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Research Paper

Farm Food Safety Practices in the North of Iran

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Abstract

Food safety begins on the farms and farmers play a crucial role in producing healthy food. Several factors were investigated here including water quality, labor health, health facilities, packaging and storage, transportation, fertilizers and solid organic materials, and field sanitation to reach more comprehensive results. So, 380 farmers were selected from 77 villages of rural areas of Gonbad-e Kavus County, north of Iran, using multistage random sampling. Data were collected by a questionnaire and analyzed with the SPSS18 software. Results showed that the score of the food safety practice index was above average and could be evaluated at a good level. Farmers had the best practice in "field sanitation" and the worst practice in "labor health". Literate farmers had better food safety practices than illiterate farmers. The food safety practice index showed positive correlations with educational level and farmer income from other jobs. However, negative correlations were observed regarding farmer age, job experience and income from husbandry. It is suggested that educational programs and essential facilities are needed to enable farmers to adhere to farm food safety practices.

Keywords:
Agricultural products, farmers, field sanitation, food safety

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INTRODUCTION

Food is one of the important sources of disease and also chemical contamination for humans (Flynn et al., 2018). Therefore, people from all around the world are demanding high-quality and safe food products (Chaves et al., 2016). With the promotion of people's awareness and increased concern about their health, the need for adequate attention to food safety is evident. But, evidence shows that countries have been struggling with food safety issues (Alaimo et al., 2001) and every year, millions of people around the world suffer from food-borne illnesses (WHO, 2000). Furthermore, the diseases caused by the consumption of infected foods have become one of the most widespread public health problems (Schwatz, 1995). It is estimated that unhealthy food causes two million people to die annually most of whom are children. In addition, food contaminated with bacteria, viruses, parasites, or harmful chemicals is responsible for more than 200 diseases (Riordan et al., 2002). The World Health Organization (WHO) has estimated 23 million cases of foodborne illnesses and 5000 deaths in Europe every year (Flynn et al., 2018). At the same time, some studies have shown that while food safety incidents have already been predominantly chemical pollutants, recent outbreaks have been caused by microbial agents (Fung et al., 2018).

Nowadays, food safety challenges including the globalization of food trade, urbanization, lifestyle changes, international travel, and environmental pollution have complicated food supply chains and the development of pathogenic contamination and growth pathogens. The transmission of food-borne diseases that were previously confined only to specific areas has become a global issue in recent times (Scott, 2003). In these circumstances, the production of unhealthy foods can lead countries to lose food trade (WHO, 2017). Food safety can be defined as making sure that the food is healthy and free of contamination (Lynch et al., 2006). Therefore, the term "food safety" means ensuring healthy food being free from any chemical, microbial and heavy metals pollutions. Food safety can also be defined as ensuring that nutrition does not harm consumers when they are produced, prepared, stored, transported, distributed and consumed (Diaz & Cabrera, 1997; DAFSIS, 2003). According to WHO (2000), healthy or safe food is made from healthy raw materials and is free from harmful substances for consumers. This denotes practicing of food-safety principles all along the food chain that focuses on cost-effective prevention (Unnevehr, 2015; Dudeja & Singh, 2016). Therefore, food safety should be monitored in a coherent chain that starts on the farm and ends at the table (Godwin et al., 2005; Sheikholeslam, 2014; Turner 1997). It helps to practice good agricultural practices at the farm level to guarantee the safety of food at the consumer level.

Due to its vital significance, WHO promoted its slogan in 2015 as "improving food safety from farm to table" (Diaz & Cabrera, 1997). Food contamination at the farm level can include residues of pesticides and chemical fertilizers, additives, paints, and biological contaminants such as bacteria, viruses, and parasites. If farmers do not produce safe and hygienic products, they will spread various diseases across the community. Furthermore, they will be unable to sell their infected crops in the current markets (especially the global market) and they will economically fail (Pretty, 1995). As the world becomes increasingly sensitive to food safety, the ability of agricultural producers to compete in local and international markets depends on the production of safe products (Turner, 1997).

Based on the literature, few studies have addressed food safety on farms in Iran. For example, a study about lettuce producers showed that there were three factors including attitudes, norms and perceived behavioral control involved in the farmers' intention to engage in food safety practices

on the farm (Rezaei et al., 2018). However, some studies in other countries have focused on food safety at the farm level. For example, a study conducted in Kenya showed that farmers producing vegetables for local markets use less chemical pesticides as compared to those who produce for export. In addition, compliance with the EU standards by farmers producing for export has had no effect on the amount of pesticides used by them (Asfaw et al., 2009). In other research, it was shown that the assurance of the products in terms of food safety is an important factor in the sales and purchase of products. Meat retailers try to buy from slaughterhouses that use healthy cattle. Therefore, slaughterhouses also seek to purchase livestock from fields comply with food safety standards (Northen, 2001). In another study, horticultural and fish producers rigorously evaluated their fields to lower the risk of food safety and diseases and they usually performed risk assessments on an annual basis. These evaluations were about water sanitation, labor health, toxins, and medical drugs (Soon & Baines, 2011). Tobin et al. (2013) indicated that increasing technical information among farmers would not necessarily result in food safety on the farm. Factors such as farm size and the interest in improving product safety can help farmers to make better decisions about food safety issues on the farm. Parker et al. (2012) showed that farmers' perceptions and beliefs about food safety challenges and opportunities are dependent on the farm size and marketing strategy. As a result, a farmer's knowledge of food safety practices on the farm is an important tool to ensure food safety in the community (Sharifimoghaddam, 2010). Although some studies have investigated food safety on the farm level, farmers' behavior still needs to be explored. For example, national organizations responsible for healthy food production and food consumers have too often neglected farmers, who are directly involved in producing agricultural crops for society (Rezaei, 2018). Because human factors influence the implementation and follow-up of a food safety management system, a more human behavioral approach for food safety management is needed (De Boeck et al., 2017). In this regard, the present study has been considered to answer the following questions:

- How are food safety practices at the farm level?
- What are the relationships between farmer's socio-economic characteristics and farm food safety practices?

METHODOLOGY

The present study was conducted using the descriptive-survey method in the villages of Gonbad-e Kavus County, Golestan Province, Iran. Figure 1 represents the study area.

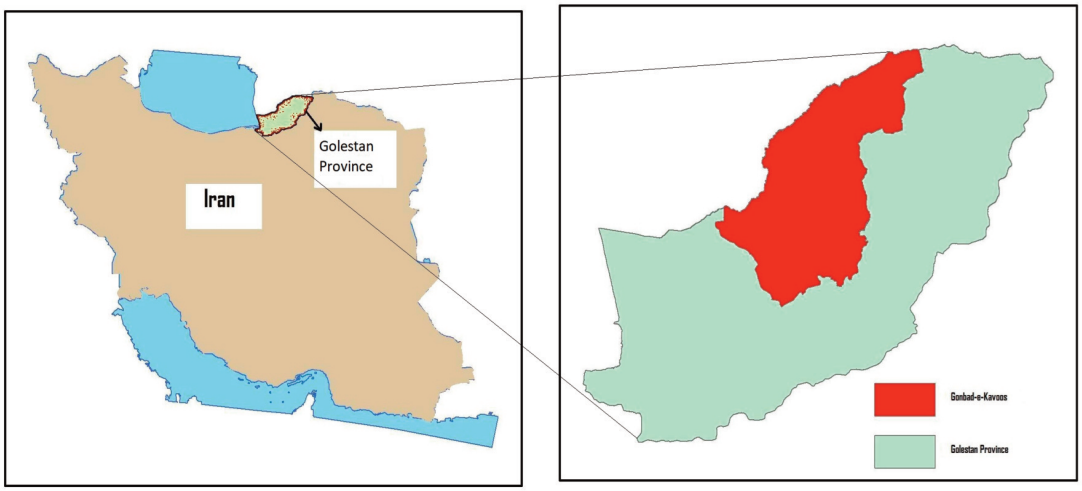

Figure 1. The location of Golestan Province in Iran and the study site

The population of the study consisted of 32,438 farmer households. The sample size was 380 estimated by the Krejcy-Morgan table. They were selected using two methods including the multistage random sampling and the proportional assignment in which the sample size of each village was calculated according to the population of that village in the total study population. In order to carry out these methods, all districts of Gonbad-e Kavus County (two districts) were selected. Then, all rural regions located in each district (Dasheli-Bron district with two rural regions and Markazi district with four rural regions) were selected. Afterward, the number of samples was estimated in each rural region using the proportional assignment method. Then, based on the number of villages in each rural district, villages were randomly selected (a total of 77 villages), and five households were selected in each village as shown in Table 1.

The responsible farmer was interviewed in each household. Data were collected using a structured and pre-tested questionnaire. Face-to-face interviews were conducted to collect data. The questionnaire included questions about personal information, economic status, and farm food safety practices. Food safety practices on the farm were studied with 42 questions based on the 5-point Likert scale (from very little to very high). These items were designed according to the items introduced by the Australian Government's Agricultural, Fisheries and Forestry Bureau (Department of Agriculture Fisheries and Forestry, 2004). It should be noted that these items have been developed by the method of Hazard Analysis and Critical Control Points (HACCP) which identifies the potential risks that threaten food production during the phases of production. In the present research, the items were modified by the conditions of the studied farmers. For this purpose, some items that were not relevant to farmers were replaced with other appropriate ones. Furthermore, food safety practice was investigated regarding seven factors introduced by Schneider et al. (2014) including water quality, labor health, health facilities, packaging and storage (warehouse), transportation, fertilizers and solid organic materials, and field sanitation. The questionnaire was validated by referring to the academic members and agricultural experts. The reliability of the index of food safety practice on the farm was investigated by calculating Cronbach's alpha coefficient (α=0.78). The SPSS$_{18}$ software package was used to analyze the data both in descriptive and inferential (Mann-Whitney U, Friedman Test and Spearman correlation) statistics procedures.

Table 1

Districts, Rural Districts, Number of Villages and Samples in Gonbad-E Kavus County

Districts	Rural districts	No. of households	No. of selected villages	No. of Sample
Dashliborun	Atrak	2527	6	30
Dashliborun	Kerend	1567	4	20
Markazi	Aq-Abad	5931	14	70
Markazi	Baqlimarama	7179	17	85
Markazi	Fajr	8932	21	105
Markazi	Soltan-Ali	6302	15	75
Sum	32438	77	380	

RESULTS

The average age of the studied farmers was 45.5 years and about one-third of them were illiterate (27.6%). On average, they had 22 years of job experience in agriculture. The irrigated and rain-fed lands were, on average, 0.6 and 10.1 hectares, respectively. A variety of crops including wheat, canola, barley, rice, rapeseed, peas, corn, watermelon, tomato, and sesame were grown in the selected rural districts. Most farmers had livestock with an average of 4 heads of cattle and 50 sheep and goats. The average annual income of farmers from agriculture was about USD 4,000. Furthermore, most farmers had their own agricultural lands.

Table 2 presents the mean and standard deviation of the items of farm food safety practices. Among the items examined in this index, "quick delivery of the product to the market" and "discarding contaminated products" were of the highest priorities. In this regard, "storing products outdoors" and "storing various products together" were of the lowest priorities. For further examination, the score of the items 8 and 10 was aligned with the rest of the items. The sum of the items' scores was considered as the score of the food safety index. The average score for the food safety index in the field was 172.78. Considering the maximum possible score (210) and the lowest possible score (42), it was concluded that the food safety practice of the farmers was higher than the average and could be evaluated as good on a continuum from bad to excellent.

The results of the Mann-Whitney U test indicated that literate farmers (mean=206.16) had better food safety practice than illiterate farmers (M=149.51) (U =10133.5, p<0.001). The results of the Spearman correlation coefficient showed that the food safety practice had positive and significant correlations with the number of years of education and also the income from occupations other than agriculture. In other words, farmers with higher education level (r= 0.31, p<0.001) as well as more income from other occupations (r = 0.29, p < 0.001) had better food safety practice. In contrast, food safety practice had negative and significant correlations with age, agricultural job experience, and income from animal farming. In other words, the older farmers (r= -0.25, p<0.001), farmers with higher work experience in agriculture (r=-0.25, p<0.001) and farmers with more income from animal farming (r=-0.38, p<0.001) had more inappropriate practice regarding food safety. The findings showed that farmer income did not have a significant relationship with food safety practice (r=-0.14, p>0.07).

For further investigation, food safety practices were summarized in seven factors including water quality, labor health, health facilities, packaging and storage, transportation, fertilizers and solid organic materials, and field sanitation. Then, the sum of the item scores of each factor was calculated. Since the factors had different numbers of items, the unweighted linear combination of each factor was calculated as represented in Table 3. The mean score of each factor was divided by the number of items related to that factor, so the mean scores could be comparable among the factors. The results of Friedman's test showed significant differences among the factors of farmers' food safety practices. The factor of "field sanitation" with the highest mean score was in the first rank and the factor of "labor health" with the lowest mean score was considered to be in the lowest rank (Table 4).

DISCUSSION AND CONCLUSION

Food safety begins on the farm, and farmers have a crucial role in healthy products and the health of society. Strengths and weaknesses of food safety practices can be identified by investigating the farmers' approach to implementing essential standards in the field. The results of this study showed that farm food safety practices of farmers were good. This indicates that the studied farmers have been able to maintain a

Table 2

Mean, Standard Deviation and Priority of Items of Food Safety Practice in the Field

Item No.	Items	Mean	SD*	Rank
9	Quick delivery of the product to the market	4.58	0.68	1
5	Discarding contaminated products	4.50	0.61	2
7	Proper storage of the product to prevent contamination	4.48	0.65	3
4	Avoiding molding of the product	4.47	0.63	4
6	Observing the time needed to harvest the product after spraying	4.46	0.66	5
3	Avoiding the contamination of products with livestock dung	4.40	0.62	6
2	Avoiding the contamination of products with agricultural wastes	4.39	0.60	7
1	Avoiding the contamination of products with agricultural pesticides	4.36	0.69	8
39	Keeping the products at the right temperature	4.32	2.20	9
36	Performing good precision when loading and unloading the product	4.24	0.79	10
38	Not keeping the products in direct sunlight	4.22	0.81	11
40	Transporting the products at the right temperature	4.21	0.84	12
37	Using clean transportation tools to move the products	4.19	0.82	13
33	Cleaning the dirty boxes before using to store the products	4.15	0.76	14
15	Availability of a suitable place for washing hands in the farm	4.12	1.77	15
20	Cleaning the water canals on the farm	4.11	2.14	16
32	Keeping the cartons or empty boxes in a suitable and indoor place	4.10	0.77	17
30	Being careful to keep newly harvested products from contamination	4.09	1.66	18
41	Being careful to keep products from damage while moving	4.08	0.88	19
35	Fighting pests in the warehouse	4.07	0.87	20
22	Avoidance of the storage site of animal manure from the place where the products are collected	4.06	0.76	21
23	Avoidance of the storage site of chemical fertilizer from the place where the products are collected	4.05	0.76	22
21	Using rotten animal manure instead of fresh manure on the farm	4.04	0.76	23
24	Storing the products in a place where rainwater does not enter	4.03	0.77	24
19	Using clean water to wash hands and face in the field	4.02	0.74	25
26	Using proper boxes or equipment to store the products	4.01	0.76	27
31	Keeping the harvesting tools clean	4.01	0.77	27
17	Sanitary disposal of dead animals in the farm	4.01	0.82	27
13	Lack of sick workers	4.00	0.71	30
14	Availability of sanitary toilets next to the farm	4.00	0.79	30
25	Storing the products where animals and birds could not enter	4.00	0.80	30
16	Using suitable gloves and overalls for field work	3.99	0.79	32
12	Using cold storage for perishable product	3.98	0.65	33
29	Using hand-washing liquid after toilet	3.97	0.73	34
18	Using safe and clean water for irrigation	3.96	0.78	35
27	Training workers to observe health advices	3.95	0.79	36
28	Wearing suitable cloths for collecting the products	3.94	0.78	37
11	Proper packaging of the products after harvest	3.85	0.84	38
34	Discarding broken and damaged product storage boxes	3.84	0.80	39
42	Writing the name and address of the place of production on shipping boxes	3.31	0.95	40
8	Storing the products outdoors	2.07	0.90	41
10	Storing various products together	1.80	0.87	42

Mean=172.78
SD=18.09
Min=104
Max=210

*Standard deviation

Table 3

Mean, Standard Deviation and Non-Weighted Linear Combination of Factors of Food Safety Practice in the Farm

Factors	Related items	Range	Mean	SD	Non-weighted linear combination
Field sanitation	1,2,3,4,5,6,17,30,31	9-45	38.73	4.50	4.30
Transportation	9,36,37,40,41,42	6-30	24.93	3.72	4.10
Packaging and storage	7,8,10,11,12,24,25,26,32,3,34,35,38,39	14-70	57.23	6.77	4.08
Health facilities	14,15	2-10	8.13	2.17	4.06
Fertilizers and solid organic materials	21,22,23	3-15	12.14	1.95	4.04
Water quality	18,19,20	3-15	12.10	2.81	4.03
Labor health	13,16,27,28,29	5-25	19.86	2.67	3.97

Table 4

Friedman Test Results for Comparing Food Safety Factors in the Farm

Factors of food safety	Mean rank	Rank
Field sanitation	5.12	1
Transportation	4.17	2
Packaging and storage	3.95	3
Health facilities	3.85	4
Fertilizers and solid organic materials	3.82	5
Water quality	3.64	6
Labor health	3.46	7
Chi-square=151.37Degree of freedom=6Significance level=0.001		

fairly good level of food safety standards in the fields. Among the items of food safety practice, the highest priority was evaluated as "the quick delivery of the product to the market". Also, the practice of the lowest priority was "storing various products together". The findings showed that there were significant differences between the seven factors of food safety practices. The factor of "field sanitation" was in better condition than the other factors. On the other hand, the factor of "labor health" was in the last position. This means that the farmers' compliance with the field sanitation practice was better than the other factors. The practices associated with this factor included "avoiding contamination of the products with agricultural pesticides", "avoiding contamination of the products with agricultural wastes", "avoiding contamination of the products with livestock dung", "avoiding molding of the products", and "removing contaminated products from the rest of the products" which have pivotal roles in the health and safety of products and, ultimately, in the consumer health. At the same time, the farmers practice regarding labor health was the factor with the lowest rank among the other factors including "the lack of sick workers", "the use of suitable gloves and overall for field work", "training workers to observe health advice", "wearing

suitable cloth when collecting the products", and "using hand-washing liquid after toilet". This was likely to result from the costly worker equipment and the lack of permanent agricultural workers. It was also observed in other related research in which one of the reasons for not adhering to health practices was related to its costs (International Finance Corporation, 2016). Despite this fact, the consideration of the health status of workers should be prioritized as many diseases can be spread through the agricultural produce contaminated with infected humans (Unicomb, 2009).

The findings showed that literate farmers had better food safety practices than illiterate ones. This revealed the importance of literacy in producing healthy products. Based on the available findings, literacy can help farmers acquire the needed knowledge and understand and observe it in the production of agricultural crops that are consistent with food safety standards (Spielmaker & Leising, 2013). Literacy is a means to help people to be aware of their position and be ready to accept and make positive changes (Kolovelonis et al., 2011). In fact, the acquisition of basic literacy skills is seen by many as the first step on the ladder of knowledge. It should be considered that the increase in technical information among farmers does not necessarily lead to the observance of food safety in the field, and factors such as farm size and farmers' interest in increasing the safety of crops can influence the farmer decision to adhere with food safety (Tobin et al., 2013). Other studies have shown that there is usually a high gap between the knowledge of farmers and their activities at the farm level. In other words, farmers do not implement all of their knowledge in the field. Another reason is the lack of farmers' awareness of food safety issues (Akanda & Roknuzzaman, 2012; Malhan & Singh, 2010). It is also worth mentioning that the studied farmers were small farmers, and the relationship between literacy and food safety on the field can vary based on region and type of land utilization system. The findings also showed a negative relationship between age and food safety practices. Since illiteracy is more common among older farmers with higher job experience, the negative relationship between age and food safety practice is justified. Also, the relationship between job experience and food safety practice was negative. The reason for this can be more illiteracy among farmers who are older and have more experience. By comparing these results, it can be concluded that literacy can be directly related to food safety practices on the farm.

The findings showed that higher educational levels and greater income from other jobs resulted in better farm food safety practices. It re-affirmed the importance of farmer's educational level to execute good agriculture (FAO, 2003). The positive correlation between income from other jobs and food safety practices indicated that farmers with better financial circumstances could better meet food safety standards. The implementation of some food safety standards requires the provision of equipment that can best be met by farmers who could earn more money. Furthermore, higher educational levels can help to better understand food safety on the farm and the proper implementation of the relevant principles.

The findings represented those older farmers with higher work experience in agriculture as well as higher income from livestock husbandry gained a lower score in food safety practices. It should be noted that livestock husbandry in the economy of rural households had probably adverse effects on the issues related to agriculture including food safety standards. Restricting farmers to the farming job could make them concentrate their efforts on improving their farming. This could give them more incentive to comply with farm food safety standards.

The main results and recommendations are organized as follows:

It is essential to promote food safety

practices among studied farmers in order to produce healthy food and prevent society from possible food-borne infections.

Appropriate educational contents of food safety are required to promote farmers' knowledge and awareness and help institutionalize the principles of food safety among farmers.

Much attention can be drawn to non-formal education offered by the Iran Agricultural Extension Service Centers and other organizations helping farmers to deal with food safety issues.

The top priority of educational training should be given to illiterate and the educational level of farmers.

It is highly recommended to provide the necessary tools and instruments to enable farmers to observe food safety practices.

Since food safety is a shared responsibility among farmers, producers, retailers, and consumers, it is suggested to conduct a comprehensive investigation into food safety beyond the farm level.

Effective monitoring systems for the safety of agricultural products and food can help to promote the quality, health, and safety of the food produced on the farms and the final consumption stage.

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