International Journal of Humanities & Social Science Studies (IJHSSS)
A Peer-Reviewed Bi-monthly Bi-lingual Research Journal
ISSN: 2349-6959 (Online), ISSN: 2349-6711 (Print)
ISJN: A4372-3142 (Online) ISJN: A4372-3143 (Print)
Volume-IV, Issue-I, July 2017, Page No. 352-359
Published by Scholar Publications, Karimganj, Assam, India, 788711 Website: http://www.ijhsss.com

Saffron Production in Jammu and Kashmir
(A test with Cobb-Douglas production function model)

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Abstract

Jammu and Kashmir, being a hilly state, is blessed with naturally occurring micro agro-climatic regions suitable for cultivation of a wide range of agri-horticultural crops with a great potential for development. The purpose of this paper is to analyse the production, productivity, area and significance of different inputs in saffron production of Jammu and Kashmir. It is based on primary data collected from 200 saffron growers. In India entire saffron production comes from j and k. India ranks sixth in terms of productivity among the top saffron producing countries of the world. Saffron cultivation has shrunk over the past decade. Low productivity, lack of irrigation facilities and traditional unscientific method of cultivation has been attributed the primary factors. The present study is an attempt to explore the impact of different variable inputs on the saffron production of Jammu and Kashmir. The study revealed that saffron cultivation is highly influenced by labours than fertilizers. Further both area and production is decreasing in state of Jammu and Kashmir. Saffron cultivation is found to be a lucrative proposition for all the categories of farmers in the state. Immediate attention of the state government and other funding agencies are required to strengthen the saffron production in Jammu and Kashmir. Despite various constraints, there is a great scope for increasing productivity of land and farmer's economy through creation of saffron mandies, land development, use of efficient farm power and implements, rain water harvest, disseminating post-harvest engineering principles.

Key words: Agriculture, Farmers, Jammu and Kashmir, saffron, significant.

1. Introduction: Jammu and Kashmir are situated in the northern region of the Great Himalayan range, spreading over 33-37 ºN latitude and 72-80 º E longitude. The state comprises 6.7 % of the total geographical area of the country, covering over 2.22 lakh square km, of which about 30 % is under cultivation. Despite small geographical area, the state is blessed with diverse agro-climatic conditions, topography and natural resources for cultivation of a wide range of agro-horticultural crops. Agro-climatic conditions vary from

subtropical in outer plains and outer hills of Jammu division; subtropical to temperate in mid to high altitude zone including major parts of district Udhampur, Poonch, Rajori and Doda; temperate to cold temperate in Kashmir valley and cold arid in Ladakh-Kargil area. Each agro climatic zone can be further divided into various micro-agro-climatic zones based on variation in slope, topography and soil and water availability. These numerous micro agro- climatic zones make feasible the cultivation of almost all types of agricultural as well as horticultural crops in the state, which include cereals, pulses, oilseed, vegetables, fruits, dry fruits, spices and ornamentals.

The spice saffron is composed of the red-orange filaments of the dried tripartite stigmas from the flowers of Crocus sativus L., a perennial herb of the family Iridaceae. It is highly valued as a culinary spice for its flavouring and colouring properties, and for its medicinal use in both traditional treatments and for a range of potential new clinical and pharmaceutical uses. A growing body of research in recent years has demonstrated that saffron extracts including metabolites such as safranal, crocin and various flavonoids reported from different flower parts, possess chemo-preventative properties against cancer . Such anti-tumour effects of saffron extracts have been observed in vivo in mice and rats and in vitro with human carcinoma cells without having any toxic side effects at the doses used. Saffron extracts also been shown to have anti-inflammatory and anti-depressant effects in humans and to have great potential for promotion of learning and memory in patients with neurodegenerative disorders. The saffron crocus (Crocus sativus L.) is sterile and does not set viable seed. Therefore, the crop must be propagated by corm multiplication. The saffron crocus flowers in autumn shortly after planting, before, together with or after leaf appearance. The remainder of its growing season consists of initiation, filling up, and maturation of the daughter corms at the beginning of summer. Each corm only lasts a single season and is replaced by 1 to 10 corm lets, depending on the original size of the mother corm. Corms are globular and depressed, up to 4.5 cm in diameter and covered with a tunic of parallel fibres. Corms are dormant during the summer and produce 5 to 11 erect, narrow, grass-like green leaves, up to 40 cm long that emerge in autumn. Flowers are fragrant, up to 8 cm long, and usually pale lilac or mauve with darker coloured veins. The outstanding feature of the flower is its style, which divides into three brilliant red stigmas 25- 30 mm long.

Saffron is native to the Mediterranean environment, characterized by cool to cold winters, with autumn-winter spring rainfall, and warm dry summers with very little rainfall. In Greece, saffron growing areas have more than 500 mm annual rainfall while in Spain saffron is grown in dry temperate conditions with an annual rainfall of around 400 mm per annum, but the crop is usually irrigated. Saffron is grown successfully under non-irrigated

conditions (1000-1500 mm per annum) in Kashmir, India. Spring rain is considered favorable for corm production, while rain immediately before flowering encourages high flower yield. However, rain or cold weather during flowering spoils the saffron and persistent wetness and high temperatures encourage disease. Saffron likes light, friable soils that have a high nutrient content. It grows in a wide range of soils, but thrives best in deep, well drained clay-calcareous soils with a loose texture that permits easy root penetration.

2: Saffron Flowers Harvesting: The flowering stage of saffron starts from October and continues for some 3 weeks. Each flower lives only for some 48 hours. This is the reason why saffron has such a high value. The vast amount of labour required for harvesting and on-farm processing in a relatively short period. Saffron flowers should be picked early morning as soon as they open. The timing of the harvest and speedy processing is important, as the wilting of the flowers makes the post-harvest process difficult to impossible, and the quality suffers considerably. The optimal harvest time is therefore early in the morning before there is full sun. The flowers should be cut from the plant by the fingernails near to the ground. It should be put in a clean basket to avoid contamination of stigma. A good flower collector can collect as much as 3,000 flowers per hour. After collection, the flowers should be transported to a farm house or other location where it should be kept in a clean and shady place until further processing. If necessary, the saffron flowers should be stored at temperatures near 0°C, and the layer of fresh flowers should not exceed 10 cm. Under these conditions, saffron flowers can be kept for up to 7 days.

3: Objectives:

1. To know the present status of saffron production in terms of productivity, production and area in Jammu and Kashmir.

2. To evaluate among input variables the impact of fertilizers and labours on the saffron production of Jammu and Kashmir.

4: Hypothesis:

H_0: Fertilizers are more significant than labours in the saffron production of Jammu and Kashmir.

H_1: Fertilizers are not more significant than labours in the saffron production of Jammu and Kashmir.

5: Methodology: For the purpose of significance and impact of different variable input analysis of saffron cultivation in Jammu and Kashmir, multistage random sampling technique was used to draw the ultimate study sample. Four major saffron producing districts of Jammu and Kashmir were selected for a detailed study from these four districts, major four saffron producing blacks were selected. Finally, saffron producing farmers were

selected on the basis of size of holding. The cultivated area owned by the growers was classified into four groups on the basis of the size of holding. For this research work, research design was made in accordance with the requirements of the subject while both the source of information, primary and secondary was taped effectively. Emphasis was placed on gathering first hand assessment of the situation. For primary data collection purposive interview and questionnaire cum schedules was considered to be the best alternative. The main sources of primary data were farmers. To draw out the results and for the justification of hypothesis and data, the relevant statistical tools were used epically Cobb- Douglas production function.

6: Area, Production and Productivity of Saffron in Jammu and Kashmir: Jammu and Kashmir agriculture has an international identity. The world's best saffron is grown in the valley and its major intensity is in district Pulwama and Budgam. Nearly 90% of the total area in the state under the crop is cultivated in Kashmir province only. Its cultivation in Jammu division is limited to district Kishtwar only. Saffron is a rain fed crop and the main output of the crop is a dark red substance obtained from the flowers called the saffron. Saffron is a Kharief crop. Saffron cultivation has declined over the years in terms of area, production and average yield rate, because of inadequate irrigation facilities and increasing diversion of agricultural land into urbanisation and industrialization. It is necessary that replacement of the existing corms, through introduction of new variety of grim plasma and significant enlargement of the area under saffron cultivation on the highest priority basis. The decline in the area and production of saffron over the years in indicated in the following table.

Table No. 1.1

Trends in Production Area and Productivity of Saffron in J & K

Sl.no.	Year	Area in (Hec.)	Production in (Mts)	Yield rate (Kgs/hect.)
1.	1996-97	5707 (0%)	15.95	2.80
2.	1997-98	4161 (-27%)	12.88	3.13
3.	1998-99	2880 (-30.79%)	7.65	2.27
4.	1999-00	2742 (-4.79%)	3.59	1.88
5.	2000-01	3075 (12.14%)	0.3	1.57
6.	2001-02	2989 (-2.80%)	6.5	2.96
7.	2002-03	2928 (-2.04%)	5.15	1.66
8.	2003-04	2436 (-10.80%)	6.86	3.75
9.	2004-05	3110 (27.87%)	7.04	1.63

10.	2005-06	3130 (0.64%)	6.5	2.25
11.	2006-07	3010 (-3.83%)	8.2	2.15
12.	2007-08	3000 (-0.33%)	7.7	2.5
13.	2008-09	3280 (9.33%)	9.46	2.34
14.	2009-10	3785 (15.40%)	9.55	2.5
15.	2010-11	3790 (16.04%)	9.85	2.52

Source: Financial Commissioner Revenue, Jammu & Kashmir.

The table 1.1 shows that area, production and productivity of the precious and high value horticulture fruit saffron in the state has decreasing since 1996-97. Area has declined from 5700 hectares in 1996-97 to 3000 hectares in 2007-08 and productivity decline from3.72 kg/hectare in 2003-2004 to 2.52 kg/hectare. The growth rate is quite fluctuating due to the reasons of inadequate irrigation facility and natural elements plays a vital role in overall production. The matter of concern is that why the area under the high commercial spice (saffron) is declining? This is due to the severe constraints and problems faced in the saffron cultivation, farmers have withdrawn from saffron cultivation. Existence of some serious problems related to disease of corm seeds, lack of irrigation facilities, lack of proper soil testing, unavailability of sufficient marketing facilities in the sector, adulteration in quality saffron which degrades the quality of Kashmiri saffron. Existence of commission agents, exploit the farmers in terms of remunerative prices of their production and they gets discouraged. Government of India has realized the importance of this famous spice and conditions prevalent has initiated National Mission on saffron with the total outlay of 288 crores for the revival and rejuvenation of the saffron industry in the state to strength the marketing, irrigation and quality control of the saffron cultivation in the state to promote this sector.

7: Cobb-Douglas production function model -A test with special reference of saffron production in Jammu and Kashmir: According to the theoretical concept of production function, production function expresses a relationship between inputs and outputs. It shows the proportion between inputs and output under a given technique of production, during a specified period of time. In economics, a very important actual production function which has been desired by the use of statistical methods by the name of "Cobb Douglas production function" this model consists of the essential elements related to production, i.e. labour and capital. Objectively this model shows relationship between the amounts of production in respect of given units of inputs (labour, capital etc). Saffron production is also the function of various inputs. In other words output of saffron is a functional relationship between various inputs and output in a given period of time. Production is determined and affected

by various factors especially in the agriculture sector, productivity and production of saffron is the outcome of different factors like, labour, price, fertilizer mechanization etc. What is the relationship of labour, fertilizers in the production of saffron in Jammu and Kashmir, with the interference of Cobb Douglas production function model we can see how much actual production should be done by the use of given labour and fertilizer as inputs.

Cobb- Douglas production function has been extensively applied in agriculture and in majority of cases restraints of α+β being equal to 1 has been given up. Further, the number of factors included in the production function is no longer confined to two factors only i.e. labour and capital. Now, many inputs are being used as independents variables in such a production functions. The production function used now a day can be described in the following form.

$Y = Ax_1^{\alpha} \quad X_2^{\beta} \quad X_3^{y}$…….

Where α+β+ y may or may not be equal to one. It all depends upon the value of α, β, y as determined after the function has been fitted.

But here we consider only two input factors as independents variable and put them in Cobb- Douglas production function to see the cause and effect relationship between production of saffron and these two factors inputs are labour and fertilizer.

Therefore our model

$$Y = f(X_1, X_2)$$

$$Y = AX_1^{\alpha} X_2^{\beta} u$$

Where Y = Production of saffron per hectare in kilograms.

x_1 = Consumption of fertilizers per hectare in kilograms.

x_2 = Number of laboures per hectare.

α, β and A are constant

α and β > 0.

For converting nonlinear form of model into linear form of model. We can use In (natural log) technique. Therefore the above nonlinear form of model can be written in its linear form in the following value.

$\text{In}y = \text{In}A + \alpha \text{In}x_1 + \beta \text{In}x_2 + \text{In}\, u.$

According to least square estimation method

Inu = 0 (on the least square principle method)

So,

$$ln\ \hat{y} = ln\hat{A} + \hat{\alpha}\ ln x_1 + \beta\ ln\ X_2$$

In $\hat{y}$ = Estimated value of y.

$\hat{b}$ = Estimated value of x_2 variable parameter.

$\hat{a}$ = Estimated value of x_1 variable parameter.

In $\hat{A}$ is the estimated value of efficiency parameter.

Therefore putting the value in the model we get

In $\hat{y}$ = -3.486 + .119 Inx_1 + .671 Inx_2

$\hat{y} = \hat{A}\ x_1^{(.119)} . x_2^{(.671)}$ R^2 = .23

SE.	(0.077)	(0.092)
t	(1.545)	(7.29)

So we can write the original form of the model which is: -

$\hat{y} = e^{(-3.436)}\ X_1^{(.119)}\ X_2^{(.671)}$ R^2=0.23

S.E.	(0.077)	(0.092)
t*	(1.545)	(7.29)

Conclusion: Production of saffron in Jammu and Kashmir is function of multiple input factor variables. However, the results drawn on the basis of Cobb – Douglas production function where we had taken only two independents variable factor inputs into considerations reveals that X_2 (labour) is relatively playing vital role than X_1 (fertilizers) for enhancing the productivity of saffron in the state of Jammu and Kashmir. In other words ($.X_2$) is more significant than X_1(fertilizers). Saffron is being cultivated as a rainfed crop on the Karewa lands in Jammu and Kashmir. The soil nutrients which are essential for the growth and increase in productivity of saffron are rich by nature in these uphill Karewa lands. Besides the application of fertilizers in the absence of moisture/ irrigation does not work properly as the crop is highly sensitive in nature. Saffron is a labour intensive crop it needs keen watching right from plantation to recycling period. Highly skilled labour is required for growth of this crop at different and maximum stages. Finally we can say that other factors as input in the production function of saffron are of vital importance and have more or less contribution in the production of saffron in Jammu and Kashmir.

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