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The Driving and Inhibiting Factors of Mechanized Tobacco Production in Iran Using the Delphi Technique

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Abstract

Increased cost of tobacco cultivation is a major concern for its sustainable production in Iran. Therefore, the development of tobacco mechanized cultivation is a necessity. Given this, the driving and inhibiting factors of the development of mechanized tobacco cultivation were investigated by the Delphi technique in three rounds in Guilan Province, Iran. Nineteen experts from the Jahad Agriculture Organization of Guilan Province and the Agriculture Management Services in Rasht County and Western Guilan were selected as the research panel as recommended by the academic professors of the Guilan Province. The results were analyzed by $SPSS_{21}$. In the last round, 10 superior driving and inhibiting factors were ranked based on the final experts' consistency as the final decision. The results revealed that identification of pioneer farmers and their encouragement to mechanized tobacco cultivation and the import of the latest technologies of tobacco cultivation and their modification in accordance with regional conditions were the most important driving factors as 97.37 and 94.74% of panel experts agreed, respectively. In addition, 98.68% of experts rated insufficient research on tobacco cultivation mechanization and 96.05% of experts rated the small size of tobacco farms as the most important inhibiting factors. Accordingly, the development of supportive policies to support pioneer tobacco growers in mechanized cultivation of this industrial crop, the technical assessment for modern tobacco cultivation machinery, the reduction of imported tobacco machinery prices, and the support of research on mechanization of tobacco cultivation are some important strategies that should be considered by those involved in tobacco production in Guilan Province, Iran.

Keywords:
agriculture mechanization, Delphi technique, tobacco, tobacco cultivation

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INTRODUCTION

As an important industrial crop, tobacco (*Nicotiana tabacum* L.) plays a major role in economics of many countries. It is a wealth creation factor, an economical driver, and one major underpinning of national income in many parts of the world (Zamani, 2010). Tobacco cultivation area in Iran has declined from about 20,000 ha in 1998 to 6,000 ha in 2009 and had slight variations until 2014. Higher production costs and skilled labor unavailability in traditional cultivation system are mainly blamed for the loss of its cultivation area in Iran. The production of this industrial crop not only ensures the subsistence of tobacco growers but also is a source of income for thousands of people involved in processing, distribution, and marketing of final products. The use of tobacco transplanters cuts labor costs, reduces seedling losses, and improves the accuracy and speed of transplanting. So, it is necessary for Iranian Tobacco Company to supply tobacco-growers with appropriate tobacco transplanters in accordance with local requirements (Namvar Rezaei, 2008). Also, the manual topping and harvesting of tobacco leaves and shoots are very costly. So, the movement towards mechanized cultivation of tobacco is unavoidable if its production is intended to be sustainable and competitive with foreign products.

For a successful formulation of a comprehensive plan for the development of local farming mechanization, it is necessary to recognize the driving and inhibiting factors at the first step. Clarke et al. (1993) proposed three factors of "funding farmers to supply farm equipment and machinery", "providing technical consulting", and "training farm machinery users" as the approaches to develop agricultural mechanization in Slovakia. Salokhe and Oida (2003) noted that "the small size of farms in the Philippines" and "farmers' financial limitations" were the most important limitations for mechanized farming in this country. He also stated that agriculture mechanization in the Philippines depended on providing the small-scale, inexpensive, and environmentally-friendly farm machinery. Capareda et al. (2002) also found the implementation of different mechanization projects throughout the Philippines useful for the transfer of agriculture technologies to the farmers. In a study on factors affecting the development of peanut mechanization in Guilan Province, Iran, Zehtab Naebi et al. (2015) identified three factors including "allocating provincial and national funds to develop mechanization", "organizing training programs to increase farmers' technical knowledge", and "conducting pilot and model projects" as the main driving factors of peanut mechanization development in Guilan Province. Firouzi (2015) reported the unsatisfactory state of mechanization of rice weeding operation in Guilan Province of Iran; therefore, an essential was proposed to enhance the availability to rice weeding machinery in the region. Julius (2014) suggests that increasing tractor hiring points and reducing tractor hiring rate are how the state can help the development of agriculture mechanization in small farms of Abuja, Nigeria. Rasouli et al. (2010) examined factors affecting sunflower mechanization development in Iranian farms by the Delphi method and mentioned the small size and dispersion of sunflower farms as the main factors inhibiting the development of sunflower mechanization in Iran. Kutte and Tya (2001) believe that the inconsistency of mechanization approaches with local farmers' requirements and interests is the main challenge for the development of mechanization in Nigeria. So, they mentioned the inattention of the Nigerian public organizations to the technological changes of farming mechanization as a major reason for the undeveloped status of agriculture mechanization. According to Ou et al. (2002), agriculture mechanization as a system engineering depends on the cooperation and coordination of many factors in addition to the quantitative and qualitative development of farm machinery. These factors can be dealt with as economic, environmental, social, and agronomical factors. In a study in Vietnam, Chi (2010) showed that attending in educational courses resulting in the acquisition of technical knowledge by Vietnamese farmers about farm machinery, investment capacity in agriculture sector, increasing labors' knowledge and the performance of the Vietnam Mechanization Development Organization were

the most important factors among factors affecting the development of agricultural mechanization in rice fields of this country. In a study on reasons for non-acceptance of new farm machinery in the Andica region of Khuzestan, Iran, Baldaji and Aghapour Sabbaghi (2015) concluded that the farm size, income in recent years, attendance in educational classes, and irrigated to rain-fed land ratio had positive influence on the acceptance of new machinery for the cultivation of wheat in the studied region. In contrast, farmers' experience and land fragmentation negatively affected the acceptance of new machinery. So, they proposed attempts to transfer the ownership of farms, to integrate lands, to hold educational classes, and to increase the irrigated lands as strategies to motivate the adoption of modern technologies, especially in the cultivation of wheat. Capehart (2004) noted that the tobacco farms are becoming less in number and U. S. tobacco cultivation area has been decreased since the 1950s. Mechanization of burley tobacco production in Kentucky State has not been adapted to the same extent due to limits on farm sizes resulting from the topography problems in the region and difficulties in mechanized harvesting of burley tobacco.

An investigation showed that except for land preparation and spraying, all agronomic practices of tobacco cultivation in Guilan Province are performed manually; therefore its production is very costly due to high demand for labor requirement, especially for harvesting of tobacco leaves. Consequently, in order to keep the sustainability of tobacco production, its mechanized cultivation is unavoidable. So, identifying and analysis of factors affecting the development of mechanization of tobacco production in Guilan Province is essential. A review of reports revealed that no attempt has been made to recognize factors affecting the development of mechanized tobacco growing in Iran and in Guilan Province yet. So, given the strategic importance of tobacco production as the most important industrial crop in Guilan Province and its decisive role in the subsistence of Guilanian families, it is necessary to examine and analyze all aspects of sustainable production of tobacco. Accordingly, the objective of the present study was to identify and study the driving and inhibiting factors of the development of mechanization of tobacco cultivation in tobacco farms of Guilan Province.

MATERIALS AND METHODS

The case study

The present study was carried out in Guilan Province in the north of Iran in spring and summer of 2015. Total cultivated area of tobacco in Guilan Province is estimated to be over 500 ha by which about 1,000 families make a living (Guilan's Organization of Jihad Agriculture, 2013). Table 1 shows the type and date of common agronomic operations for tobacco cultivation in Guilan Province. The present study is a qualitative

Table 1
Type and Date of Different Operations for Tobacco Production in Guilan Province of Iran

Operations type	Date of operation*
Fall tillage	5October to 5November
Seeding in tobacco nursery	10 March to 30 March
Spring tillage	10 April to 30 April
Transplanting	30 April to 10 May
Re-planting	15 May to 30 May
Weeding and earth up	25 May to 30 May
Spraying	25 May to 30 May
Topping and first harvesting	15 July to 20 July
Second harvesting	5 August to 15 August
Third harvesting	15 August to 25 August
Fourth harvesting	25 August to 5 September
Fifth harvesting	15 September to 25 September

*based on the tobacco cultivation experts' comments in Guilan Province

research study in terms of research paradigm with diagnostic needs assessment approach aiming at exploring and identifying the driving and inhibiting factors of the development of the mechanization of tobacco cultivation in Guilan Province by the Delphi method (Conner & Gardy, 2013).

The Delphi technique

Delphi is a systematic method in management research based on achieving a consensus through a series of questionnaire rounds filled out by anonymous respondents and providing the research panel with their feedback (Keeney et al., 2001). The main components of the Delphi technique are iteration, questionnaire, experts, controlled feedback, and anonymity of technical panel, analysis of the results, consensus, time, and facilitating team (Dunham, 1996). The results of this method are based on the non-informed but organized consensus of the experts in a specific field. As such, unlike other methods, the validity of its results depends not on the number of participants but on the expertise of the research panel. According to previous works, the participants of the Delphi technique can be in the range of 5 to 20 people. Thus, 19 mechanization experts including the experts of Jahad Agriculture Organization of Guilan Province and Agriculture Managements of Rasht and western Guilan cities were selected as the research participants after consulting with academic professors in the region. Next, they were briefed about the details and the objectives of the study, and they were requested to cooperate in all the three rounds. In the first round of the three-round Delphi study, two following open-ended questions were asked and the respondents were asked to provide detail answers to the following probes:

1. What are the most important driving factors of the development of mechanization of tobacco cultivation in Guilan Province?

2. What are the most important inhibiting factors of the development of mechanization of tobacco cultivation in Guilan Province?

The questionnaires were distributed among participants and were collected before the deadline. The responses given in the first round were summarized after the analysis of their contents. The results were presented in the tables of the first round including frequency, response percentage, and case percentage. Next, a questionnaire including 16 driving and 17 inhibiting factors was designed for the second round on the basis of the content analysis of the first round. In the second round, the participants were asked to express their agreement with each driving and inhibiting factor of the development of mechanization of tobacco cultivation in Guilan Province on a five-point Likert scale (very strongly, strongly, fairly, weakly, very weakly). Once the questionnaires of the second round were collected, the results were analyzed by SPSS in terms of the importance and normalized score for which the following rating scheme was used: 1=very low; 2=low; 3=fair; 4=high; and 5=very high. The degree of importance of each statement was calculated as the sum of the experts' opinions (the equivalence coefficient of the responses) divided by the number of statements. The normalized weight score of the statements was calculated by their importance divided by total sum of the importance of all statements. Next, the Kendall's W test confirmed the need for the third round of the Delphi technique (Heiko, 2012). Accordingly, 10 high priority inhibiting and 10 high priority driving factors were chosen for the questionnaire of the next round. Since fewer statements were left, it was possible to compare individual items and determine the percentage of agreement with each statement more accurately. The final opinions were organized and discussed as percentage in a descending order. As a final consensus, all factors with agreement percentage of >90% were selected as the most important factors (Abedi et al., 2017). At the end of each round, the results were tabulated as driving and inhibiting priorities.

RESULTS AND DISCUSSION

Driving factors

According to the frequency of the responses to the open-ended question of the first round (What are the most important driving factors of the development of mechanized tobacco cultivation in Guilan Province?), 16 driving factors

Table 2
Delphi Study First Round: Driving Factors of Mechanized Tobacco Cultivation in Guilan Province

Factor	Freq.	Percent of responses	Percent of cases	Priority
Conducting pilot projects of mechanized tobacco cultivation in tobacco growing regions of Guilan Province	10	15.1	52.6	1
Using the development pattern of mechanization of tobacco cultivation in the leading tobacco producing countries	8	12.1	42.1	2
Governmental support through timely purchase of tobacco from farmers	8	12.1	42.1	2
Enhancing tobacco growing experts' technical knowledge	7	10.6	36.8	3
Devotion of bank credits especially for the development of mechanization of tobacco cultivation in the Guilan Province	5	7.6	26.3	4
Visiting mechanized tobacco farms by tobacco farmers	5	7.6	26.3	4
Identifying pioneer tobacco growers and supporting them to mechanized tobacco cultivation	5	7.6	26.3	4
Implementation of intelligent irrigation system and improving water use efficiency in tobacco farming	4	6.1	21.1	5
Enhancing the quality of tobacco leaves by the management of pests and plant diseases and other improving agronomic operations	4	6.1	21.1	5
Promoting the knowledge of benefits of mechanized tobacco cultivation system through conducting educational classes	3	4.5	15.8	6
Formulation of national and provincial plans to develop mechanization of tobacco cultivation in the Guilan Province	2	3.0	10.5	7
Modifying tobacco cultivation pattern in order to executing the mechanized cultivation of tobacco in the Guilan Province	1	1.5	5.3	8
Importing the latest technologies of tobacco cultivation and their modification in accordance with the local conditions	1	1.5	5.3	8
Establishing or strengthening tobacco growing cooperatives	1	1.5	5.3	8
Establishing and specially supporting tobacco mechanization service companies	1	1.5	5.3	8
Enhancing the technical knowledge of mechanization of tobacco cultivation among Guilan's craftsmen	1	1.5	5.3	8
Total	66	100		

were identified (see Table 2). Results showed that *conducting pilot projects of mechanized tobacco cultivation in tobacco growing regions of Guilan Province* was ranked the first driving factor with response frequency of 10 and case percentage of 52.6%. *Using the development pattern of mechanization of tobacco cultivation in the leading tobacco producing countries and governmental support through timely purchase of tobacco from farmers* were ranked the second most important factors with response frequency of 8 and case percentage of 42.1%.

Results of Table 2 were used in the second round of the Delphi technique in which the panel's opinions were presented to the respondents as five-choice questions and the results were prioritized in terms of the importance and normalized weight score. Table 3 summarizes the agriculture mechanization experts' agreement with different opinions. The shift of the

Ranks in the second round are a feature of this technique which leads to the convergence of panels' opinions over the steps. According to the results of the second round (see Table 3), *importing the latest technologies of tobacco cultivation and their modification in accordance with the local conditions* was the most important driving factor with normalized weight score of 7.40. This factor was ranked the eighth in the first round with the frequency of 1.

Promoting the benefits of mechanized tobacco cultivation system by educational classes" and "enhancing tobacco growing experts' technical knowledge, which had been ranked the sixth and third with the frequencies of 3 and 7 in the first round, were ranked the second and third most important driving factor in the second round with normalized weight scores of 7.22 and 6.57, respectively.

According to the results of the third round (see Figure 1), 97.37% of panel experts believed that *identifying pioneer tobacco growers and supporting them* is the most important promoting factor. Research shows that there have always

Table 3
Delphi Study Second Round: Driving Factors of Mechanized Tobacco Cultivation in Guilan Province

Motivator	Level of importance	Normalized weight score	Priority
Importing the latest technologies of tobacco cultivation and their modification in accordance with the local conditions	4.7	7.40	1
Promoting the knowledge of benefits of mechanized tobacco cultivation system through conducting educational classes	4.58	7.22	2
Enhancing tobacco growing experts' technical knowledge	4.17	6.57	3
National and provincial plans to develop mechanization of tobacco cultivation in the Guilan Province	4.11	6.48	4
Enhancing the technical knowledge the mechanization of tobacco cultivation among Guilan's craftsmen	4.05	6.38	5
Devotion of bank credits especially for the development of mechanization of tobacco cultivation in Guilan Province	4.05	6.38	5
Identifying pioneer tobacco growers and supporting them to mechanized tobacco cultivation	4.05	6.38	5
Implementing intelligent irrigation system and improving water use efficiency in tobacco farms	3.94	6.20	6
Visiting mechanized tobacco farms by tobacco farmers	3.94	6.20	6
Modifying tobacco cultivation pattern in order to execute the mechanized cultivation of tobacco in the Guilan Province	3.88	6.11	7
Conducting pilot projects of mechanized tobacco cultivation in tobacco growing regions of Guilan Province	3.82	6.01	8
Establishing and specially supporting tobacco mechanization service companies	3.76	5.92	9
Governmental support through timely purchase of tobacco from farmers	3.76	5.92	9
Using the development pattern of mechanization of tobacco cultivation in the leading tobacco producing countries	3.76	5.92	9
Establishing or strengthening tobacco growing cooperatives	3.52	5.55	10
Enhancing the quality of tobacco leaves through the management of pests and plant diseases and other improving agronomic operations	3.35	5.27	11
Total	63.44	100	

been some farmers in Guilan Province who have welcomed modern agricultural systems to reduce production costs and time. Obviously, identifying these farmers and providing them with specific supports can be a good model and motive for mechanized tobacco cultivation for all tobacco growers. According to Zehtab Naebi et al. (2015), this factor was ranked the fifth most important factor promoting mechanized peanut cultivation in Guilan Province.

Importing the latest technologies of tobacco cultivation and their modification in accordance with the local conditions was found to be the second most important driving factor with 94.74% consensus of the panel. Given the specific technical specifications of tobacco planting machinery particularly tobacco transplanters, leaf toppers and harvesters, it seems that the most possible way to enjoy the advantages of mechanized tobacco cultivation in Guilan Province is to plan for the import of appropriate machinery and to conduct studies on their optimization in accordance with the local conditions. Abedi et al. (2017) reported that specifically supporting studies on optimization of olive harvesting machinery as well as supporting harvesting machinery were ranked the second most important driving factor for the development of mechanized olive harvesting in Guilan Province.

Devotion of bank credits to the development of mechanized tobacco cultivation was found to be the third most important driving factor of the development of mechanized tobacco cultivation in Guilan Province as 93.42% of panel experts agreed. Mohammadi and Zarifian (2008), also, described the complicated procedure for borrowing bank credits as one significant barrier against agriculture mechanization in Nishapur, Iran. Some conditions to get loans for the purchase of agriculture implements are to have bank account turnover, to pay back delinquent debts, and to give guarantees with specific conditions. It seems necessary for the authorities in charge of the development of agriculture mechanization to suggest practical approaches to solve this problem.

Pishbin et al. (2007) suggested low-interest

Table 4
Delphi Study First Round: Inhibiting Factors of Mechanized Tobacco Cultivation in Guilan Province

Inhibitor	Freq.	Percent of responses	Percent of cases	Priority
Fragmented status of tobacco farms in Guilan Province	11	18.0	57.9	1
Higher income of tobacco's competing crops in Guilan Province	9	14.8	47.4	2
High costs of mechanization of tobacco cultivation due to its special cultivation conditions	7	11.5	36.8	3
Higher age of tobacco growers in Guilan Province	6	9.8	31.6	4
Small size of tobacco farms in Guilan Province	6	9.8	31.6	5
Inappropriate financial position of tobacco growers and their inability for mechanized cultivation	4	6.6	21.1	6
Insufficient research on mechanized tobacco cultivation in Guilan Province	3	4.9	15.8	7
Rental status of some tobacco farms in Guilan Province	3	4.9	15.8	7
Low attention of agricultural managers and experts to the mechanized tobacco cultivation	3	4.9	15.8	8
Old traditions of tobacco growers about mechanized farming	2	3.3	10.5	8
Negative view towards the use of tobacco products in governmental systems	1	1.6	5.3	9
Low price of tobacco leaves	1	1.6	5.3	9
Insufficient attention of Guilan's tobacco organization to mechanized cultivation	1	1.6	5.3	9
Lack of tobacco mechanization experts in Guilan Province	1	1.6	5.3	9
Complexity and monopoly status of tobacco farming-specific machinery	1	1.6	5.3	9
Low tobacco cultivation area in Guilan Province	1	1.6	5.3	9
Slope of some tobacco farms in Guilan Province	1	1.6	5.3	9
Total	61	100		

loans with long repayment period and simple guarantees as a policy for the development of mechanization in the Jahrom Region of Fars Province. Clarke et al. (1993), also, mentioned financial support as an important factor for the development of mechanization in the Republic of Slovakia and Ghosh (2010) suggested the devotion of organizational credits as an approach to promote mechanization in the Burdwan region, India.

Promoting the benefits of mechanization and technical introduction of tobacco cultivation machinery through conducting educational classes was ranked the fourth most important driving factor of the development of mechanized tobacco cultivation

Table 5
Delphi Study Second Round: Inhibiting Factors of Mechanized Tobacco Cultivation in Guilan Province

Factors	Level of importance	Normalized weight score	Priority
Small size of tobacco farms in Guilan Province	4.64	7.60	1
Higher income of tobacco's competing crops in Guilan Province	4.52	7.39	2
Fragmented status of tobacco farms in Guilan Province	4.52	7.39	2
Insufficient research on mechanized tobacco cultivation in Guilan Province	4.41	7.22	3
Higher age of tobacco growers in Guilan Province	4.11	6.73	4
Inappropriate financial position of tobacco growers and their inability for mechanized cultivation	4.05	6.63	5
High costs of mechanization of tobacco cultivation due to its special cultivation conditions	3.82	6.25	6
Low tobacco cultivation area in Guilan Province	3.76	6.15	7
Rental status of some tobacco farms in Guilan Province	3.58	5.86	8
Slope of some tobacco farms in Guilan Province	3.29	5.39	9
Old traditions of tobacco growers about mechanized farming	3.05	4.99	10
Low price of tobacco leaves	3.00	4.91	11
Negative view towards the use of tobacco products in governmental systems	3.00	4.91	11
Insufficient attention of Guilan's tobacco organization to mechanized cultivation	3.00	4.91	11
Lack of tobacco mechanization experts in Guilan Province	2.94	4.81	12
Complexity and monopoly status of tobacco farming machinery	2.82	4.62	13
Low attention of agricultural managers and experts to the mechanized tobacco cultivation	2.58	4.22	14
Sum	61.09	100	

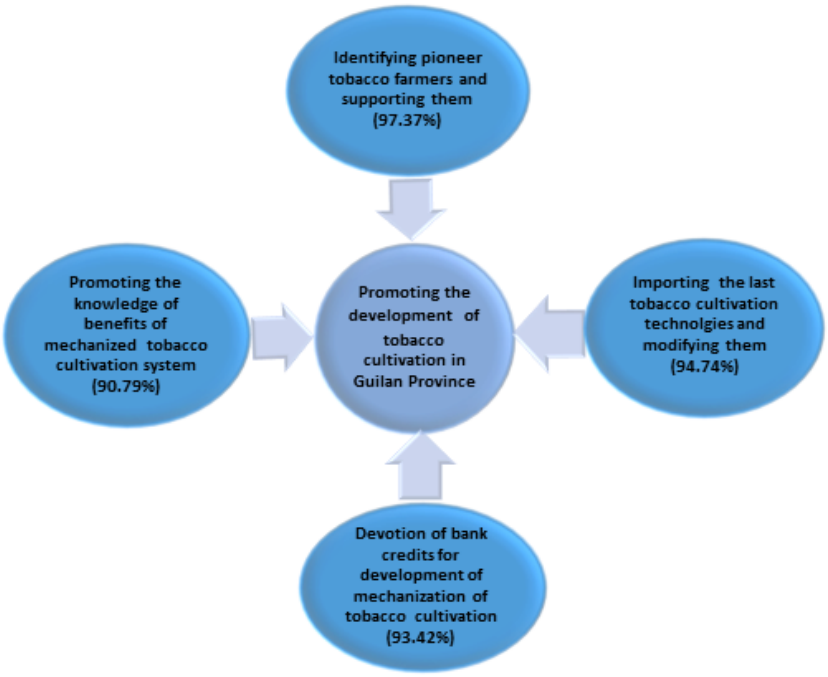

Figure 1. Driving factors of mechanized tobacco cultivation in Guilan Province

in Guilan Province obtaining 90.79% of panel's consensus. In Zehtab Naebi et al. (2015)'s study too, the factor "enhancing peanut growers' technical knowledge by holding specific educational courses" was ranked second most important driving factor of mechanized peanut cultivation in Guilan Province. In Abedi et al. (2017)'s study too, the factor "scientific training and enhancing olive garden owners' technical knowledge about specific machinery for olive harvest" was regarded as the third most important driving factor of the development of mechanized olive harvest in Guilan Province.

Inhibiting factors

According to the frequency of responses to the first open-end question at the first round of the inhibiting factors of the development of

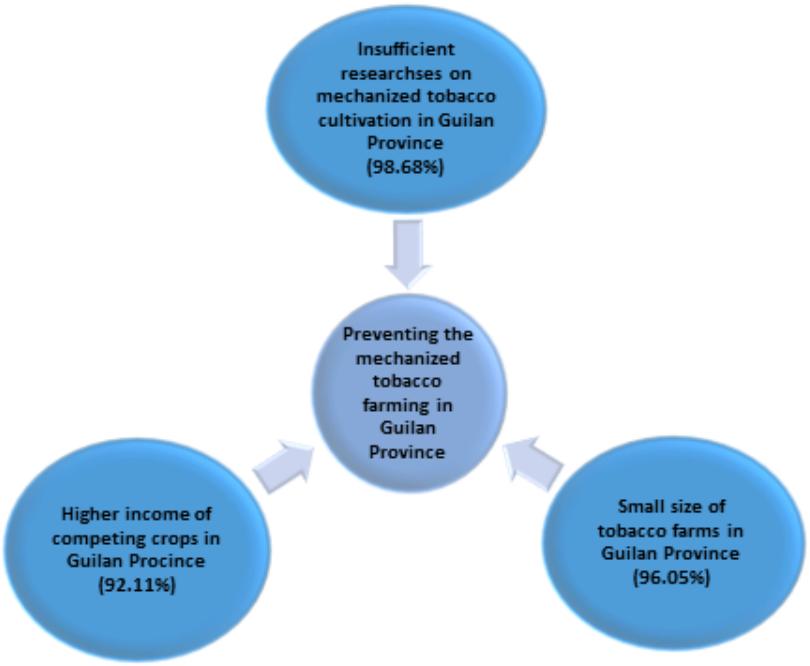

Figure 2. Inhibiting factors of mechanized tobacco cultivation in Guilan Province

mechanized tobacco cultivation in Guilan Province, 17 opinions were identified (Table 4). It shows that *fragmented status of tobacco farms in Guilan Province, higher income of tobacco's competing crops in Guilan Province,* and *high costs of mechanization of tobacco cultivation due to its special cultivation conditions* had the highest response frequency among the responses provided by the selected experts with case percentages of 57.9, 47.4, and 36.8%, respectively.

The results of Table 4 were used in the second round. Table 5 summarizes panel experts' agreement with the opinions provided by the experts of the first round about inhibitors. According to Table 5, *small size of tobacco farms in Guilan Province* was rated as the most important suppressing factor with normalized weight score of 7.60. It had been rated in the fifth rank with the frequency of 6 in the first round. *Higher income of tobacco's competing crops in Guilan Province* and fragmented status of tobacco farms in Guilan Province, which had been ranked second and first with the frequencies of 9 and 11 in the first round, respectively, were commonly rated as the second factor inhibiting the development of mechanized tobacco cultivation in Guilan Province with normalized weight score of 7.39.

According to the results of third round (see Fig. 2), *insufficient research on tobacco cultivation mechanization in Guilan Province* was rated as the first inhibiting factor of the development of mechanized tobacco cultivation in Guilan Province with 98.68% consensus percentage. The review of research reports in Guilan Province shows that they have been mostly conducted on rice production due to its higher importance in this province. So, the Guilan's Tobacco Company and the Guilan's Jahad-e Agriculture Organization must provide research supports dealing with the research topics for mechanized tobacco cultivation.

The same inhibiting factor was mentioned in Abedi et al. (2017)'s study on factors affecting mechanical olive harvesting in Guilan Province as specific support of research on the construction and modification of olive harvesting machinery acquiring 96.23% of panel experts' agreement.

Small size of tobacco farms in Guilan Province that acquired 96.05% of panel experts' final agreement was rated as the second inhibiting factor. Most of tobacco cultivation machinery especially for tobacco harvesters is of self-propelled type having low maneuverability in small farms; hence, the consolidation of small farms to easily turning and handling at the ends of harvesting trips in greater lands is a necessity. Moreover, the costs of purchase and maintenance of large farm machinery can be justified only in large farms (Almassi et al., 2006). Zehtab Naebi et al. (2015) also mentioned this factor as well as fragmented status of peanut farms in Guilan Province as the most important factor suppressing the development of mechanized peanut cultivation in Guilan Province which is in agreement with Rasouli et al. (2010)'s results about factors affecting the development of mechanized sunflower cultivation in Iran and Balachandran (2003)'s study on factors affecting mechanized agriculture in Kerala of India. Lamidi and Akande (2013) found tenure system or small farm holding as one of the main factors for undeveloped agriculture mechanization in Osun State of Nigeria. So, agriculture policy-makers in Guilan Province should consider strategies to prevent the fragmentation of tobacco farms due to inheritance.

There was a 92.11% agreement among panel experts that higher income of competing crops in Guilan Province was the third most important factor inhibiting the mechanization of tobacco cultivation in this province. The increase in the costs of tobacco production in recent years has decreased its cultivation area in exchange for low-cost, high-income crops like kiwifruit. Therefore, the governmental organizations in charge of tobacco cultivation and production should consider strategies to improve tobacco growers' income through enhancing their farming knowledge, crop insurance, and guaranteed purchase. It should be considered that the acceleration of mechanized tobacco cultivation which was examined in the present study can be a decisive factor for reducing tobacco cultivation costs.

CONCLUSION

The present study revealed that various technical, agronomical, skill, economic, social, and

policy-making factors are involved in the development of mechanized tobacco cultivation in Guilan Province, among which identifying pioneer tobacco growers and supporting them to mechanized tobacco cultivation, importing the latest tobacco cultivation technologies and their modification, insufficient research on mechanized tobacco cultivation in Guilan Province, and small size of tobacco farms in Guilan Province were recorded as the most important factors. Thus, in order to develop mechanized tobacco cultivation and therefore, sustainable development of its production in Guilan Province, the Ministry of Jahad Agriculture and the Guilan's Tobacco Company should develop operational strategies to encourage the pioneer tobacco growers to use the tobacco cultivation machinery through allocating especial financial and technical assistances; to support the technical researches on modern tobacco cultivation technologies of the leading tobacco producing countries according to the type of tobacco cultivar cultivated in Guilan Province and its local agronomic conditions; to provide all peer reviewed tobacco cultivation machinery from abroad; to support the technical researches on imported machinery to modify them in accordance with the local condition; to codify plenary policies to consolidate the small tobacco farms in the studied region to provide infrastructures of the mechanized tobacco cultivation in Guilan Province.

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