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Factors affecting the adoption of new technologies by poplar growers in North Iran (Case study: Sowmeh Sara City)

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ABSTRACT

The purpose of this study is to determine the factors affecting the adoption of new technologies by poplar growers in Sowmeh Sara City, Guilan Province, north of Iran. The statistical population of the study includes poplar growers in the city. A total of 200 individuals were examined based on Cochran's formula and cluster sampling method at 2018. Structural equation modeling (SEM) was used to examine the impact of attitudes toward technology, understanding the use of technology, technological features, and social participation on the adoption of new technologies. Understanding the use of technology and social participation, and their constituent items, have had the greatest impact on the adoption of new technologies by poplar growers in Sowmeh Sara City. Accurate and transparent information about the features of new technologies and their differences with traditional methods is the key strategy in introducing these technologies and it will lead to adoption by poplar growers.

Key words: New technologies, Hyrcanian forests, Poplar growers, Structural Equation Modeling.

INTRODUCTION

The world forest area is estimated at about 4 billion hectares (ha), covering one-third of the world. These levels do not have a uniform distribution in different areas, so that the share of the southern half of the land from the forest areas is only one-third of the total. This inequality of distribution is more severe in different countries. Iran is located in an area where the share of forest lands in the countries where it is located is small, and in general, most of these countries are among the low-lying areas of the forest. In 1961, the amount of forest cover in Iran was 18 million ha, of which 3.7 million was the share of northern Hyrcanian forests. At present, the total forest cover of Iran is 12.4 million ha, of which 1.7 million is located in the northern Hyrcanian forests. Therefore, 6 million ha of the country's forest lands have been destroyed in the last 44 years, which is a very worrying issue (Tabesh 2014). Planting wood includes cultivating operations of fast-growing woody species (with the aim of economic harvesting of wood up to the maximum in the tenth year) such as poplar and eucalyptus varieties (Mousavi 2016). Wood cultivation has always been one of the most important economic activities in the rural areas of northern Iran. The residents of these rural areas have the possibility of multi-purpose use of the lands using wood cultivation. In addition, wood cultivation reduces the pressure on natural forests. However, in many cases, it is performed in the traditional way and is often based on trial and error among farmers (Mohammad pour *et al*. 2011). Wood cultivation as a main activity and only as a production and supply of wood for the market has less scope, limitations and capabilities and is involved in many issues and problems. Lack of logical market formation and proper system of evaluation as well as pricing of wood sales, lack of proper and comprehensive governmental support, insufficient promotion and training of scientific poplar growing compared to other common crop cultivations in agriculture sector are the economic and social constraints that is most involved in this economic activity (Modir rahmati & Bagheri 2004). Inappropriate surface, surface scattering, small size and small holders are the problems of wood cultivation in Guilan Province.

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There are more than 35,000 ha of lands which grow poplar in this province. Also, there are 101,000 ha of ruined, non-economic forest lands, as well as scattered alluvial lands with suitable acidity of poplar cultivation in this province, which shows the development capacity of wood cultivation in the province (Yousef poor 2016). The purpose of poplar cultivation is to produce wood, which reduces the exploitation pressure in the forests, since the amount of production even reaches 45 m^3 or 15 tons per hectare (Christersson 2010). The use of new technology includes: genetic manipulation of poplar in specific climatic and regional conditions, establishment of bases for the growth and planting of hybrid poplar trees, employing early returns seedlings, new cultivation methods, taking in account for the cultivation distance, adopting wastewater as well as pesticides along with bio-and nano-fertilizers have a significant role in improving the economic performance of this activity (Chen & Peng 2010). Environmental problems caused by the uncontrolled use of chemical fertilizers on the one hand along with the excessive energy consumption and production costs on the other hand, as well as the issue of producing sufficient wood with good quality to provide increasing market demand, it has made it necessary to study on the ways which leads the less application of chemical fertilizers. To achieve this, there are two approaches: 1) Activation of inactive elements in the ecosystem, such as nitrogen and inactive phosphorus, along with the less-readily available soil micronutrients such as iron and zinc, 2) increased speed of recycling nutrients (Taherkhani *et al*. 2009). Exploitation of inactive elements by plants after their availability by new nanotechnology, such as the application of nano-fertilizers and some soil microorganisms is one of the new technologies in poplar cultivation which improves the economic performance of this crop (Hosseini & Dehyouri 2009). Applying new technology by poplar growers can lead to an increased performance of wood cultivation in Guilan Province. If new technologies are not applied by poplar growers, economic performance will be degraded and their potential resources will be wasted. In addition, adopting new technologies does not happen all at once, but is a process taking place over time and being effective only in condition that a technology should be adopted. Undoubtedly, moving towards new technologies and adopting them by any manufacturing company is an undeniable necessity.

The present study examines the attitude factors influencing the adopting new technologies by the poplar growers in Sowmeh Sara City, Guilan Province, Iran.

MATERIAL AND METHODES

Based on the review of the literatures, the current study presents a conceptual model (Fig. 1) of the 4 potential attitude factors affecting the adoption of new technologies. A hypothesis has been developed for each component of the conceptual model.

Structural equation modeling

In this study, structural equation modeling (SEM) was used to analyze the effect of attitude components. This approach allows investigators to have a holistic and more accurate look at the components used in their study and to correctly identify the effect of the components (Hair *et al*. 2011). The most obvious difference between structural equation modeling and previous techniques is the adoption of multiple relationships to each of the dependent variables. In other words, SEM by determining the structural pattern used in a statistical program simultaneously simulates a set of multiple regression equations. In hybrid models, unlike reflective models, the assumption of homogeneity and one-dimensionality is not valid. In these models, the latent variable is a linear combination of explanatory variables, and this apparent variable plays an external role in its measurement model (in SEM, errors are not calculated at the level of exogenous variables). Accordingly, reliability (internal stability) issues and methods of reflective measurement models cannot be applied in hybrid models. Therefore, as the reliability role decreases, the validity test of such models has played a pivotal role (Mohsenin & Esfidani 2017).

Bootstrapping method was used to examine the results of structural equations, which is very suitable for this purpose (Chin, 2002; Hair *et al*. 2011)

In order to achieve the desired purposes, a questionnaire on people's attitudes towards various factors that affect the acceptance of new technologies has been prepared. To determine the sample size, we used the online sample size calculator (suitable for structural equation modeling) provided by Soper (2019) found to be 200 people. The required information were collected through face-to-face interviews with 200 samples of poplar growers in Sowmeh Sara during September 2018. All farmers in this study were residents in urban areas of this city. In the first part of the questionnaire, we recorded the individual characteristics of each respondent such as gender, education, number of family members, income and age.

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The second section deals with the components of attitude (for example: the attitude towards technology, understanding the importance and aspects of technology, and also social participation). Each attitude component had different items. The attitude towards technology and social participation each had 2 items, while understanding the importance and aspects of technology each encompassed 3 items.

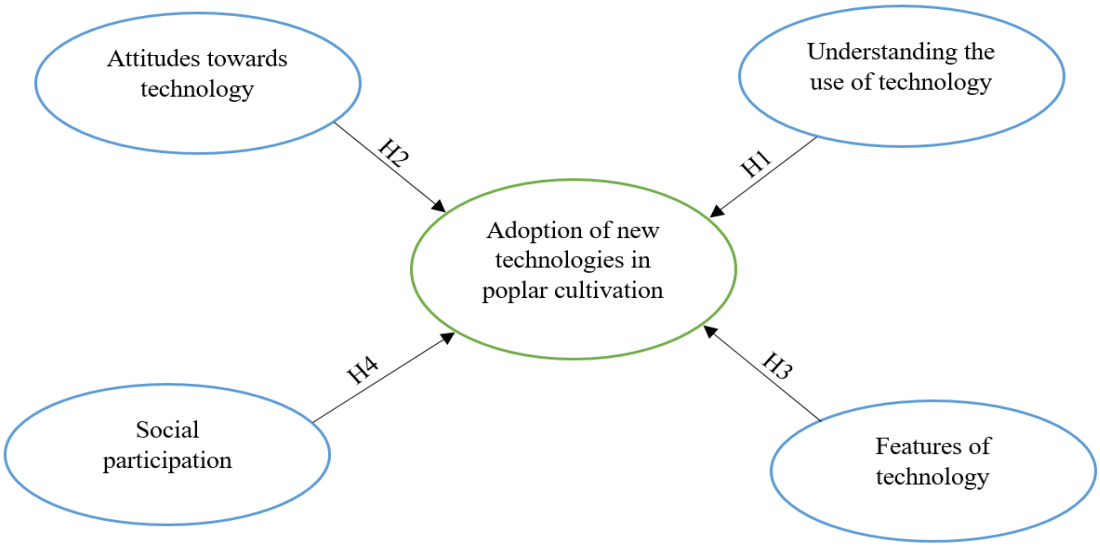

Fig. 1. Conceptual model for investigating the effect of attitude components.

The Likert scale was used to evaluate the attitude components. 30 questionnaires were completed by pre-test to assess their reliability. In addition, 10 experts were consulted and their opinions were included in the questionnaire. The interview time was 15-30 min. Before interviewing, the purpose of the study was explained to respondents and their consent was obtained.

After sorting, the data was entered into SmartPLS3 software, then path coefficients (total effects) were obtained. Due to the latent variables, we employed the partial least squares method (PLS). In addition, in order to evaluate the overall reliability of the research instruments, we performed Cronbach's alpha test in SPSS 25 software. The R^2 determination coefficient was employed to connect the measurement section and the structural part of the SEM, for exhibiting the effects of the exogenous variables on the endogenous ones. The range of R^2 is from zero to one, and larger values indicate higher predictive accuracy levels.

RESULTS

The study of adopting new technologies in poplar cultivation was performed on 200 poplar growers in Sowmeh Sara City. Adopting new technologies rises the efficiency of exploiting natural resources such as water and soil. In addition, less labor will be spent on agriculture, increasing profits, while reducing costs. Also the amount of product (for example, wood from poplar cultivation) will be increased. Table 1 presents the descriptive statistics of age, gender, education, number of family members, and income.

Various factors affect the willingness of poplar growers to adopt new technologies. For this purpose, several variables were collected through a questionnaire. Some of the most important variables eventually employed to estimate the PLS model, are shown in Table 2.The results of estimating the path coefficients in the structural model and the outer weights in the measurement model performed by Smart-PLS software are illustrated in Fig. 2. According to the path coefficients, the most important variables that affect the acceptance of new technologies in poplar cultivation are: aspects of technology (0.398), social participation (0.292), understanding the importance of technology (0.234) and attitude towards technology (0.219). In this conceptual model, 52.8% of alterations in the willingness of poplar growers to adopt new technologies are explained by latent variables. Therefore, according to the obtained coefficients, the technological aspects has been the most effective factor in the poplar growers willingness to adopt new technologies in Sowmeh Sara.

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Table 1. Descriptive statistics for respondents (number = 200).

Variable	Specifications	Number %	Mean	SD.DEV
Gender	Male	95.5	-	-
	Female	4.5	-	-
Educational level	High school	4.1	-	-
	Diploma	48.5	-	-
	Academic	10.5	-	-
Number of family members	Per person	-	2.59	0.092
Income	Total income in Rials	-	186,010,000	5,216,484,261
Age	Years	-	54.08	0.71

Table 2. Descriptive statistics of attitude variables

Variable	Mean	SD	Maximum	minimum
Attitude towards technology (ATT)	4.925	0.0808	7	2
Understand the use of technology (UUT)	8.845	0.140	13	5
Features of technology (FT)	9.675	0.171	15	3
Social participation (SP)	5.595	0.113	8	2

Table 3. Specifications of PLS model.

Variable	CR[3]	AVE[2]	VIF[1]	P-Value
ATT	0.835	0.717	1.585	0.000
SP	0.827	0.705	1.084	0.000
TF	0.901	0.754	2.095	0.000
UUT	0.761	0.523	1.066	0.000
Y	1.000	1.000	-	-

1- Variance Inflation Factor; 2 - Average Variance Extracted; 3- Composite Reliability.

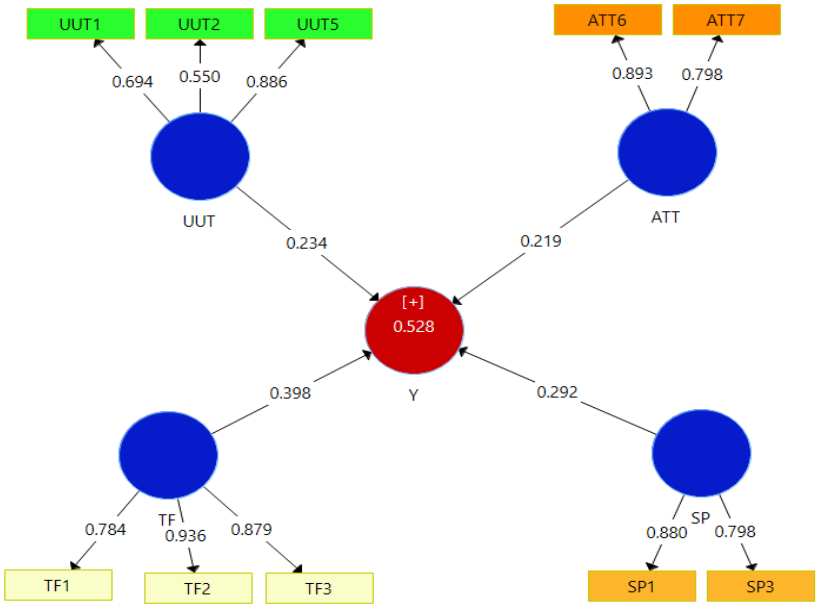

Fig. 2. Estimated model for attitude factors influencing the adoption of new poplar cultivation technologies.

Cronbach's alpha, an old criterion for measuring reliability and a good tool for assessing internal consistency, was calculated for this model to be 0.701. Since the Cronbach's alpha coefficient is an old-fashioned criterion for determining the reliability of structures, the PLS method uses a more modern criterion than alpha called composite reliability (CR). If the CR value for each structure is greater than 0.7, then it indicates intrinsic consistency for the measurement models (Werts *et al.* 1974). Convergent validity is the second criterion used to assess the appropriateness of PLS measurement models. This coefficient is calculated to ensure that the model measures what it needs to measure (Fornell & Larcker 1981). The value of the average variance extracted (AVE) is estimated to evaluate the convergent validity, indicating that the critical value for AVE is 0.5 (Hair Jr *et al.* 2016).

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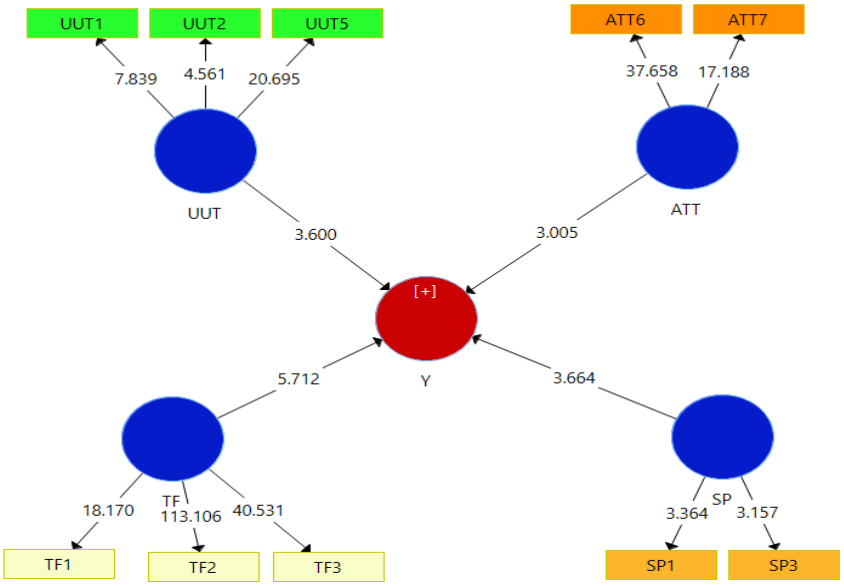

Fig. 3. Significance of coefficients used in PLS model.

Using the bootstrapping method, we investigated the significance of outer weights for structures. These weights are shown in Fig. 2, while their significance in Fig. 3. The results indicated that research hypotheses, i.e., the importance of attitude components in adopting new agricultural technologies among the poplar growers in Sowmeh Sara, have been accepted.

DISCUSSION

In this study, we analyzed attitudinal factors affecting the acceptance of new poplar technology by farmers located in Sowmeh Sara district. According to the results obtained by SEM, the hypothesis H1, H2, H3 and H4 are confirmed. Very few studies are available in this field, either inside Iran or abroad, because the inclusion of attitude factors in this field has given a kind of innovation to our study. The results of the present study revealed that the technological aspect has the greatest impact on the poplar growers in Sowmeh Sara to adopt new technologies, consistent with the results of Qorbani piralidehi *et al*. (2013) and Asimeh & Nouripour (2017). In the case of the next component affecting poplar growers, i.e., social participation, our result was in line with those obtained by Rezvanfar & Mandappeh (2000), while differ from those of Salehi *et al*. (2008) and Alizadeh Anaraki *et al*. (2012). Understanding the importance of technology was another component that influenced the attitude of poplar growers. This conclusion is consistent with those of Salehi *et al*. (2008), Asimeh & Nouripour (2017), while differ from Qorbani Piralidehi *et al*. (2013). The last influential factor, i.e., the attitude towards technology, exhibited the least impact on the adoption of new technologies, in line with results of Atafar *et al*. (2012) and Alibeigi *et al*. (2011).

CONCLUSION

According to the results of the present study, the technological aspects have the greatest impact on the adoption of new technologies by poplar growers. Therefore, more efforts need to introduce the best and most complete technologies as well as their main and key specifications, since the poplar grower's awareness of technology will be elevated, along with the likelihood of its acceptance. Proper information and training on how to use technology can be very effective. Due to the lack of extension-service-counseling courses in most rural areas of Iran and especially in the villages of Sowmeh Sara, the Ministry of Agriculture should take serious action to hold more of these courses. In these courses, we should introduce and fully explain new technologies in a simple and understandable explanations for the general public. Television, social media, and internet sites are also should promote the technological issues. It is advisable to rent a land in each village as a sample farm to cultivate poplar using new technologies. When the villagers see the results and feel it closely, the probability of adopting the technology will increase.

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Finally, the key to develop new technologies among poplar growers is to provide information which should be pleasantly done by promoters, explaining the benefits well, the differences with the traditional method, and emphasizing more on reducing costs and increasing revenue.

Conflicts of Interest

Authors declare that they have no conflict of interest.

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عوامل مؤثر در پذیرش فن‌آوری‌های جدید توسط صنوبرکاران در شمال ایران

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چکیده

هدف از این مطالعه تعیین عوامل مؤثر در پذیرش فن‌آوری‌های جدید توسط صنوبرکاران در منطقه صومعه‌سرا در استان گیلان، شمال ایران است. جامعه آماری این پژوهش شامل صنوبرکاران بخش صومعه‌سرا استان گیلان است و ۲۰۰ نفر براساس رابطه کوکران و روش نمونه‌گیری خوشه‌ای در این منطقه بررسی شدند. از الگوسازی معادلات ساختاری (SEM) برای بررسی تأثیر نگرش به فناوری، درک استفاده از فناوری، ویژگی‌های فناوری و مشارکت اجتماعی در پذیرش فناوری‌های جدید استفاده شد. درک استفاده از فناوری و مشارکت اجتماعی و گویه‌های تشکیل‌دهنده آن‌ها، بیشترین تأثیر را در پذیرش فن‌آوری‌های جدید توسط صنوبرکاران در منطقه صومعه‌سرا داشته است. اطلاعات دقیق و شفاف در مورد ویژگی‌های فن‌آوری‌های جدید و تفاوت آن‌ها با روش‌های سنتی راهبرد اصلی در معرفی این فن‌آوری‌هاست و منجر به پذیرش این فناوری‌ها توسط صنوبرکاران می‌شود.

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