



Research Article

Economic Evaluation of Advanced Production System Module in Saffron by using an Economic Surplus Model in India

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Abstract | The cultivation of saffron started around three or four centuries back in Arabia and Spain, afterwards its cultivation spread to Iran, Sweden and India. In India, around 5,707 ha. of land are under its cultivation with annual production of around 16,000 kgs. The state of Jammu and Kashmir ranks at top of the list of saffron growing states in India, with district Pulwama at slot one. Out of the total 5,707 ha. of land under saffron cultivation in India, 3,785 ha. are exclusively in Jammu and Kashmir. The main aim of this study is to encourage farmers to adopt the new production system module developed by Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir for getting doubly benefited through production gains and employment avenues. Keeping in view the benefits and economic value of this legendary crop, the present study is undertaken in the state of Jammu and Kashmir, which enjoys virtual monopoly in the cultivation of saffron, producing around 99 percent of the total saffron production. Due to technological change, saffron production has witnessed a substantial increase during last decade. Keeping the production potential of production system module of saffron in consideration an ex-ante, ex-post and propensity score matching evaluation of the developed module was undertaken.

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Keywords | Economic evaluation, Production system module, Benefits, Productivity, Export potential



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Introduction

The portion of Agriculture in the State Gross Domestic Product (SDGP) has diminished from 50% in 1978-79 to 17.49 percent during 2018-19 (Economic Survey, 2019). In any case, hilly states can possibly push the development in horticulture past projected figures, owing the regions for misuse which produce items that have trade potential. The Jammu

and Kashmir state has 71% populace living in provincial territories, the greater part of which rely upon farming for procuring their occupation. While 48% of the work power occupied with farming contribute just 21% of SGDP, staying 52% of work power occupied with non-structure exercises contribute 79% to the SGDP (UNIDO, 2014). In this manner, re-investigate the recognizable proof of the potential specialty regions and the wares developed turns out

to be vital for guaranteeing the upkeep of agro-eco framework and expanding per unit return of accessible land asset. Saffron is one among different specialty crops developed in the territory of Jammu and Kashmir, be that as it may, it is experienced with multi-dimensional issues. Developed on a space of 3785 hectares delivering 13.2 mt of saffron with a normal yearly profitability of 3.5 Kg/ha. Saffron encountered a decrease in its developed region and creation from 5707 ha to 3280 ha and 16 mt to 7.70 mt from 1996-97 to 2008-09 separately (Department of Economics and Statistics, 2018). Albeit the decrease underway was credited to the lessening in its developed territory and absence of water system offices (Mohammad *et al.*, 2017), notwithstanding, the primer logical examinations in Jammu and Kashmir uncovered that after a long planting pattern of >15 years without soil well-being the board welcomed high rate of saffron corm decay infection (46%), (Sahu, 2015). Utilisation of non-reviewed corms for new estate with a low weight corms and seed rate/non upkeep of appropriate plant thickness/plant math was presumably the primary driver that lead to huge number of decrepit fields with low saffron profitability (2.5 kg/ha) coming about into low monetary returns (Shah, 2018; Nehvi *et al.*, 2018). The harm (10-15 %) by Rodent (*Pitymus leucurus* spp) which is diurnal in nature, dynamic all through the vegetative stage (November to May) was found to assault vegetative early stage at the base of saffron plant which apparently went to be the significant reason for worry in the saffron developing spaces of J&K (Daawar and Yadvinder, 2019). Post-reap treatment of saffron, especially the drying interaction is basic to the nature of saffron estimated by the degrees of auxiliary metabolites viz., Crocin (shading), Picrocrocin (taste) and Safranal (fragrance) (Wani, 2018).

The current examination is embraced in the Jammu and Kashmir territory of India which appreciates virtual restraining infrastructure developing saffron in the nation, creating around 99% of the absolute saffron creation. Empowered by innovative change, saffron creation has seen a considerable increment during the decade gone. Considering the creation capability of creation framework module in saffron, the current examination was embraced to take in to the ex-ante and ex-post assessment of the created module for concocting a down to earth strategy for its turn of events (Chen and Ravallion, 2003). The purpose of this study is to highlight the gains of farmers after adopting the new developed production system mod-

ule of saffron corm. The study aims to highlight the net gains of the farmers after adopting the new corm.

Materials and Methods

A complete study of the saffron developing regions was embraced to evaluate the effect on ground of creation framework module in saffron created by the Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAS-K). The effect of new innovation was surveyed by taking when appropriation of new innovation module by a gathering of farmers which gathering was treated as non-adopters before the reception of innovation to have a levelheaded evaluation of new innovation. The Saffron delivering belt is restricted to Pampore territory where around 5700 ha were put under development of this yield (Agricultural Production Department, 2018). The entire tehsil Pampore develops saffron and have the agrarian land in a similar belt. An absolute number of 400 farmers were chosen from among 753 number of farmers. The essential information for ex-ante assessment was gathered straightforwardly from the Scientists associated with building up the bundle, while concerning ex-post assessment information was gathered through overview strategy. Distributed reports by the concerned office who executed the bundle in the saffron developing belt were likewise scrutinized. The normal profitability and information costs were assessed from the field information in the saffron belt while the selection of the bundle was evaluated utilizing monetary overflow model which is generally used to survey the effect of advances attributable to its less prohibitive presumptions and least information prerequisites. Given the way that little open economy presumption attributable to the tradability of a large portion of the rural items and furthermore non-critical impact of the majority of the nations (Alston *et al.*, 1988; 2000) on global costs, we decided to appraise the monetary excess because of yield improvement in a little open financial system. India being second in the creation of saffron on the planet and as needs be the second in its fare, the advantages gathering out of the appropriation of improved innovation get ordinarily executed to the makers.

The financial overflow model was used along with the examination expenses to ascertain the net present worth (NPV), the inner pace of return (IRR), and the advantage cost proportion (BCR). This model was utilized to quantify the pace of get back to the examination under different frameworks. The total mone-

tary effect was evaluated thinking about the rate and season of selection.

Estimation of Benefit

$$\begin{aligned}\Delta CS &= P_o Q_o Z (1+0.5Z\eta) \\ \Delta PS &= P_o Q_o (K-Z) (1+0.5Z\eta) \\ \Delta TS &= \Delta CS + \Delta PS = P_o Q_o K (1+0.5Z\eta)\end{aligned}$$

Where;

K : Vertical shift of supply function expressed as a proportion of the initial price; b : Absolute value of the elasticity of demand; $Z = Ke / (e + b)$: Reduction in price, relative to its initial (*i.e.* pre-research) value, due to the supply shift; e : Elasticity of supply; ΔCS : Change in consumer surplus; ΔPS : Change in producer surplus; ΔTS : Change in total surplus. Noe'mi *et al.* (2014) and Jones *et al.* (2009).

In addition, propensity score matching technique was utilised to assess the overall impact of advanced technology on the yield and income of the growers.

Results and Discussion

Impact of new technology on saffron growers

A total outline of the saffron creating districts was endeavored to assess the impact on ground of creation system module in saffron made by the SKUAS-K. The impact of new development was reviewed by taking when allotment of new advancement module by a social event of ranchers which get-together was treated as non-adopters before the choice of development to have a practical evaluation of new advancement. The Saffron conveying belt is confined to Pampore region where around 5700 ha were put being worked on of this yield. The whole tehsil Pampore creates saffron and have the agrarian land in a comparable belt. A total number of 400 farmers were browsed among 753 number of farmers. The fundamental data for ex-ante appraisal was accumulated directly from the Scientists drew in with developing the group, while concerning ex-post evaluation data was assembled through outline procedure. Circulated reports by the concerned association who executed the group in the saffron creating belt were moreover investigated. The ordinary productivity and data costs were evaluated from the field data in the saffron belt while the choice of the pack was studied using money related flood model which is extensively used to assess the impact of advancements owing to its less restrictive speculations and least data requirements. Given the way that little open economy assumption inferable from the tradability of most of the green things and

besides non-basic effect of most of the countries (Alston *et al.*, 1988; 2000) on overall expenses, we chose to evaluate the money related abundance due to yield improvement in a little open monetary framework. India being second in the production of saffron in the world and suitably the second in its passage, the benefits working out of the choice of improved development get conventionally executed to the creators.

The economic surplus model was utilized alongside the investigation costs to determine the net present worth (NPV), the internal rate of return (IRR), and the benefit cost extent (BCR). This model was used to measure the speed of return to the investigation under various structures. The absolute monetary impact was assessed thinking about the rate and period of appropriation.

Table 1: Impact of improved production system module on saffron growers (*Ex-ante*).

Particulars	Improved technology	Traditional technology	(%) Change
Saffron Yield (Kg/ha)	6.05	2.5	142.0
Corms yield (q/ha)	15	9	66.7
Gross returns (Rs/ha)	1060200	343413	208.7
Net returns (Rs /ha)	744000	206353	260.5
Cost of cultivation (Rs /ha)	248008	161974	53.1
Cost of production (Rs / kg)	91245	60468	50.9
Returns per dollar invested (Rs/ha)	4.3	2.1	104.8
Labour productivity (Kg/ha)	0.031	0.016	93.8
Marketable surplus(Kg/ha)	5.978	2.44	143.3
Employment (human days/ha)	308	219	40.6
Domestic consumption (Kg/ha)	0.072	0.043	67.44

The appropriation of new innovation (NAIP creation module framework) has changed the harvest financial aspects. It has prompted changes in input use example and work use. The reception of new innovation expanded the yield of saffron and the corms pushing the gross and net returns up by 208.7 percent and 260.5 percent in ex-ante study and 138.4 percent & 185.5 percent in ex-post examination separately, consequently builds the attractive excess generously. Moreover, the expense of development was essentially higher by 50.9 percent and 76.2 percent under ex-ante and ex-post examinations individually. The capability of the improved innovation could be decided

by the way that its utilization expanded the profits per rupees contributed by around 104.8 percent and 22.6 percent under ex-ante and ex-post investigations separately. The other financial ramifications were the increment in the work by 40.6 percent and 28.3 percent and homegrown utilization by 67.44 percent under ex-ante and ex-post investigations separately, showing that the appropriation of the new innovation improved the financial status of the adopters (Table 1 and 2).

Table 2: *Impact of improved production system module on saffron growers (Ex-post).*

Particulars	Before technology	After Technology	(%) Change
Saffron Yield (Kg/ha)			
Main Product			
Stigmas	2.48	4.39	77.0
By Product			
Stamens	2.45	4.24	73.1
Petals	22.6	34.1	50.9
Corms yield (q/ha)	9	15	150.0
Gross returns (Rs/ha)	343413	818610	138.4
Cost of cultivation (Rs/ha)	161974	313750	86.8
Net returns (Rs/ha)	206353	605407	185.5
Cost of production (Rs/kg)	60468	106529	76.2
Returns per rupee invested (Rs/ha)	2.12	2.60	22.6
Labour productivity (kg/ha)	0.016	0.021	31.3
Marketable surplus(kg/ha)	2.44	4.32	77.0
Employment (human-days/ha)	219	281	28.3
Domestic consumption (kg/ha)	0.043	0.072	67.4

Partial budget estimates

Fractional planning was utilized to additionally survey the effect of reception of improved innovation regarding net monetary increases. The outcomes uncovered that new innovation required more expenses on human work and corms representing Rs 84892/ha and Rs 154287/ha under ex-ante and ex-post examinations separately. Notwithstanding, the credit side shows significant additions as expanded saffron respect the tune of 3.55 kg and 1.91 kg per hectare and corm yield 6 q per hectare individually under ex-ante and ex-post examinations, adding up to the absolute credit of Rs 549898.8/ha & Rs 475404/ha separately. The net change in restores prompted an expanded

measure of Rs 465006.8 ha⁻¹ & Rs 321117 ha⁻¹ under ex-ante and ex-post investigations separately (Table 3 and 4). Consequently, it very well may be inferred that the selection of new saffron innovation improved the occupation by producing extra work and pay.

Aggregate benefits

Economic surplus model appraisals are introduced in Table 5 and 6. The value versatilities of interest and supply of saffron were assessed through utilitarian investigation utilized on optional and essential data gathered on costs from the makers and shoppers (from different pay gatherings) relating to different timeframes in a year. The assessments of interest and supply flexibility in this way got were 0.31 and 0.21 individually under both ex-ante and ex-post examinations. The investigation showed a huge improvement in yield level in the examination region on selection of new innovation. Evaluations of ESM uncover that on every rupee contributed, the advantage cost proportion was 39.53 and 37.3 and the IRR 112% and 110 percent, under ex-ante and ex-post examinations individually.

Conclusions and Recommendations

This investigation has given assessments of potential and acknowledged monetary advantages from reception of new innovation. The appraisal of innovation uncovered that its selection increment the creation of saffron as well as guarantees a normal saffron profitability acquire from 2.5 kg/ha to about 6.37 kg/ha (1-2 kg/ha in the main year to 10-12 kg/ha in the fourth year of Planting cycle) over the creation time of 4 years. Despite the fact that at miniature level the expense of development under new innovation was high when contrasted with old innovation, however it profited adopters as higher profitability and at large scale level created work openings (both talented and untalented work man days). The assessment of monetary overflow model uncovers a potential yield gain of 1.42 kg/ a however real yield acknowledged was 4.39 kg ha⁻¹ against expected capability of 6.05 kg/ha in improved creation framework (for example just 77 percent expansion against a capability of 142 %), likely BCR of 39.53 yet acknowledged BCR was 37.27 and the potential IRR was assessed as 112 percent, while as the acknowledged IRR was every available ounce of effort, showing the capability of the innovation to build the financial prosperity of the saffron makers. The outcomes recommend that the post-harvest treatment of saffron is a significant

Table 3: *Partial Budgeting of improved production system module (Ex-ante).*

Debit		Credit	
Particulars	Amount (Rs/ha)	Particulars	Amount (Rs/ha)
Increase in cost per hectare		Increase in income per ha	
Corms 3 q@ Rs 13464	40392.0	Saffron yield 3.55 kg@ Rs 132145	469114.8
Human labour 89 man days @ Rs 500 per day	44500.0	Corms yield 6 q/ha @ Rs 13464	80784.0
Decrease in income per hectare	0.00	Decrease in cost per hectare	0.00
Total (Rs)	84892.0		549898.8
Net change (Rs)	465006.8		

Table 4: *Partial Budgeting of improved production system module (Ex-Post).*

Debit		Credit	
Particulars	Amount (Rs/ha)	Particulars	Amount (Rs/ha)
Increase in cost per hectare		Increase in income per ha	
Inputs (Corms)		Main product (Stigmas)	
<i>Quantity effect</i>		<i>Quantity effect</i>	
Increase in corm use 3.54 q/ha @ Rs 13987	49514	Increase in saffron yield 1.91 kg/ha@ Rs 132145	252396
<i>Price effect</i>		<i>Price effect</i>	
Pre technology Corm use 6.75 q/ha @ Rs 3848*	25974	Pre technology saffron yield 2.48 kg/ha @ Rs 33854*	83958
Inputs (Labour)		By product (Corms)	
<i>Quantity effect</i>		<i>Quantity effect</i>	
Increase in human labour 62 man days @ Rs 484 per day	30008	Increase in corm yield 6 q/ha @ Rs 13987	83922
<i>Wage effect</i>		<i>Price effect</i>	
Pre technology human labour 219 man days @ Rs 94* per day	20586	Pre technology corm yield 9 q/ha @ Rs 3848*	34632
Inputs (Fertilizers)		By product (Stamens)	
Organic and inorganic fertilizers	28205	<i>Quantity effect</i>	
		Increase in stamens yield (by product) 1.79 kg/ha@ Rs 4133	7398
		<i>Price effect</i>	
		Pre technology stamens yield (by product) 2.45 kg/ha @ Rs 2133*	5225
		By product (Petals)	
		<i>Quantity effect</i>	
		Increase in petals yield (by product) 14.5 kg/ha@ Rs 304	4408
		<i>Price effect</i>	
		Pre technology petals yield (by product) 22.5 kg/ha @ Rs 154*	3465
Decrease in income per hectare	0.00	Decrease in cost per hectare	0.00
Total (Rs ha ⁻¹)	154287		475404
Net change (Rs ha ⁻¹)	321117		

Note: * Price differential = Price after technology – price before technology.

territory associated with its creation and advertising requesting foundation of preparing units and labs for its post-gather taking care of particularly drying and pressing. The investigation further recommends that strategies should be advanced by the Government of India towards its proficient evaluating, marking and naming which were seen to be significant determinants of its exchange and are required to help in

contending in the global market. The results suggest and advise that the postharvest dealing with of saffron is an crucial area involved in its manufacturing and advertising and marketing disturbing status quo of processing devices and labs for its post-harvest managing specially drying and packing. The study further suggests that guidelines want to be evolved by way of the Government of India clos-

er to its efficient grading, branding and labelling which were found to be important determinants of its exchange and are predicted to assist in competing within the global market.

Table 5: *Returns from Investment on New Technology revealed through Estimates of Economic Surplus Model (Ex-ante).*

Particulars	Values
Yield change/ha	1.42
Variable cost change/unit of output	5.31
Target area (%) to be covered in 2020	75
Time to achieve maximum adoption	2014-2020
Elasticity of supply	0.21
Elasticity of demand	0.31
Annual growth in area (%) during 1983-2013	0.08
Prob. Success	1
NPV(cr)	161.06
IRR	112%
BC Ratio	39.53

Table 6: *Returns from Investment on New Technology revealed through Estimates of Economic Surplus Model (Ex-post).*

Particulars	Values
Yield change Kg/ha (%)	77
Variable cost change per ha (%)	85.5
Target area to be covered in 2020 (%)	70
Time to achieve maximum adoption	2014-2020
Elasticity of supply	0.21
Elasticity of demand	0.31
Prob. Success	0.7
NPV(cr)	132.8
IRR	110
BC Ratio	37.27

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Novelty Statement

This is a worldwide based approach to measure the
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impact of pesticide residues on human health and ecological biosphere.

Author's Contribution

Masudul Haq Wani: Designed methodology, provided suitable input while writing the description of the paper.

Arshad Bhat: Collected, tabulated and analysed the data, wrote the interpretation of the article.

Conflict of interest

The authors have declared no conflict of interest.

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