

Full Length Research Paper

Saffron (*Crocus sativus*) potentials for sustainable rural development: A case study of Balavelayat village in Kashmar, North Eastern Iran

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Saffron (*Crocus sativus*) is one of the most precious agricultural and medicinal plants in the world. It is resistant to dry climates and so it requires very little water. The cultivation of saffron can help create new job opportunities for many people especially in the Iranian province of Khorasan, with its few industrial places in which many young people can be involved. In addition, promoting the cultivation of saffron can convert the economic and social structure of Kashmar and particularly the village of Balavelayat into an area of success and prosperity. The unemployed villagers who usually seek for a job in cities will stop doing so when they can find good jobs with good income in their own town. As a result, there will be a reduction in the number of people immigrating to big cities.

Key words: Saffron (*Crocus sativus*), rural development, environmental potentials, employment, reduction of migration.

INTRODUCTION

Today with a daily increase in the number of human population and the subsequent need for food, there is pressure on the natural resources. As a result, it is quite essential to identify the pieces of land, which are apt to raise certain plants. In so doing, the village of Balavelayat in Kashmar town, in the north east of Iran, seems to be an appropriate choice for the cultivation of the plants, which require a minimum level of water, resistant to dryness and at the same time can be of economic significance to the country.

Saffron, with the scientific name "*Crocus sativus*" belongs to Iridaceae family. It is the most valuable plant under cultivation on the earth. It is widespread in the Mediterranean climate, west of Asia from a geographical latitude of 30° to 50° northern and a longitudinal of 10° western to 80° eastern and in the regions where there is high rainfall in Iran and has a cold winter and a hot summer without rainfall in early autumn (Kafi, 2002). Saffron is a unique and incomparable plant whose production technology has much complexity in its own type. A prominent characteristic of this plant is the

appearance of its flower prior to any other growth organ. The beginning of its growth is in autumn and the end of its growth is in spring. Although it produces plenty of flowers and it is necessary to pick saffron early in the morning just before it gets warm, it lacks productive seeds (Habibi, 1997).

Historical documentaries state the fact that from the earliest times, Iranians had a considerable interest in and attention to gold and saffron in such a way that they used to spread gold and saffron in celebrations and festivals, such as wedding parties and feasts or welcoming grandees and pilgrims. Therefore, it was first cultivated in Iran and originated at the foothills of Zagros and especially Alvand regions (First National Festival of red gold saffron, 2002).

Iranian farmers cultivate saffron on more than 44000 ha² of land. Iran is the biggest saffron producer and exporter country in the world. It produces about 170 to 200 tons, each year. It is 85% of the world production. After Iran, Greece with 5.7 tons, Morocco 3.2 tons, Cashmere 2.3 tons, Spain 1 ton, and Italy 0.1 ton are in the next levels from second to sixth ranks in the world (Kafi, 2002).

Saffron is a plant, which requires very little water and nutritional treatment. It grows in autumn, winter and early

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spring when there is an ample amount of rainfall, little vaporization and naturally saffron's needs for water and irrigation lessens to about zero (Behina, 2002). The income earned through the cultivation of saffron is of great importance in several aspects. The gynoecium of saffron which is presented as the calycle has the most significant role in earning money. The flower petals are used in paint industry and the corms (bulbs) of saffron can bring a good wealth for the farmers in the process of replication. Generally, the high economic value of saffron, the recruitment for a lot of labor at the time of cultivation and harvest can be good reasons to involve the farmers of the region especially at the time of unemployment.

THEORETICAL CONCEPTS

Research Objectives

The goal of the research is to identify the environmental potentials for cultivating and spreading saffron in the region, offering solutions for constant rural development in the district, boosting the income and creating job opportunities for the inhabitants.

Research hypothesis

Molazadeh (2005) believes that a hypothesis is a term that can be considered as an expected studied guess, a conscious conjecture, a pre-assumption, a suggestion, a surmise, and an approximation. The hypothesis of this research is:

According to the features of the area, saffron is regarded as one of the basis of development of the rural economy, and due to the unemployment season, the inhabitants of the area can find it quite useful to get engaged in the job to raise their income.

Research method

The nature of the study is applied and the method is analytical which is based on the statistical documents the author has collected from offices in Kashmar. He has also conducted some observation, and analyzed the data gathered

Rural development

Rural development is a principle for economic and social improvement of poor villagers. Critical and effective factors on the development can be classified into three groups:

1. Natural factors: This includes position, weather, and

size, access to water resources, subterranean resources and topographic features.

2. Human factors: It comprises of population, economic system, social system, scientific and technological improvements.

3. Geographical surroundings: It involves villages and cities, locations for different activities of the men and exploitation of the field and any geographical surrounding owes its status to the environmental conditions and the ecological factors related to them.

Rural development can be considered as a factor for improving the life style of the lower-class people and making them self-sufficient in the procedure of general development of a country; therefore, rural development is a guideline planned for the economic and social affairs of certain groups of people (Sadatinejad, 2003).

GEOGRAPHICAL LOCATION

The village Balavelayat, whose center is Qal'e Baalaa Farah Abaad, is in Kashmar town. Balavelayat is in the east of Kashmar. It is 689 sq km and nine km far from Kashmar. It is located on a longitude of 58° 26' to 58° 44' and latitude of 34° 41' to 34° 56'. In the north, it is bordered by Kouhsorkh and Paen-velayat districts and the west by Khalil Abaad town and east by Mah-velat town (Effati-Moghadam, 2005).

Natural and environmental potentials

According to the geological and geomorphological studies, Balavelayat dates back to Precambrian era and outcropped in the northern heights, especially along Taknar fault. Due to the vicinity of the heights and desert, the climate of Balavelayat is quite variable. As a whole, the climate of the area is affected by several types of air mass: torrid-desert air mass, cold polar air mass and Mediterranean warm and humid air mass

In a period of fifteen years, the average yearly temperature of the synoptic station of Kashmar has been reported as 17.5°C. The maximum yearly temperature recorded for July was around 42.5°C and the minimum temperature was 9.8°C in February. The average yearly relative humidity in the district is 38% and the maximum of relative humidity in January is 59%. As it starts to grow warmer and the amount of rain lessens, the spell of hot weather starts and in July and August, the average relative humidity decreases to 22%. The average rainfall during a period of fifteen years has been reported as 2184.4 mm whose average monthly maximum in February is 45.6 mm and its minimum in August is 0.2 mm (Table 1).

The freezing period of the area starts from November and continues until the middle of March. The minimum temperature is in February but the most freezing days that take 15.5 days long are in January (Figure 1).

Table 1. Weather variations in Balavelayat 1991-2006.

Months	Maximum rainfall 24 h	Monthly Rainfall	Number of glacial days	Evaporation	Temperature degree (°C)		Average of temperature			Relative humidity		Sunny hours	
					Maximum total	Minimum total	Daily	Minimum	Maximum	Average	Minimum		Maximum
January	34.1	29.5	15.5	-	18.4	-9.6	4.4	0.2	8.8	59	38	83	177
February	41.8	45.6	10.1	-	19.4	-9.8	6.3	1.7	10.8	55	36	81	170
March	34	52.6	2.6	-	25	-4.8	10.7	5.9	15.6	51	30	78	194
April	47	29.1	-	228.3	32.6	0.6	17.8	12.1	23.5	41	26	66	231
May	27.4	13.1	-	231.8	35.8	2.2	22.9	16.6	29.1	31	21	53	300
June	5	1.8	-	430.6	40.6	12	28.2	21.5	34.8	24	17	37	320
July	6.9	0.6	-	477.4	42.5	16.2	29.8	23.1	36.6	22	16	34	358
August	1.3	0.2	-	410.4	41.5	8.4	28.2	20.9	35.4	22	16	36	357
September	11	0.9	-	309.3	38.4	6.5	24.3	17.1	31.5	24	16	36	309
October	20	5.3	-	206.2	33.6	-0.8	18.1	11.7	24.5	33	22	53	281
November	17	9.5	1.6	115.4	26	-3.3	12.5	7	18.5	40	25	62	226
December	38	30.2	8.1	-	24.4	-9.5	7	2.4	11.6	55	36	79	179
15 Years	27	218.4	37.9	2509.5	42.5	-9.8	17.5	11.7	23.3	38	25	58	3106

Source: Meteorology statistics of synoptic station, Kashmar (2008).

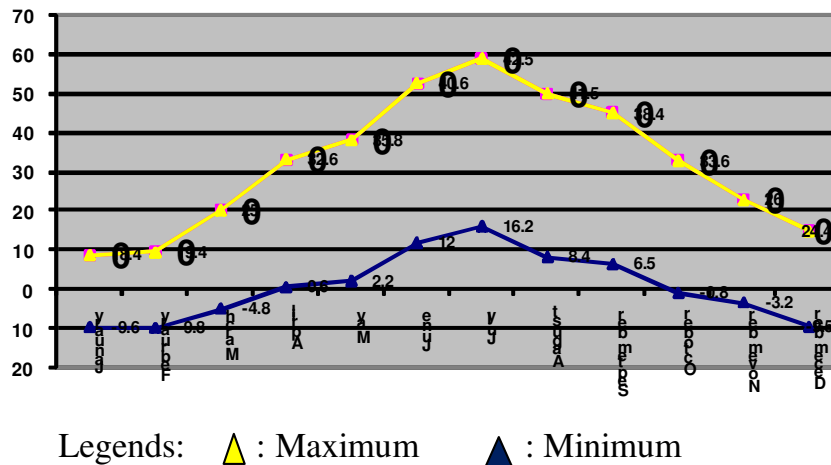


Figure 1. Maximum and minimum total temperature (°C) during a fifteen-year period 1991-2006. Source: Writer's field research and statistics of meteorology of Kashmar, (2008).

The average evaporation in a statistical period has been reported as 2509.5 mm per year. It has to be explained that the rate of evaporating in the meteorology station of Kashmar has been measured by evaporation basin of Class A, and by calculating the coefficient of the basin (0.65) its amount is reduced to 1338.35 (Figure 2). The soil in Balavelayat is classified into several groups:

- Group A: Includes sandy soil and rubbles that have high permeability; they are mostly seen in the river-bed of the north of the district.
- Group B: All the land inside the plain except agricultural and residential areas.
- Group C: The border of this territory is covered with heights and mountains. This group includes sandy and

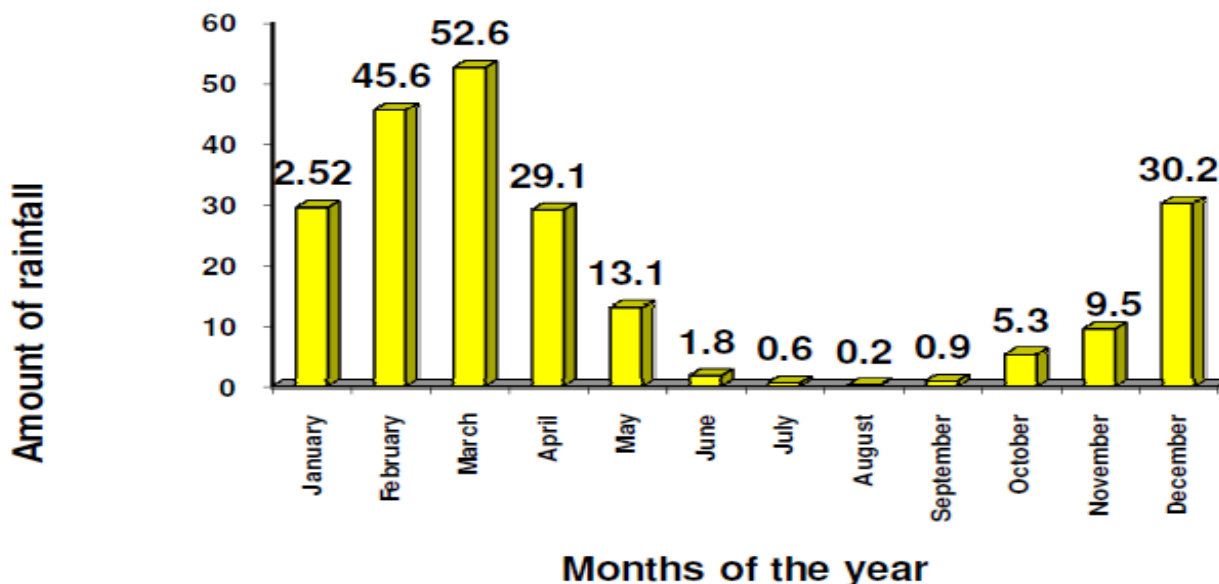


Figure 2. The amount of rainfall in different months of the year during fifteen years 1991-2006. Source: Statistics of meteorology station of Kashmar (2008).

hard layers at the bottom.

Group D: The border of this area is around villages and includes farming land plots and residential areas; most of the soil of such fields is pug.

Balavelayat, having flat and prolific fields with more than 5000 ha² farms and gardens, is one of the most suitable agricultural areas in Kashmar. Balavelayat lacks any rivers or constant surface course or surface water is usually seasonal and periodic. The rivers are Roud-jerof or Zherof Kal, Khorasan-darreh kal, Aliabad, Kharmangah and Chenar Ismail Baloch (Khorasan Regional Waters Cooperative Co. 2006).

The subterranean water resources of the region in the case study include aqueducts and wells. There are 15 main aqueducts lying in the villages without which the villages face problems. The average amount of water of aqueducts is 34 L per second and the evacuation rate is about 16 million cubic meters per year. The increase of the population and a need for more water has forced the farmers to dig wells and use underground water.

In 1951, the first farming well was dug in Ghouzhd village, one of the environs of Balavelayat. Right now, the number of the farming wells has increased to 53 and it has to be mentioned that due to low downfall of underground water, the extraction of water has been banned by the Ministry of Power and Water Affairs and digging wells is only allowed in the area of the dried aqueducts (Khorasan Regional Waters Cooperative Co., 2006). The average amount of water drawn from each well is 470444 m³/year; as a result, the whole water of the farming wells of Balavelayat reaches 25 million cubic meters. Because of weather variations and differences in the types of soil, the condition of animal and vegetation

coverage is unvarying all over the region (Monazam, 2001).

Cultural, social and human characteristics

Based on the consensus in 2006, the population of Balavelayat is 30699, and accordingly it has a relative population density of 38.78 persons per sq 1. The most populated village of the district in the year is Ghouzhd with a population of more than 4762. It is located 2 km away from the south of Kashmar, and Haji-Rajab village with a population of 9 is the least populated village in the region.

The center of Balavelayat is Ghaleh-bala (Farahaabaad) village, which has a population of 2740 and is located 9 km away from the city. In Balavelayat, 33% of the population includes youngsters, 61% adults and 6% old people. According to such age groups, it is possible to determine the Dependency Development Indices in this area.

The calculation of Dependency Ratio in different censuses in Iran shows a result of about 1 (Jahanfar, 1995). According to gross economic bar formula, the dependency ratio of Balavelayat is 0.6. Such a figure shows a good economic condition for the people. In fact, due to an increase in the population, this ratio stands in the age group of 15 to 6:

1819 = age group over 65; 10035 = age group of 0-14; 18845 = age group of 15-65; C.D.R = 1819+10035:18845 = 0.62; Gender Ratio = 15583 × 100: 15116 = 103; 15583 = number of men, 15116 = number of women.

In 2006, Balavelayat had a population of around 30699; 15583 were male and 15116 were female. The gender ratio was 103; that is, there were 100 females for 103 males:

Gender Ratio: $15583 \times 100 = 103$

Of the whole employed population of the area in 2006, 43%, that is, 4434 work in the agriculture sector, 48%, that is, 4958 work in the industry sector and 9%, that is, 971 work in the service sector (Mihaan, 2006).

One of the most critical indices for developing societies is the percentage of literacy and the rate of present facilities in a society. The educational services in the area start from the pre-school and continue to secondary-school. In the academic year of 2006, in 17 villages of the district, 28 primary-schools were active and 1962 boys' students and 1774 girl's students studied. There were 9 boys' secondary schools with 1240 students and 8 girl's secondary schools with 879 students. One of the reasons in reduction of girl students at this level is the presence of carpet making workshops, which simply led to the girls quitting school.

Functional method for specifying rural services centers

In order to specify an appropriate center for rural services in the area or a complex of villages, the most important criterion is the hierarchical specification and arrangement of construction in the villages to provide the best possible way of services; thus the rural society would be able to optimize the present service facilities at higher levels (Moti'ie and Seyed, 2003). On the basis of the total of such points, the village settlements have different sets of points according to which it is possible to classify and grade each of the places (Tables 2, 3 and 4).

SAFFRON

Saffron grows in the regions where there is very high rainfall with a cold winter and a hot summer without rainfall in early autumn (Kafi, 2002). A prominent characteristic of this plant is the appearance of its flower prior to any other growth organ. The beginning of its growth is in autumn and the end of its growth is in spring. According to the growth of the aerial organs, the growth process of saffron is divided into three stages as thus explained.

Generative growth stage

This stage is the most important one and as producers say, it starts in autumn with the weather getting cold. The

generative growth stage begins with the start of irrigation and the appearance of the first flowers; it ends with the appearance of the last flower. Its duration is between 15 to 25 days long.

Start stage

This stage is taken as the longest physiological stage of growth for saffron. It starts immediately after the appearance of flowers. Apparently, the leaves have reached maturity and provide the essential storages for feeding the base through photosynthesis.

Record stage

This stage starts with the leaves turning yellow in spring and continues with the first irrigation in autumn. This period usually takes five months. It has a lesser significance for farmers and the public idea runs that it is the rest time for the base of the saffron and the preparation for yielding in autumn (Kafi et al., 2002).

Weather - ecological requirements of saffron

Temperature

Although saffron is cultivated in dry and moderate areas; the season of its cultivation is in such a way that its aerial and visible organs grow out of the soil in the cold period of the year. In Balavelayat, the average temperature at the time of appearance of the flower and growth of the leaves in autumn does not exceed 20°C, whereas the average minimum temperature during this time is about zero (Javanmard et al., 2002).

Humidity

The growing season starts with the autumn rain and ends with the spring rain. During its growth, particularly in winter, other plants' need for water is less and regarding the current water like subterranean water and rivers. it does not cost too much to provide water for saffron (Sadeghi et al., 1997).

Suitable soil

It is necessary for the soil of the field for cultivating saffron to have a structure with relative softness with good permeability; saffron grows well in siliceous, clayish, ferric and chalky soils, since in such soils, which are rich in calcium, the organic materials can be properly dissolved (Vafabakhsh et al., 2002).

Table 2. The number of service facilities in Balavelayat in 2008.

Village name	Primary school	Secondary School	High-School	Farmland	Library	Public bathhouse	Health center	Medical clinic	Social-welfare complex	Physician	Basij Base	Islamic council	Cooperative Co.	Pipelined water	Electricity	Post Office	Telephone	Public transport	Bank or credit	Gas station	Total
Iss'haqhabad	1	1	0	0	0	1	1	0	0	0	1	1	1	1	1	1	1	0	0	1	12
Baharieh	1	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	1	0	0	0	7
Torbaghan	2	3	2	0	1	2	1	0	0	0	1	1	0	1	1	1	1	1	1	1	21
Telabad	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	1	9
Jardouy	1	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1	0	0	1	11
Haji-Rajab	1	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	5
Razghabad	2	2	0	0	0	0	2	0	0	0	1	1	1	1	1	1	1	1	0	1	16
Tahirabad	0	2	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	3
AArifabad	2	2	0	1	1	2	1	0	0	0	1	1	1	1	1	1	1	1	0	1	18
Fadafan	2	2	0	0	1	4	1	1	0	1	1	1	1	1	1	1	1	1	0	1	21
Farsheh	1	1	0	0	0	1	1	0	0	0	1	1	1	1	1	1	1	1	0	1	13
Farg	2	2	0	1	0	2	1	0	1	0	1	1	1	1	1	1	1	1	0	1	18
Forotagheh	2	2	1	1	1	2	1	0	0	0	1	1	1	1	1	1	1	1	1	1	20
Ghaleh-bala	2	2	2	0	1	2	1	1	1	1	1	1	1	1	1	1	1	1	0	1	22
Ghoch-palang	1	1	0	0	0	1	1	0	0	0	1	1	1	1	1	1	1	1	0	1	13
Ghoujhd	4	2	1	1	1	3	1	1	0	1	1	1	1	1	1	1	1	1	1	1	24
Kajhghuneh	1	0	0	0	0	1	0	0	0	0	0	1	0	1	1	1	1	1	0	1	9
Kalateh-naie	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Gondbar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Naay	1	1	0	0	0	1	1	0	0	0	1	1	1	1	1	1	1	1	0	1	13
Sum	28	21	6	4	5	27	13	3	2	3	14	17	14	17	19	17	18	12	3	15	

Source: Field and library studies by the writer (2008).

The status of cultivating saffron in Balavelayat

Planting stage

Field preparation: In preparing fields for planting saffron, it is necessary to plough the field with ploughshares after spring rain and if the field has clods, the ploughshare should be disassembled

and the clods should be broken using a trowel. After two or three weeks before the third plough, the field should be ploughed again vertically. For each hectare, 40 to 80 tons of manure and 200 kilograms of ammonium phosphate should be used. The farmers have found out that continuous ploughing, in addition to providing a good field for cultivation, removes the weeds to some extent.

And after this stage, they divide fields into patches according to the gradient and water pressure.

Choosing corm and time of cultivation: The corm must be healthy and without any cut, having a diameter of 25 to 23 mm and a length of 35 to 40 mm. Larger corms improve the function on the surface to such a proportion that the weight of the

Table 3. Coefficient of present service facilities in Balavelayat in 2008.

Village name	Primary school	Secondary school	High-school	Farmland	Library	Hygienic bathhouse	Health Center	Medical Clinic	Social-welfare complex	Physician	Basij base	Islamic council	Cooperative Co.	Pipelined water	Electricity	Post office	Telephone	Public transport	Bank or credit	Gas station	Villages points	Villages level
Iss'haqhabad	0.46	0.62	0	0	0	0.48	1	0	0	0	0.93	0.76	0.93	0.68	0.68	0.93	0.81		0	0.87	9.15	11
Baharieh	.018	0	0	0	0	0	0	0	0	0	0.36	0.29	0		0.26	0	0.31	0	0		1.4	16
Torbaghan	0.68	0.9	4.75	0	0	0.7	1.46	0	0	0	1.36	1.12	0.36	0.19	1	1.36	1.9	1.73	0	1.27	20.07	7
Telabad	0.32	0	4.75	0	0	0.33	0	0	0	0	0	0.53	0.64	0.56	0.47	0.46	0.56		0	0.6	4.47	15
Jardouy	0.36	0	0	0	0	0.37	0.77	0	0	0	0.71	0.59	0.71	0.93	0.53		0.63	0	0	0.67	5.95	13
Haji-Rajab	0.14	0	0	0	0	0.15	0	0	0	0	0	0.24		0.21			0	0			0.74	17
Razghabad	0.57	0.76	0	0	0	0.5	1.32	0	0	0	1.14	0.94	0.94	1	0.84	1.14	1	1	0	1.7	12.85	8
Tahirabad	0	0	0	0	0	0	0	0	0	0	0			0.13	0.11			0	0	1.4	0.24	18
AArifabad	0.46	0.86	0	4.5	3.6	0.67	1.38	0	0	0	1.29	1.06	1.29	1.13	0.95	1.29	1.13	1	0		22.45	6
Fadafan	0.75	1	0	0	4.2-	0.75	1.62	7	0	7	1.5	1.24	1.5	1.31	1.11	1.5	1.13	1	0	1.4	35.1	4
Farsheh	0.46	0.62	0	0	0	0.48	1	0	0	0	0.93	0.76	0.93	0.81	0.68	0.93	0.18	1	0		9.59	10
Farg	0.64	0.86	0	4.5	0	0.67	1.38	0	9	0	1.29	1.06	1.29	131	1.11	1.5	1.31	1	0	1.4	50.85	2
Forotagheh	0.71	0.95	5	5	4	0.74	1.54	0	0	0	1.43	1.18	1.43	1.25	1.05	1.43	1.25	1	10	1.33	40.11	3
Ghaleh-bala	0.75	1	5.25	0	4.2-	0.75	1.62	7	0.5	7	1.5-	1.24	1.5	1.31	1.11	1.5	1.31	1	0	1.4	50.85	2
Ghoch-palang	0.43	0.57	0	0	0	0.44	0.92	0	0	0	0.86	0.71	0.86	0.75	0.63	0.86	0.75	1	0	0.8	8.58	12
Ghoujhd	0.86	1.14	2.35	6	4.8	0.89	1.85	8	0	8	1.71	1.41	1.71	1.5	1.26	1.71	1.5	1	12	1.6	59.47	1
Kajhghuneh	0.32	0	0	0	0	0.33	0	0	0	0	0	0.53		0.56	0.47	0.64	0.56	1	0	0.8	5.03	14
Kalateh-naie	0.07	0	0	0	0	0	0	0	0	0	0	0		0	0.11	0	0	0	0	0	0.18	19
Gondbar	5	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	20
Naay	0.46	0.62	0	0	0	0.48	1	0		0	0.93	0.76	0.93	0.81	0.068	0.93	0.81	1	0	0.87	10.46	9

Source: Field and library studies by the Author (2008).

corm and the percentage of blossoming corms get increased (Ziaie et al., 2006).

Required amount of seeds per area: Depending on the size of the corms, the amount used for cultivation will be varying between 3 to 10 tons/ha.

The distance between the corms is usually 25 to 30 cm on all sides (Dadkhah, 2003).

Time and method of gathering corms on farms: Running new farms of saffron is only possible by means of the corm; saffron corm can

be taken out from the soil and get transferred to another farm or a store. The lesser the time lag between removing the corm from the soil and planting it again, the better it will be. Still the saffron corms can be stored in a scattered form at a height of 20 to 30 cm in a dry and cold place for

Table 4. Development level of villages through services point of view 2008.

Villages name	Obtained points	Village level by services	Developed Level
Ghoujhd	59.47	1	
Ghaleh-bala	50.85	2	
Forotagheh	40.11	3	
Fadafan	35.1	4	Developed villages by services
Farg	28.03	5	
AArifabad	22.45	6	
Torbaghan	20.07	7	
Razghabad	12.58	8	
Naay	10.46	9	
Farsheh	9.59	10	
Iss'haghabad	9.15	11	Developing villages by services
Ghouch-palang	8.58	12	
Jardouy	5.97	13	
Kajhghouneh	5.03	14	
Telabad	4.47	15	
Baharieh	1.4	16	
Haji-rajab	0.74	17	Under-developed villages by services
Tahirabad	0.24	18	
Kalateh-naay	0.18	19	
Gondbar	0	20	

Source: Field studies and library of the Author (2008).

several months; but such a job will reduce the quality of the plant in the first year of cultivation (Amir, 2001).

Method, depth and distance in planting saffron corms:

Cultivating saffron in Balavelayat usually takes place in two ways. The first one is by using a worker and a shovel; saffron is planted in the prepared field; several holes are dug and the corms are buried in. The advantage of this way of planting is that the corms are naturally placed, that is, straight in the ground. This will help in the blossoming of the first year. The second method uses wither a tractor, a horse, or a mule by which numerous corms are buried quite deep in rows. This will make it easy to remove the saffron flowers. The corms are planted at the depth of 15 to 20 cm. In this way, they will be safe from freezing in winter and heatstroke in summer. Each corm is usually planted 25 to 30 cm away from another corm.

Time and date of planting saffron corms: The best time suggested for planting saffron is June. It is, however, better to avoid planting saffron in mid and late July, since in these months, it is very hot and the percentage of relative humidity of air is less. It is also possible for the corms to lose humidity at the time of transferring them and so they may get damaged (Behina, 1996).

Maintenance stage

Irrigation: After planting the saffron corms, it is time for irrigation. The best irrigation time in Balavelayat is from 23rd of October to 1st of November. The first irrigation is called "aab-besaar" and after picking the flowers, the farm must be irrigated immediately which is called "Zaach-aab" and the last irrigation in Balavelayat is in mid-April which is known as "Zard-aab" (Effati-Moghadam, 2005).

Cracking the hardened soil: After the first irrigation, and immediately after the field has been ploughed, the hardened soil surface of the field must be cracked in such a way that the corms should not be damaged; the best tool for this is the hoe, furrowed shovel, Iranian ploughshare and cultivator. Cracking the hardened soil causes the flowers to sprout easily and the manure to be mixed with the soil; furthermore, it has a great effect on destroying the weeds. Cracking the hardened soil is carried out by man power or animals, such as a horse or mule or small garden-tractors.

Weeding: By competing for water, food stuff, and sunlight, weeds reduce the growth of saffron. In Balavelayat, the first weeding is before the second

irrigation, "Zaach-aab ". The second stage of weeding is usually carried out one month before the third irrigation "Zard-aab". In recent years, a number of farmers have made use of chemical weed killers.

Harvesting stage

Picking flowers and separating stigmas: Harvesting saffron includes picking flowers and separating stigmas from other parts of the flower, which needs a lot of man power as the flowers are picked by hand. The blossoming period of saffron usually lasts 15 to 25 days. During the first days, the amount of the produce is little, but from the seventh day, it begins to increase. After the flowers are picked, it is turn for separating the stigmas. This task must be carried out immediately after picking the flowers and the hygienic matters must be observed, too. Separating the flower from the stigma must be carefully carried out from the point where the stigma is divided into three threads. The lesser the number of white stalks, known as "cream", the finer the saffron will be.

Saffron processing: Compared to its production, processing and drying saffron are very important. The most basic and easiest task for enhancing the quality of saffron and its color is drying it immediately. In the case study, the drying method is in such a way that after separating the red stigmas that lacks cream, it has to be spread on a newspaper or a white cloth and has to be collected after two or three days. But the right method for drying is using special sifters and proper heat. The separated and wet threads of saffron are poured immediately into a sifter or a textile net and heated carefully so that it will be dried. The heat must be in such a degree that the saffron would not be burned.

After saffron is dried, it is packaged and stored for the market. If saffron is placed in hot areas with direct sunlight and high humidity, it will gradually lose its quality.

Threats to saffron: it involves cold stroke to the leaves and flowers, Lack of alternation in irrigation, saffron pasture and rodents damage.

a) Cold stroke to the leaves and flowers

Although saffron is cultivated in dry and hot areas, and despite the area, it is resistant to cold. The maximum cold that this plant can resist is 22°C. The outburst of bitter cold in certain years in the region causes the saffron flowers to freeze in such a way that gathering the joined flowers is not worthwhile because firstly, the flower is inseparable from the stigma, and secondly it has lost its good quality.

b) Lack of alternation in irrigation:

Saffron's need for water in autumn is removed by the

atmospheric rainfall, but that does not mean that the plant does not need irrigation at all; as mentioned earlier, saffron must be regularly irrigated three times a year.

c) Saffron pasture:

Generally, the saffron grass is used as pasture for farm animals, but it should be noted that the best time for this is when the saffron grass has completely dried. Otherwise, it will hurt the body.

d) Rodents damage:

Among the rodents, rabbits and different types of mice are the serious enemies to saffron, each of these animals destroy the saffron sprigs in their own ways.

Mixed cultivation of saffron

Mixed-cultivation refers to cultivating more than one farming plant in one field consecutively during the growth season. Therefore, the production is increased and soil and water resources are used more efficiently and the field is continuously under cultivation (Kouchaki et al., 2002) in the area under study, in the saffron fields, such trees as peanuts, pistachios, barberries and grapes are planted. The cultivation of caraway on the saffron farms can be taken into consideration (Monazzam, 2001).

Standards and quality control of saffron

The guarantee of saffron quality is observed by means of the required standards, which include packing, labeling, sampling, and testing saffron (Hemati and Abbas, 1997). Since saffron is an expensive and valuable crop, it has long been faked by greedy people; the most common cheating methods are the following: 1) dying the cream of saffron by the extracted color from the stigma; 2) adding rosy petals to the saffron; 3) dying the stigma corm and adding it to the saffron; 4) making the saffron heavy by adding moisture or smearing it with oil, honey and nitrate solution; 5) adding fibers of cow and camel meat to the saffron. However, there are some techniques to recognize the fake saffron: by (a) Chromatic reflections (b) Chromatographic methods and (c) Microscopic and laboratory methods (Hemati and Abbas, 2002).

Economic significance, properties and consumption of saffron

Among the exporting goods, saffron enjoys a considerable position in such a way that its export value was 150 tons in 2008, which worth about 600 million dollars. About 92% of the production and 98% under cultivation have been attributed to Khorasan province.

Table 5. Calculation of saffron income expenditure per hectare.

Rows	Expenditure type	Number	Price in dollars	Total price in dollars
1	Water expenditure	24 h	120	2880
2	Field rent	1 ha	2000	2000
3	Flower collecting	50 Persons	80	4000
4	Separating (picking)	45 Persons	100	4500
5	Cracking hardened soil	5 Persons	80	400
6	Manure	20 Sacks	50	1000
7	Chemical weed killers	3 L	100	300
8	Spraying Poison	2 Persons	80	160
9	Insurance	-	780	780
10	Tools	20	150	150
11	Transport costs	7 Days	50	350
12	Total of expenditures			136,40

Source: Field studies of the Author (2008).

According to the study done, for each hectare of saffron during a year, 270 working-day individuals are required to do such tasks as planting, maintaining, harvesting and separating the flower from the stigma; accordingly, for the cultivation of 47208 ha, there will be jobs for 12.7 million days. Therefore, this provides nearly 63.7 thousand jobs a year.

Saffron has different uses and because of its beautiful color, taste, fragrance, and medicinal properties, it is considered in different aspects:

- i. Nutritive consumption: In many countries in the world, saffron is used for spice, color and seasoning, adding fragrance and taste to the food, sweets, medicine and non-alcoholic drinks;
- ii. Medicinal consumption: Saffron possesses medicinal quality for its bitter materials, stimulant distillate and nerve-relieving quality;
- iii. Industrial function: Saffron is used for coloring cotton and silk in the industry;
- iv. Nurturing honey-bee: The saffron flower is very rich in nectar and pollen for the honey-bees;
- v. Saffron leaves as animal food: On the basis of the conducted research, from each hectare of saffron, nearly 1.5 tons of dried saffron leaves are harvested, which has protein supplements and are considered to be rich nourishment for farm animals.

Saffron and the necessity for its insurance

The economic part of saffron is its stigma, which lies in the sensitive and fragile part of the flower. The saffron flower grows in cold days of autumn when many dangers, such as cold, frost, rainfall, and flood endanger the plant. If one of these threats happens, the saffron flower will be damaged and turn useless. To support the farmers, the Insurance Fund for Farming Goods brings their crops under the coverage of insurance to protect them against

such probable dangers and compensate for the damage to some extent. With the insurance premium being high; the farmers have been unable to buy insurance for their crops and so they usually suffer from natural disasters particularly from the recent droughts (2008 and 2009) which have caused them a lot of loss.

Calculation of saffron income expenditure per hectare

According to Table 5, saffron expenditure per hectare is around 1.4 million dollars. Considering the average amount of harvesting flowers from one hectare, which is 5 kg, the price of 1 kg of saffron in the harvesting year of 2008 was 4 million dollars. The gross income in each hectare is 20 million dollars, where after in deducting expenditures (1.4 million dollars), the net income in each hectare is 1.86 million dollars (Table 5).

Comparison of the income earned from saffron with that from other goods

Saffron is one of the common goods in Balavelayat, which has played a significant role in recent years in terms of both cultivation and the earnings it has brought to the area. The farmers of the district, who have faced the lack of water resources, have pursued such plants, which do not need considerable amount of water and are financially beneficial.

Therefore, suitable for growth in the climatic condition of the area, saffron has been cultivated in such a way that in each year, a great number of farms are allocated for saffron cultivation. The plant is cultivated for a period of 7 to 10 years. The picking of flowers in the second three years of cultivation, that is, the third to seventh year, reaches its maximum and then decreases (Table 6).

Table 6. Comparison of saffron income with other productions.

Type of production	Efficiency in kg/ha	Price of kg in dollars	Gross income per hectare in dollars	Expenditure per hectare in dollars	Gross income per hectare in dollars
Saffron	5	40,000	200,000	13,640	186,360
Wheat	5100	4.7	23,970	8,100	15,870
Barley	4300	3.9	16,770	8,100	8,670
Patch	25,000	2	50,000	20,500	29,500
Cotton	2800	5.9	16,520	13,500	3,020
Pea	1250	2.7	3,375	2,010	13,650
Grape	22,000	2.8	61,600	13,500	48100
Pomegranate	16,000	3.6	57,600	12,500	45,100
Sum					337,985

Source: Field studies by the writer and statistics of agriculture Jihad, Kashmar, Gardening sector (2008).

Comparison of job opportunities by saffron and other goods

Saffron is one of the plants, which can involve a lot of labor. In fact, it can employ 213 to 270 day-working jobs per hectare. Averagely, in each village of the area, there are 95 ha used for the cultivation of saffron; therefore, taking 20235 working days in each village and plus the 19 villages of the area, the number grows to 384465 working days. On the one hand, this is a plant, which does not require much wealth and investment. On the other hand, when it gets ripe, it is almost the season of cold days when the farmers are not busy working on their farms and so they do not need much water for their other crops. Consequently, it can be taken into granted that it is economically quite justifiable and reasonable to grow saffron in the east of the country and particularly in the village of Balavelayat.

As Table 7 shows, the average working days in one farming year in Balavelayat have been determined, where saffron stands first with 213 working days per hectare.

Evaluation of the per capita income of the sample village AArefaabaad through cultivating saffron

AArefaabaad is one of the villages of Kashmar; it is the central part of Balavelayat and is located 7 km away from Kashmar. The reason for the formation of AArefaabaad can lie in the existence of the aqueducts, which are about 700 years old. Owing to the facilities and services, AArefaabaad is in an appropriate condition and thanks to the population control; the rate of population growth has been 82% in the past few years. The literacy rate of the village is very high and reaches 84% (Table 8).

The income of the agriculture sector is 885,364 0 dollars and according to its population of 590 families in 2008, the earned income by each family is 15006 dollars 39% of which is from saffron (Effati-Moghadam, 2005).

CONCLUSION AND SUGGESTIONS

According to the geographical location, weather, and soil conditions, Balavelayat is an appropriate region for cultivating saffron. This region proved to be apt enough to improve the conditions for cultivating saffron, create jobs, and increase the income; the farmers of the area became more motivated towards cultivating saffron. In order to develop saffron cultivation and constant rural development in the district, the following suggestions and solutions are offered:

- i. Familiarizing the farmers with the scientific principles of cultivating the plant and raising the quality of saffron by teaching sanitary issues to the farmers and promoters;
- ii. Establishing saffron -Farmers Cooperation in the district to guarantee purchase and insurance of the produce against drought and cold stroke and offering long-term facilities for developing saffron cultivation, and the most critical factor is the stabilization of the pricing system of saffron;
- iii. Establishing supplementary industries, which are dependent on saffron. This can bring more job opportunities, such as packaging;
- iv. Reducing the period of yielding from nine years to five or six years is in such a way that at the beginning and at the cultivation stages, more and higher-quality seeds should be used so that the desirable result will be achieved sooner;
- v. Preventing excessive pasture, burning the farms and punctual and appropriate irrigation;
- vi. Wide advertisements by the mass media and familiarizing people with the advantages of consuming saffron in order to increase local consumption;
- vii. Preventing the smuggling of saffron corm to the neighboring countries like Afghanistan, Pakistan etc.
- viii. Enhancing the quality of saffron and reducing its pollution through continuously training the farmers for the observance of hygienic affairs and accurate methods of harvesting saffron;

Table 7. Average number of day-jobs generated in one harvesting year, 2008.

Names of goods	Number of working days created per hectare	Field under cultivation by hectare	Total number working days created in the area
Saffron	213	1805	384465
Patch	69	885	61065
Kinds of gardens	58	647	37526
Cotton	51	360	18360
Wheat	32	1763	56416
Barley	32	719	23008

Source: Field Studies by the writer and statistics agriculture Jihad, Kashmar, gardening sector (2008).

Table 8. Earnings of agricultural sector in AArefaabaad, 2008.

Kinds of produce	Area under cultivation	Net Income per hectare in dollars	Total Income of the village through this method in dollars
saffron	312	120,000	374,400,00
Wheat	178	7,500	133,500,0
Barley	120	5,000	600,000
Cotton	77	6,300	485,100
Patch	59	3,900	230,100
Grape	140	17,000	238,000,0
Pistachio	30	2,648	79,440
Total			885,364,0

ix. Preventing fake saffron;

x. Presence of an official and government custodian in export grounds of the production and removing problems related to brokers and customs;

xi. Preventing the export of saffron in bulk to countries like Spain and UAE where it is sold by their own name after it is packed.

REFERENCES

- Amir GT (2001). Saffron the red gold of Iran, Cultural Institute of Nashre Ayandegan.
- Behina M (1996). Saffron Cultivation, Tehran University Publications, pp.2-8
- Behina M (2002). Saffron the mauve gold of wild, Zeytoun J. Number, p. 19.
- Dadkhah EF (2003). Iran's saffron , an unknown Gem.
- Effati-moghadam R (2005). Economical effects of cultivating saffron in Balavelayat in Kashmar, Thesis for M.A. Islamic Azad University, Mashhad Branch, pp.2-11
- First National Festivals of saffron the Red Gold (2002). Khorasan, Ghe`en, Climatology Research Center.
- Habibi MB, Bagheri KA (2001). saffron: Cultivation, Procedure, Chemical Compounds and Its Standards; Industrial and Scientific Researches Organization Publications of Iran, Capital of Khorasan
- Hemati KA (1997). Scheme Report of saffron Packing and Procedure Research, Industrial and Scientific Researches Organization of Iran, Capital of Khorasan.
- Hemati KA (2002). Saffron and Production Technology, Ferdowsi University Publications in Mashhad, pp. 15-20
- Jahanfar M (1995). Iran Demography, Payam-e Nour Publications, pp.5
- Javanmard SJ (2002). Consideration and Comparison of Venturing saffron Cultivation in Ecological Sectors of South Khorasan , First saffron Festival, Gha`en.
- Kaafi M (2002). Saffron, Production Technology, saffron Eco-physiology, Zaban-va-Adab Publications, pp.1-5
- Kafi M (2002). Saffron, Production Technology, Zaban-va-Adab Publications, pp.88-102.
- Kouchaki A (2002). Constant Agriculture , Jihad-e Daneshgahi Publications, pp.9
- Molazadeh MA (2005). An Introduction to Scientific Researches in Geography, pp.2
- Monazam IA (2001). Environmental Potencies in Kashmar, Thesis for M.A., Islamic Azad University, Shahr-e Rey, pp.4-9.
- Moti`ei L, Seyed H (2003). Rural Planning by an emphasize on Iran, Jihad-e Daneshgahi Publications of Mashhad, pp.5.
- Sadatinejad SJ (2003). Abkhizdari, An approach for abolishing poverty in rural areas, Jahad monthly J. Number, pp. 196-197.
- Sadeghi B (1997). The effect of irrigation in increasing the function of saffron, Industrial and Scientific Researches Organization of Iran, Faculty of Khorasan.
- Vafabakhsh JH (2002). Discovering the Potentials of Saffron Cultivation Farms in Iran, First Saffron Festival, Gha`en.
- Ziaie M, Ismailei S (2006). Saffron the Red Gold, Man.