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Economics of Brinjal Production in South Gujarat

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Abstract

The brinjal is the major vegetable crop of South Gujarat. The present investigation was carried out to study the growth rates, cost structure, returns and resource use efficiency. The study was conducted in Surat, Navasari and Tapi districts selected on the basis of area under brinjal. A sample of 240 brinjal growers was selected with probability proportional. The CGR of area, production and productivity of brinjal were positive and significant in South Gujarat but these were non-significant in all the three selected districts except CGR of productivity in Surat district which was significant at 5 % level of significance. The analysis of CV in area, production and productivity indicated that variability was less in case of Tapi as compared to other districts. Hence, a Tapi district was more stable in growing brinjal.

Keywords: Vegetable,proportion,productivity

Agriculture has never been an important part of the Gujarat growth story over the long term. Gujarat's agriculture grew faster than Indian agriculture as a whole since 1970. Agriculture in Gujarat after 2000 seems to have picked up dramatically, recording average annual growth rate of 9.6% during 2000-2001 to 2006- 2007. The main sources of Gujarat's agricultural growth post 2000 have been the massive boom in cotton production, the growth in the high value sector comprising livestock and fruits and vegetables and the rise in wheat production. The agricultural income of farmers in Gujarat has grown fastest in the country at an annual growth rate of 13% since 2004-2005 (Gulati *et al.* 2009). Gujarat government has also pursued aggressive policies to promote diversification towards high value crops, especially fruit and vegetables. It began offering farmers direct capital subsidy of ₹ 2.5 lakh to setup green houses, besides 25% relief on electricity bills. Gujarat occupies a major place in production of vegetable crops in India. The per cent share of Gujarat in leading vegetable producing states was 6.4%. The area under vegetables in Gujarat state has gone up from 189.93 thousand ha in 1998-1999 to 515.9 thousand ha while the production of vegetable has gone up from 3255 thousand tonnes in 1998-99 to 9379.5 thousand tonnes in 2010-11. The area under brinjal in Gujarat was 72 thousand ha.

The production of brinjal was 1236.3 thousand tonnes (Anonymous, 2011-12).

The proposed investigation entitled "Economics of Brinjal Production in South Gujarat" was undertaken with following objectives:-

1. To study growth and instability in area, Production and productivity of Brinjal crop in South Gujarat.
2. To estimate cost and returns from Brinjal.
3. To examine the resources use efficiency in production of Brinjal.

Methodology

Sampling framework

The state of Gujarat comprises of 26 districts. Among these, Bharuch, Narmada, Dang, Surat, Tapi, Valsad, Navsari and Dang are covered under South Gujarat. It is known for production of variety of vegetables in the state. Therefore, South Gujarat was selected purposively for the present study. Brinjal is the major vegetable of South Gujarat. Three districts namely Surat, Tapi and Navsari were selected on the basis of the highest area under brinjal crop. A sample of 240 brinjal growers was selected with probability proportional. The farmers were classified into four groups *viz.*, upto one hectare (marginal), more than one hectare to two hectares (small), more than two hectares to four hectares (medium), and above four hectares (large) on the basis of area under vegetable crops

Collection of data: Primary as well as secondary data was collected for the proposed study. The primary data was collected by survey method adopting personal interview of the selected vegetable growers with the help of well developed questionnaire. The secondary data were collected regarding area, production and productivity of selected vegetables crops of selected districts and the state from Agricultural Co-operation department of Government of Gujarat. An attempt has been made to market the compound growth rate of area, production and productivity from 2000-2001 to 2009-2010.

Analysis of data

Growth rates

$Y_t = ab^t . U_t$ …… (i)

Where,

Y_t is area/production/productivity of brinjal crops in time period t

t is time element that takes the values 1, 2, 3,…..n

a and b are parameters to be estimated

Where,

b = (1 + r); where 'r' is compound growth rate

U_t is the error term

Thus, equation (i) can be rewritten as

$Y_t = a\ (1 + r)^t.U_t$ ..... (ii)

On logarithmic transformation of equation (ii) we get :

$\text{Log } Y_t = \log a + t \log (1 + r) + \log U_t$ ..... (iii)

The compound growth rate was obtained as

r = [(Antilog of b) – 1] × 100

The significance of the compound growth rates were tested at 5 % and 1 % level with the table value of coefficient of correlation.

CACP Cost Concept

Cost A_1 : All variable cost excluding family labour cost and including depreciation

Cost A_2 : Cost A_1 + rent paid for leased-in land

Cost B_1 : Cost A_1 + interest on owned fixed capital (excluding land)

Cost B_2 : Cost B_1 + rental value of owned land + rent for leased-in land

Cost C_1 : Cost B_1 + imputed value of family labour

Cost C_2 : Cost B_2 + imputed value of family labour

Cost C_3 : Cost C_2 + 10 % of cost C_2 as management cost.

Cost of production

$$\text{Cost of production/qt} = \frac{\text{Cost of cultivation/ha}}{\text{Quantity of main product/ha}}$$

Income measures: Following income measures were calculated –

(i) Gross income: It is the total value of main product.

$GI = (Q_m \times P_m)$

Where,

GI = Gross income

Q_m = Quantity of main product

P_m = Price of main product

(ii) Returns over variable cost (RVC):

RVC = Gross income – Cost A_1

(iii) Farm business income (FBI):

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FBI = Gross income – Cost A_2

(iv) Family labour income (FLI) or returns to family labour

FLI = Gross income – Cost B_2

(v) Net income (NI):

NI = Gross income – Cost C_2

(vi) Returns to management

RM = Gross income – Cost C_3

(vii) Returns per rupee (RPR):

$$RPR = \frac{\text{Gross income/ha}}{\text{Cost } C_2\text{/ha}}$$

Resource use pattern

The use of different inputs in production of brinjal crop on sample farms was studied. To analyse the resource use efficiency in brinjal, Cobb-Dougles production function was fitted to estimated the elasticity of production, marginal physical product and marginal value productivity. The model is as follows:

$Y = a.X_1^{b1}.X_2^{b2}.X_3^{b3}\ldots Xnbn.\ U_i$

Different variables used in the production function were as under:

Y = Output (qtl/ha)

X_1 = Quantity of Seed (kg/ha)

X_2 = Quantity of F.Y.M. (qtl/ha)

X_3 = Quantity of Nitrogen (kg/ha)

X_4 = Quantity of Phosphorus (kg/ha)

X_5 = Human Labour (Mandays/ha)

X_6 = Animal Labour (days/ha)

X_7 = Machine Labour (days/ha)

X_8 = Number of Irrigation per hectare

X_9 = Number of Sprays per hectare

a = Constant

$b_1, b_2 \ldots b_9$ = Regression Coefficients / Elasticities of production

U_t = Error term.

The regression coefficients, their significance, standard error and co-efficient of multiple determination

(R^2) were worked-out. Marginal physical product and marginal value productivity were worked out for each significant input.

Marginal physical product and marginal value productivity:

The marginal physical product of the input, used in each vegetables crop was worked out with the help of following equation

$$MPP_{xi} = bi \frac{Y}{X_i}$$

Where,

bi = Elasticity of production of i^{th} input

Y = Geometric mean of output per hectare

X_i = Geometric mean of i^{th} input per hectare

The MVP was worked out as follows:

MVPxi = MPPxi x Py

Where,

MPPxi = Marginal value of product

Py = Price of output

Results and Discussion

Growth in area, production and productivity: To study growth in area, production and productivity of brinjal in South Gujarat, Surat, Navsari and Tapi districts, the compound growth rates and instability for the period (2000-2010) were worked out which are given in Table 1. A perusal of this table shows that the annual compound growth rates (CGR) of area and production in South Gujarat were 5.34 and 7.88 %, respectively. These growth rates were found significant at 5 % level of significance. One of the notable features was the significant and positive CGR (4.45 %) of productivity in South Gujarat. The CGR of area in Surat and Navsari were -0.29 and -3.57 respectively but the decline was not statistically significant. The CGR of area in Tapi was 2.00 but the increased was non-significant. The production of brinjal registered positive growth of 3.66 % in Surat district, a negative growth in Navsari (-2.88%) of Tapi district (-1.30). However, the productivity of brinjal registered growth of 3.96 % and 0.69 percent in Surat and Navsari districts, respectively. The CGR of productivity in Surat was statistically significant while in Navsari it was not statistically significant. In Navsari, CGR of production and productivity were found negative and non-significant. In Tapi, CGRs of area, production and productivity were found non-significant.

The instability in area (18.55) and production (28.46) was noted in South Gujarat The highest instability in area (20.56) and production (23.61) was observed in Navsari district. While the lowest instability i.e. 2.11 in area and 16.51 in production were observed in Tapi district. The highest instability of productivity was observed in Tapi district (18.75) and lowest in Navsari district (5.06).

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Table 1: Compound growth rates and instability of area, production and productivity of brinjal

Growth rate	South Gujarat	Surat	Navsari	Tapi
A. Area				
CGR	5.34**	-0.29 NS	-3.57 NS	2.00NS
F-value	28.52	0.03	3.28	7.72
Instability	18.55	15.62	20.56	2.11
B. Production				
CGR	7.88**	3.66 NS	-2.88 NS	-1.30NS
F-value	21.29	3.99	1.56	2.04
Instability	28.46	20.54	23.61	16.51
B. Productivity				
CGR	4.45**	3.96*	0.69 NS	-15.01NS
F-value	22.57	9.39	1.62	2.33
Instability	16.38	17.78	5.06	18.75

* and **Significant at 5% and 1% level of significance, respectively

Cost, returns efficiency and resource use

Production is normally considered as the function of area and yield. The decision regarding the choice of crop enterprise to be taken on the farm and the allocation of area and resources under it depends to a great extent, on level of yield, price of output and the cost of inputs used in the production of that crop. The cost of cultivation and the returns to different factors of production help in decision making about the selection of crop and hence, these measures was worked out for the brinjal.

Cost structure Using different cost concepts, it is possible to find out different types of income measures. These include farm business income, which indicates returns over variable cost. The family labour income is the difference between gross income and Cost B_2 and has a lot of relevance under Indian conditions.

Cost of cultivation: The comparative estimates of different costs concepts in brinjal crop for different size groups are given in Table 2.

Table 2: Cost of cultivation of brinjal on different cost concepts basis on different size holdings (₹/hectare)

Cost	Marginal	Small	Medium	Large	Weighted Average
Cost A_1	35398	37727	60211	66571	42516
Cost A_2	35398	37727	60211	66571	42516
Cost B_1	35921	38453	61635	68586	43378
Cost B_2	44921	47453	70635	77586	52378
Cost C_1	52316	54301	62378	68586	55935
Cost C_2	61316	63301	71378	77586	64935
Cost C_3	67448	69631	78516	85345	71428

The table shows that total cost of cultivation (Cost C_3) per hectare of brinjal amounted to ₹ 67448, ₹ 69631, ₹ 78516 and ₹ 85345 on marginal, small, medium and large farm, respectively with an average of ₹ 71428. On an average, Cost A_1 and A_2 was 42516. The highest Cost A_2 was observed on large farms (₹ 66571) and the lowest on marginal farms (₹ 35398). The average of Cost B_1 and Cost B_2 were 43378 and 52378 respectively. Among different land size categories, Cost C_1 was the highest (₹ 68586) for large farms and the lowest (₹ 52316) on marginal farms with an average of 55935. Cost C_3, which includes managerial cost, was worked out to be ₹ 71428 per hectare. An increasing trend was observed in different cost concepts with increase in size of farm.

Productivity and profitability of brinjal: The productivity and gross returns on sample farms for brinjal cultivation are given in Table 3.

Table 3: Gross income per hectare from brinjal cultivation on different size holdings

Size holding	Yield (q/ha)	Gross income (₹/ha.)
Marginal	125.80	94350
Small	135.43	101573
Medium	155.60	116700
Large	170.30	127725
Weighted Average	146.78	103633

The table reveals that on the overall basis, productivity of brinjal was 146.78 quintals per hectare. The yield was the highest (170.30 quintals) on large farms, followed by medium farms (155.60 quintals), small farms (135.43 quintals) and marginal farms (125.80 quintals) which indicated that as the size of holding increased, the productivity of brinjal also increased. The gross return was increased with increase in the size of holding.

Income measures A comparison of various income measures from brinjal cultivation in South Gujarat are given in Table 4.

Table 4: Returns from cultivation of brinjal crop on sample farms. (₹/ha)

Particulars	Size holding				Weighted Average
	Marginal	Small	Medium	Large	
Gross income	94350	101573	116700	127725	103633
Returns over variable cost	58952	63846	56489	61154	61117
Farm business income	58952	63846	56489	61154	61117
Family labour income	49429	54120	46065	50139	51255
Net income	33034	38272	45322	50139	38699
Returns to Mgt.	26902	31942	38184	42380	32205
Returns per rupee	1.54	1.60	1.63	1.65	1.59

It is evident from the table that on an overall basis, gross income per hectare of brinjal cultivation was ₹ 103633. It varied between ₹ 94350 to ₹ 127725 per hectare on different farm size holdings. The gross income per hectare of brinjal cultivation was the highest on large farms as compared to medium, small and marginal farms mainly because of higher productivity of large farms.

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Farm business income represents returns over variable cost. On an average, the farm business income from brinjal cultivation was worked out to be ₹ 61117 per hectare. Among different farm size holdings, it varied between ₹ 56489 on medium farms to ₹ 63846 on small farms. The family labour income per hectare of brinjal cultivation varied from ₹ 46065 on medium farms to ₹ 54120 on small farms. On an overall basis, family labour income was worked out to be ₹ 51255 per hectare. The family labour income per hectare was relatively less on medium farms as cost B2 was much higher on these farms due to higher use of casually hired labour and lesser use of family labour.

Net income implies profit per hectare after deducting cost C_3 from gross income. The overall net income from brinjal cultivation was ₹ 32205 per hectare. Among different size groups, it varied between ₹ 26902 to ₹ 42380 per hectare on different farm size holdings. The overall returns to management from brinjal cultivation were ₹ 32205 per hectare. Among different size farm groups, it varied between 26902 to 42380 on different land size holdings.

It is evident from Table 5 that on an overall basis, returns from the cost A_1, A_2, B_1, B_2, C_1, C_2 and C_3 were ₹ 61117, ₹ 61117, ₹ 60255, ₹ 51255, ₹ 47699, ₹ 38699 and ₹ 32205 per hectare of brinjal cultivation, respectively.

Table 5: Net returns per hectare from brinjal cultivation on different cost concepts (₹)

Cost	Marginal	Small	Medium	Large	Average
Cost A_1	58952	63846	56489	61154	61117
Cost A_2	58952	63846	56489	61154	61117
Cost B_1	58429	63120	55065	59139	60255
Cost B_2	49429	54120	46065	50139	51255
Cost C_1	42034	47272	54322	59139	47699
Cost C_2	33034	38272	45322	50139	38699
Cost C_3	26902	31942	38184	42380	32205

Cost of production per quintal

The cost of production of brinjal across different land size categories is given in Table 6. It reveals that on an average ₹ 517.85 was spent on producing a quintal of brinjal on Cost C_3 basis. The cost of production on Cost C_3 basis was ₹ 517.85, while on Cost A_1, Cost A_2, Cost B_1, Cost B_2, basis, it was ₹ 303.96, ₹ 303.96, ₹ 310.00 and ₹ 375.62, respectively. The C_2 cost of production was found the highest on marginal farms (₹ 487.41) followed by small farms (₹ 467.40), medium farms (₹ 458.73) and large farms (₹ 455.58) per quintal. The C_2 cost of production (₹ 536.15) on marginal farms was found the higher. This indicates that large farms are more efficient as compared to marginal, small and medium farms in utilizing their resources.

Table 6: Cost of production per quintal of brinjal on different size holdings (₹/Qtl.)

Cost	Marginal	Small	Medium	Large	Average
Cost A_1	281.38	278.57	386.96	390.90	303.96
Cost A_2	281.38	278.57	386.96	390.90	303.96
Cost B_1	285.54	283.93	396.11	402.74	310.00
Cost B_2	357.08	350.39	453.95	455.58	375.63
Cost C_1	415.87	400.95	400.89	402.74	405.15
Cost C_2	487.41	467.41	458.73	455.58	470.77
Cost C_3	536.15	514.15	504.60	501.15	517.85

Returns per rupee of investment

Return per rupee investment is one of the effective methods to measure the economic feasibility of any crop. The details are presented for brinjal cultivation in Table 7.

Table 7: Returns per rupee of investment in brinjal cultivation

Cost	Marginal	Small	Medium	Large	Average
Cost A_1	2.67	2.69	1.94	1.92	2.51
Cost A_2	2.67	2.69	1.94	1.92	2.51
Cost B_1	2.63	2.64	1.89	1.86	2.47
Cost B_2	2.10	2.14	1.65	1.65	2.02
Cost C_1	1.80	1.87	1.87	1.86	1.85
Cost C_2	1.54	1.60	1.63	1.65	1.59
Cost C_3	1.40	1.46	1.49	1.50	1.45

It is evident from the Table 7 that on an average, the returns per rupee of investment on cost A_1, A_2, B_1, B_2, C_1, C_2 and C_3 were ₹ 2.51, ₹ 2.51, ₹ 2.47, 2.02, ₹ 1.85, ₹ 1.59 and ₹ 1.45, respectively. The returns per rupee of investment on large farms on cost C_3 basis were the highest (₹ 1.50) followed by medium farms (₹ 1.49) small farms (₹ 1.46) and marginal farms (₹ 1.40).This showed that large farms were more efficient than medium, small and marginal farms mainly because of lower cost per unit of output

Resource use efficiency Linear and Cobb-Douglas production functions were used for the purpose of production function analysis. Cob-Douglas function was found to be the best fit because of high R^2 value and the results of which are presented in Table 8.

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Table 8: Regression coefficient of different production variables and their significance in cultivation of brinjal

Input Variable	Regression coefficient	Standard error	t - value	R^2
Seed (g)	0.310	0.235	1.32	0.838
FYM (tones)	0.298**	0.061	4.92	
Nitrogen (kg)	0.03360	0.041	0.08	
Phosphorus (kg)	0.03558	0.032	1.12	
Human labour (man days)	0.225**	0.850	2.64	
Bullock labours (days)	-0.03814	0.008	-0.50	
Machine labours (hours)	0.08708**	0.027	3.22	
Irrigations (No.)	0.09824**	0.037	2.67	
Insecticides sprays (No.)	0.430**	0.19	2.26	
Weeding (No.)	0.02826	0.018	1.59	

** Significant at 5% level of significance

The value of R^2 (coefficient of multiple determination) shows that 83.8 % of the variation in the yield of brinjal was explained by variables included in the model. However, only FYM, human labour, machine labour, irrigation and spray pesticides variables were found statistically significant.

Marginal value product in relation to input expenditure

The basic criterion of an efficient resource use is that as long as $MVP_{Xi} > P_{Xi}$, the farmer can increase input use till $MVP_{Xi} = P_{Xi}$. Hence, for evaluating the efficiency of resource use, the marginal value products of different factors and the factor prices were compared. For examining the resource use efficiency, the marginal value products of those inputs which were statistically significant, were worked out. The estimated marginal value products (MVP) and marginal physical products are presented in Table 9.

Table 9: G. M., MPP and MVP of different inputs for brinjal

	G M	MPPxi	MVPxi (₹)	MVPxi/Pxi
Yield (kg)	146.78			
FYM (qtls)	17.4	2.51	1882.5	4.18
Human labour (No.)	305.5	0.11	82.5	1.03
Machine labour (No.)	9.7	1.32	990	4.13
Irrigations	9.2	1.57	1177.5	2.62
Sprays (No.)	13.2	4.78	3585	2.99

G.M.= Geometric mean, MPP= Marginal physical product, MVP= Marginal value product

Marginal value product

Additional rupee invested in FYM, human labour, machine labour, irrigations and pesticides sprays brings additional returns to ₹ 4.18, ₹ 1.03, ₹ 4.13, ₹ 2.62 and ₹ 2.99. This indicates that these resources can be used further till their MVPxi = Pxi.

Policy Implications

On the basis of the results obtained in the present study, the following suggestions can be given to the policy makers:

1. The cultivators of brinjal had lack of scientific knowledge about cultivation practices and efficient use of productive resources. Therefore, it is important to impart technological knowhow at doorstep through extension workers and Vegetable Research Stations organizing field days.
2. The production and productivity levels have to be improved in the study area to increase the availability as well as to reduce per unit cost of production. This can be achieved by rational allocation of scarce resources by the vegetable growers.

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