of farming community in India. There is a need for a comprehensive framework that integrates organic farming with bottom up responses, technology diffusion with reciprocal knowledge flow from farmers' institution and their local resources and innovation.

Table – 5 Constraints faced by organic turmeric growers

Sr. No.	Constraints	Per cent position	Garrett Score	Rank
1	Unavailability of labour	25.00	63	2
2	Disease management	41.67	54	3
3	Low availability of organic manures	58.33	46	4
4	No alternate of FYM	75.00	37	5
5	Stem rotting in turmeric	8.33	77	1
6	Farmers get low price	91.67	23	6

Table– 6 Constraints faced by inorganic turmeric growers

Sr. No.	Reasons for adoption of organic farming	Per cent position	Garrett Score	Rank
1	Labour scarcity	16.67	69	1
2	Lack of co-operative societies	50.00	50	2
3	Lack of technical guidance	83.33	31	3

Garrett ranking technique was used to analyze the response given by farmers for an adoption of inorganic farming and outcome is presented in Table6.From this Table results revealed that labour scarcity was the main constraint for inorganic turmeric farmers followed by lack of co-operative societies and lack of technical guidance were major constraints of inorganic turmeric farming.The findings are also similar with BM, Navyashree*et al.*

(2024)and Abeynayaka*et al.*(2020), they highlights the non-availability of labor, high wage rates, insufficient storage facilities, market price fluctuations, and lack of technical guidance as the primary constraints faced by turmeric cultivators.

Conclusion

Resource use efficiencyin organic farming, the regression coefficient of human labour, planting material and manure were -0.1375, -0.1453 and 4.1844 respectively. From these total irrigation charges showed positive as well as significant effect on gross return. The R^2 value was 0.4989 which indicated that 49.89 per cent variation could be explain by these independent variables. In case of inorganic turmeric cultivation, the regression coefficient of human labour, fertilizer, planting material and irrigation were -0.2165, -0.0813, 0.1346 and 0.9166, respectively. From these, planting material and irrigation charges showed positive as well as significant effect on gross return. The R^2 value was 0.7836 which indicated that 78.36 per cent variation could be explain by these independent variables. In case of organic farming returns to scale value was 2.7604 while in case of inorganic farming returns to scale value was 0.4257. In organic farming 2.7604 indicated increasing returns to scale while inorganic farming constant returns to scale. In case of organic farming MVP:MFC ratio of human labour, planting material and irrigation was -7.36, 9.82 and 43.60. Here, human labour was overutilization, while planting material and irrigation were underutilization. In case of inorganic farming MVP:MFC ratio of human labour, planting material, fertilizer and irrigation charges were -6.31, 11.38, -16.67 and 54.33, respectively. From these human labour and fertilizer was overutilization while planting material and irrigation charges were underutilization.

In case of constraints faced by organic turmeric farmers as per the results, stem rotting in turmeric ranked first among the major constraints faced by organic farmers followed by unavailability of labour, disease management, low availability of organic manures, No alternatives of FYM, farmers got low price.In case of constraints faced by inorganic turmeric farmers as per the results, labour scarcity was the main constraint in inorganic farming followed by lack of co-operative societies, lack of technical guidance.

Suggestions

1. Optimum utilization of over utilised resource will help farmers to reduce cost.

2. To develop organic plant protection which protect organic crop from diseases and pests.

3. Special preference should be given to organic market so that farmer can get proper price.

4. Make sure that village level extension workers provide good service to each and every farmer so farmer can get proper technical guidance.

Disclaimer (Artificial intelligence)

Option 1: **NO AI technologies is been used.**

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