"Comparative Study of Open and Indoor Cultivation of Saffron in Pulwama District of Union Territory of Jammu & Kashmir"

Aqib Bashir
2018-HBM-12-M

School of Agri-Economics and

Horti-Business Management

Faculty of Horticulture

Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir

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MBA Project Report

Submitted to

Faculty of Horticulture

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir in partial fulfillment of requirements for the award of the degree of

Master of Business Administration
(Horti-Business)

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I dedicate this dissertation

to my parents.

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir
Faculty of Horticulture,
School of Agricultural Economics and Horti-Business Management

Certificate – I

This is to certify that the MBA Project Report entitled **"Comparative Study of Open and Indoor Cultivation of Saffron in Pulwama District of Union Territory of Jammu & Kashmir"** submitted in partial fulfillment of the requirements for the award of the degree of **Master of Business Administration (Horti-Business),** to the **Faculty of Horticulture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir** is a record of bonafide research work carried out by **Mr. Aqib Bashir (Regd. 2018-HBM-12-M)** under my supervision and guidance. No part of the dissertation has been submitted for any other degree or diploma.

It is further certified that any help or information received during the course of investigation has duly been acknowledged.

Endorsed

(Dr. Kusumakar Gautam)
Chairman
Advisory Committee

Head,
School of Agricultural Economics and Horti-Business Management

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir
Faculty of Horticulture,
School of Agricultural Economics and Horti-Business Management

Certificate – II

We, the members of the Advisory Committee of **Mr. Aqib Bashir (Regd.No.2018-HBM-12-M)** a candidate for the degree of **Master of Business Administration (Horti-Business)** have gone through the manuscript of the MBA Project Report entitled, **"Comparative Study of Open and Indoor Cultivation of Saffron in Pulwama District of Union Territory of Jammu & Kashmir"** and recommend that it may be submitted by the student in partial fulfillment of the requirements for the award of the degree.

Advisory Committee

Major Advisor	**Dr. Kusumakar Gautam** Assistant Professor SAE & HBM, FoH, SKUAST-K, Shalimar
Members	**Dr. Mudasir Ahmed** Assistant Professor GPB, ARSSS, SKUAST-K, Shalimar
	Dr. Junaid Nazir Khan I/C Head Soil and Water Conservation Engineering CoAE& T, FoH, SKUAST-K, Shalimar
	Dr. Abid Sultan Assistant Professor SAE & HBM, FoH, SKUAST-K, Shalimar
Dean's Nominee	**Dr. M. S. Pukta** Division of Agri Stat, FoH. SKUAST-K

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir
Faculty of Horticulture,
School of Agricultural Economics and Horti-Business Management

Certificate – III

This is to certify that the Project Report entitled, **"Comparative Study of Open and Indoor Cultivation of Saffron in Pulwama District of Union Territory of Jammu &Kashmir"** submitted by **Mr. Aqib Bashir (Regd. No. 2018-HBM-12-M)** to the **Faculty of Horticulture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir** in partial fulfilment of the requirements for the award of the degree of **Master of Business Administration (Horti-Business)** was examined and approved by the Advisory Committee and External Examiner on …….

Chairperson **External Examiner**
Advisory Committee

Head,
School of Agricultural Economics and Horti-Business Management,

Dean,
Faculty of Horticulture,
SKUAST-Kashmir

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Aqib Bashir

Place: Shalimar, Srinagar
Dated:

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Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir
Faculty of Horticulture
School of Agricultural Economics & Horti-Business Management

Name of the student : **Aqib Bashir**

Registration No. : 2018-MBA-12-M

Major subject : Horti-Business Management

Major advisor : **Dr. Kusumakar Gautam**
Assistant Professor, School of Agricultural Economics & Horti-Business Management, SKUAST-Kashmir

Title of the Thesis : **"Comparative Study of Open and Indoor Cultivation of Saffron in Pulwama District of Union Territory of Jammu & Kashmir"**

EXECUTIVE SUMMARY

The present study titled **"Comparative Study of Open and Indoor Cultivation of Saffron in Pulwama District of Union Territory of Jammu & Kashmir"** was carried out keeping in consideration the growth potential for indoor cultivation in the saffron in the UToJK. This study has chalked out the immense scope of growing saffron under indoor cultivation. The literature review sites the possible increment in production and productivity using limited land resources. The present study was purposively carried out in District Pulwama Kashmir division based on the objectives of study. Only one block i.e., Pampore from Pulwama district was selected based on the convenience and the booming productivity in the only region of India. Total of 90 respondents were selected from the Pampore tehsil using stratified simple random sampling. A well-structured questionnaire was formulated for the survey and distributed among the selected respondents. Primary data was collected from respondents by face-to-face interaction and secondary data was collected from ARSSSS, Dusoo. The present study attempted to analyze the costs, returns and profitability of saffron in both open cultivation as well as indoor cultivation. The data revealed that the cost of cultivation in open field conditions was much lower than that of the indoor conditions. However, the returns were proportionally higher in indoor cultivation compared to that of open cultivation. Average Cost of Cultivation in

open conditions was found to be 188716 Rs/ha while that of Indoor cultivation, the average cost was found out to be 15905269 Rs/ha and the average returns from the open cultivation and indoor cultivation was found out to be 316691 Rs/ha and 45941704 Rs/ha respectively. The potential impact of indoor cultivation on production, productivity and marketability of saffron in Kashmir was carried out. The production and productivity of saffron under indoor conditions was found better than open field cultivation of saffron. The productivity of indoor cultivation was found out to be 208.5 kg/ha in 6 tier system and that is 34.75 kg/ha per tier. compared to 1.87 kg/ha in open field cultivation of saffron. Marketing system of saffron obtained from open cultivation in Kashmir was found highly unorganized, as it has been largely in the hands of private enterprises, and there exists a long chain of intermediaries between the producer and the ultimate consumer. However, the marketing system of saffron obtained from indoor cultivation was found out to be highly organized with zero intermediary interventions. The study in the end comes with few policy suggestions for eradicating the existing problems of production, productivity and marketability of saffron.

Key words: Saffron, Indoor Cultivation, Open Field Cultivation, ARSSSS, Pampore.

Signature of Student

Dated:_____

Signature of Major Advisor

Dated:_____

LIST OF ABBREVIATIONS

CGR	Compound Growth Rate
FIMASAFRAN	Saffron Farmers Federation
GVA	Gross Value Added
J&K	Jammu & Kashmir
ICARDA	International Center for Agricultural Research in the Dry Areas
MT	Million Tonnes
NHB	National Horticulture Board
NHM	National Horticulture Mission
RKVY	Rashtriya Krishi Vikas Yojana
SGDP	State's Gross Domestic Product
HMNEH	Horticulture Mission for North East and Himalayan States
UAE	United Arab Emirates
UToJK	Union Territory of Jammu and Kashmir

Chapter-1

INTRODUCTION

Indian economy is in a general sense Horticulture based and is considered as the sunrise sector. The rich variety in crops and different agro-climatic conditions and hereditary assets empower India to create a wide assortment of agricultural harvests round the year. Horticultural crops in India are being cultivated in 25.24 million hectares, which is around 7 percent of India's total cropped area (2016-17). The production of fruits and vegetables is presently more significant than the production of food grains in the country. The total horticulture production has expanded from 211.2 million tons in 2007-08 to 310.74 million tons in 2018-19. (Table 1.1) India is the second largest producer of fruits and vegetables in the world. Among vegetables, India ranks second in the production of potato, onion, cauliflower, brinjal and cabbage. In fruits, it is the largest producer of banana, mango, guava, lemon and papaya. In late many years, this area has acquired conspicuousness over contributing a Gross Value Addition of the Agriculture and associated areas. Furthermore, India is the leading producer of spices and condiments. It is known as "The land of Spices" with its rich flavor legacy and production predominance. The assessed production of spices is more than 3 million metric tons (Table 1.2). Some of the significant spices of India are pepper, cardamom, bean stew, ginger, turmeric, coriander, cumin, fennel, fenugreek, celery, saffron, tamarind and garlic. Saffron is a local of Southern Europe. It is developed in Spain, France, Italy, Austria, Greece, Iran, Turkey, Persia, England, India and China. In India, it is generally developed in the Pampore area of Jammu and Kashmir and different locale like Budgam, Srinagar and Kishtwar.

Table 1.1: Area & Production of Horticulture in India

Horticulture	2018-19	2019-20*
Area (Million Hectare)	25.43	25.61
Production (Million Tonnes)	310.74	313.35

*Source: National Horticulture Board (NHB)**1st Advanced Estimate

Table 1.2: Area & Production of Spices in India

Spices	2018-19	2019-20*
Area ('000 ha)	3960	3866
Production ('000 MT)	9428	9372

*Source: National Horticulture Board (NHB)** 1st Advanced Estimate

Saffron (Crocus L.) has a place with the subfamily Crocoideae, the biggest of the four subfamilies as of now perceived in Iridaceae family (Goldblatt *et al.,*2006). The genus comprises of 88 small, corm-bearing, perennial species distributed in Central and Southern Europe, North Africa, and from Southwest Asia to Western China (Mathew 1982; Petersen *et al.,*2008) and are profoundly esteemed as garden plants for their beautiful blossoms, horticultural assortments, for industrial applications and as remarkable collector's things (Rashed-Mohassel 2007; Petersen *et al.,*2008). Most of species and subspecies are limited to Turkey and the Balkan Peninsula. Only Greece is country of 40 percent of the world's wild Crocus variety (Tsoktouridis *et al.,* 2009) while a total of 32 species (18 of them being endemic) are included in Turkey′s flora (Arslan *et al.,* 2007). Several nations have likewise representatives of some Crocus species including Italy (10 species), Spain (6 species), Hungary (6 species), and others.

The genus is principally known by *Crocus sativus* commercially developed for the production of the spice saffron (Fernández 2004). Saffron is a high-value, sustainable crop where improvement is conceivable through exploitation of biodiversity, and it contains numerous novel or ineffectively

described bioactive particles consistent with its utilization as a spice and medicinal enhancement more than millennia (Abdullaev 2002, 2004; Abdullaev and Espinosa-Aguirre 2004; Radjabian *et al.,*2009; Dalezis *et al.,*2009). Saffron spice is produced using the dried stigmas of the saffron bloom (C. sativus), a triploid sterile plant categories that is vegetative produced by means of corms called bulbs or "onions". Iran, India, Spain and Greece are the significant saffron creating nations with Iran involving the greatest region and contributing about 88 per cent of world's saffron production (Table 1.3).

Table 1.3: Area and Production of Saffron in the world

Country	Area (ha)	Production (MT)	Yield (kg/ha)
Iran	43,408	174	4.00
India	4265	7.50	2.29
Greece	1000	4.30	4.30
Azerbaijan	675	3.70	5.48
Spain	600	5.00	2.00
Morocco	500	1.00	2.00
Italy	29.4	0.24	**8.16**
Total	**494477.4**	**195.74**	**3.96**

Source: Menia et al. 2018

However, India occupies the second largest area yet delivers around 7 per cent of the all world production. Jammu and Kashmir is the solitary state in India where saffron is produced. The main saffron developing nations like Iran, Spain and Greece with intensive production innovations are able to accomplish higher production and productivity than our productivity and presenting extraordinary threat to our saffron industry as imports are expanding each year. Subsequently,

there is a need to increase production by bringing more area under cultivation and twofold the average productivity by embracing intensive production framework, efficient processing and marketing to make it worldwide competitive and gainful to cultivators.

The entire territory of UToJK under saffron cultivation in J&K is 3715 ha with production and productivity of 16 MT and 3.0 – 4.0 kg/ha, individual (Table 1.4). Saffron in J&K is basically cultivated in four regions (Pulwama, Budgam, Srinagar, Kishtwar) with 86 per cent saffron cultivating framework in legacy site of Pampore over more than 3200 hectares.

Table 1.4: Area, production and productivity of saffron in Jammu & Kashmir

Year	Area, (ha)	Production, (MT)	Productivity, (Kg/ha)
1996-97	5707	15.85	2.8
1997-98	4161	12.88	3.13
1998-99	2880	7.65	2.27
1999-00	2742	3.59	1.88
2000-01	3075	0.3	1.57
2001-02	2989	6.5	2.96
2002-03	2928	5.15	1.66
2003-04	2436	6.86	3.75
2004-05	3110	7.04	1.63
2005-06	3130	6.5	2.25
2006-07	3010	8.2	2.15
2007-08	3000	7.7	2.5
2008-09	3280	9.46	2.34
2009-10	3785	9.55	2.5
2010-11	3790	8.85	2.52
2011-12	3674	10	2.72
2012-13	3674	11.5	3.13
2013-14	3674	15	4.08
2014-15	3674	9.6	2.61
2015-16	3674	10.2	2.80

Source: NHB

Jammu and Kashmir State of India enjoys a virtual monopoly in the cultivation of saffron in the sub-continent, and contributes around 99 per cent of the national saffron production. Around seven lakh individuals across 226 villages are exclusively subject to saffron cultivation for their livelihood (Gurkoo, 2007). Saffron is a vital cash crop and second largest agri-arranged business activity after fruit production in the State of Jammu and Kashmir. It is perhaps the one of the main foreign exchange earners, as around 50 per cent of its produce is sent out of the country. The saffron of Kashmir is acclaimed globally as of unrivaled quality and is consistently in high demand (Munshi, 1992).

The State of Jammu and Kashmir in India produces 8 to 10 tons of Saffron, (Tantry *et al.,* 2017). The demand for unadulterated and quality saffron at the worldwide level is extremely high. World production isn't sufficient to fulfil the developing worldwide need. Additionally cost of production in European nations is extremely high with odds of its horizontal expansion in production comparatively low. It is here that the nations like India with gigantic human asset have extension to advance and grow saffron production and become the main exporters in the worldwide market. Presently once recognized the competitive inflexion point, there is a requirement for a planning to accomplish it. This should be possible by expanding the area, upgrading the production, improving post-harvest, handling and packaging, and improving the marketing system of the crop, and subsequently the profitability. Another methodology is cultivation under protected environment/indoor cultivation like greenhouses. Uncontrolled and unpredictable climate like high wind, warm and humid environment, an extreme cool to extraordinary hot forces to the farmer and researcher to build up an innovation for development of crops under prevailing unfriendly environment conditions. Protected cultivation, which incorporates polyhouse, conceal/shade net, poly-tunnel, poly-mulch, and so forth, secures the rural/agricultural yields from abrupt changes in climate and directs the climate inside these constructions (Negi *et al.,* 2013). Greenhouse/poly house/net house are appropriate innovation

for all year and off season crop production. The indoor crop cultivation innovation can be used for the production of high worth, low volume crops, pest free/quality seedlings, quality mixture seed creation and as a device for sickness obstruction reproducing programs. The need of in house cultivation since last 10 years has significantly expanded. The different reasons for the protected/in house cultivation are decreased weed pressure, conservation of moisture, decrease of certain insect pests, higher crop yields, and more effective utilization of soil supplements (Negi *et al.,* 2013).

This act of developing crops in protected environments otherwise called in-house or indoor cultivation of crops, adopted by developed and developing nations to improve productivity round the year. Indoor cultivation, which empowers some control of wind speed, dampness, temperature, mineral supplements, light intensity, and atmospheric arrangement, has contributed and will keep on contributing a lot to a superior comprehension of growth factor prerequisites and contributions for improving yield efficiency in open fields. Protected/Indoor cultivation is an exceptional and specific type of horticulture. Devices or advancements for protection or constructions perhaps utilized with or without heat. The expectation is to develop crops where otherwise they couldn't survive by altering the natural habitat to delay the reap/harvest period, frequently with prior development to expand yields, improve quality, upgrade the strength of production and make commodities accessible when there is no open air production. The essential accentuation is on delivering high-value plant crops.

Indoor or in-house cultivation practices can be characterized as cropping procedures wherein the micro climate encompassing the plant body is controlled mostly/completely, according to the prerequisites of the plant species grown, during their time of development (Mishra *et al.,* 2010). The different kinds of in house cultivation have been adopted based upon the prevailing climatic condition. Among them, greenhouse/poly-house is very helpful for round-the-year crop development in temperate condition (Mishra *et al.,* 2010). In house cultivation

otherwise called Controlled Environmental Agriculture (CEA) is profoundly gainful, preservation of water and land and furthermore defensive of the environment (Jensen, 2002).

Production territories, constructions, and crops have been extending quickly during the previous century. All along, agrarian production has been basically outside in open air. It is an important industry that is principally environment and climate dependent. Indeed, the most determinate factor in horticultural crop production is the environment (Trivedi and Singh, 2015). There are various benefits in protected cultivation compared to open-field cultivation; e.g., (1) decrease of life cycle from planting to harvest; (2) decrease in water utilization; (3) broadened length of temperatures above 20°C; (4) higher pace of photosynthesis; (5) protection against wind and other climatic conditions; and (6) expanded bunch and finger weight (Galan Sauco *et al.,*1998). Moreover, in protected cultivation, chilling injury and low temperature contrasts don't contrarily influence the plants. The fundamental benefit of protected cultivation is that the yield and quality are higher.

Among the greatest constraints in open field crop production are an absence of daylight, temperatures that are either excessively hot or excessively chilly, dampness inadequacies or abundances, weed development, insufficiencies in soil supplements, extreme wind speed, and environmental carbon dioxide. A large portion of these are climatic variables or straightforwardly identified with them (Max *et al.,* 2009), high insect pest infestation pressure (Nguyen *et al.,* 2009) and fungal diseases (Sringarm *et al.,* 2013). Large numbers of these limitations have been mitigated or reduced by protected cultivation or controlled environmental conditions.

Climate is the most determinate factor in horticultural crops (Trivedi and Singh, 2015). Protected cultivation is being utilized to control the impact of climate impact. Protected cultivation is the sustainable methodology toward the crop production under unfriendly environment. Furthermore, from protection to

antagonistic climatic condition, the crops under protected cultivation yield great harvests in terms of shape, size and colors. (Sringarm *et al.,* 2013). The micro environment can be changed inside the poly house. Certain insects require UV light, the UV dark covering material for poly house assists with limiting the insect to go into the house. Thus, there is least utilization of insect spray. The production of plant crops is higher than the open field condition because of suitable inside microclimate. The Protected cultivation contains various gadgets and advances namely windbreaks, water system, oil mulches and so forth and the constructions which are greenhouse, tunnel, row covers made the production round the year by altering the indigenous habitat (Trivedi and Singh, 2015). It will additionally drag out the collect time frame, increment yield, quality improvement, and keep the accessibility of commodities oftentimes.

It is the conventional production framework, which depends upon the control over the nature of root media through tillage, compost, manure/fertilizer application and water system i.e., irrigation scheduling. It's anything but a matter of care about light, temperature, air quality, relative humidity that influence the crop production in the open field condition. In houseor indoor cultivation can be utilized as one of the answers for above parameters.

The absence of water is the absolute most significant natural hindrance to plant development and worldwide food production. Water is our generally valuable and most squandered asset.

The best yield misfortunes in the United States from 1930-78 were brought about by drought. Losses from drought were practically equivalent to any environment prompted misfortunes, including excess water, floods, cold, hail, and wind (Boyer, 1982).

Controlled-environment horticulture or protected cultivation or in house cultivation has now reached out a long ways beyond the domains of crop irrigation and water management. There are different constructions and

technologies utilized for plant protection. All plant species have an ideal range for each ecological factor. Introducing a screen or shelter modifies the energy and other exchanges between the entire plant (or a piece of it) and the climate. The position of the screen or shelter, comparative with the plant, decides the kind of protection. In mulches, the screen is situated underneath over the ground portions of the plant, over the soil. Greenhouses, tunnels and direct covers are different types of protection, where the screen is put over the plants as a cover. Windbreaks are put laterally to the plants (CPA, 1992).

The general target of indoor cultivation is to change the natural habitat by practices or designs to accomplish ideal productivity of crops by upgrading yields, improving quality, broadening the harvest period, and extending production areas. There are additionally explicit goals and benefits in chosen topographical zones for restricting precipitation and hail harm and decreasing high sun radiation by concealing. The general goal is the best utilization of land, water, energy, mineral supplements, and space, and the climatic assets of daylight, temperature, relative moistness and air CO2.

Different studies show that tomato yields expanded by 192 per cent in soilless culture contrasted with soil-based ensured culture in UAE. Hydroponics additionally saved nearly 120 m^3 of water for every ton of tomato contrasted with traditional soil frameworks. Cucumber yields expanded by 40 per cent in soilless closed frameworks in Oman, and decreased water use and the use of manures and pesticides. Across the Arabian Peninsula, hydroponics with ideal crop management expanded water productivity fifteen-fold, contrasted with conventional field production. Farmers have been able to recuperate the expense of greenhouse construction within two years (ICARDA).

By and large, there are more than 50 nations around the globe where cultivation of crops is embraced on a commercial scale under cover. The United States of America has a total area of around 4000 ha under greenhouses generally utilized for floriculture with a turnover of more than $ 2.8 billion per annum. The

region under greenhouse cultivation is expected to go up impressively, if the expense of transportation of vegetables from adjoining nations keeps on rising. The area under greenhouse cultivation in Spain has been assessed to be around 25,000 ha and Italy has 18,500 ha generally utilized for developing vegetable crops like watermelon, strawberries, beans, cucumbers and tomatoes. China has adopted greenhouse technology undeniably of around 2,000,000 hectares.

As of now region under protected cultivation of horticultural crops is just around 40,000 ha and out of which huge portion generally in northern pieces of India isn't effectively being used for protected cultivation (Singh, 2014).

The Government of India has started various schemes like National Horticulture Mission (NHM), National Horticulture Board (NHB), Rashtriya Krishi Vikas Yojana (RKVY) and Horticulture Mission for North East and Himalayan States (HMNEH) for the advancement and improvement of protected cultivation. The major scheme is NHM, which offers a 50percentubsidy for setting up of protected cultivation structures and furthermore gives 50 per cent subsidy for acquisition of planting materials and development of vegetables and owners under polyhouse/conceal net house. With these interventions, the zone accomplished under secured development by NHM in India was 14136 ha during 2005-06 to 2017-18 (Prakash *et al.,* 2009).

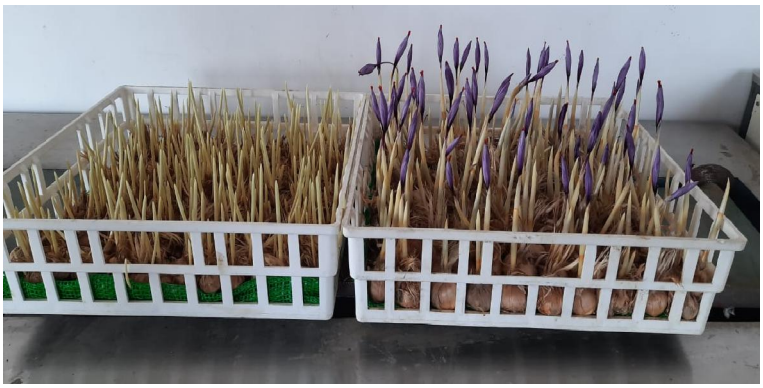
Indoor cultivation/ Protected cultivation/Greenhouse technology has huge prospects especially for the horticulture sector of UT of J&K. The production and productivity have increased manifold due to this technology especially in the high value crops low volume crops, seeds and planting materials, off season fruits and vegetables, like tomato, cucumber, capsicum, Brinjal, Garlic, Cucurbits etc. Therefore it's imperative that saffron being the most important high value & low volume cash crop of UT of J&K has tremendous potential to be cultivated under indoor/protected cultivation. Various studies suggest that the production of Saffron under greenhouse circumstances an be 10 to 12 times higher than the production achieved under open field cultivation.

Indoor Saffron Cultivation at ARSSSS:

Indoor Saffron Technology has been developed by SKUAST-Kashmir for the industrialists as well as the interested farmers who have small land holding. A 20 x 20 ft multitier structure can yield at least 1.0 -1.5 kg of saffron. After uprooting of corms from the field in June, they are kept under complete darkness for the period of 90 days from 25th of June to 25th of September under room temperature. After dark period the corms are put on trays in racks without any media at ultra-high density. The flowering begins at day temperature of 20-23 ^{O}C and night temperature of 10-12 ^{O}C from 25th of October and completes upto 2nd of November. After harvesting of flowers the lateral buds of the corms are detached and only apical bud is kept for planting. The corms are planted in raised beds having high nutritional status and good texture for desired corm development and required chilling requirements. All other intercultural operations are similar as per the recommended package.

In purview of this, the current study titled as "Comparative Study of Open and Indoor cultivation of Saffron in Pulwama District of Union Territory of Jammu & Kashmir" aims at exploring the potential of saffron production under in house conditions with following objectives:

1. To compare the costs, returns, and profitability associated with saffron cultivation in study areas under open and protected cultivation.
2. To study the potential impact of in house cultivation on production and productivity of saffron.
3. To identify the problems associated with production and marketing of saffron and suggest suitable mitigation measures based on the study.



Chapter-2

REVIEW OF LITERATURE

Cavusoglu and Erkel (2009) performed out the analyses for the prospects of greenhouse condition for saffron stigma and corm production and expanded the harvest period. In light of the outcomes, huge size mother corm dimension gave statistically significant outcomes than the small corms for the most parameters (quantitative characters, first and last blooming date, reap period, blossom number, fresh saffron stigma yield, dry saffron stigma yield) studied in the first year. Results showed that in the second year saffron stigma yield parameters expanded in both the large size and small size corms and in the third year stigma yield diminished. Harvested corms showed an increment in small corms and lessening in large corms. From their investigation it could be deduced that if the point is stigma production, their plantation can be endured successively two years while for corm production, plantation can be set for just a single year.

Cavusoglu *et al.* (2009) carried out an examination on saffron and researched the saffron profitability utilizing 2 diverse horizontal corm measurements (A size with 10-24 mm and B size with 25-40 mm) under greenhouse condition in fall-winter season in Kacoeli region of Turkey. Examinations on the treatments were: first-last blooming time (date), harvest periods (absolute days), blossom number (blossoms/plant), fresh saffron stigma yield and dried saffron stigma yield. Results of this investigation showed that, with B corm measurement on the whole parameters were higher than a corm measurement. Their examination recommends that huge size corm measurement significantly affects fresh or dry saffron yield and to expand reap period. Then again in their environment, saffron can be developed effectively under greenhouse condition.

Parray *et al.* (2012) examined the cormlet production of saffron *in-vitro* conditions and the blooming response under greenhouse conditions. In this study,

they have described a total protocol for the saffron corm let production under *in-vitro* conditions and subsequent blossoming under greenhouse conditions. It was seen that a fruitful blossoming could be accomplished from *in-vitro* raised corm lets under greenhouse.

Medany *et al.* (2009) noticed a higher yield of mango when utilizing a white net contrasted with open field conditions. The decrease of radiation is responsible for the down-regulation of the leaves' photosynthetic potential and, therefore, a lower saturated photosynthetic light intensity contrasted with the control (Gindaba and Wand, 2007).

Kaur and Kaur (2017) assessed the exhibition of papaya (Carica papaya) cv. Red lady 786 under different growing conditions. The plants under net house showed an expansion in fruit length (22.68 cm), broadness (11.93 cm), weight (874.32 g) and fruit volume (895.16 cc). Additionally, higher fruit yield was acquired from the plants under the net house (35.15 kg/plant) when contrasted with an open field (21.87 kg/plant).

Prakash *et al.* (2015) analyzed yield qualities in papaya assortment Pusa Nanha under polyhouse and open field conditions. The assessment of papaya under polyhouse showed higher fruit yield (34.56 kg/plant) when contrasted with open field conditions.

The quality and yield of raspberry (Rubus spp.) expanded in high tunnels (9630lb/section of land) contrasted with 5082 lb/section of land in an open condition. Furthermore, the fruit size was somewhat more noteworthy in this examination, with an overall average of 2.8 g per berry contrasted with 1.7 g in the first year of the external trial (Weber *et al.,* 2004).

Reddy and Gowda (2014) noticed papaya plants free from Papaya Ringspot Virus Disease (PRSV) in greenhouse conditions until the end of the investigation period, while the occurrence of open field PRSV happened at 163.23 days with a 100 percent rate. Nonappearance of disease might be because of the

insect-proof net exclusion of viruliferous aphids.

Cucumber production cultivated in PE sacks utilizing perlite, sand and volcanic scoria as substrates was superior to soil creation (Bas, 1991). Singh *et al.* (2007) that low-cost, naturally ventilated greenhouses were the most reasonable and prudent for all year cucumber cultivation on the northern fields of India. Capsicum is a most widely grown vegetable under green houses and gives higher yields (Chandra *et al.,* 2000).

Juntamanee (2013) researched the impact of plastic rooftop on canopy microclimate and found that irradiance level under plastic rooftop surpassed 1600 µmol PPF m-2 s - 1, which was 26 per cent lower than natural condition but considered as enough for net photosynthesis (Pn) of mangoes (*Mangifera indica*) while, in both day time and night, the plastic rooftop didn't bring down air temperature. The relative humidity estimated during the day under a plastic rooftop was lower than that under natural conditions, while the growing conditions didn't influence the relative humidity of the evening. These outcomes correspond with Iglesias and Alegre (2006), who reported a 2-6 per cent expansion in humidity related with the utilization of nets in "Mondial Gala" apples (*Malus domestica*). Jiang *et al.* (2013) detailed that impermeable plastics covering grapevine lines expanded air temperature and diminished photosynthetic radiation and wind speed.

Menzel *et al.* (2016) detailed that around 2 per cent of the strawberry fruit under the protected cultivation was influenced by rain, contrasted with around 10 per cent of the fruit under outdoor conditions.

Lawrence (1895) in his research highlighted that saffron has been utilized as an ingredient in Ayurvedic medicines by the popular Kashmiri Vaids, in particular, Vegbhatta and Sushtra. The recorded account of saffron development in Kashmir dates to year 550 AD, almost four centuries earlier than its recorded development in Spain by Arabs around the year 961.

Torkamani (2000) investigated the production and marketing of Iranian saffron. He saw that farmers didn't utilize a portion of the inputs ideally and an investigation of the technical efficiency showed that there was a tremendous potential for expanding the production by expanding farmers' efficiencies.

Mounira *et al.* (2016) examined participatory plant breeding of saffron, started in Morocco, under Green Morocco Plan Strategy and detailed that profitable cultivation is restricted by the low augmentation pace of chosen corms. The green Morocco Plan technique in the saffron area for the time frame 2012-2020, projected to build saffron region and to encourage the utilization of certified saffron corms. In this specific circumstance, determination program was started by the National Institute of Agronomic Research as a team with the Saffron Farmers Federation (FIMASAFRAN). For this reason, enormous field studies were led over 2 years (2014-2016) to accumulate a few local accessions gathered in the most saffron growing zone. These assortments will be followed up, utilizing a participative choice with farmers dependent on individual selection plants. Preliminary outcomes are promising for identification of promoting corms to be utilized in the micro propagation, to have homogenous clones as basis (corm) for beginning the huge multiplication program.

Toktam *et al.* (2016) estimated the technical proficiency of small and enormous saffron farms in Iran. They collected information from 170 surveys completed by saffron producers in Torbat-e-Heydarieh and Zaveh provinces in year 2014. To guarantee the precision of selected production function, the performance of three Cobb Douglas, Transcendental and Translog practical structures were tried. Results propose that Translog practical structure is the most proper structure for articulation of production technology of this product. In addition, the correlation of technical proficiency between two groups of farms shows that 49 per cent of little ranches and 18 percent of enormous farms work at inefficient degree of production. The enormous contrast between lowest and highest technical proficiency in huge farm group shows that there is an alternative

to build technical proficiency in these fields using great management practices.

Yildirim *et al.* (2016) considered impact of changes in various planting depths of saffron (*Crocus sativus* L.) corms and deciding their agronomic qualities under conditions of Turkish region of Hatay. The outcomes showed that the quantity of blossoms was positively influenced by medium and little circumference of corms at both planting depths. Surface planted corms showed expanded relatively regeneration of new corms. The stigma yield were positively influenced at various corms circumference in second year, however had no huge impact at various depths. Weight of collected corms was expanded by corms circumference at 15 cm planted profundity during second year. Particularly second year was better contrasted with the primary year when the corms expanded in circumference bringing about improved number of blossoms, stigma yield extraordinarily at 15 cm planting depth.

Zouahri *et al.* (2016) did portrayal of soils utilized for saffron creation in the Taliouine district, south of Morocco. During the investigation 33 locales were examined and portrayed by deciding pH, organic matter, phosphorus, potassium, exchange capacity, texture, saltiness, and absolute limestone. The investigation uncovered that soils utilized for saffron have a loamy fine texture with an alkaline pH that promotes the culture of saffron. Moderately significant degrees of organic matter clarify the high adsorbent force of nutrients in the soil under saffron, especially phosphorus and potassium. With respect to salinity, soils have a place with the non-saline soil class which was reasonable for growing saffron. Nonetheless, some high limestone levels in certain soils of the territory may significantly affect the quality of the saffron produced in these soils.

Munshi *et al.* (1989) saw that saffron is the most popular crop of J and K. It was developed over a region of around 3030 hectares delivering 9000 kgs of dry saffron. The productivity anyway remained very low.

Munshi (1990) believed that saffron is quite possibly the main foreign exchange earners among the spices of India. Grown mostly in the State of Jammu and Kashmir, this mono-crop is said to represent up to 2 percent of total export revenue. In any case, its market is concentrated in the hands of a couple of dealers and exporters, and a more competitive climate is alluring to raise its productivity and profitability. He saw that government intervention in explicit zones was expected to guarantee a superior price for the product and a predictable quality for export.

Munshi and Baba (1991) saw that saffron is the world's most costly spice. It is the spice of commerce getting Rs. 15000/- to Rs. 20000/- per kg. A yield of 2 kg for each hectare has been recorded for J&K State. Review led by the author in Pampore region uncovered that the normal yield went between 2-3 kg/hectare, while yield detailed from Spain was a lot higher, being around 10 kg of dry saffron per hectare.

Munshi (1992) investigated that the J&K State was the sole state growing saffron in tehsil Kishtwar of area Doda in Jammu Province and in the region of Pulwama, few parts in Srinagar, Budgam, and Anantnag in Kashmir Province and recommended that to set up production in the State, it is critical to advance varieties which are fit for fostering maximum economic yield and reliable in their performance in a given environment.

Sharma *et al.* (2012) expressed that there is huge opportunity for improving the production, productivity, and income of the saffron producers by improving their quality diversification of area, improving in packaging material, proficient marketing channel's proper distribution of price spread and so on will clearly bring about expanding the income and employment of the saffron cultivators.

Yasmin and Nehvi (2013) deduced in an investigation that cultivation of saffron is under danger of extinction and consequently warrants consideration of

scientists and policy makers. Like Kashmir, its recovery is to be adopted on mission mode approach, especially in the regions where its cultivation has been abandoned by the farmers. Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, India, and other International Organizations, have established research program for deliberate improvement of saffron from production to consumption framework.

Mysir *et al.* (2014) revealed for expanding production and productivity of saffron. There is need of the advancement of irrigation schemes and the use of drip and sprinkler and improving soils with suggested levels of fertilizers and manures and organic cultivation.

Saqib (2015) laid prominence on geographic indication as a branding tool for saffron. He announced that Kashmir has assortment of agrarian products and one agrarian product which should promptly be enrolled as Geographical Indication is "Saffron". "Kashmir Saffron" should be marked as Branding of saffron which will permit saffron growers to accomplish market recognition, distinguish their offerings, and gain legitimate protection and Geographical Indication can be the branding tool for it.

Nehvi (2016) while introducing a paper on Advance in Saffron Research for Integrated Development of Saffron in Kashmir-India announced that farming system connected to more than 16000 farm families, warranted attention of researchers and policy makers in 2000 as farmers had gotten capable about eventual fate of Kashmir saffron because of low economic returns. Further, noteworthy issues of conventional saffron value chain and gave solution for all missing connections for making farming system reasonable and economically practical. Research prompted improvement and release of GAP for saffron cultivation, mechanization, water management, integrated disease management and post-harvest management with an aim to increase twofold farmers' income and profitability. Innovations gave birth to National Saffron Mission for restoration of saffron Industry that has improved overall production from 9.6 MT (2009) to 15 MT (2013).

Chapter-3

MATERIAL AND METHODS

The research methodology employed for conducting the present study has been discussed in this chapter under the following headings:

3.1 Description of the study area

3.2 Sampling design

3.4 Data collection

3.5 Analytical framework

3.1 Description of the study area

The UT of Jammu and Kashmir is located in the north Western corner of India, extends between 32^{o}-17′ and of 37^{o}-5′ North parallels of latitude and 73^{o}-26′ and 80^{o}-30′ East of meridians of longitudes and 81^{o} East of Greenwich. The geographical position and the physiography offer the State wide-ranging climatic variation. The UToJK divided into three zones vis-à-vis sub-tropical, valley temperate & intermediate. The UToJK is mostly mountainous area and forms an essential position in the continent of Asia.

UT of J&K has agro-climatic conditions best suited for agriculture and horticulture. Agriculture/Horticulture is the mainstay of the rural economy, providing employment to large number of local inhabitants. The State's Gross Domestic Product (SGDP) grew at a Compound Annual Growth Rate (CAGR) of 10.30 percent, during 2011-12 to 2017-18.

The UT of Jammu and Kashmir is predominantly horticulture state. In J&K cultivators and those engaged in primary occupation constitute about 64.8 per cent of the total work force.

The Kashmir region or valley is a significant part of the UToJK. The mountains surrounding the valley make sure that the climate in Kashmir remains

pleasant throught out the year. Kashmir provides best yields in rice, saffron, vegetables and a variety of fruits. In UToJK, saffron is mainly cultivated in four districts, namely; Pulwama, Budgam, Srinagar and Kishtwar. District Pulwama known as saffron bowl of Kashmir, isone of the main contributors to saffron production .The proposed study was selected purposively in Pampore tehsil of Pulwama District.

3.2 Sampling design

Multi stage stratified Simple Random Sampling procedure was adopted to select the ultimate samples for the study. In first stage, districts were selected. In second stage, blocks were selected and finally villages and respondents were selected to obtain ultimate sample.

3.2.1 Selection of districts

The proposed study was selected purposively in one district i.e., Pulwama of Kashmir division due to following reasons:-

- Saffron is the major crop of Pulwama district and has the highest acreage in the entire J&K State. Pulwama district alone contributes about 80 per cent of the total saffron area/production in the State.
- Investigator's familiarity with the district helped in collecting the valid data from the respondents by explaining every question in their mother tongue (Kashmiri).

3.2.2 Selection of blocks

One block from the district i.e., Pampore from Pulwama was selected purposively due to following reasons:

- Saffron is grown on commercial scale in this tehsil and World's best saffron is grown in Pampore.
- The investigator had intimate knowledge about this Tehsil.
- In Pulwama, there are 11 blocks and Block Pampore being famous

worldwide has maximum area/production than rest of the blocks.

3.2.3 Selection of villages and respondents

A list of saffron growers was obtained from Nodal Officer, National Saffron Mission (NSM), Pampore and other sources. Out of the list, village wise beneficiaries were sorted out randomly from the villages Chandhara, Konibal, Dusso, Lethpora and Ladoo. A sample of 150 respondents was obtained by muti-stage stratified simple random sampling with large land holdings.

Table 3.1: Selection of villages and respondents

S. No	Villages	Acreage (hectare)	No. of respondents
1	Chandhara	45.3	30
2	Konibal	31.28	30
3	Dusso	36.65	30
4	Lethpora	46.50	30
5	Ladoo	28.00	30
Total		**187.73**	**150**

3.3 Data collection

The present study includes both qualitative and quantitative methods. Data was collected by using both secondary sources and primary field survey.

3.3.1 Primary data

The primary data on costs like irrigation, fertilizer, labour charges in man-days, harvesting and processing and returns including information on income, age and other socio-economic characteristics of respondents was collected through survey via personal interview method.

3.3.2 Secondary data

The secondary data was collected from the research materials provided by Directorate of Agriculture, Financial Commissioner's office, SKUAST publications, Directorate of Economics & Statistics, Horticulture-Planning & Marketing, Spices Board, Marketing officers, other relevant publications, etc.

3.4 Sample Description

3.4.1 Gender

During the survey it was observed that male participants were dominating females. Only 2 female farmers were identified and rest of the farmers were of male gender (Table 3.2).

Table 3.2: Gender profile of the sample

Gender	Number of farmers
Male	142
Female	08

Source: Author's Calculation based on primary survey

3.4.2 Age

During the survey it was observed farming is highly male dominant in the surveyed areas and female contribution to the agriculture is significant but not much recognized in the economic perspective.

Table3.3: Age profile of the sample

Age Groups	Frequency	Percentage
40-50	12	8.00
50-60	48	32.00
60-70	63	42.00
70-80	23	15.33
>80	4	2.66
Total	**150**	**100.0**

Source: Author's Calculation based on primary survey

3.4.3 Family Size

Table 3.4: Family Size profile of the sample

Family Size	Frequency	Percentage
2-5	23	15.33
5-10	89	59.33
10-15	27	18.00
>15	11	7.33
Total	**150**	**100.0**

Source: Author's calculation based on primary survey

3.4.4 Land holdings

Table 3.5: Land Holdings of the sample

Land Holdings (ha)	Frequency	Percentage
0-1	38	25.33
1-2	64	42.66
2-3	23	15.33
3-4	15	10
>4	10	6.67
Total	**150**	**100.0**

Source: Author's calculation based on primary survey

3.4.5 Primary Occupation

It refers to the main occupation of an individual respondent, used as the main source of income. All the respondents' primary occupation was found out to be farming.

3.4.6 Income

It is operationally defined as income of individual respondents derived from farm. Respondents were categorized by equal interval method.

Table 3.6: Income profile of the sample

Income from Farm	Frequency	Percentage
1 lakh -2 lakh	67	44.66
2 lakh- 3 lakh	42	28.00
3 lakh – 4 lakh	22	14.66
4 lakh – 5 lakh	14	9.33
>5 lakh	5	3.33
Total	**150**	**100.0**

Source: Author's Calculation based on primary survey

3.4.7 Analytical Procedures

Tabular Analysis was employed based on objectives of study.

- **Average Costs and Returns per hectare:** Per hectare average costs and returns are calculated by the total costs and return figures of all the farmers by total acreage under the crop. Net return is calculated by deducing the total costs per hectare from the total gross return per hectare which include the value of the main as well as the by product. The average costs and returns are calculated for open and in-house cultivation of saffron independently.
- **Net Returns per rupee of investment:** In order to see the profitability of investment in open and in door cultivation of saffron, the net return per rupee of investment is calculated by dividing the per hectare net return by the estimated per hectare cost of production.

- **Net Returns over various cost concepts:** In the cost of production studies, the determination of profit levels is significantly impacted by the elements of the costs being considered.

Cost A_1

I. Value of hired human labour

II. The value of bullock labour

III. Value of manure

IV. Field Preparation Cost

V. Value of fertilizers

VI. Irrigation

3.5 Feasibility analysis (Economics feasibility measures)

Economic feasibility measures like payback period, net present value, internal rate of return and benefit cost ratio are used to analyse the data.

3.5.1 Payback period (PBP)

The length of time required for an investment to recover its initial outlay in terms of profits or savings. Function of the following structural form will be employed to find the length of time required to recover the cost of an investment. (Financial and Managerial Accounting)

$$\text{Payback Period} = \frac{\text{Cost of the investment}}{\text{Annual net cash flow}}$$

3.5.2 Net present value (NPV)

Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyse the profitability of a projected investment or project. The following is the formula for calculating NPV:

$$NPV = \sum (Bt - Ct) / (1 + r)t$$

Where;

B = benefits in the year t,

C = costs in the year t,

i = selected discount rate, and

t = time period

Generally, an investment with a positive NPV will be a profitable one and vice versa.

3.5.3 Internal rate of return (IRR)

It is the interest rate at which the net present value of all the cash flows (both positive and negative) from a project or investment equals zero. IRR is used to evaluate the attractiveness of an investment or any project. If the IRR of a project exceeds a company's required rate of return, that project is desirable. If IRR falls below the required rate of return, the project needs to be rejected.

The formula for IRR is:

$$0 = P_0 + P_1/(1+IRR) + P_2/(1+IRR)^2 + P_3/(1+IRR)^3 + \ldots + P_n/(1+IRR)^n$$

Where,

B = benefits in the year t,

C = costs in the year t,

i = selected discount rate, and

t = number of time periods

IRR equals the project's internal rate of return. When the calculated IRR is more than that of the market rate of interest then the investment will be considered viable.

3.5.4 Benefit cost ratio (BCR)

BCR makes an effort to identify the relationship between the cost and benefits of a planned project. Benefit cost ratios are most often used in corporate finance to detail the relationship between possible benefits and costs quantitatively and qualitatively of undertaking new projects or replacing old ones.

Following exponential form will be employed to identify the relationship between the cost and benefits of a proposed project

$$\mathbf{BCR} = \sum \frac{\mathbf{Bt/\ (1+r)^t}}{\mathbf{Ct/\ (1+r)^t}}$$

Where,

'B' are the benefits accruing in year 't'

'C' are the costs accruing in year 't'

'i' is the selected discount rate

'n' no. of years for which system will operate

The BCR should be greater than 1 for any working system andonly then it can be considered worthwhile.

3.6 Compound Growth Rate (CGR) of area, production and productivity of saffron in J & K

Compound growth rate in area, production and productivity of saffron can be computed by the exponential function of the following form

$$Y = A\ Bt$$

Taking log on both sides

$$\log Y = \log A + t \log B$$

Assuming log Y = y

$$\log A = a$$

$$\log B = b$$

We get:

$$y = a + bt \ (t = 1, 2 \ldots. n)$$

After regression between y and t, we have values of a and b

a = constant

b = coefficient

$$\text{As} \qquad b = 1 + r$$

$$\text{Hence} \qquad r = (b - 1) \times 100$$

Where,

r = compound growth rate

= (antilog b – 1) × 100

t = time variable; t = 1, 2, ……..n, and

b = regression coefficient

y = index no. of area, production and productivity of saffron.

3.7 Marketing Analysis

3.7.1 Identification of different marketing channels:

Collection of information regarding marketing of the saffron shall be done by visiting various markets and contacting the different intermediaries involved in marketing of same crop.

3.7.2 Price Spread (Producer's share in consumer's rupee)

In the present study, price spread in the marketing of saffron will be composed of costs of marketing incurred in rendering marketing services like plucking,, grading, packing, picking, assembling and packaging, forwarding, parceling/transporting, , retailing, wholesaling etc., and the margins of the intermediaries. These costs and margins are impacted by the performance and

efficiency of different marketing functions simultaneously influencing the returns to the farmers on one hand and price to the consumers on the other hand.

The price spread will be evaluated following formula

$$PS = (PP / PR)\ 100$$

Where,

PS is the producer's share in consumer's rupee

PP is the Producer's price and

PR is the retail price.

3.8 Partial Budgeting Analysis

Partial budgeting is a planning and decision-making framework used to compare the costs and benefits of alternatives faced by a farm business (Anonymous, *2007*). It centres just on the changes in income and expenses that would result from implementing a specific alternative. In this way, all aspects of farm profits that are unaltered by the decision can be securely ignored. More or less, partial budgeting permits one to improve handle on what a choice will mean for the profitability of the enterprise, and eventually the profitability of the farm itself. Prior to computing, it is important to have a significant thought of the financial losses and gains, which are then used to compute net change in profits from the replacement of one alternative with another. Fixed costs don't make a piece of this analysis, and this fact was confirmed after examining the work of Shastri C.P. (1962). Financial losses were comprised of added costs of the replacing alternative and reduced returns from the replaced. On the other hand, financial gains are the sum of added returns from the replacing alternative and reduced costs of the replaced. The net change in profits is computed utilizing the formula given below:

$$Net\ Change\ in\ Profits = Financial\ Gains - Financial\ Losses$$

Where,

Financial Gains = Added Returns + Reduced Costs

Financial Losses = Added Costs + Reduced Returns

Chapter -4

ANALYSIS AND DISCUSSION

The present chapter is going to put forth the results obtained from the analysis on various objectives which are already mentioned in chapter-1. The findings of the study have been presented under the following heads:

4.1 Cost and Returns of saffron

4.2 Economic viability of Saffron Cultivation

4.3 Impact assessment of potential of indoor cultivation

4.4 Marketing of saffron

4.1 Cost and Returns of saffron in open field cultivation

The study of farm business as a whole can provide a thought of the profitability of the farm and proficiency of resource use. Such kind of study takes into consideration the inputs and outputs associated in the farming business. The farm receipt comprises of the value of all the produce on a farm whether stocked, sold, or consumed. In the same way, the farm expenses include cost of human labour both hired & family, bullock labour both owned & hired, manure fertilizer and seed etc. The value of farm inputs varies from area to area. At the micro level, it enables the farm management experts to study the efficiency of the cultivation practices and make alterations in the crop plan by providing relevant information regarding their profitability. This helps the experts to make practical suggestions for farm planning aimed at better allotment of existing resources and introduction of enhanced agronomic practices which would boost the efficiency of saffron production. The cost and return analysis of saffron has been worked out for economically viable life i.e., seven years in the present study. The findings are presented under following heads.

4.1.1 Cost of cultivation of saffron in open field

The cost of cultivation is of wide significance to the users of cost data and

assumes importance in the area of planning. For the present study cost of cultivation incurred by respondents in study area has been worked out over the crop cycle for seven years. The present study compares the cost incurred by respondents in open cultivation of saffron for the cycle of seven years starting in 2014 and ending in 2020. The data collected is based on the memory of the respondents.

Average Cost of cultivation (Rs/ha) in open cultivation for the first year, second year, third year, fourth year, fifth year, sixth year and seventh year was found out to be 6,13,286 Rs/ha, 1,17,504 Rs/ha, 1,20,941 Rs/ha, 1,22,200 Rs/ha, 1,25,704 Rs/ha, 1,27,307 Rs/ha and 94,072 Rs/ha. Average cost of cultivation (Rs/ha) for seven years was worked out and was found to be 1,88,716 Rs/ha. It is noteworthy that the cost of cultivation for the first year is significantly high. This is primarily due to the seed cost that is required only during the first year and not for the subsequent years. It is also noteworthy that the cost of cultivation for the last year reduces drastically. This is due to the fact that no operational costs are incurred during this year as the corms need to be transplanted due to the end of cropping cycle.

Table 4.1: **Cost of cultivation of saffron in open field**

Year	Cost of Cultivation (Rs/ha)
2014	613286
2015	117504
2016	120941
2017	122200
2018	125704
2019	127307
2020	94072
Average Costs (Rs/ha)	**188716**

4.1.2 Returns from saffron in open cultivation

The data collected was obtained from a primary survey using a well-structured questionnaire and based on farmer's memory. A perusal of data presented in table 4.13, depicts that the gross returns hectare^{-1} in a planting cycle of seven years was Rs. 15195, Rs. 286663, Rs. 298689, Rs. 291907, Rs. 294710, Rs. 296107 and Rs. 733567. The yield from saffron remains relatively low in first year and increases considerably from second year onwards. The yield from daughter corms is received after the completion of cropping cycle. The gross returns were lowest during the first year and highest during the seventh year. The table 4.15 depicts that gross returns in a planting cycle of seven years. The average returns hectare^{-1} was Rs. 316691 (table 4.13).

Table 4.2: Returns from saffron in open cultivation

Year	Returns (Rs/ha)
2014	15195
2015	286663
2016	298689
2017	291907
2018	294710
2019	296107
2020	733567
Average Returns/ha	**316691**

4.2 Cost and returns of saffron in indoor cultivation

The cost of cultivation of saffron in indoor cultivation is of wide importance to the users of cost data and presumes significance in the area of planning. For the present study cost of cultivation incurred by ARSSSS

(Advanced Research Station for Saffron and Seed Spice) has been worked out for the cycle of four years on an area of 144 square feet from which the costs were calculated for an area of 1 hectare. The present study compares the cost incurred in open cultivation of saffron and in house cultivation of saffron.

Average cost of cultivation for an area of 144 square feet in indoor cultivation for the first year and second year was found out to be Rs 128250 and Rs 5250 respectively. The cost of cultivation of saffron in indoor cultivation for the subsequent years i.e., third and fourth year remains same as second year i.e., 5250 Rs for an area of 144 square feet.

Average Cost of cultivation (Rs/ha) in indoor cultivation for the first year and second year was found out to be 9,58,52,018 Rs/ha and 39,23,767 Rs/ha respectively. The cost of cultivation of saffron in in-house cultivation for the subsequent years i.e., third and fourth year remains same as second year i.e., 39,23,767 Rs/ha. Average cost of cultivation (Rs/ha) for four years was worked out and was found to be 2, 78, 86,771 Rs/ha. The cumulative of all the average cost of cultivation for 8 years was worked out to be 1, 59,05,269 Rs/ha (Table 4.11). These Average Costs of Cultivation were arrived at from the Costs obtained from an area of 144 square feet. It is noteworthy that the cost of cultivation for the first year is significantly high. This is largely due to the establishment costs that are required only during the first year and not for the successive years. It is also noteworthy that the cost of cultivation for last three years vis-à-vis second, third and fourth years remains the same. This is due to the fact that same operational costs are incurred after the establishment cost has already been incurred in the first year.

Table 4.3: Cost of cultivation of saffron in indoor cultivation

Year	Cost of Cultivation (Rs/ha)
1	95852018
2	3923767
3	3923767
4	3923767
Average Costs	**2,78,86,771**
Year	**Cost of Cultivation (Rs/ha)**
1	3923767
2	3923767
3	3923767
4	3923767
Average Costs	3923767
Cumulative Average for 8 Years	**1,59,05,269**

The item wise cost of cultivation of saffron (Rupees hectare^{-1}) in indoor cultivation for a period of four years was worked out for Human labour@10-Labours), Racks 11000@ 2500, Trays 134530@225, Value of seed @2242 quintal and Miscellaneous which was found out to be 6726460, 28026906, 30269058, 33632287 and 8968608 respectively.

Table 4.4: Item wise cost of cultivation of saffron (Rupees hectare^{-1}) in indoor cultivation

	Years				
	1st	**2nd**	**3rd**	**4th**	**Total**
Human labour@10-Labours)	1681615	1681615	1681615	1681615	6726460
Racks 11000@ 2500	28026906	-	-	-	28026906
Trays 134530@225	30269058	-	-	-	30269058
Value of seed @2242 quintal	33632287	-	-	-	33632287
Miscellaneous	2242152	2242152	2242152	2242152	8968608
Grand Total	**10,76,23,319**				

4.2.1 Returns from saffron in in-door cultivation

A perusal of data presented in Table 4.14 depicts that the gross returns hecatare^{-1} in a planting cycle of four years was Rs. 37533632, Rs. 37533632, Rs. 37533632 and Rs. 71165919 respectively. The gross returns were highest in the fourth year as it includes the corm yield. The average returns hectare^{-1} was Rs. 45941704 (Table 4.14).

Table 4.5: Returns from Saffron in Indoor Cultivation

Year	Returns (Rs/ha)
1	37533632
2	37533632
3	37533632
4	71165919
Average Returns/ha	**4,59,41,704**
Total Returns	**18,37,66,815**

4.3 Compound Growth Rate (CGR) of area, production and productivity of saffron in J & K

A glance of data presented in table 4.22 exposes that area under saffron cultivation in Jammu and Kashmir has shown CGR of -0.17 per cent while as production and productivity has shown CGR of 0.07 per cent and 3.15 per cent respectively. Additionally, it can be wrapped up that area under saffron cultivation has reduced significantly, while as production and productivity of saffron over past two decades in J & K has increased non-significantly. The area under saffron cultivation in J & K has dropped from 5707 ha in 1996-97 to 3715 ha in 2017-18. In previous two decades, the maximum production and productivity of saffron in J & K was found in year 2016-17 which was 16.45 MT and 4.42 kg/ha in that order.

Table 4.6: Compound growth rate of area, production and productivity of saffron in J & K from 1996-97 to 2017-18

S.No.	Year	Area(ha)	Production (MT)	Productivity (Kg/ha)
01	1996-97	5707	15.95	2.80
02	1997-98	4618	13.39	2.90
03	1998-99	4116	12.88	3.13
04	1999-00	3997	7.65	1.89
05	2000-01	2831	3.59	1.27
06	2001-02	2713	0.30	0.095
07	2002-03	2825	6.50	2.28
08	2003-04	2742	5.15	1.88
09	2004-05	3143	6.86	2.23
10	2005-06	3010	6.50	2.15
11	2006-07	3280	8.20	2.50
12	2007-08	3280	7.70	2.34
13	2008-09	3785	9.46	2.50
14	2009-10	3715	10.40	2.75
15	2010-11	3715	10.03	2.69
16	2011-12	3715	10.79	2.90
17	2012-13	3715	12.45	3.34
18	2013-14	3715	14.01	3.77
19	2014-15	3715	5.57	1.50
20	2015-16	3715	16.17	4.35
21	2016-17	3715	16.45	4.42
22	2017-18	3715	5.20	1.40
CGR		**-0.17*** (0.0026)	**0.07** (0.0122)	**3.15** (0.0111)

Source: Directorate of Agriculture Kashmir, 2019.
*- At 5% level of significance
Figures in parenthesis indicate standard error of coefficient

4.4 Economic viability of Saffron Cultivation in open and indoor cultivation

Economic viability of saffron cultivation in open and indoor conditions was worked out by determining benefit cost ratio, net present value, internal rate of return and payback period. The economic feasibility of saffron enterprise was examined for open cultivation and indoor cultivation for the crop cycle of seven years for open cultivation and four years for protected cultivation. The findings are put as under.

4.4.1 Economic viability of saffron in open cultivation

A perusal of data presented in table 4.15 reveals that benefit cost ratio (B-C ratio) at 12 per cent discounting rate is 1.679. The net present value (NPV) at discounting rate 12 per cent was found 675993.2. The internal rate of return (IRR) at 12 per cent discounting rate was found 408.90 per cent. The payback period (PBP) was worked out to be 3.855 years.

Table 4.7: **Economic viability of Saffron in open field Cultivation**

S. No.	Particulars	Value
1	**B -C ratio**(at 12% discounting rate)	1.679
2	**NPV (Rs)**(at 12% discounting rate)	675993.2
3	**IRR (%)**	408.90
4	**PBP (years)**	3.8

4.4.2 Economic viability of saffron in indoor cultivation

A perusal of data presented in table 4.16 reveals that benefit cost ratio (B-C ratio) at 12 percent discounting rate for first cycle was found out to be 0.71 and for the second cropping cycle was found out to be 10.71. The net present value

(NPV) at discounting rate 12 percent for the first cropping cycle was found out to be Rs. 52884 and for the second cropping cycle was found out to be Rs. 175884. The internal rate of return (IRR) at 12 percent discounting rate for the first cropping cycle was found out to be 28.43 per cent and for the second cropping cycle was found out to be 957.16 percent. The payback period (PBP) for the cropping cycle was worked out to be 3.126 years and for the second cropping cycle was found out to be 0 years.

Table 4.8: Economic Viability of Saffron in Indoor Cultivation

S. No.	Particulars	First Cropping Cycle	Second Cropping Cycle
1	**B -C ratio**(at 12% discounting rate)	0.71	10.71
2	**NPV (Rs)**(at 12% discounting rate)	52884	175884
3	**IRR (%)**	28.43	957.16
4	**PBP (years)**	3.126	0

4.5 Impact assessment of potential of indoor cultivation

The impact assessment of potential of indoor cultivation in Kashmir was worked out by using secondary source of data collected from ARSSSS Department, Dusoo, Pampore. The results showed an exhilarating performance impact of indoor cultivation on productivity of saffron. The yield per hectare in open cultivation was around 2 kg and that of indoor cultivation was around 208 Kg per hectare. The yield per hectare was surprisingly more than the yield per hectare under open field conditions i.e., more than 100 times which is greater than the yield obtained under open field cultivation of saffron. It is to be noted that the productivity in indoor cultivation is too high, it is because of the fact that indoor cultivation employs vertical model of land use i.e, one hectare of indoor cultivation equals six hectares of outdoor cultivation as 6 tiers are used.

The yield of saffron per quintal of corms in open high density field was found out to be 0.062 Kg per year and the yield of saffron per quintal of corms in indoor cultivation was found to be 0.093 Kg per year. This shows the potential of saffron cultivation under indoor conditions is highly impressive. It has also been found that a corm under field conditions is able to produce one flower at a time however it has been observed that the same corm yields two flowers under indoor conditions due to the fact that temperature and relative humidity are highly regulated in the indoor cultivation of Saffron.

The post-harvest handling during open cultivation is mostly poor and the various volatile compounds present in the saffron responsible for its flavor and aroma are degraded. Also, there is poor color development of saffron due to shade drying. However, there is no significant loss of volatile compounds and the color development is somewhat rich because of method of solar drying is employed under indoor cultivation. Hence, the quality of the saffron is highly impacted by the mode of cultivation used and it's evident that the quality of saffron under indoor cultivation performs significantly well when compared with open cultivation of saffron.

We can also grow Saffron on Industrial Scale as vertical expansion of land under indoor cultivation is carried out. The vertical expansion enables lesser use of land and simultaneously increasing the production and productivity. The resources used are less and that is economically viable in a resource-constraint region like UT of J&K.

4.6 Marketing of saffron

4.6.1 Marketing of saffron obtained from open field cultivation

In this section an attempt was made to study the important parameters of saffron marketing like market functionaries, marketing costs, losses and margins, issues of efficiency, price realized by the growers and price spread in the study region.

It was revealed from study that marketing system of saffron in Kashmir is not organised and systematic, as it has largely been in the hands of private enterprises, there exists a long chain of intermediaries between the producer and the ultimate consumer.

The following were identified as main channels in the sampled area for the marketing of saffron (Table 4.25).

Table 4.9: Marketing channels of saffron obtained from open cultivation

Channel–I	(Direct Marketing) Producer–domestic consumer
Channel–II	Farmer – retailer – consumer
Channel–III	Farmer –wholesaler – retailer – consumer
Channel–IV	Farmer-commission agents-wholesaler-retailer-consumer
Channel–V	Farmer – sub-firm – wholesaler – retailer – consumer

Table 4.10: Percentage share of different marketing channels of saffron (N=150)

S.No.	Marketing channel	Number (f)	Percentage
1	Channel–I	23	15.33
2	Channel–II	20	13.33
3	Channel–III	13	8.66
4	Channel–IV	49	32.66
5	Channel–V	45	30.00
Total		**150**	**100**

It was found out that channel–IV was followed by around 32.66 percent of the respondents and channel–V was followed by 30 percent of respondents. While, channel–I, channel–II and channel–III was followed by 15.33, 13.33 and 8.66 percent of respondents respectively. It is to be noted that until 2019channel–I was least followed but with the introduction of India International Kashmir

Saffron Trading Centre (IIKSTC), channel–I is being followed at an increased pace.

4.6.2 Marketing of saffron obtained from indoor cultivation

In this section an attempt was made to study the important parameters of saffron marketing like market functionaries, marketing costs, losses and margins, issues of efficiency, price realized by the growers and price spread in the study region.

It was revealed from study that marketing of saffron obtained from indoor cultivation in Kashmir is highly organised and systematic, as it has largely been in the hands of Spice Park which provides a minimum support price (MSP) of 180000 per kg and there exists no long chain of intermediaries between the producer and the ultimate consumer.

The following were identified as main channels in the sampled area for the marketing of saffron obtained from indoor cultivation (Table 4.25).

Table 4.11: Marketing channels of saffron obtained from indoor cultivation

Channel–I	(Direct Marketing) Producer–domestic consumer

Table 4.12: Percentage share of different marketing channels of saffron obtained from indoor cultivation

S.No.	Marketing channel	Percentage
1	Channel–I	100
Total		**100**

4.7 Marketing costs, margins, losses and price spread in different channels of saffron

The price spread is the gap between the price paid by the consumer and the price received by the farmer at a particular time because from the producer, it has to pass through various agencies before it reaches to the final consumer. The price spread consists of marketing costs, losses and margins of intermediaries involved in the marketing process. It explains the variance in the price received by the producer and price paid by the consumer. The study of price spread is very essential from the stand point of efficiency of the marketing system. The channel wise price spread in terms of consumers price is given in Table 4.21.

A cursory glance of the Table 4.21 revealed that, Net Price Received by Farmer (NPRF) is more in channel I (84 % of the consumer's price) followed by channel II, III, IV and V. To sum up NPRF is more in the channel where the numbers of intermediaries are very less. This is due to the fact that number of intermediaries is less in channel I.

As far as the price spread of saffron was concerned, retailer grabbed maximum margins because he sold the produce in much small quantities and furnishes it before consumers on relatively high prices.

Table 4.13: Marketing cost, physical loss, marketing margin, price spread, producers share in consumers' rupee and marketing efficiency of different channels (Rs/10g)

Particulars	Channel–I	Channel–II	Channel–II	Channel–V	Channel–V
Gross farmers price	1800	1195	1150	1280	1285
Cost incurred by farmer	110	116	135	125	118
Losses at farmer level	25	23	28	26	26
Net farmers price	1665	1056	987	1129	1141
Gross price of agent	-	-	-	1300	-
Cost incurred by agent	-	-	-	3	-
Losses at agent level	-	-	-	4	-
Margins at agent level	-	-	-	52	-
Gross price of firm	-	-	-	-	1300
Cost incurred by firm	-	-	-	-	10
Losses at firm level	-	-	-	-	9
Margins at firm level	-	-	-	-	22
Gross price of wholesaler	-	-	1250	1320	1350
Cost incurred by wholesaler	-	-	16	16	18
Losses at wholesale level	-	-	19	22	23
Margins at wholesale level	-	-	33	21	19
Gross price of retailer					
Cost incurred by retailer	-	1360	1300	1800	1850
Losses at retail level					
Margins at retail level	-	12	7	7	9
	-	15	18	13	18
	-	68	72	72	71
Price paid by Consumer	1800	1360	1300	1800	1850
Total marketing costs	110	128	160	151	155
Total physical losses	25	38	65	65	76
Total marketing margin	0	68	105	145	112
Price spread	**135**	**310**	**313**	**261**	**279**
Producer Share in Consumer's Rupee (%)	**92.5**	**77.64**	**75.92**	**62.72**	**61.67**

4.8 Partial Budgeting Analysis (Open Cultivation of Saffron v/s Indoor Cultivation of Saffron)

Partial Budgeting was employed to evaluate the financial effect of substituting open cultivation with that of indoor cultivation of saffron. It involves subtraction of financial losses from financial gains to deduce the Net Change in Profits, which, if positive, indicates that incremental returns could be realized due to the introduction of indoor cultivation of saffron in this particular study.

Before the commencement of the analysis, it is to be understood that all the average cost and return components were scaled on per-ha basis. Table 4.14 details the farm-level economic impact of replacing open cultivation with that of indoor cultivation of saffron. The possible changes that occur due to this replacement were grouped under two broad categories, namely, Financial Losses and Financial Gains. Financial Losses, which amounted to Rs. 87664500, comprised of added costs (for indoor cultivation) and reduced returns (from open cultivation). Similarly, Financial Gains amounted to Rs. 95352000, which was constituted by added returns (from indoor cultivation) and reduced costs (for open cultivation). There was a positive Net Change in Profits of Rs. 7687500per ha, which is an indication that substituting open cultivation with that of indoor cultivation of saffron could be remunerative to the farmers.

Table 4.14: Partial Budgeting Analysis (Open cultivation vs Indoor cultivation)

S. No.	Particulars	Value *(in Rs. ha^{-1})*	S. No.	Particulars	Value *(in Rs. ha^{-1})*
A.	**Added Costs (for Indoor Cultivation)**		**B.**	**Added Returns (from Indoor Cultivation)**	
	(i) Corm Cost	27,660,000		(i) Corm Yield	Nil
	(ii) Labour Cost	1,660,500		(ii) Saffron Yield	36990000
	(iii) Trays Cost	30294000		**TOTAL**	**36990000**
	(iv) Racks Cost	28050000			
	TOTAL	**87664500**			
S. No.	**Particulars**	**Value *(in Rs. ha^{-1})***	**S. No.**	**Particulars**	**Value *(in Rs. ha^{-1})***
C.	**Reduced Returns (from Open Cultivation)**		**D.**	**Reduced Costs (for Open Cultivation)**	
	(i) Corm yield	Nil		(i) Labour Cost	18000
	(ii) Saffron yield	Nil		(ii) Trays Cost	30294000
	TOTAL	**Nil**		(iii) Racks Cost	28050000
				TOTAL	**58362000**

Therefore,

1. **Total Financial Losses (A+C) = 87664500**
2. **Total Financial Gains (B+D) = 95352000**
3. **Net Change in Profits (Total Financial Gains - Total Financial Losses) = 7687500**

Chapter-5

FINDINGS, SUGGESTIONS AND CONCLUSION

The present study entitled **"Comparative Study of Open and Indoor Cultivation of Saffron in Pulwama District of Union Territory of Jammu & Kashmir"** was carried out to study the potential of indoor cultivation of saffron in UT of J&K and compare its cost, returns, production, productivity, marketing of saffron obtained from open field cultivation of Saffron. The study is based on the primary data collected from the farmers and secondary data collected from the ARSSSS Department, Dusoo. Saffron is one of the most profitable cash crops of India that is perennial in nature. Horticulture is the backbone and main source of livelihood to nearly 70 per cent of population UToJK.

Current study examined the impact of indoor cultivation on the production and productivity of Saffron in UT of J&K. The study emphasized on the potential of cultivating Saffron under protected conditions like greenhouse, etc. The major findings of the study are as below:

- Average Cost of cultivation (Rs/ha) in open cultivation for the first year, second year, third year, fourth year, fifth year, sixth year and seventh year was found out to be 613286 Rs/ha, 117504 Rs/ha, 120941 Rs/ha, 122200 Rs/ha, 125704 Rs/ha, 127307 Rs/ha and 94072 Rs/ha.
- Average cost of cultivation (Rs/ha) for seven years was worked out and was found to be 188716 Rs/ha.
- Average Cost of cultivation (Rs/ha) in indoor cultivation for the first year and second year was found out to be 95852018 Rs/ha and 3923767 Rs/ha respectively.
- Open field cultivation depicts that the gross returns hectare^{-1} in a planting cycle of seven years was Rs. 15195, Rs. 286663, Rs. 298689, Rs. 291907,

Rs. 294710, Rs. 296107 and Rs. 733567.The average returns hectare^{-1} was Rs. 316691.

- Indoor cultivation depicts that the gross returns hecatare^{-1} in a planting cycle of four years was Rs. 37533632, Rs. 37533632, Rs. 37533632 and Rs. 71165919 respectively. The average returns hectare^{-1} was Rs. 45941704.
- For open field cultivation, benefit cost ratio (B-C ratio) at 12 per cent discounting rate was worked out to be 1.679. The net present value (NPV) at discounting rate 12 per cent as found to be 675993.2 Rs. The internal rate of return (IRR) at 12 per cent discounting rate was found 408.9 per cent. The payback period (PBP) was worked out to be 3.855 years.
- A glance of data presented in table 4.22 exposes that area under saffron cultivation in Jammu and Kashmir has shown CAGR of -0.17 per cent while as production and productivity has shown CAGR of 0.07 per cent and 3.15 per cent respectively.
- The area under saffron cultivation in J & K has dropped from 5707 ha in 1996-97 to 3715 ha in 2017-18. In previous two decades, the maximum production and productivity of saffron in J & K was found in year 2016-17 which was 16.45 MT and 4.42 kg/ha in that order.
- For indoor cultivation benefit cost ratio (B-C ratio) at 12 per cent discounting rate for first cycle was found out to be 0.71 and for the second cropping cycle was found out to be 10.71. The net present value (NPV) at discounting rate 12 per cent for the first cropping cycle was found out to be Rs. 52884 and for the second cropping cycle was found out to be Rs. 175884. The internal rate of return (IRR) at 12 per cent discounting rate for the first cropping cycle was found out to be 28.43 per cent and for the second cropping cycle was found out to be 957.16 per cent. The payback period (PBP) for the cropping cycle was worked out to be 3.126 years and for the second cropping cycle was found out to be 0 years.

- The yield per hectare was surprisingly more than the yield per hectare under open field conditions i.e., more than 100 times which is greater than the yield obtained under open field cultivation of saffron.
- The yield of saffron per quintal of corms in open high density field was found out to be 0.062 Kg per year and the yield of saffron per quintal of corms in indoor cultivation was found to be 0.093 Kg per year.
- It was revealed from study that marketing system of saffron in Kashmir is not organized and systematic, while as marketing of saffron obtained from indoor cultivation in Kashmir is highly organized and systematic, as it has largely been in the hands of spice park which provides a minimum support price (MSP) of 180000 per kg and there exists no long chain of intermediaries between the producer and the ultimate consumer.
- It was also revealed that the productivity of saffron has become stagnant. Even after the inception of National Saffron Mission there has been no considerable increase in its productivity which revolves around 2Kg/ha. However indoor cultivation was found out to be showing promising results.

- Financial Losses, which amounted to Rs. 87664500, comprised of added costs (for indoor cultivation) and reduced returns (from open cultivation). Similarly, Financial Gains amounted to Rs. 95352000, which was constituted by added returns (from indoor cultivation) and reduced costs (for open cultivation). There was a positive Net Change in Profits of Rs. 7687500per ha, which is an indication that substituting open cultivation with that of indoor cultivation of saffron could be remunerative to the farmers.

CONCLUSION

Saffron is perhaps the most beneficial cash crop that is perennial in nature. It is derived from the *Crocus sativus* plant. It is purple a purple flower having six

petals, red stigmas and three stamens. The stigmas have the actual worth. Greenhouse/indoor cultivation is an encased structure covered with a transparent material to grow crops either under partial or completely controlled ecological conditions to get ideal growth. For the past numerous years particularly after the flood that occurred in September 2014 ecological system of UT of Jammu and Kashmir became unstable. Greenhouse technology is generally appropriate for observing and controlling the ecological framework unsteadiness. Since September 2014 floods, Saffron Industry was the worst hit with falling production levels. It is smarter to pick the indoor/greenhouse alternative to improve this very industry. An ideal day temperatures needed for the development of saffron plant are 20 degree to 22 degree C. Extreme temperatures hinder its growth while temperate sort of environment upgrades its development and as needs be, indoor development is a feasible choice in such climatic conditions.

Saffron cultivation on cost-effective and greenhouse is a challenging and hard job in terms of temperature and relative humidity. Hence, it's viable to use greenhouses for production, early harvest, typically for reducing the growth cycle and very high likelihood of growing in offseason under unsuitable climatic conditions.

Saffron farming has been facing sustainable development challenges and hard livelihood security thereby making it imperative for the adoption of suitable technologies (FAO, 2012) including economical indoor/greenhouse technology. In present-day times, Kashmiri saffron is confronting marketing issues on an account of the low quality because of conventional post-harvest methods, low degree of education, and low degrees of production. Hence, advanced technologies particularly greenhouse sort of technology are to be made accessible to producers majority of who are small so it can guarantee the best quality and decrease costs to a greater extent.

POLICY MEASURES

1. Program level intervention on protected cultivation.
2. Some technological adoption on protected horticulture
3. Stakeholders' involvement in protected horticulture technology in J&K
4. Need separate precision and protected horticulture research and development unit in J&K
5. Strong monitoring and evaluation mechanism for material quality inspection
6. Subsidies need to be provided by the government to the farmers for establishing indoor structures as the productivity is very promising
7. Soft loan/zero interest subsidy based on initial investment for youth and progressive farmers and agri-entrepreneurs.
8. It requires around 19,000 crores to bring all the area under saffron cultivation under indoor cultivation. It can be done on pilot basis to bring the areas under indoor cultivation in a phased manner.

LITERATURE CITED

Abdullaev, F. I. 2002. Cancer chemo-preventive and tumoricidal properties of saffron (*Crocus sativus* L.) *Experimental Biology and Medicine* **227**(1): 20-25.

Abdullaev, F. I. 2003. Anti-tumor effect of saffron (*Crocus sativus* L.): overview and perspectives. In *I International Symposium on Saffron Biology and Biotechnology* **650**: 491-499.

Abdullaev, F. I. and Espinosa-Aguirre, J. J. 2004 Biomedical properties of saffron and its potential use in cancer therapy and chemoprevention trials. *Cancer Detection and Prevention* **28**(6): 426-432.

Arslan, N., Ozer, A. S. and Akdemir, R. 2007. Cultivation of saffron (*Crocus sativus* L.) and effects of organic fertilizers to the flower yield. In *I International Medicinal and Aromatic Plants Conference on Culinary Herbs* **826**:237-240.

Brahma, S. and Singh, B. 2014.Advances in protected cultivation. *New India*.

Cavusoglu, A., Erkel, E. I. and Sulusoglu, M. 2009. Saffron (*Crocus sativus* L.) studies with two mother corm dimensions on yield and harvest period under greenhouse condition. *American-Eurasian Journal of Sustainable Agriculture* **3**(2):126-129.

Dalezis, P., Papageorgiou, E., Geromichalou, E. and Geromichalus, G. 2009. Antitumor activity of crocin, crocetin and safranal on murine P388 leukemia bearing mice. In *3rd International symposium on saffron Forthcoming challenges in cultivation research and economics. Krokos, Kozani, Greece* **58**.

Fernandez, J. A. 2004. Biology, biotechnology and biomedicine of saffron. *Recent Research Developments in Plant Science* 127-159.

Fernandez, Jose-Antonio, 2011. “The world saffron and Crocus collection:

strategies for establishment, management, characterization and utilization. "*Genetic Resources and Crop Evolution* **58**(1):125-137.

Goldblatt, P., Davies, T. J., Manning, J. C., van der Bank, M. and Savolainen, V. 2006. Phylogeny of Iridaceae subfamily Crocoideae based on a combined multigene plastid DNA analysis. Aliso: *A Journal of Systematic and Evolutionary Botany* **22**(1):399-411.

Gurkoo, M. A. 2007. Zaffran- The Vanishing Treasure. *The Daily Greater Kashmir (*Sunday Supplement)*,* 24th December.

Jensen, Merle H. 2001. "Controlled Environment agriculture in deserts, tropics and temperate regions-A World Review." In *International Symposium on Design and Environmental Control of Tropical and Subtropical Greenhouses* **578:** 19-25.

Lage, M., K. Bakhy, and C. Alfaiz 2016. "Participatory plant breeding of saffron, initiated in Morocco, under Green Morocco Plan Strategy." In *V International Symposium on Saffron Biology and Technology: Advances in Biology, Technologies, Uses and Market* **1184:** 69-70.

Lawrence, W. R. 1895. Saffron – *The valley of Kashmir*, 342-344, London.

Mathew, B. 1983. *The Crocus: A revision of the genus Crocus (Iridaceae)*. Timber Pr.

Mattoo, M. S. and Beigh, B. A. 1992. Saffron cultivation in Kashmir. *Yojana*, **36**(4): 16.

Max, J. F., Horst, W. J., Mutwiwa, U. N. and Tantau, H. J. 2009. Effects of greenhouse cooling method on growth, fruit yield and quality of tomato (*Solanumly copersicum* L.) in a tropical climate. *Scientia Horticulturae* **12 2**(2):179-186.

Mir, G. M. 1984. Saffron Agronomy in Kashmir. *M.Phil.Thesis*, University of Kashmir, Srinagar.

Mishra, G. P., Singh, N., Kumar, H. and Singh, S. B. 2010.Protected Cultivation for Food and Nutritional Security at Ladakh. *Defence Science Journal* **60**(2).

Munshi, A. M. 2001. Marketing and trade mechanism of saffron in Jammu and Kashmir a review *Agricultural Marketing*, **44**(3): 14-17.

Munshi, A. M. 1989. Economic analysis of saffron under rain fed conditions of Kashmir, *Agricultural Situation in India* **44**(5):379-381.

Munshi, A. M. 1990. Marketing and trade of saffron in India- review. *Agricultural Marketing* **33**(1):29-31.

Munshi, A. M. and Baba, G. H. 1991. Improved cultivation practices for saffron, *Indian Farming* **39**(3): 27-30.

Mysir, J., Patidar, R. and Choura, T. 2014. Status of saffron in J&K: an economic analysis. *International Journal of Research* **1**(4): 111-135.

Nehvi, F. A. 2016. Advance in Saffron Research for Integrated Development of Saffron in Kashmir-India. In: *Fifth international Saffron Symposium Biology and Technology (VISSBT 2016)*, National Institute of Agriculture Research (INRA- Morocco), The International Society for Horticultural Science (ISHS)/Section of Medicinal and Aromatic Plants, 28.

Nehvi, F. A., Koul, G. L., and Wani, S. A. 2008. Status of Saffron in Jammu & Kashmir. *Saffron Production in Jammu & Kashmir*. Directorate of Extension Education, SKUAST-K **1**(21).

Parray, J. A., Kamili, A. N., Hamid, R. and Husaini, A. M. 2012. In vitro cormlet production of saffron (*Crocus sativus* L. Kashmirianus) and their flowering response under greenhouse. *GM Crops & Food* **3**(4): 289-295.

Petersen, G., Seberg, O., Thorsoe, S., Jorgensen, T. and Mathew, B. 2008. A phylogeny of the genus Crocus (Iridaceae) based on sequence data from five plastid regions. *Taxon* **57**(2): 487-499.

Rashed-Mohassel, M. H. 2006. "Saffron from wild to the field." In *II International Symposium on Saffron Biology and Technology* **739:** 187-193.

Saqib, N. 2015. Geographic indication as a branding tool for saffron. *International Journal of Management and Social Science Research Review*, **1**: 18-27.

Sharma, A., Singh, J. and Hussain, M. 2012. Economics of Saffron Cultivation in Jammu and Kashmir. *Environment and Ecology* **30**(3): 1070-1075.

Tantry, M. A. 2017. Saffron Production in Jammu and Kashmir. *International Journal of Humanities & Social Science Studies* (ISJN: A4372-3142), **4:** 352-359.

Tantry, M. A., Dar, B. A. and Singh, S. 2017. An Economic analysis of production and marketing of saffron in Jammu and Kashmir. *International Journal of Social Relevance & Concern* (ISSN-2347-9698), **5**:12- 19.

Toktam, M., Kharbasi. A. and Zandi, B. 2016. Measurement of technical efficiency of small and large Saffron farms in Iran. In: *Fifth international Saffron Symposium Biology and Technology (VISSBT 2016)*. National Institute of Agriculture Research (INRA-Morocco). *The International Society for Horticultural Science* (ISHS)/Section of Medicinal and Aromatic Plants **18**.

Torkamani, J. 2000. Economic analysis of production, technical efficiency and marketing of Iranian Saffron. *Journal of Science & Technology of Agriculture & Natural Resources* **4**(3): 29-45.

Tsoktouridis, G., Krigas N., Karamplianis T., Constantinidis, T., Maloupa, E. 2009. Genetic differences among wild Greek *Crocus* taxa and cultivated saffron (*Crocus sativus* L.). **In**: 3rd International symposium on saffron Forthcoming challenges in cultivation research and economics. Krokos,

Kozani, Greece Book of Abstracts, 37.

Yasmin, S. and Nehvi, F. A. 2013. Saffron as a valuable spice: A comprehensive review. *African Journal of Agricultural Research* **8**(3): 234-242.

Yildirim, M. U., H. Asil, M. Hajyzadeh, E. O. Sarihan, and Khawar, K. M. 2016. "Effect of changes in planting depths of saffron (Crocus sativus L.) corms and determining their agronomic characteristics under warm and temperate (Csa) climatic conditions of Turkish province of Hatay." In *International Symposium on Saffron Biology and Technology: Advances in Biology, Technologies, Uses and Market* **1184**: 47-54.

Zouahri, A., N. El Madani, M. Lage, Douaik, A. and Alilou, H. 2016. "Characterization of soils used for saffron production in the main saffron producing zone in Morocco." In *V International Symposium on Saffron Biology and Technology: Advances in Biology, Technologies, Uses and Market* **1184:** 131-136.

Juntamanee, K., Onnon, S., Yingjajaval, S. and Sangchote, S. 2013. Leaf photosynthesis and fruit quality of mango growing under field or plastic roof condition. *Acta Horticulturae* **975**: 415-420.

Iglesias, I. and Alegre. S. 2006.The effect of antihail nets on fruit protection, radiation, temperature, quality and profitability of "Mondial Gala" apples. *Journal of Applied Horticulture* **8**(2): 91-100.

Jiang-Fei, M., Peng-Fei, N., Teng-Fei, X. and ZhenWen, Z. 2013. Effect of rain-shelter cultivation of Vitisvinifera cv. Cabernet Gernischet on the phenolic profile of berry skins and the incidence of grape diseases. Molecules **18**: 381-397.

Medany, M. A., Abdrabbo, M. A. A., Farag, A. A., Hassanien, M. K. and Abou-Hadid, A. F. 2009. Growth and productivity of mango grown under greenhouse conditions. *Egyptian Journal of Horticulture* **36**(2): 373-382.

Gindaba, J. and Wand, S. J. E. 2007. Do fruit sunburn control measures affect leaf photosynthetic rate and stomatal conductance in "Royal Gala" apple. *Environmental and Experimental Botany* **59**(2): 160-165.

Kaur, K. and Kaur, A. 2017.Papaya performance under various growing conditions cv. Red Lady 786. *Agriculture Science Digest* **37**(4): 290-293.

Prakash, J., Singh, K., Goswami, A. K. and Singh, A. K. 2015.Comparison of plant growth, yield, fruit quality and biotic stress incidence in papaya var. PusaNanha under polyhouse and open field conditions. *Indian Journal of Horticulture*, **72**(2): 183- 186.

Weber, C. A., Maloney, K. E. and Sanford, J. C. 2004. Long-term field performance of primocane fruiting raspberry cultivars in New York. *Hort Technology* **14**(4): 590-593.

Reddy, P. V. K. and Gowda V. N. 2014. Influence of greenhouse cultivation on fruit quality of "Red Lady" papaya. *Acta Horticulturae* **1024**: 109-114.

Bas, T. 1991.Possibilities of Using Different Organic and Inorganic Materials for Greenhouse cucumber production. Phd Thesis.Ege Univ., Izmir.

Singh B., Kumar M. and Sirohi N. P. S. 2007.Protected cultivation of cucurbits under low-cost protected structure: a sustainable technology for peri-urban areas of northern India. *Acta Horticulturae.* 7**31**: 267–272.

Chandra, P., Sirohi P. S., Behera, T. K. and Singh, A. K. 2000.Cultivating vegetable in polyhouse. *Indian Horticulture* **45** (3): 17-32.

Negi, V. S., Maikhuri, R. K., Rawat, L.S. and Parshwan, D. 2013. Protected cultivation as an option of livelihood in mountain region of central Himalaya, India. *International Journal of Sustainable Development & World Ecology* **20**(5): 416–425.

Menzel, C. M., Smith, L. A. and Moisander, J. A. 2016.Protected cropping of strawberry plants in subtropical Queensland. *Acta Horticulturae* **1117**: 273–278.

Prakash, P., Pramod Kumar, AmitKar, Awani Kumar Singh and Anbukkani, P. 2019. Progress and performance of protected cultivation in Maharashtra, *Indian J. Econ. Dev*.**15**: 555-63.

APPENDIX-I

QUESTIONNAIRE

Research Topic: Comparative Study of Open and Indoor Cultivation of Saffron in Pulwama District of Union Territory of Jammu & Kashmir

PART-A **Personal Profile**

1. Name of the farmer
2. Fathers name
3. Age
4. Educational qualification
5. Name of the village
6. Name of the block
7. Contact number
8. No. of family members
   a. Males
   b. Females
9. Annual income from all sources
10. Land inventory
    a. Total holding
    b. Fallow land
    c. Operational holding
    d. Irrigated
    e. Unirrigated

Cropping pattern

Crops	Area (kanal)	Production (kg/kanal)
Kharif Rice Maize Pulses Any other, specify		
Rabi Mustard Oats Pulses Any other, specify		
Perennial Saffron Apple Almond Any other, specify		

B Cost of Cultivation and Returns from Saffron

*(Note: To be calculated per kanal basis but recorded as per the land holding of farmer under saffron)

A. Costs and Returns in Open cultivation of saffron

1. Fixed Cost (Rs.)

Items	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.	6th yr.	7th yr.
Sprinkler irrigation							
Farm assets							

2. Variable Cost (Rs.)

Item	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.	6th yr.	7th yr.
Human labour Family labour Hired labour							
Bullock labour							
Machine labour							
Value of seed(corm)							
Value of manure FYM Manure							
Value of fertilizer Urea DAP MOP							
Value of seed treatment							
Irrigation charges							
Plant protection spray Fungicide Insecticide Herbicides							
Miscellaneous							
Marketing cost Harvesting Grading Packaging Transportation							

Returns (Rs.)

Returns	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.	6th yr.	7th yr.
Saffron flower							
Dry saffron							
Corm							

B. Costs and Returns in Indoor cultivation of saffron

1. Fixed Cost (Rs.)

Items	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.	6th yr.	7th yr.
Sprinkler irrigation							
Farm assets							

2. Variable Cost (Rs.)

Item	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.	6th yr.	7th yr.
Human labour Family labour Hired labour							
Bullock labour							
Machine labour							
Value of seed(corm)							
Value of manure FYM Manure							
Value of fertilizer Urea DAP MOP							
Value of seed treatment							
Irrigation charges							
Plant protection spray Fungicide Insecticide Herbicides							
Miscellaneous							
Marketing cost Harvesting Grading Packaging Transportation							

3. **Returns (Rs.)**

Returns	**1st yr.**	**2nd yr.**	**3rd yr.**	**4th yr.**	**5th yr.**	**6th yr.**	**7th yr.**
Saffron flower							
Dry saffron							
Corm							

PART- C **Potential for Indoor cultivation of saffron**

1. **Rejuvenation /Replanting of Existing Saffron Area for improving productivity**
   a. Total area under Open cultivation of saffron _____
   b. Total area under Indoor cultivation of saffron
2. **Field preparation (scientific/traditional, whether raised bed with furrows or not)**
   a. Open cultivation _____
   b. Indoor cultivation _____
3. **Soil treatment (improving soil health by INM, IPM, IDM practices)**

Item	**Open cultivation**	**Indoor cultivation**	**remark**
Soil treatment			
Corm treatment			
Management of rodents			

4. **Duration of corm Replacement (years)**
   a. Open cultivation _____
   b. Indoor cultivation _____
5. **Plant population (no. of corms) maintained per kanal**
   a. Open cultivation _____
   b. Indoor cultivation _____

6. Irrigation system

Item	Open cultivation	Indoor cultivation	Remarks
Irrigation if provided			0 for No, 1 for yes
Type of irrigation			If yes, indicate type of irrigation, whether drip, bore well, manual etc
No. of irrigations			If is it yes, indicate number here
Time of irrigation			Indicate month

7. Application of manures and fertilizers

Application of Manures and Fertilizers as per Recommendations						
	Open cultivation			Indoor cultivation		
Item	Recommended dose	Lesser	Greater	Recommended dose	Lesser	Greater
Urea						
DAP						
MOP						
FYM						

Recommended Dose of SKUAST-Kashmir (kg/Kanal)
Urea=5 kg, DAP=5 kg, MOP=3 kg & FYM=500 kg

8. Method of drying

Methods used for drying of saffron		
Open cultivation	**Indoor cultivation**	**Remarks**
		Indicate method of drying Is it now tent/poly-house/ other protected drying or open sun drying? Also indicate time required for drying through different methods.

9. Production and Productivity of dried saffron

Item	Open cultivation	Indoor cultivation
Production (grams/kanal)		
Productivity(grams/kanal)		

10. Marketing system

Item	Open cultivation	Indoor cultivation	Remarks
Packaging			Indicate method of packaging. Also indicate where these producers get packing material and capacity wise.
Grading of saffron and its subsequent marketing			Indicate if they were grading the saffron prior to marketing
Marketing through			Channels involved (identification of different channels)
Gross price received by farmer in different marketing channels			

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir
Faculty of Horticulture,
School of Agricultural Economics and Horti-Business Management

C E R T I F I C A T E

Certified that all the corrections/amendments as suggested by External Examiner **Prof. S. Mufeed,** Department of Management Studies, University of Kashmir during Viva-Voce examination held on 27-05-2021 have been incorporated in the manuscript entitled **"Comparative Study of Open and Indoor Cultivation of Saffron in Pulwama District of Union Territory of Jammu & Kashmir"** submitted by **Mr. Aqib Bashir (Regd.No.2018-HBM-12-M)**.

(Dr. Kusumakar Gautam)
Major advisor