



Research article

Factors influencing the adoption of sericulture by farmers in Guilan Province, Iran

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Abstract: Sericulture and silk production are among the activities that can, along with other agricultural activities, generate income for rural households in a short period of time. The objective of the present study was to identify factors influencing the adoption of sericulture by farmers in Guilan province, Iran. The sericulture farmers of Langarud and Shaft counties (N = 4187), were included in the statistical population of the study. The sample size was determined to be 198, using the least sample size table of Bartlett et al. (2001) and subsequently, the size of the second group, i.e., non-sericulturists, was specified from these regions. The research tool was a questionnaire whose face and content validity was confirmed by a panel of experts. The reliability of the research tool was evaluated by alpha Cronbach estimated α value to be 0.78. The results revealed that sericulture adoption was significantly related to all demographic characteristics except gender including age, number of dependents, education level, and experience in sericulture as well as technical and economic characteristics including the type of cocoonary ownership, profitability of sericulture given its shorter rearing period compared to other agricultural activities, willingness to rehabilitate coronary, and willingness to attend sericulture and other relevant courses. The studied groups differed significantly in terms of the impact of all supportive policies including the provision of loans and facilities for the rehabilitation and construction of coronaries, the insurance of silkworm rearing, the training and promotion of sericulture and relevant activities, free distribution of improved saplings, distribution of high-yielding silkworm eggs, and the guaranteed purchase of cocoons. The results revealed that all supportive policies played an effective role in the adoption of sericulture.

However, free distribution of improved saplings, distribution of high-yield silkworm eggs, and the guaranteed purchase of cocoons were found to be the most effective policies in both sericulturist and non-sericulturist groups.

Keywords: adoption; sericulture; silkworm; Guilan

1. Introduction

Agriculture is one of the economic sectors of Iran with remarkable contributions to gross domestic production (GDP), employment, satisfaction of food needs, non-oil exports, and the satisfaction of industrial requirements [1]. Development of agricultural sector is a prerequisite for the country's economic development [2]. Among the various agricultural sectors, the sericulture industry enjoys a distinctive niche [3]. Sericulture and silk production are among the activities that can, along with other agricultural activities, generate income for rural households in a short period of time [4,5]. The favorable climatic conditions and facilities for the development of sericulture and silk industries in Iran and the creation of jobs by this industry to exploit hidden unemployment and labor centralized in rural areas on the one hand [6], and its proper development in proportion to the climatic conditions of different regions on the other hand can help to solve some economic and social problems of farmers [7]. Likewise, developing countries have the chance to increase their silk production rate by adopting modern methods in response to the improvement of the standard of living among citizens. This is especially true in developed countries due to the popularity and significance of the chemical and physical properties amongst the environmental community who appreciate the health and sanitation aspects of the product. Barriers to production however exist in developed countries due to land constraints and wage increases. Cocoon and silk production in Iran has fallen by more than fifty percent up to 2010, but it had a slight growth in 2011 [8]. Despite the decline in cocoon production and the decrease in domestic silk supply in recent years, silk prices have not risen. This was due to the reduction in silk yarn prices in the global markets and, moreover, the production of cheap silk in neighboring countries such as Afghanistan, Tajikistan, and Uzbekistan. Due to the high quality of its silk eggs, Iran was exporting silk eggs to Central Asia in 2001 and 2002, but unfortunately these markets have been lost in recent years. Presently, China is the largest and India is the second largest silk producer in the world [9]. Nonetheless, since sericulture has always been looked upon as a subsidiary activity for farmers, less attention has been paid to it. Studies in Iran on sericulture and silk industry have been mostly focused on the development of this industry in the form of studies on the development of the sericulture and silk industries in Iran as well as on issues related to the breeding of silkworm and the berry trees, and their pests and diseases. In general, less attention has been paid to the scientific study of the causes of the decline of farmers' adoption of this long-standing profession and the factors affecting their adoption. For this reason, it is necessary to conduct studies in this area.

According to the studies in Bulgaria, despite the high potential for the development of sericulture industry thanks to its favorable climatic and socioeconomic conditions, the country's rapid political and economic changes have hindered the development of a sericulture industry in a large part of the rural community. So, to encourage more farmers to engage in sericulture, some

networks have been established for the distribution of silkworm larvae, the purchase of cocoons, drying, grading, and maintenance. The production of improved saplings with doubled yields and their distribution among farmers have also been helpful to encourage farmers' adoption. At the same time, sericulture farmers enjoy financial and technical support throughout the rearing season [10]. A survey among rural people in a state in India showed that the limitations of technology acceptance were rooted in inadequate knowledge, lack of access to technologies, and high costs [11]. Also, it has been reported that Indian sericulture farmers only accept the existing and available technologies in sericulture management, whilst there is a need to accept technology in critical areas to deal with damages [12].

In a study to find the educational needs of sericulture farmers in Guilan Province, Iran, Charmchian Langerodi and Chizari [13] found a positive, significant relationship between connection with the Sericulture Office and other sericulture farmers, participation rate, acquisition of scientific information from the Sericulture Office, information acquisition methods, main and secondary occupations, the ownership type of mulberry farms, the visitation of the other mulberry farms, the attendance in training courses, the acquisition of scientific information from radio and television, and the study of magazines and publications in the field of sericulture. Also, there was a significant negative relationship between age, literacy, income level and educational needs of people in the general sericulture context. But, no significant relationships were observed between sericulture earnings, number of silkworm egg boxes, experience in sericulture, and sericulture farmers' educational needs. A study in Sari county of Iran indicated that economic variables were the most important factors in this regard [14]. The results of a study in South Khorasan Province, Iran revealed that the adoption of new technologies was positively and significantly related to such factors as experience in agriculture, experience in pistachio growing, production rate per hectare, the effectiveness of educational and promotional activities, and subsidization, whereas it had no significant relationship with educational level, sex, place of residence and age [15]. A study on the role of sericulture industry in rural development in Golestan Province, Iran, showed that the natural factors including soil type, water resources, topography, and socio-economic factors and political-historical factors including the migration of Sistani-Baluch peoples as farm labor were among the factors that significantly influenced the establishment and development of silkworm rearing in rural settlements [16].

Total area under cultivation mulberry gardens in Iran is about 14,723 ha and 6,065 ha out of it is located in Guilan Province. According to Sericulture Development Center of Iran [17], 18,483 households are working in sericulture in Iran and 8,180 of them living in Guilan. Total production of fresh cocoons are estimated at 850,103 kg and Guilan produce 435,592 kg of it. Accordingly, Guilan Province has a critical role in sericulture industry of Iran because it produces about 55 to 60% of fresh cocoons and is the leading province in sericulture. Thus, we explored factors influencing sericulture adoption in the Guilan province and the reasons it has not been adopted by farmers. In fact, the need to examine sericulture in this province cannot be exaggerated given its specific niche in this industry-profession and the fact that it is the leading silk producer in Iran. This study aims to answer the following question: What are the most important economic, social and technical factors affecting the adoption of sericulture in Guilan Province?

The main aim of the study was to identify the factors influencing (i.e. technical, economic and social features) the adoption of sericulture by farmers in the Guilan Province.

2. Materials and Methods

The present study was a quantitative applied research study. Also, it was descriptive-correlation in terms of data collection methodology which was dominated by a questionnaire-based survey. The statistical population of the present study consisted of two groups. The first group consisted of sericulture farmers that amounted to a population of 4187 farmers rearing silkworms in Langarud and Shaft geographical domains as two major sericulture centers of the Guilan Province in 2012. The second group was composed of non-sericulture farmers who either had some experience in sericulture or did not. A stratified technique was used for sampling the statistical population of both groups. The sample size was calculated to be 198 farmers on the basis of the least sample size table of Bartlett et al. [18] with 1% error. Since social sciences have low return rate of questionnaire, more questionnaires were distributed for a total response of 212 returned questionnaires.

The main research tool was a questionnaire. In order to ensure its validity, its copies were provided to 10 professors and experts of the Iran Silk Research Center (ISRC), and modifications were made based on their feedback. In order to ensure reliability of the research tool, the designed questionnaire was randomly administered to 30 sericulture farmers. Then, the reliability of the research tool was evaluated by alpha Cronbach estimated α value to be 0.78, implying its acceptable reliability. Data were analyzed using SPSS19 Software Package in two levels of descriptive statistics (frequency, percentage, mean, standard deviation, etc.) and inferential statistics (chi-square test, independent paired sample t-test, Mann-Whitney test and binomial test).

3. Results

3.1. Respondents' demographic, socioeconomic, and technical characteristics

The frequency distribution of the respondents' demographic characteristics in Table 1 shows that 63.7% of sericulture farmers were from Shaft and 36.3% were from Langarud, whereas the frequency of non-sericulture farmers was 37% for Shaft and 63% for Langarud. Most respondents were male (94.3% of sericulture farmers and 91.9% of non-sericulture farmers). Sericulturist respondents were, on average, 50.9 years old and non-sericulturists were, on average, 55.7 years old. The highest frequency of age in both groups was in the age range of 50 to 60 years (29.2% for sericulturists and 34.1% for non-sericulturists) and the lowest frequency in both groups was in the age range of less than 30 years (7.1% for sericulturists and 4% for non-sericulturists). In addition, in terms of the number of dependants, the highest frequency was in the range of 2–4 people (49.1%) for sericulturists and in the range of less than 2 people (59%) for non-sericulturists. It was found that sericulturists had, on average, at least one year and at most 55 years of experience in sericulture. The average experience of non-sericulturists in sericulture was at least 0 years and at most 12.9 years. With respect to educational level in both sericulture and non-sericulture groups, the highest level was related to those who had only reading and writing literacy constituting 34.4% of sericulturists and 29.5% of non-sericulturists.

A look at respondents' economic and social characteristics (Table 2) indicates that most of them were employed in one or more agricultural or non-agricultural economic activities. In both groups, the highest number of employment was in tea growing (61.8% of sericulturists and 59% of non-sericulturists) and the lowest was in beekeeping (0.9% in the first group and 2.9% in the second

group). It was revealed that in the sericulture group, 43.9% had miscellaneous income of less than 10 million IRR which was the stratum with the highest frequency. Among non-sericulturists, the highest frequency was 34.7% whose miscellaneous income was 10–20 million IRR. According to the results, most participants (52.8%) earned 10–20 million IRR from sericulture and the lowest frequency of sericulture income was found to be in the range of 30–40 million IRR.

Table 1. Frequency distribution of sericulturists and non-sericulturists' demographic characteristics.

Characteristic	Group	Sericulturists		Non-sericulturists	
		Frequency	Percentage	Frequency	Percentage
Region	Shaft	135	63.7	64	37.0
	Langarud	77	36.3	109	63.0
	Total	212	100.0	173	100.0
Gender	Male	200	94.3	159	91.9
	Female	12	5.7	14	8.1
	Total	212	100.0	173	100.0
Age (year)	< 30	15	7.1	7	4.0
	30–40	35	16.5	20	11.6
	40–50	51	24.1	30	17.3
	50–60	62	29.2	59	34.1
	> 60	49	23.1	57	32.9
	Total	212	100.0	173	100.0
Number of dependents	< 2	69	32.5	102	59.0
	2–4	104	49.1	66	38.2
	> 4	39	18.4	5	2.9
	Total	212	100.0	173	100.0
Experience in sericulture (year)	< 5	11	5.2	53	30.6
	5–15	50	23.6	55	31.8
	15–25	61	28.8	28	16.2
	25–35	35	16.5	9	5.2
	> 35	50	25.9	28	16.2
	Total	212	100.0	173	100.0
Education level	Illiterate	66	31.1	25	14.5
	Reading/writing	73	34.4	51	29.5
	Intermediate school	43	20.3	34	19.7
	Diploma	25	11.8	44	25.4
	Academic degree	5	2.4	19	11.0
	Total	212	100.0	173	100.0

In terms of supportive policies, 82.1% had insured their products in 2012 but 17.9% had enjoyed no support. As is evident in Table 3, 79.7% of sericulture farmers had sold their product at the guaranteed price in 2012. Furthermore, 92% of sericulturists had been granted with bank credits in 2009–2012. According to the results, 75.9% of sericulturists had participated in relevant training courses in 2009–2012. Also, 51.4% asserted that they had received inbred mulberry plants during 2009–2012.

Table 2. Frequency distribution of sericulturists and non-sericulturists' socioeconomic characteristics.

Characteristic	Stratum	Sericulturists		Non-sericulturists	
		Frequency	Percentage	Frequency	Percentage
Non-sericulture activity	Rice growing	130	61.3	63	36.4
	Tea	131	61.8	71	59.0
	Flowers, vegetables, seasonal	10	4.7	39	22.5
	Animal and poultry production	105	49.5	49	28.3
	Beekeeping	2	0.9	5	2.9
	Industrial trees production	5	2.4	22	12.7
	Non-agricultural activities	38	17.9	34	19.7
	Total	212	100.0	173	100.0
Non-sericulture Income (million IRR*)	< 10	93	43.9	39	22.5
	10–20	41	19.3	60	34.7
	20–30	30	14.2	22	12.7
	30–40	16	7.5	15	8.7
	> 40	32	15.1	37	21.4
	Total	212	100.0	173	100.0
Sericulture Income (million IRR)	< 10	38	17.9	–	–
	10–20	112	52.8		
	20–30	20	9.4		
	30–40	9	4.2		
	> 40	33	15.6		
	Total	212	100.0		

*1 USD ≈ 28000 IRR in 2014

Table 3. Frequency distribution of sericulture farmers in terms of the use of supportive policies.

Supportive policies	Yes		No	
	Frequency	Percentage	Frequency	Percentage
Insuring silkworm rearing activity	174	82.1	38	17.9
Guaranteed purchase of fresh cocoons	169	79.7	43	20.3
The use of bank loans in 2009–2012	195	92.0	17	8.0
Attendance in sericulture training courses in 2009–2012	161	75.9	51	24.1
Reception of improved subsidized saplings in 2009–2012	109	51.4	103	48.6

Regarding the technical characteristics of sericulture farmers, it was found that 79.2% of the studied sericulturists had one cocoonery (silkworm nursery and *Talnbar* in Persian), while only 0.5% of them owned five coronaries (Table 4). The results indicated that 90.6% of the sericulturists with the highest frequency performed their silkworm rearing operations in their private cocooneries, and 4.2% of them performed them in rental cocooneries. Also, 57.5% of the studied cocooneries had an area of less than 50 m² which was the highest frequency and the least frequency of cocoonery area (16.1%) was related to the range of more than 100 m². It was revealed that the highest frequency (66%) of the number of hatched silk egg boxes was in the range of 2–5 boxes and the

lowest frequency (14.2%) was in the range of one box. Also, 76.9% of sericulturists had traditional cocooneries, whereas the share of industrial cocooneries was as low as 2.8%. We observed that 41% of sericulture farmers had mulberry gardens with the area of 1000–5000 meters, while only 2.8% of them had gardens of more than one hectare. As well, 68.4% of farmers have inherited their mulberry gardens, and only 8% have rented the gardens for silkworm rearing.

Table 4. Frequency distribution of sericulture farmers' technical characteristics.

Characteristic	Group	Frequency	Percentage	Valid percent
Number of cocooneries	1	168	79.2	80.4
	2	37	17.5	17.7
	3	3	1.4	1.4
	5	1	0.5	0.5
	No-response	3	1.4	100.0
	Total	212	100.0	
Cocoonery ownership type	Private	192	90.6	
	Leased	11	5.2	
	Joint	9	4.2	
	Total	212	100.0	
Cocoonery area (m ²)	< 50	122	57.5	
	50–100	56	26.4	
	> 100	34	16.1	
	Total	212	100.0	
Number of silkworm egg boxes	1	30	14.2	
	2–5	140	66.0	
	> 5	42	19.8	
	Total	212	100.0	
Cocoonery type	Traditional	163	76.9	77.3
	Semi-industrial	42	19.8	19.9
	Industrial	6	2.8	2.8
	No-response	1	0.5	100.2
	Total	212	100.0	
Mulberry garden area (m ²)	< 1000	16	7.5	
	1000–5000	87	41.0	
	5000–10000	45	12.2	
	> 10000	6	2.8	
	No-response	58	27.4	
	Total	212	100.0	
Mulberry ownership	Inherited	145	68.4	68.7
	Purchased	49	23.1	23.2
	Leased	17	8.0	8.1
	No-response	21	5.0	100.0
	Total	212	100.0	

As shown in Table 5, results for the income generation by sericulture, which has a short rearing period, reveals that 39.2% of sericulture farmers believed that the income from the production of

silkworms was high, while 34.7% of non-sericulturists did not see any differences between income from this activity and the income of other agricultural activities. In contrast, 6.6% of sericulturists perceived sericulture income to be very low. Also, 12.3% of non-sericulturists believed that silkworm rearing could generate high income. The findings indicated that a high percent of both sericulturists and non-sericulturists (44.8 and 44.5%, respectively) categorized sericulture among the grind works hard activities. Also, 36.7% of sericulture farmers acknowledged that the rearing techniques provided by the extension agents were highly coordinated with sericulture facilities, whereas 5.2% of sericulturists assessed those techniques to be just poorly tailored with their facilities and 37.6% assessed them to be moderately tailored. Indeed, only 4.8% said that the coordination was very high. Based on the findings, 69.8% of sericulturists and 51.5% of non-sericulturists expressed their willingness for either themselves or their family members to attend sericulture training courses. Finally, 91.5% of sericulturists and 68.2% of non-sericulturists tended to receive improved saplings for the restoration or construction of mulberry gardens.

Table 5. Frequency distribution of respondents in terms of production characteristics.

		Sericulturists (n = 212)		Non-sericulturists (n = 173)	
		Frequency	Percentage (valid%)	Frequency	Percentage (valid%)
Sericulture income is	Very high	26	12.3	4	2.3
	High	73	39.2	47	27.2
	Almost the same of other incomes	50	23.6	60	34.7
	Low	39	18.4	50	28.9
	Very low	14	6.6	12	6.9
The physical activity and labor need is	Harder	95	44.8	77	44.5
	Similar	49	23.1	48	27.7
	Easier	68	32.1	48	27.7
The coordination of extension agents' training methods with facilities is	Very high	10	4.7 (4.8)	13	7.5 (7.8)
	High	77	63.3 (36.7)	51	29.5 (30.5)
	Moderate	79	37.3 (37.6)	78	45.1 (46.7)
	Poor	33	15.6 (15.7)	22	12.7 (13.2)
	Very poor	11	5.2 (5.2)	3	1.7 (1.8)
	No-response	2	0.9	6	3.5
Willingness to participate in sericulture training courses?	Yes	148	69.8	88	50.9 (51.5)
	No	64	30.2	83	48 (48.5)
	No-response	0	0	2	2 (1.2)
Willing to receive improved mulberry saplings	Yes	194	91.5	118	68.2
	No	18	8.5	55	31.8

3.2. Factors enhancing cocoon production and influencing sericulture revival

As can be seen in Table 6, sericulturists listed the factors that can improve cocoon production and sericulture revival as guaranteed purchase of cocoon, distribution of high-yielding silkworm eggs, and free distribution of improved saplings. These factors from the non-sericulture group's

perspective included free distribution of improved saplings, distribution of high-yielding silkworm eggs, and guaranteed purchase of cocoons.

Table 6. Factors affecting the enhancement of cocoon production and the revival of sericulture from the viewpoint of sericulturists and non-sericulturists.

Variable	Sericulturists		Non-sericulturists	
	Mean	SD	Mean	SD
Granting loans and facilities for the rehabilitation and construction of cocooneries	5.10	1.380	4.62	1.230
Insuring silkworm rearing	5.31	0.926	4.91	0.984
Training and promoting sericulture and the relevant activities	4.75	1.414	4.60	0.878
Free distribution of improved saplings	5.41	0.951	5.24	1.098
Distribution of high-yielding silkworm eggs	5.58	0.925	5.18	0.965
Guaranteed purchase of cocoon	5.59	0.812	5.04	1.023

Five-point Likert type scale (1 = none, 2 = very low, 3 = low, 4 = moderate, 5 = high, 6 = very high)

3.3. Association between independent variables and sericulture adoption

Results summarized in Table 7 shows a significant association between sericulture adoption and where respondents work at the 1% level. Similarly, sericulture adoption was found to be significantly related to educational level, non-sericulture employment, cocoonery ownership type, short duration of silkworm rearing as compared to other agricultural activities, labor need, rearing techniques provided by extension agents, willingness to rehabilitate cocoonery, willingness to attend in training courses, willingness to receive improved mulberry saplings, and ways to learn about sericulture. However, no significant association was observed between sericulture adoption and gender.

Table 7. The relationship between demographic, technical and social factors with the adoption of sericulture (χ^2 test).

Variable	χ^2	p-value
Activity region	27.165**	0.000
Gender	0.925ns	0.336
Educational level	35.025**	0.000
Occupation in non-sericulture fields	127.133**	0.000
Cocoonery ownership type	315.763**	0.000
Short rearing period	264.627**	0.000
Extent of physical activity	256.745**	0.000
Rearing practices suggested by extension agents	253.107**	0.000
Willingness to rehabilitate cocoonery	268.822**	0.000
Willingness to attend in educational courses	270.036**	0.000
Willingness to receive improved mulberry sapling	262.021**	0.000
Ways to gain information about sericulture	205.676**	0.000

*: Significance at 5% level; **: Significance at 1% level; ns: Non-significance

3.4. Means comparison of demographic, economic, and technical characteristics of farmers in both groups

The variables of sericulturist and non-sericulturist groups were compared by t-test and Mann-Whitney test. The results of t-test for demographic characteristics of sericulturists and non-sericulturists showed that they differed in age, number of dependents, and experience in sericulture significantly at the 1% level. Also, it was found that although the average income of non-sericulture farmers was higher from non-sericulture activities than from sericulture activity, no significant difference was found in the income from non-sericulture activities among two studied groups (Table 8).

Table 8. Comparison of demographic characteristics of two groups with t-test

Variable	t-statistic	p-value
Age	3.573**	0.000
Number of dependants	-6.853**	0.000
Experience in sericulture	-8.320**	0.000
Income from non-sericulture activities	0.838ns	0.404

*: Significance at 5% level; **: Significance at 1% level; ns: Non-significance

The economic and social characteristics of the two studied groups (annual income from sericulture and non-sericulture activities, enjoying supportive policies) were examined by Mann-Whitney test. According to the results at $p < 0.01$ presented in Table 9, the groups significantly differed in all factors including granting loans and facilities for the rehabilitation and construction of cocooneries, insurance of silkworm rearing, training and promotion of sericulture and relevant activities, free distribution of improved saplings, distribution of high-yielding silkworm eggs, and guaranteed purchase of cocoon. Table 6 shows that all supportive policies were effective on sericulture adoption. However, free distribution of improved saplings, distribution of high-yielding silkworm eggs, and guaranteed purchase of cocoons were the most effective on sericulture adoption in both sericulturists and non-sericulturists groups.

According to Table 9, the studied groups had significantly different opinions about the coordination of rearing practices promoted by extension agents with sericulture facilities at $p < 0.01$ level. According to Table 5, 36.7% of sericulture farmers believed that the rearing practices promoted by extension agents were highly coordinated with sericulture facilities, but 37.6% assessed it to be moderate. This coordination was assessed to be very poor by 5.2% of them. Among non-sericulturists, 46.7% believed that the cooperation was moderate and only 7.8% believed that it was very high.

Sericulturists and non-sericulturists expressed significantly different opinions about income generation by sericulture considering the short rearing period at $p < 0.01$ level. Accordingly (Table 5), 39.2% of sericulture farmers believed that silkworm rearing had high income, while 34.7% did not distinguish the income of sericulture from other agricultural activities. In contrast, 6.6% of them assessed sericulture income to be very low. According to 2.3% of non-sericulturists, silkworm rearing had very high income.

The comparison of sericulture farmers granted with supportive policies and those who were not between two groups in terms of the significance level set as in Table 10 gave the following results:

(1) The use of insurance in 2012: The groups were different at $p < 0.01$ level. It means that sericulture farmers who use insurance service are more willing to produce silkworm.

(2) The sale of fresh cocoons at guaranteed prices in 2012: Table 10 indicates significant differences between the group using insurance and those not using them. Therefore, the use of insurance service plays an effective role in sericulture adoption.

(3) Attendance in training courses in 2009–2012: A significant difference was observed between sericulturists who had attended sericulture training courses in 2009–2012 and those who had not. Since 76% of the studied sericulturists attended the training courses, it can be acknowledged that these training courses were effective in the adoption of sericulture.

(4) The use of bank facilities in 2009–2012: The results revealed a significant difference between sericulturists who had used bank facilities for the rehabilitation and construction of their own cocooneries and those who had not.

(5) The use of subsidized (improved) saplings in 2009–2012: The comparison of sericulturists who had received free improved saplings in 2009–2012 with those who had not did not show any statistically significant differences between them at $p > 0.01$ level.

Table 9. Comparison of social and economic characteristics of two groups.

Variable	Mann-Whitney U	p-value
Granting loans and facilities for the rehabilitation and construction of cocooneries	4683.500**	0.000
Insuring silkworm rearing	4062.500**	0.000
Training and promoting sericulture and the relevant activities	3942.500**	0.000
Free distribution of improved saplings	3243.500**	0.000
Distribution of high-yielding silkworm eggs	4346.000**	0.000
Guaranteed purchase of cocoon	4090.000**	0.000
Coordination between training methods used by extension agents and facilities	3146.000**	0.000
Income generation of sericulture given its short rearing time	1247.500**	0.000

*: Significance at 5% level; **: Significance at 1% level; ns: Non-significance

Table 10. Binomial statistic.

Variable	Observed ratio	p-value
Insurance of products and activities in 2012	82 to 18	0.000
Sale for guaranteed price in 2012	80 to 20	0.000
Attendance in training courses in 2009–2012	76 to 24	0.000
The use of bank facilities in 2009–2012	8 to 92	0.000
The use of subsidized (improved) saplings in 2009–2012	51 to 49	0.731

4. Discussion

Sericulture has had a long history in Iran and has played a significant cultural and economic role over the time. Presently, it is faced with some challenges making it imperative to implement

appropriate policies and strategies [7]. Accordingly, the present study aimed to explore the factors influencing the adoption of sericulture by farmers in Guilan Province.

According to the results, sericulture farmers' mean age was 50.9 years and they were mostly older than 50 years. This finding is consistent with Rahi Masouleh [7] and Pourhossein et al. [19] who reported a frequency of about 60% for sericulturists with the age of older than 50 years. It shows that the population working in the field of sericulture has been becoming younger. In other words, younger farmers show more willingness towards sericulture in current situations, and if this trend persists which will enhance the energy among sericulturists, an increase can be expected in the tendency towards sericulture. Also, we found that both sericulturists and non-sericulturists had 2–4 dependents. The family members can be used as labor during silkworm rearing to reduce production costs if they have relevant experience and technical knowledge. The findings showed that more than half of sericulture farmers had more than fifteen years of experience in sericulture, indicating their high experience. However, most of them were illiterate or had just basic literacy for reading and writing while the proportion of people with an academic degree was very low. The proportion of educated sericulturists did not differ from Rahi Masouleh [7], but the proportion of illiterate sericulturists or those with just reading and writing literacy shows a decline. But, most non-sericulturists had a diploma or higher degree. Given the results of analysis of correlation and mutual relationship between sericulture adoption and educational level, it can be expected that an increase in educational level can enhance sericulture adoption. Also, the results showed a reciprocal relationship between the amount of income from non-sericulture activities and the adoption of sericulture. Accordingly, it can be said that the lower the income from non-sericulture activities, the more likely it is that the individual will adopt sericulture. In the case of cocoonery ownership, the correlation test displayed a relationship between the type of ownership and sericulture adoption. Obviously, personal ownership can have an instrumental impact on the adoption of this practice.

The results showed that more than half of the non-sericulture farmers perceived sericulture income to be very high, high or at least equivalent to other agricultural activities. Considering the existence of a mutual relationship between sericulture adoption and the perspective on silkworm rearing profitability, sericulture can be expected to be looked upon as a minor but profitable activity by non-sericulture farmers. It was observed that a high percentage of both sericulturists and non-sericulturists (44.8% and 44.5%, respectively) believed that sericulture is a hard activity. Given the relationship of sericulture adoption with the amount of physical activity and the need for workforce, it can be acknowledged that despite the difficulty of this activity from the viewpoint of both groups, many sericulture farmers are involved in silkworm rearing due to their financial needs and the relatively significant income of this profession.

According to the results, the majority of sericulturists and non-sericulturists assessed the coordination of rearing practices suggested by extension agents with sericulture facilities to be moderate to high. Since the results of the correlation test revealed the relationship of sericulture adoption with the coordination of rearing practices suggested by extension agents with sericulture facilities, these practices have desirable impact on the adoption of sericulture. As well, it was found that most respondents expressed their willingness to attend educational courses related to sericulture or to send their family members to these courses. Considering the mutual relationship between sericulture adoption and the willingness to participate in training courses, it is obvious that sericulture adoption would be favorably impacted by on-time advertisement of training courses, the conduct of applied training classes, the establishment of an appropriate relationship between research,

promotion and training, and the sound timing of the training courses and rearing periods. Given the relationship between sericulture adoption and the willingness to rebuild cocooneries, the facilitation of the conditions for receiving and paying bank loans can be effective in sericulture adoption. Most sericulturists and non-sericulturists tended to receive improved saplings for the restoration or construction of mulberry gardens. The relationship between sericulture adoption and the willingness to receive improved saplings implies an interaction between these two variables. Therefore, sericulture adoption can be motivated by increasing the production and propagation of improved saplings and their proper distribution, which will also serve to replace indigenous, relatively old and inefficient trees with improved mulberries.

The results leads us to the following recommendations:

(1) Although sericulturists and also non-sericulturists were mostly older than 50 years, our results showed the tendency of the relatively younger people to practice sericulture in recent years. Also, given the significant relationship between educational level and sericulture adoption, it is recommended to take sound policies with financial motives that attract new, younger and more educated individuals to this profession.

(2) Given the willingness of both studied groups to participate in training courses of sericulture and relevant professions on the one hand and the crucial importance of training and promotion for sericulture adoption, it is recommended to allocate funds for developing comprehensive, applied short-term and medium-term programs tailored to the users' training needs.

(3) Since most respondents tended to receive improved saplings to restore or build mulberry gardens, it is recommended to allocate funds to develop the free mulberry sapling propagation and distribution.

(4) With respect to the important role of the cocoonery and its equipment to silkworm rearing and the fact that over 75% of the cocooneries are operated in a traditional way and are in poor condition, it is recommended to rehabilitate cocooneries and to construct new ones by low-interest bank credits. These cocooneries can be multi-purpose so that they can be utilized silkworm rearing off-season and the investment return is optimized.

(5) The distribution of high-yield silkworm eggs is an important factor in the adoption of sericulture among both sericulturists and non-sericulturists. Therefore, it is recommended to conduct studies on the breeding of silkworm with a practical perspective.

(6) Considering the importance of insurance in both sericulturists and non-sericulturists, it is recommended to institutionalize silkworm insurance and to develop mechanisms like improving farmers' awareness of the importance of insurance, enhancing users' easy access to insurance fund agents, increasing the number of insurance experts and improving their awareness of silkworm rearing processes including their diseases, improving insurers' performance in determining the damages and paying the indemnities, and discounting premiums for sericulture farmers who had not used insurance in previous years.

(7) Finally, it is recommended to provide rural people interested in sericulture with some comprehensive programs to motivate them towards silkworm rearing.

In conclusion data provided in this study can be useful for policy development efforts of the local authorities to promote adoption decisions of sericulture more effectively, taking into account locally important factors that affect the decision-making process among farmers and villagers. The study revealed that sericulture adoption was positively and significantly related to demographic features including age, number of dependents, education level, and experience in sericulture as well

as technical and economic characteristics including the type of cocoonary ownership, profitability of sericulture given its shorter rearing period compared to other agricultural activities, willingness to rehabilitate coronary, and willingness to attend sericulture and other relevant courses. Also, it confirmed that supportive policies can play an effective role in the adoption of sericulture. Sericulture makes small farms more diverse and sustainable as it focuses on efficient use of the available resources. If adequately promoted and the current constraints of the farmers are addressed, it could enable farmers to improve their status.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

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