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Resource use efficiency and economics of onion cultivation in Bhavnagar district of Gujarat

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Abstract

The present investigation was undertaken with a view to study the cost & returns and resource use efficiency of onion in Bhavnagar district of Gujarat as it has the largest share in onion cultivation in the Saurashtra region of Gujarat state with a random sample of 120 respondents. The results indicated that the average total cost of cultivation per hectare of onion farms was Rs. 158678 which was the highest on large farms and the lowest on marginal farms by on an average, Cost-A (paid out cost) formed 69.18 percent of total cost, while Cost-B accounted for 82.42 percent of total cost. The average yield of onion per hectare was 299.56 quintal on sample farms which lead to give Rs. 182280, Rs. 78219, Rs. 52590 and Rs. 64743 as gross income, farm business income, family labour income and farm investment income, respectively to selected onion growers. The average cost of production (Cost-C₂) was Rs. 529.65 per quintal which was the highest on small farms, followed by medium farms, large farms and marginal category of farms. The variables of manures & cakes, irrigation charges and plant protection chemicals found to have significant influence on the gross income. The sum of the elasticities was less than one indicating diminishing returns to scale. The ratio of MVP to factor cost in case of all farms found to be greater than one for manures & cakes, irrigation, plant protection chemicals and fertilizer indicating that still there exists a scope for higher utilization of these inputs in order to increase the gross income. There is need to put more efforts to train the farmers regarding the use of pest and disease resistant varieties and creating awareness among the farmers regarding the efficient utilization of underutilized resources are some of the suggestions emerge from the study.

Keywords Onion, cost-returns, profitability, resource use efficiency

Introduction

Onion is one of the important horticultural crop enhance farmers' economy with the pace of agricultural development in Indian economy. It is grown mainly for its bulb, which is used in every home as a constituent of meal. In India, onion occupied 13.06 lakh hectares area under cultivation with production of about 224.27 lakh metric tonnes in 2016-17 (Anon., 2017_a)^[3]. Moreover, area, production and yield of onion crop grown considerably in India during last decade but it found quite unstable due to fluctuation in prices and several other factors. Gujarat is the leading onion producing state in India with the highest productivity of 26.54 tonnes/ha in year 2016-17. The area and production of onion was about 0.51 lakh hectares and 12.90 lakh tonnes, respectively during the year 2016-17 in Gujarat (Anon., 2017_b)^[3]. It is also reported that the annual area, production and productivity of onion increased at the rate of 6.50, 9.96 and 0.68 percent, respectively in Gujarat during 1990-91 to 2006-07 (Ardeshta and Shiyani, 2014)^[4]. It is also noteworthy that Saurashtra region alone contributes area of 0.48 lakh hectares in onion cultivation and 12.19 lakh tonnes of onion production in year 2016-17. The Bhavnagar districts of Saurashtra region alone contribute 67.82 percent in terms of area and 69.88 percent in terms of production of onion during the year 2016-17 (Anon., 2017_b)^[3]. Keeping all this in view, the present study was undertaken to work out the cost of production and input-output ratio, to estimate different profitability measures and to analyze the resource use efficiency of onion growers in Bhavnagar district of Gujarat state.

Methodology

Bhavnagar district was selected purposively, as it collectively covers 67.82 percent area of onion cultivation with 69.88 percent share in production of onion in the state in the year 2016-17. Mahuva and Talaja talukas of Bhavnagr district were selected on the basis of its largest share in onion cultivation in the district. Three villages of Mahuva taluka namely Kumbhan, Tared and Kalsar, while three villages from Talaja taluka namely Dihor, Zanjmer and Thaliya were selected on the basis of concentration of area under onion cultivation. A proportional sample of 120 respondents comprises of 20 respondents from each of the selected villages was selected for study. They are classified in to four different farm size groups *viz.*, Marginal (up to

1.00 hectare), Small (>1.00 to 2.00 hectares), Medium (>2.00 to 4.00 hectares) and Large (above 4.00 hectares). The collected data were analyzed using ratios and percentages to work out the standardized concepts of different costs and returns in addition to production function to work out the resource use efficiency. Different cost *viz*: Cost-A, Cost-B, Cost-C₁ and Cost-C₂ / Yield of main Product in quintal estimated and The various income measures used in the present study are shown as; Value of gross output, Farm business income, Family labour income, Intensive income, Farm investment income and Net income.

In order to determine the efficiency of resources used in the production of onion, the following form of Cobb-Douglas production function was fitted.

$$Y = ax_1^{b_1} x_2^{b_2} x_3^{b_3} \dots \dots x_n^{b_n}$$

The original equation was converted into log linear form and the parameters will be estimated by using the ordinary least square method.

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + e$$

Where,

Y = Gross income of onion (Rs. /ha)

X₁ = Cost of human labour (Rs. /ha)

X₂ = Cost of bullock and machine power (Rs. /ha)

X₃ = Cost of manures (Rs. /ha)

X₄ = Cost of planting materials (Rs. /ha)

X₅ = Cost of fertilizers (Rs. /ha)

X₆ = Cost of plant protection chemicals (Rs. /ha)

X₇ = Irrigation charges (Rs. /ha)

a = Intercept

b₁, b₂... b₇ = Regression co-efficient (output elasticity of respective inputs (X_i's))

e = Error term with usual assumptions

Results and Discussion

The results of component wise costs for onion cultivation on different size of farms per hectare revealed that the average per hectare total cost of cultivation of onion crop was Rs. 158678.00 (table 1). It was the highest on large farms (Rs. 163056.00) followed by the same on medium farms (Rs. 161272.00), small farms (Rs. 158622.00) and marginal farms (Rs. 151760). On overall basis, among the different items of cash expenditure, the cost of human labour ranked first with 30.52 percent of the total cost as onion requires more number of labours for raising seedbed, uprooting the seedling, transplanting, digging, cleaning and for application of

irrigation to the crop. In addition to the share of human labour in total cost of onion, the major share of inputs was observed in case of planting material (11.78%), manures and cakes (6.93%), fertilizer (5.59%), insecticides/pesticides (5.10%), tractor charges (4.92%), irrigation charges (4.71%), miscellaneous (1.41%), bullock labour (0.85%) and depreciation (0.35%). Similar results were found by Mohapatra (2001) [9], Barakade *et al.* (2011) [5], and Meena *et al.* (2016) [8]. They also observed the higher share of cost of planting material (11.10%) in Odisha during year 2001, pesticides (5.65%) & irrigation charges (4.77%) in Maharashtra during year 2011 and fertilizers (5.20%) in Rajasthan during year 2016 in total cost of cultivation of onion. As far as different fixed cost are concerned, the highest share in total cost was observed in case of rental value of owned land (15.66%) followed by managerial costs (9.09%) and interest on fixed capital (0.57%). The data in the table also indicated that the share of family and bullock labour was found declining while the share of tractor was found increasing in the total cost according to farm size. Similar trend was also observed in the use of fertilizers and plant protection measures which increased with increase in farm size. Estimates of different costs such as Cost-A, Cost-B, Cost-C₁ and Cost-C₂ were calculated and presented in Table 2. It could be inferred that overall per hectare Cost-A was (Rs. 104997). It was found the highest on large farms (Rs. 111186/ha) and lowest on marginal farms (Rs. 97058/ha). Further, the study also showed that Cost-B and Cost-C₁ accounted for about 82.42 and 90.90 percent of the Cost-C₂. Overall, Cost-C₂ was Rs. 158678 per hectare which was the highest on large farms (Rs. 163056/ha) and lowest on marginal farms (Rs. 151760/ha). Increasing trend was observed in total cost (Cost-C₂) which increased with increase in farm size from marginal to large. These results are in conformity with the findings of Anon. (2017c) [3]. They also observed the total cost of onion to the tune of Rs. 146702/ha in year 2016-17. The average yield of onion was 299.56 quintals per hectare on overall farms. It ranged from 290.30 quintals on marginal farms to 308.83 quintals on large farms (Table 3). Higher yield level on large farms may be due to optimum level of inputs utilized by them along with timely weeding operations, seed treatment, advance plant protection and proper selection of varieties of onion, which affect the output to a greater extent, as compared to other farms. The variation in the yield might be due to the different time of sowing, types of land, use of hybrid variety and proper management *etc.* The data in the table also revealed that the per quintal average farm harvest price received by the onion growers was Rs. 608.33.

Table 1: Break-up of the total cost of cultivation for onion (Rs/hectare)

Sr. No.	Item	Farm size				
		Marginal	Small	Medium	Large	Overall
1.	Human Labour	45499 (29.98)	47682 (30.51)	48557 (30.11)	48778 (29.91)	47629 (30.52)
	(a) Family	15836 (10.43)	14271 (9.32)	13213 (8.19)	10584 (6.49)	13476 (8.74)
	(b) Hired	29663 (19.55)	33411 (21.19)	35344 (21.92)	38194 (23.67)	34153 (21.77)
2.	Bullock labour	1982 (1.45)	1747 (1.35)	1339 (0.83)	381 (0.23)	1362.25 (0.85)
3.	Tractor charges	7546 (4.97)	7580 (4.78)	8029 (4.98)	8120 (4.98)	7818.75 (4.92)
4.	Planting material	18265 (12.04)	18382 (11.59)	17687 (10.97)	18839 (11.55)	18293.25 (11.78)

5.	Manures and cakes	9616 (6.74)	10423 (6.57)	10771 (6.68)	11118 (6.82)	10482 (6.93)
6.	Fertilizer	7257 (5.49)	7412 (5.36)	7566 (5.74)	7721 (6.16)	7489 (5.59)
7.	Irrigation charges	7721 (4.78)	8493 (4.67)	9265 (4.69)	10037 (4.74)	8879 (4.71)
8.	Insecticides/pesticides	7412 (4.88)	8030 (5.06)	8338 (5.17)	8647 (5.30)	8106.75 (5.10)
9.	Miscellaneous cost	2007 (1.31)	2162 (1.36)	2316 (1.44)	2471 (1.52)	2239 (1.41)
10.	Depreciation cost	584 (0.38)	549 (0.35)	572 (0.35)	567 (0.35)	568 (0.35)
11.	Interest on working capital	3733 (2.46)	4013 (2.53)	4131 (2.56)	4276 (2.56)	4038 (2.54)
12.	Interest on fixed Capital	1599 (1.05)	874 (0.55)	679 (0.42)	521 (0.42)	918.25 (0.57)
13.	Rental value of owned land	23471 (15.47)	24707 (15.58)	25324 (15.70)	25942 (15.91)	24861 (15.66)
14.	Managerial cost	13796 (9.09)	14420 (9.09)	14661 (9.09)	14823 (9.09)	14424.25 (9.09)
15.	Total	151760 (100.00)	158622 (100.00)	161272 (100.00)	163056 (100.00)	158678 (100.00)

Table 2: Estimation of different costs for onion cultivation

Farm size	Different costs (Rs./hectare)			
	Cost-A	Cost-B	Cost-C ₁	Cost-C ₂
Marginal	97058 (63.95)	122127 (80.47)	137963 (90.90)	151760 (100.00)
Small	104350 (68.76)	129931 (81.91)	144202 (90.90)	158622 (100.00)
Medium	107395 (70.76)	133398 (82.72)	146611 (90.90)	161272 (100.00)
Large	111186 (73.26)	137649 (84.42)	148232 (90.90)	163056 (100.00)
All farms	104997 (69.18)	130776 (82.42)	144252 (90.90)	158678 (100.00)

Note: Figure in parenthesis indicate percentages to Cost-C₂

The large size growers realized higher prices per quintal (Rs. 617.84) followed by small (Rs. 615.00), medium (Rs. 612.64) and marginal (Rs. 600.42) category of farmers. Generally, large growers sell their produce at higher prices compared to other category of farmers mainly due to their retention capacity, time of sale, selection of agencies to which the produce sold. Moreover, as the category of farms changed from marginal to large, the risk bearing ability, and bargaining power increases, hence they sell their produce to distance market at higher price. The overall average gross returns per hectare on onion farms amounted to Rs. 182280.00 and it varied from (Rs. 174301.00) on marginal farms to (Rs. 190807.00) on large farms. Thus, gross income also increased with an increase in size of the farms.

A perusal of Table 4 shows that per hectare net returns over operational Cost (Cost-A) was the highest (Rs. 79621.00) on large farms and the lowest (Rs. 77243.00) on marginal farms with an average of about Rs. 78219.00 on overall sample farms. Net returns on overall farms over Cost-B, Cost-C₁ and Cost-C₂ were Rs. 52590.00, Rs. 38965.00 and Rs. 24539.0 per hectare, respectively. It is apparent from the analysis that per hectare net returns on onion farm over Cost-C₂ ranged from Rs. 22541.00 on marginal farms to Rs. 27751.00 on large farms with an average of Rs. 24539.00. Net income over different costs on onion farms increased with increase in the size of farms. It is apparently clear from the result of net income as well as the need of human labour in cultivation of onion has vast potential of generating employment and income for farmers.

Table 3: Yield level, harvest price and gross income per hectare

Farm size	Yield (quintal)	Harvest price (Rs./quintal)	Value of gross output (Rs.)
Marginal	290.30	600.42	174301
Small	296.48	615.00	182335
Medium	302.66	612.64	185423
Large	308.83	617.84	190807
All farms	299.56	608.33	182280

Table 4: Net gains over different costs per hectare

Farm size	Net gains over different costs (Rs./hectare)			
	Cost-A	Cost-B	Cost-C ₁	Cost-C ₂
Marginal	77243.00	52174.00	36338.00	22541.00
Small	77985.00	52404.00	38133.00	23713.00
Medium	78028.00	52625.00	38812.00	24151.00
Large	79621.00	53158.00	42575.00	27751.00
All farms	78219.00	52590.00	38965.00	24539.00

Table 5: Farm business income, family labour income, farm investment income net profit, intensive income (over Cost-C₂) (Rs. /hectare)

Particulars	Farm size				
	Marginal	Small	Medium	Large	All farms
Farm business income	77243	77985	78028	79621	78219
Family labour income	52174	52404	52625	53158	52590
Farm investment income	61407	63714	64815	69037	64743
Net profit	22541	23713	24151	27751	24539
Intensive income	47611	49294	50154	54214	50318

The overall per hectare farm business income, family labour income, farm investment income and intensive income were Rs. 78219, Rs. 52590, Rs. 64743 and Rs. 50318, respectively on all farms. The net profit per hectare (over Cost-C₂) was Rs. 24539 on all farms. The analysis also brought to the fore that farm business income, family labour income, farm investment and intensive income as well as net profit was increased as the category of farms changed from marginal to large farms.

Cost-price relationship generally decides the economic prosperity and the degree of commercialization on the farm. Given the price, offered by the market mechanism to a unit of output, the farmers' prosperity depends upon his capacity to produce his output at a lesser cost than the market price. The estimated cost of production per quintal of onion is given in Table 6. The overall paid out cost of production (Cost-A per quintal) was Rs. 350.29, which was 66.13 percent of the total cost. The overall Cost-B came to Rs. 436.35 per quintal which was 82.38 percent of total cost of production while Cost-C₁ and Cost-C₂ per quintal of onion production was about Rs.

481.50 and Rs. 529.65, respectively. The total cost of production (Cost-C₂) was highest on small farms (Rs. 535.02/quintal), followed by medium farms (Rs. 532.85/quintal), large farms (Rs. 527.08/quintal) and marginal category of farms (Rs. 522.77/quintal). It was also observed that as the farm size increased the total cost per quintal was increased. It was due to the fact that the cost of cultivation increased with increase in farm size as observed in results presented in Table 2. The costs of production also depend on production per unit area. It was observed from findings presented in Table 3 that the production also increased with increase in farm size but its increase was less than increase in cost of cultivation. Further, it revealed that cost of production on all farms was less than the farm harvest price of onion, which ranged from Rs. 600 to Rs. 650 per quintal in the study area. Thus, it can be concluded that the onion cultivation was quite remunerative for all category farmers in Bhavnagar district of Gujarat state.

Table 6: Cost of production per quintal on the basis of different cost

Farm size	Different costs (Rs./quintal)			
	Cost-A	Cost-B	Cost-C ₁	Cost-C ₂
Marginal	334.34 (63.95)	420.69 (80.47)	475.24 (90.91)	522.77 (100.00)
Small	351.96 (65.79)	438.25 (81.91)	486.38 (90.91)	535.02 (100.00)
Medium	354.84 (66.59)	440.75 (82.72)	484.41 (90.91)	532.85 (100.00)
Large	360.02 (68.19)	445.71 (84.42)	479.98 (90.91)	527.98 (100.00)
All farms	350.29 (66.13)	436.35 (82.38)	481.50 (90.91)	529.65 (100.00)

Note: Figures in parenthesis indicate the percentages to Cost-C₂

The input-output ratio reflects the criteria for economic viability of the crop based on gross return per rupee invested. The overall input output ratio found to be 1:1.15 on the basis of Cost-C₂ indicated that an investment worth Rs. 1.00 on all the inputs used in the cultivation of onion yielded an output worth Rs. 1.15 (table 7). The input output ratio was the lowest (1:1.14) on marginal farms and it was highest (1:1.17) on large farms. Further, it was observed that the input output ratio on the basis of Cost-A *i.e.* paid out cost, was highest

(1:1.80) on marginal farms followed by as small farms (1.75) and medium farms (1.73) while lowest on large farms (1:1.71). The overall input-output ratio over Cost-A, Cost-B, Cost-C₁ and Cost-C₂ was 1.74, 1.40, 1.26 and 1.15, respectively. Results indicated that on an average, the farmers got Rs. 1.74 per rupee invested. Thus, looking to the yield, gross return, net return and input output ratio of all categories of farms, it is concluded that onion cultivation is considered more profitable for farmers of Bhavnagar district.

Table 7: Input-output ratio

Farm size	Cost-A	Cost-B	Cost-C ₁	Cost-C ₂
Marginal	1:1.80	1:1.43	1:1.26	1:1.14
Small	1:1.75	1:1.40	1:1.26	1:1.15
Medium	1:1.73	1:1.39	1:1.27	1:1.15
Large	1:1.72	1:1.39	1:1.29	1:1.17
All farms	1:1.74	1:1.40	1:1.26	1:1.15

It can be seen that the co-efficient of multiple determination was 0.67 which showed that 67 percent of the variation in the gross income was accounted for by the independent variables included in the function (Table 8). The conspicuous

observation is that the variables of manures & cakes (0.218), and irrigation charges (0.114) exerted highly significant while plant protection chemicals (0.104) exerted significant influence on the gross income. It implies that 1 percent and 5

percent increase in the use of manures & cakes, irrigation and plant protection chemical resulted in increase of 0.218, 0.115 and 0.104 percent in the gross income, respectively. Similar results were found by Naik *et al.* (1998) [10]. They observed that the manures found highly significant indicating that there is scope to increase the use of these inputs in *rabi* onion production in Karnataka. Ghulghule *et al.* (2008) [8], also found that the effect of manures was positive and highly significant in Maharashtra. The variable like expenses of

human labour (0.079), cost of bullock and tractor charges (0.007) and cost of fertilizers (0.058) are positive but non-significant. Regression analysis of planting material measure with the gross income of onion (-0.016) have the also found to negative and non-significant in the study area. These results are in line with those of Karthick *et al.* (2015) [7], who found that the elasticity of plant protection chemicals was significant and positive in onion cultivation in Tamil Nadu in during the year 2015.

Table 8: Estimated production function for selected onion growers (Rs. /ha)

Sr. No.	Variables	Production Elasticity (b _i)
1.	X ₁ = Cost of human labour (Rs.)	0.079 (0.075)
2.	X ₂ = Cost of bullock labour and tractor charge (Rs.)	0.007 (0.012)
3.	X ₃ = Cost of manures and cakes (Rs.)	0.218** (0.074)
4.	X ₄ = Cost of planting material (Rs.)	-0.016 (0.026)
5.	X ₅ = Cost of fertilizers (Rs.)	0.058 (0.072)
6.	X ₆ = Cost of plant protection chemicals (Rs.)	0.104* (0.046)
7.	X ₇ = Irrigation charges (Rs.)	0.115** (0.032)
8.	a = Constant (Intercept)	6.857
9.	R ² = Co-efficient of multiple determination	0.674
10.	Σ b _i 's = Returns to scale	0.564
11.	n = Number of farms	120

Note: Figures in parenthesis are standard errors while ** and * denotes significant at 5 and 1% level of significance.

Thus, it is concluded that the sum of elasticities of production of each input on all the sample onion farms are less than one, indicating diminishing returns to each variable input. It implies that if we simultaneously increase each input by one percent, the gross income from onion increased by less than one percent (with diminishing return). The expenditure on human labour, bullock labour & tractor and fertilizer were found to have non-significant influence in explaining the variability in gross income. Similarly, expenditure on planting materials influenced gross income negatively. The Cobb-Douglas Production function estimates and geometric levels of inputs were used to estimate the marginal value product. A neoclassical theory indicates that marginal value product (MVP) must be equal or above the unit price of respective input for profit maximization.

Table 9: Resource use efficiency of selected onion growers (Rs. /ha)

Sr. No.	Variables	MVP
1.	X ₁ = human labour (Rs.)	0.30
2.	X ₂ = bullock labour and tractor (Rs.)	0.13
3.	X ₃ = manures and cakes (Rs.)	3.81
4.	X ₄ = planting material (Rs.)	-0.16
5.	X ₅ = fertilizers (Rs.)	1.43
6.	X ₆ = plant protection chemicals (Rs.)	2.35
7.	X ₇ = Irrigation (Rs.)	2.38

This principle is used to examine the resource use efficiency for selected crop of onion (Table 9). It is observed that the ratio of MVP to factor cost was the highest for manures & cakes (3.81) followed by irrigation (2.38), plant protection chemicals (2.35) and fertilizer (1.43). These results are in line with those of Sameer *et al.* (2014) [11], who found that the ratio of MVP to factor cost was the plant protection chemicals was greater than unity in onion cultivation in Karnataka in during the year 2014. They were more than one indicating

that still there exists a scope for higher utilization of these inputs which in turn would increase the gross income. This would help to maximize their profit in onion production. In Bhavnagar district, for human labour (0.30) and bullock labour & tractor (0.13) the ratio of MVP to factor cost found less than unity. Use of inputs therefore calls for its restricted application in respective area. However, production co-efficient for planting material was negative (-0.16) and thus, it was over used than the requirement, there was a need to reduce this to optimize returns.

Conclusions & Policy implications

The average total cost of cultivation per hectare of onion farms was the highest on large farms, followed by on medium, small and marginal farms. On an average Cost-A (paid out cost) formed 69.18 percent of total cost, while Cost-B accounted for 82.42 percent of total cost. The overall average gross returns per hectare of onion farms amounted to Rs. 182280.00. The overall per hectare farm business income, family labour income and farm investment income were Rs. 78219, Rs. 52590 and Rs. 64743, respectively on overall farms. The net profit per hectare (over Cost-C₂) was Rs. 24539 on overall farms. The average cost of production (Cost-C₂) was Rs. 529.65 per quintal which was the highest on small farms, followed by medium farms, large farms and marginal category of farms. The variables of manures & cakes, irrigation charges and plant protection chemicals found to have significant influence on the gross income. The sum of the elasticities was less than one indicating diminishing returns to scale. The ratio of MVP to factor cost in case of all farms found to be greater than one for manures & cakes, irrigation, plant protection chemicals and fertilizer indicating that still there exists a scope for higher utilization of these inputs in order to increase the gross income.

There is need to put more efforts to train the farmers regarding the use of pest and disease resistant varieties so as to reduce the major cost component incurred towards plant protection chemicals. Creating awareness among the farmers regarding the efficient utilization of resources particularly manures & cakes, irrigation, plant protection chemicals and fertilizer which found to be underutilized will definitely help for better yield realization.

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