Prioritization of industrial saffron value chains

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Abstract

One of the most important economic sectors in Iran is agriculture, where any development in this field is the basis for development of other industries of the country. Saffron has a high economic and social importance among Iranian crops. Currently, Iran is the largest producer and exporter of saffron so that about 95% of the world's precious product is dedicated to Iran. The abundant and extensive use of saffron, it's special and valuable properties as herbal medicine, the particular role in the life of farmers in some of the provinces of the country, as well as its high added value, makes it necessary to pay special attention to saffron-related topics. The purpose of this research is to identify and rank the value chain of saffron as its industry uses with the approach of network analysis process. The results show that there is no significantly different between the two value chain of powder and liquid use of saffron in industry according to ideal, normal and raw weights in the model. However in terms of the two criteria, packaging and processing of industrial saffron value chain, using saffron in liquid is more important.

Keywords: Saffron, Liquid, Powder, Process

Introduction

In the field of agricultural products, Iran has a privileged position among developing countries in terms of production, price and asset quality. The climatic conditions of Iran have caused the quality of agricultural products and the aroma and taste of some products, including Zaban-Zed saffron, to be special and common (Hakimpour, 2016). Today, saffron is widely cultivated in Iran and in some other countries such as Italy, Greece, France, Spain and Afghanistan to a limited extent (Bakhtiari et al., 2015). Iran has a long history in saffron cultivation and is the most important producer of this product. It also owns about 93% of the world's saffron cultivation and production area. The production of saffron as a key commercial product increased from 336 tons with about 103 thousand hectares of cultivated area in 1995 to more than 376 tons with about 107 thousand hectares of cultivated area in 1996, which represents more than 4 thousand hectares increasing in The area under cultivation. (Ministry of Agricultural Jihad, 2017; Ministry of Agricultural Jihad, 2017). This is while Iran is not yet recognized as the largest producer and exporter in the world, and Spain is mentioned as a reference for saffron in the world (Aghaei and Qolizadeh, 2010).

Therefore, saffron, which is cultivated in the areas of Khorasan and has a high relative advantage, its processing can be an important step in the direction of preventing bulk export, creating employment and prosperity of villages and saffron cultivation areas. Therefore, it seems necessary to know and examine the internal environment (strengths and weaknesses) and the external environment (opportunities and threats) in the field of saffron production and processing to be able to think of measures and formulate strategies.

Literature

In the context of the value chain, Karbasi et al. (2017) studied the challenges of the Iranian saffron value chain in global markets. The results of the study showed the lack of ability to price saffron in foreign markets, the lack of attention to the different uses of saffron according to the target markets, the lack of recognition of the Iranian brand in the world markets, and Iran's low share of the added value resulting from the processing of this product, which are all missing links in the saffron value chain. are, it has caused the decrease of Iran's share of the world value of saffron market. Regarding the network analysis process, Mirzarmazani et al. (2016) identified the technological risks of the new product development process and prioritized them with the network analysis process (ANP). In the end, the obtained results showed that the three technological risks "product stability and stability", "expert manpower (technical knowledge and experience)" and "expected product performance" have the highest priorities in product development processes.

Khajuipour et al. (2015) selected the competitive marketing strategy in Rafsanjan Pistachio Producers Cooperative Company by using network analysis process. The results showed that among the 3 strategies for the company, the focus strategy is the most prioritized. Also, from the point of view of the studied company, among the sub-criteria, the sub-criteria of Iran's political

and economic conditions are among the most important factors affecting the company's marketing strategy, and the sub-criteria of social and cultural conditions and the management of environmental factors are among the least important. In this context, we can also refer to the studies of Ebrahimzadeh et al. (2018), Hasanpour et al. 2016), Ashrafi et al. (2016) and .... pointed out.

Among the foreign studies, we can mention But et al.'s research (2017), McCormack (2018) and....

The purpose of this research is to rank the different value chains of saffron in the field of dyes and industry. Identifying the highest priority among these value chains based on the opinion of experts and trying to produce diverse and processed products from this red gold can be valuable for the activists of this field to increase the country's income and profit from exports.

Methods

Analytical Network Process (ANP) method:

One of the primary techniques in multi-criteria decision making is AHP, which is suitable for solving most complex problems. AHP was proposed by Saati in 1980 as a method to solve socio-economic decision-making problems, and then it was used to solve a wide range of decision-making problems. AHP has provided a broad platform so that all problems with sensory properties, rationality, irrationality despite being multi-objective and multi-criteria and multi-decision maker in certain or uncertain conditions and in the presence of Solved different options. Many decision-making issues cannot be placed in a hierarchical structure, and this is due to the interactions between different factors, sometimes high-level factors have a special dependence on low-level factors. Structuring a problem with operational dependencies allows us to weave feedback between identified clusters in the network system. "Saati" has proposed the AHP method to solve problems in the state of independence between options and criteria, and the ANP method to solve problems that have dependence between options or criteria. ANP was founded by Saati and presented as a generalization of AHP. As AHP provides a platform for hierarchical structures with one-way relationships, ANP allows complex internal relationships between different decision levels and criteria. For this reason, in recent years, the use of ANP instead of AHP has increased in most fields. The Analytical Network Process (ANP) considers each topic and problem as a "network" of criteria, sub-criteria, and options that are clustered together. All elements in a network can be related to each other in any way. In other words, in a network, feedback and mutual communication between clusters is possible (Garcia-Melon, 2008).

Results and Discussion

A number of 23 paired comparison questionnaires were completed by stakeholders in the field of saffron production and processing in Razavi Khorasan province. In order to increase the accuracy of the response, a preliminary model of the saffron value chain was prepared, with the aim that the experts, while confirming the current model, determine the chains not mentioned in

this model. Due to the high volume of questions, the questionnaires of this stage of the work were divided into four general topics of saffron consumption: edible, medicinal, color and industry, and cosmetics.

In the edible section, there are 4 chains of sprays, tablets, powders and capsules; In the pharmaceutical sector, there are 4 chains of tablets, capsules, syrups and sprays; In the paint and industry sector, 2 chains of powder and liquid and in the cosmetic sector, 2 chains of nano particles and capsules were investigated. In each of these sections, 8, 5, 5 and 6 questionnaires were completed by experts. In this article, an attempt was made to rank the value chains based on the conditions of the province with the help of the network analysis (ANP) method with the information obtained from the saffron dye and industry sector. Then, with the help of this method, the priority of the development of the saffron value chain processing sector in Razavi Khorasan province was determined so that the managers could provide the necessary conditions for the improvement of the research and development sector in that chain according to the results.

In order to identify and rank saffron value chains, in the first step, we examine the results of paired comparisons and unbalanced, balanced and limited super matrices in Super Decision software.

The structure of network analysis of saffron value chains in the field of dyes and industry

In order to form comparisons and start working with Superdesign software, the network analysis structure is drawn below. The process of network analysis requires breaking the decision problem with multiple indicators into a hierarchy of levels. For this purpose, the decision tree is used, which consists of four levels: the first level includes the general purpose of decision making. In the second level, there are general criteria on which decisions are made. In the third level, sub-criteria are placed, which in this research, there is no sub-criteria, and in the last level, there are decision options that include saffron value chains. According to Figure 2, in this research, the goal (first level) is to prioritize saffron value chains in the field of dyes and industry. The second level (criteria) are actually the factors that affect the value chains of saffron with the consumption of color and industry. And at the end, the options are placed and interact with the criteria.

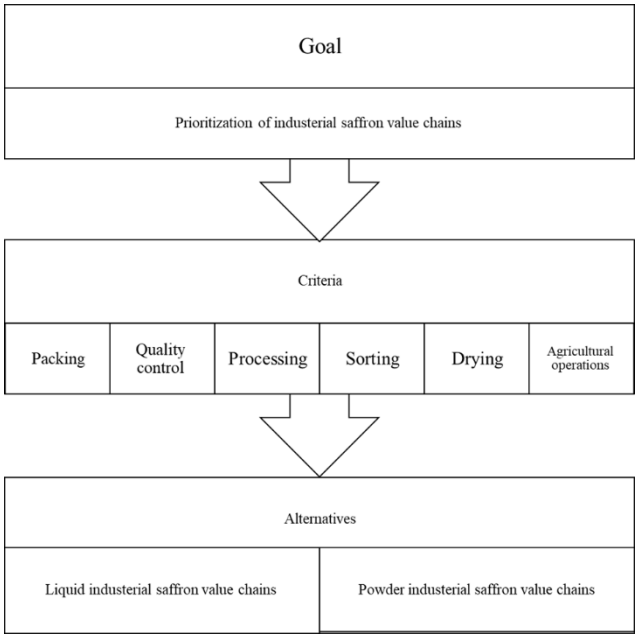

Figure 2- Network analysis structure of prioritizing saffron value chains in the field of dyes and industry

The final prioritization of the value chains of the field of color and saffron industry based on each criterion

At this stage, the two value chains of powder and liquid in the field of paint and industry are compared according to the 6 considered criteria. The inconsistency rate index, which shows the consistency of experts' responses to evaluations and pairwise comparisons, is zero in all outputs and is in its ideal state. When questionnaires are designed and given to experts, the weights that people give to each comparison are called raw weights, which are not directly used for research work. In order to apply these weights and refer to them, we need a normal weight that is provided by the software after entering the geometric mean of the questionnaire answers. In fact, these weights show the priority of each criterion over others. The sum of normal weights in each cluster is always equal to one.

Criteria chain	**Packing**	**Quality control**	**Processing**	**Sorting**	**Drying**	**Agricultural operations**
Liquid	0.75	0.5	0.75	0.25	0.5	0.5
Powder	0.25	0.5	0.25	0.75	0.5	0.5
incompatibility rate	0	0	0	0	0	0

Table 1- The final prioritization of color and industry value chains based on each criterion

Table 1 shows the final prioritization of color and industry value chains based on each criterion. Values shown are normal weights. According to this table, the value chain of paint and industry

in liquid form has priority over the powder value chain in the two criteria of processing and packaging. Also, no difference can be seen between the two chains of powder and liquid in the three parameters of planting, holding and harvesting, drying and quality control.

Formation of unbalanced (initial), balanced and limited super matrices

One of the ways to perform calculations in the ANP method is to place the weights obtained from pairwise comparisons in a matrix called a super matrix. A super matrix is a matrix of relationships between network components that are obtained from the special vectors of these relationships. The supermatrix can be divided into various blocks. Each block represents the weight obtained from the pairwise comparison of the rows with respect to the columns. This initial supermatrix is called unbalanced supermatrix.

	Liquid	Powder	Agricultural operations	Packing	Processing	Quality control	Drying	Sorting	Goal
Liquid	0	0	0.5	0.75	0.75	0.5	0.5	0.24812	0
Powder	0	0	0.5	0.25	0.25	0.5	0.5	0.75188	0
Agricultural operations	0.20809	0.27862	0	0	0	0	0	0	0.23693
Packing	0.06979	0.05969	0	0	0	0	0	0	0.15552
Processing	0.12205	0.07605	0	0	0	0	0	0	0.1361
Quality control	0.19981	0.20458	0	0	0	0	0	0	0.15373
Drying	0.21768	0.24607	0	0	0	0	0	0	0.20154
Sorting	0.18258	0.13499	0	0	0	0	0	0	0.11619
Goal	0	0	0	0	0	0	0	0	0

Table 4- Unbalanced super matrix for comparing the value chains of paint and industry

After forming the unbalanced super matrix, if necessary, the columns of this matrix are normalized and the weighted or balanced super matrix is obtained. In the weighted supermatrix, the sum of the weights of each cluster is equal to one.

	Liquid	Powder	Agricultural operations	Packing	Process	Quality control	Drying	Sorting	Goal

Liquid	0	0	0.5	0.75	0.75	0.5	0.5	0.24812	0
Powder	0	0	0.5	0.25	0.25	0.5	0.5	0.75188	0
Agricultural operations	0.20809	0.27862	0	0	0	0	0	0	0.23693
Packing	0.06979	0.05969	0	0	0	0	0	0	0.15552
Process	0.12205	0.07605	0	0	0	0	0	0	0.1361
Quality control	0.19981	0.20458	0	0	0	0	0	0	0.15373
Drying	0.21768	0.24607	0	0	0	0	0	0	0.20154
Sorting	0.18258	0.13499	0	0	0	0	0	0	0.11619
Goal	0	0	0	0	0	0	0	0	0

Table 5- Weighted super matrix for comparing the value chains of paint and industry

As can be seen in Tables 7 and 8, there is no difference between balanced and unbalanced supermatrix values. In such examples, due to the existence of only two clusters in the network structure, a comparison between these clusters does not happen in the software, so the weights of these two supermatrices are the same, and therefore the unbalanced supermatrix is the same as the balanced one.

The limit supermatrix is obtained by exponentiation of all elements of the balanced supermatrix. This operation is repeated until all the elements of the super matrix become similar. In this case, all the registers of the supermatrix will be equal to zero, and only the registers related to the sub-criteria will be a number that will be repeated in all the rows related to that register. The limit supermatrix calculated with Superdecision software can get the final priority of indicators and options.

	Liquid	Powder	Agricultural operations	Packing	Process	Quality control	Drying	Sorting	Goal
Powder	0.24952	0.24952	0.24952	0.24952	0.24952	0.24952	0.24952	0.24952	0.24952
Agricultural operations	0.12164	0.12164	0.12164	0.12164	0.12164	0.12164	0.12164	0.12164	0.12164
Packing	0.03238	0.03238	0.03238	0.03238	0.03238	0.03238	0.03238	0.03238	0.03238
Process	0.04954	0.04954	0.04954	0.04954	0.04954	0.04954	0.04954	0.04954	0.04954

Quality control	0.1011	0.1011	0.1011	0.1011	0.1011	0.1011	0.1011	0.1011	0.1011
Drying	0.11592	0.11592	0.11592	0.11592	0.11592	0.11592	0.11592	0.11592	0.11592
Sorting	0.07941	0.07941	0.07941	0.07941	0.07941	0.07941	0.07941	0.07941	0.07941
Goal	0	0	0	0	0	0	0	0	0

Table 6- Limit super matrix for comparing the value chains of paint and industry

According to the limit super matrix (Table 6) and Table 7 obtained from the software, there is not much difference between the two value chains of saffron with industrial consumption in the form of powder and liquid. Also, Table 6 states that in the field of industry, the three criteria of planting, holding and harvesting, drying and quality control are important respectively.

Value chain	**Raw weight**	**Normal weight**	**Ideal weight**
Liquid	0.250	0.500	1.000
Powder	0.249	0.499	0.996

Table 7- Prioritization of value chains in the field of color and saffron product industry (choosing the best option)

The purpose of this research is to identify and rank the value chains of saffron with industrial uses, which was used to obtain reliable results from the Analytical Network Process (ANP) method and the opinions of experts. For this purpose, paired comparison questionnaires were prepared and completed by experts. We modeled the collected data with super decision software and extracted the necessary supermatrices and pairwise comparisons.

The results showed that there is no significant difference between the liquid and powder chain according to the 6 criteria of planting, harvesting, drying, sorting, processing, packaging, and quality control. Also, in the field of paint and industry, the criteria of planting, holding, harvesting and drying operations have priority respectively.

Today, due to the need to carefully examine the value chains of agricultural products and specifically the value chain of saffron and the discussion of innovative production and creation of added value, it seems necessary to identify the value chains of saffron in various fields. As mentioned earlier, the purpose of the present study is to rank the value chains of saffron in the field of dyes and industry. Looking at the results and considering the processing ring that plays a significant role in the production of a new product with a higher value than raw saffron; It can be said that encouraging investors to invest in the chains of this field for industrial purposes such as candle production and... and special attention to the two criteria of planting, harvesting and drying operations can be associated with the creation of significant added value.

Considering that the field of the value chain in the agricultural sector and especially the saffron product is very wide, the space for conducting various researches in this field is very wide. Each of the saffron value chains alone contains a world of issues and challenges that open the way for

more research in this field. In the end, the use of various other techniques such as ideal planning, linear planning and fuzzy logic can be suggested as alternative methods for prioritizing saffron value chains.

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