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To Workout Resource use Efficiency of Cauliflower cultivation on sample farms in Varanasi District of Eastern Uttar Pradesh

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ABSTRACT
Keeping in view the importance of the vegetable crops in nutritional security and generating the income and employment to the farm population a study on economics of cauliflower cultivation in Chiraigaon block of Varanasi district of U.P. was conducted in agriculture year 2016-2017. Stratified purposive cum random sampling technique was applied to select the sample respondents primary data were collected through interview method. Tabular and function analysis was done to present the result. Overall average size of holding was 0.78 ha. which were 0.56 ha., 1.19 ha. and 2.76 ha. at marginal, small and medium size of farms respectively. Cauliflower cultivation was found profitable on each size group of farms and it was characterized of decreasing returns to scale as sum of elasticity were less than one in all categories of farms. Value of multiple coefficient of determination (R^2) shows 93.65, 80.67 and 95.87 per cent variation in output due to all included input factors in study. MVP of all the input factors in every farms size except few were more than one which showed the further possibility of increased expenditure to receive additional profit. At last cauliflower cultivation was found more suitable for the farmers of the study area.
Keyword : Tabular analysis, Functional Analysis, Cobb-Douglas Production function, Marginal Value Productivity

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INTRODUCTION

Indian subcontinent has been endowed by nature with vast diversity of land, soil and agro-climate condition found suitable to produce various types of vegetable crops. There is substantial increase in production and productivity of vegetables crop. The area and production of vegetables are increasing year after the green revolution, owing to growing of improved varieties and adoption of improved cultivation technologies. Cauliflower is one of the most important winter vegetables in India. It was introduced in India during 1822 from France. Cauliflower is grown for its tender head or curd. It is a delicate crop and needs more care to grow successfully than most of the other vegetable. It can be grown in all types of soil with good fertility and good water regime. Therefore, in the cultivation of Cauliflower steady growth is important since rampart growth may retard the formation of curd and it may also slow the growth of bracts. Under the Indian conditions, especially in North India the mid-season crop and late crop will grow very well in medium heavy and heavy soils when temperature is 10-16^0 C for curd formation. The optimum pH for cauliflower cultivation is 6-6.5. However, it has been reported that maximum yield of cauliflower is obtained at soil having pH between 5.5-6.5. Cauliflower is sensitive to high acidity. It is delicious cool season vegetable. The head is eaten while the stalk and surrounding thick, green leaves are used in vegetable broth or discard. India is the second largest producer of Cauliflower in the world after China followed by Italy, France and Spain. Cauliflower cover an area of 414 m. ha in India, its production is 7897 million tonnes and productivity is 19.10 tonnes/ha which constitutes 21.92% of world Cauliflower production. Production of China is 806 million tonnes & worldwide highest productivity recorded in Japan. In India, major Cauliflower producing State are West Bengal, Orissa, Bihar, Maharashtra and Assam. In Uttar Pradesh during 2014 area, production and productivity of Cauliflower was reported 10.15m. ha, 222.62 million tonnes and 21.9 tonnes/ha, respectively. In district Varanasi,

area, production and productivity of Cauliflower were reported 356 ha, 7223 tonnes and 20 tonnes/ha, respectively [1]. The per capita consumption of vegetables in India is 170g per day per person as against recommendation of 280gm per day per person (Food and Agriculture Organization, India). Fresh Cauliflower is an excellent source of vitamins, its 100gm provide about 48.2mg or 80% daily recommended value vitamin-C is a proven antioxidant that helps to fight against harmful free radical. It contains good amount of many vitamin-B complex group of vitamins, such as floats pantothenic acid (vitamin B_1) niacin (B_3), as well as, vitamin K. These vitamins are in the sense that body requires them from external source to replenish. Further it is good source of minerals, such as, Mn is used in the body as co-factor for the antioxidant enzyme [2]..

MATERIAL AND METHODS

Methodological aspect of study on Economics of Cauliflower cultivation has been discussed under the following four heads. 1- Sampling technique, 2-Collection of data and method of enquiry, 3-Period of enquiry and 4-Analytical tools.

Sampling Technique: Multistage stratified purposive cum random sampling technique was used for the selection of District, Block, Villages and Respondents (Cauliflower grower).

Selection of District: In the first stage Varanasi District of Utter Pradesh was selected purposively because of large amount of vegetable trading takes place in Varanasi.

Selection of Block: There were 8 Blocks in Varanasi district *i. e. (i)*Arajiline, (ii) Baragaon, iii) Chiraigaon, (iv) Harhua, (v) Cholapur (vi) KashiVidyapith (vii) Pindara and (viii) Sewapuri Out of 8 Blocks of Varanasi District 1 block namely Chiraigaon was selected purposively where Cauliflower grower are in large numbers.

Selection of villages: Out of 94 villages of selected block 5 Villages namely Bariyasanpur, Gaurakala, Rustampur, Chiraigaon and Umarahan were selected purposively where maximum number of farmers grow Cauliflower on large scale.

Selection of farmers/growers: A separate list of Cauliflower growers of selected villages was prepared along-with their size of holding obtained from record (Khasara and Khatauni) available at Tehsil level and further it was grouped into three categories *i.e.* 1. Marginal farmer (<1 ha), 2. Small farmer (1-2 ha) and 3. Medium farmer (2-4ha). At last 100 respondents were selected following the proportionate random sampling technique.

Collection of data and method of enquiry:

Primary Data: The primary data on production aspects were collected on well prepared schedule by survey method. Frequent visits were done by the investigator to the selected respondents and required data were recorded by personal interview. Accuracy of the data were assured through cross-checking.

Secondary Data: The secondary information was compiled from the published report at Block, Tehsil and District offices.

Period of Enquiry: The data were collected to the main-season crop of the 2016-2017.

Analytical tools: The data collected from the sample cultivators were analyzed and estimated with certain statistical techniques which are mentioned below.

Functional Analysis: To study the effect of various independent variables on the output, various forms of production function have been dealt. However, Cobb-Douglas function was found more suitable to the data; therefore it was used for measuring resource use efficiency.

The mathematical form of Cobb-Douglas function is:

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

Where,

Y= per hectare output (Rs.)

X_1= Manure and fertilizers (Rs/ha)

X_2= Total human labour (Rs./ha)

X_3= seed (Rs/ha)

X_4=Irrigation charge (Rs/ha)

a = Constant (intercept)

e^u= Error

b_1, b_2, b_3 and b_4 production elasticity of the respective input variables.

Cobb-Douglas Production function in log form:

$$\text{Log } Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 \ldots\ldots \mu \log e$$

This formula was used for estimating the parameters of the function based on sample data.

Marginal Value Productivity (MVP): The marginal value product of inputs was estimated by following Formula;

$$MVP\ (X_j) = \frac{b_j \overline{Y}}{\overline{X}_j}$$

Where,
MVP=marginal value product of Jth input
b_j=Production elasticity with respect to X_j
Y=Geometric mean of the dependent variable Y
X_j=Geometric mean of the independent variable X
Reliability of the test: Having estimated the elasticity co-efficient, it is desirable to ascertain the reliability of these estimates. The most commonly used "t" test was applied to know, whether 'b_j' is statistically significant fromzero or not at some specified probability level.

$$'t'\ cal = \frac{bj}{S.E\ of\ bj}$$

If calculated 't' value is greater than table value of "t" at specified probability level at 'n-k-1' degree of freedom b_j is said to be statistically different from zero.
F test was used to test the significance of the regression as a whole.

$$F = \frac{Regression\ mean\ square}{Error\ mean\ square} = \frac{\left(SSR/K\right)}{\Sigma e^2/(n-k-1)}$$

SSR = sum of square due to regression
Σ e2 = sum of square of error term
M. V. P. of jth input factor was tested using the formula
$t=MVP_j/S.E.\ of\ MVP_{ji}$
S.E. of MVP_j= (Y/X) standard error of b_j

RESULT AND DISCUSSION

The discussion of the cauliflower grower in the study area are as follows:
The details of land holding owned by the sample farmers under different size group of sample farms are given in table1. It is revealed from the table the average size of holding of marginal, small and medium farms were found 0.56, 1.19 and 2.76 hectares respectively. The overall average size of holding in study area was found to be 0.78 hectare.

Table 1: Average holding size of sample farmers under different size group of farms.

Sl. No.	Size groups of farms	No. of farmers	Net cultivated area (ha)	Average size of farms
1.	**Marginal**	82	45.94 (58.60)	0.56
2.	**Small**	11	13.11 (16.72)	1.19
3.	**Medium**	7	19.34 (24.68)	2.76
Grand Total		**100**	**78.39 (100)**	**0.78**

Resource use efficiency in cauliflower cultivation:

Resource use efficiency, elasticity of production, return to scale and other qualities of interest in cauliflower crop of different size group of farms are displayed in table 2. High value of R^2 of the fitted function indicates that sufficient and maximum proportion of the total variation in the dependent variable was explained by the included factors in production process. The five variables *viz*., manure & fertilizers, human labour, seed/nursery, irrigation and plant protection, were considered to find their effect on dependent variable (income/ha.). It is revealed from table 2. 93.65, 80.67, and 95.87, percent variation in the dependent variable on marginal, small, and medium farms were caused by these five included variables. In case of marginal farms, manure and fertilizers was found statistically significant at 5 percent probability level, human labour, irrigation and plant protection were found statistically significant at 1 percent probability level and while one factor *viz*, seed/nursery was found statistically non significant. In case of small farms human labour was found significant at 1 percent and seed/nursery and plant

protection were found statistically significant at 5 percent probability level, while manure & fertilizers and irrigation were non significant. In case of medium farms, manure and fertilizers and seed/nursery, were found statistically significant at 5 percent probability level while, human labour, irrigation and plant protection were found non significant. The sum of elasticity's (return's to scale) at marginal, small and medium size of farms were recorded as less than one which shows that cauliflower cultivation was decreasing return's to scale of nature.

Table 2: Production Elasticity of Cauliflower group on different size group of farmer.

Size group of sample farms (ha.)	Production elasticity					Sum of elasticities return to scale	R^2
	X_1	X_2	X_3	X_4	X_5		
Marginal	0.153247* (0.06301)	0.20055** (0.04253)	0.137767 (0.08087)	0.14202** (0.02603)	0.30193** (0.04891)	0.935553	0.936573
Small	0.011598 (0.14578)	0.41602** (0.09361)	0.11211* (0.03166)	0.291255 (0.71199)	0.148976* (0.05006)	0.979965	0.80679
Medium	0.31254* (0.02145)	0.010231 (0.09947)	0.61723* (0.03297)	0.030299 (0.72811)	0.010976 (0.82498)	0.98133	0.958722

*Significant at 5% level of probability, **Significant at 1% level of probability, X_1, X_2, X_3, X_4 and X_5, stand for Manure & Fertilizers, human labour, seed & nursery, irrigation & plant protection (Rs.) respectively.

Marginal value productivity (MVP) of cauliflower:

It is clear from table 3. that the MVP of all included factors in study i.e. Manure & Fertilizers, human labour, seed/nursery, irrigation and plant protection measure were considerably high varying from 7.706812 to 13.59612 in various size group of farms.

The MVP of manure and fertilizers observed lowest 0.51637 and human labour observed 0.6016 showed negative response to production on small farms and medium farms. The MVP of plant protection showed positive response to production on marginal farms, where it was observed highest 13.5961showing there by a positive response of production. The use of human labour, seed/nursery, manure and fertilizers, irrigation and plant protection, had positive response of production on all size group of farms. It indicate the further possibilities to get additional income by adding additional quantity of mentioned input factors [3, 4].

Table 3: Marginal Value Productivity (MVP) of included factors in production process of Cauliflower crop.

Size group of forms	Marginal Value Productivity of input / Factors				
	X_1	X_2	X_3	X_4	X_5
Marginal	1.941185	2.079515	5.663841	7.706812	13.59612
Small	0.516371	2.118152	3.677837	12.2283	7.963444
Medium	2.903872	0.60162	4.084792	2.495424	1.84007

X_1, X_2, X_3, X_4 and X_5, stand for Manure & Fertilizers, human labour, seed & nursery, irrigation & plant protection (Rs.) respectively.

CONCLUSION

The importance of vegetable crops in our country can be judge from the fact that majority of the Indian population is vegetarian. Vegetables are the main source of minerals and vitamins and other nutritive ingredients in vegetarian diet. Multistage stratified purposive cum random sampling technique was used for the selection for district, block, villages and respondents. Accordingly the Chiraigaon block of Varanasi district were chosen for this study and one hundred respondents from five selected villages of Chiraigaon block were chosen from three categories of farms size *i.e.* marginal, small and medium. Pre structured schedule were used to collect the primary data from sample farmers with personal interview method and secondary data were collected from official records at block and district offices. Simple tabular and functional analysis of data were done to interpretate the result. Resoures use efficiency was also studied in which five factors of production *i.e.* cost of manure & fertilizers, human labour, seed/nursery irrigation and plant protection were included. It was found that on marginal size group of farms manure & fertilizers at 5 per cent and human labour, irrigation and plant protection each at 1 per cent level of profitability have significant association with dependent variable. In case of small farms human labour at 1 per cent and seed/nursery and plant protection at 5 per cent level of probability showed significant result. Similarly at medium size of farms only two factor *i.e.* manure and fertilizers and seed/nursery were significant at 5 per cent probability level. Sum of elasticity of all included factor in all categories of farms were less than one shows the deceasing return to scale in production. All these included input

factors had 93.65, 80.67 and 95.87 per cent bearing on the change in the dependent variable. MVP of all these factors were found of more than one indicate further scope to invest more on these factor in order to have the additional profit.

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