Validation of the professional competencies model required by experts of agricultural consulting, technical, and engineering services companies to provide private extension services

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One of the important pillars for achieving organizational objectives is the presence of qualified human resources. Professional competencies in experts working in agricultural consulting, technical, and engineering services companies (ACTESCs) can be a basis for the quality of human resources and assure the quality of the functions of this system. Accordingly, this study aimed to identify the professional competencies required by extension experts working in these companies to provide extension services from their perspectives. The research method was a survey. The statistical population of the study consisted of 593 extension experts working in these companies, from whom 234 people were selected as the sample by the use of Cochran's formula. In the field stage, a questionnaire was used as the main research tool. The face and content validities as well as the reliability of the research tool were confirmed. The result of the structural equation modeling approach confirmed the hypothesis that economic, technical, and communicational functions play roles in providing extension services. Accordingly, it is recommended to fill the gap between the existing competencies and the competencies required by the experts working in the ACTESCs to provide appropriate Private Extension Services (PESs).

KEYWORDS

communication competencies, economic competencies, extensional-educational competencies, individual competencies, technical competencies, private extension, agricultural extension, consulting services companies

Introduction

Government extension has been widely criticized by experts during recent decades. One of the strategies used by some countries to cover and reduce the weaknesses of government extension is to implement private extension (Hanchinal et al., 2001; Saravanan, 2001). Privatization of agricultural extension refers to the services provided by extension agents in private centers or companies to those farmers who are able and willing to pay for the services and are regarded as a complement to the government extension (Hanchinal et al., 2001). In Iran, with the formation of ACTESCs, the flow toward the privatization of agricultural

extension was initiated by applying an approach for reducing government ownership and using the capacity of the private sector. In Iran, the first private company called "Sabz Andishan Hegmataneh" was registered in Hamadan province in 2001, and provided private consulting and extension services. After this measure, the formation of the private extension was initiated earnestly in the form of a consulting, technical, and agricultural engineering services network in 2002, so that in addition to Hamedan province, these companies also began to operate on a trial basis in some other provinces such as Kermanshah and Zanjan. After these activities in 2007, this program was officially expanded throughout the country (Shabanali Fami et al., 2008).

One of the functions and duties of these companies is to provide consulting, extensional educational, and technical engineering services (Ebrahimi, 2008; Noorozi et al., 2017). The efficiency of private extension and ACTESCs depends to a large extent on the competence of the extension agents working in these companies (Dundar, 2016). Experts working in ACTESCs are considered as an important element in the private extension system and their capabilities and competencies affect the performance of these companies and the private extension system. It seems that the experts working in ACTESCs need special professional competencies to complete their missions in the private sector, which, of course, is different from what is required in the public sector.

Private extension and ACTESCs

One of the most important programs implemented in different countries with the main goal of reducing government ownership and privatization is the establishment of agricultural business firms. In Iran, two factors "the limited financial resources in the public extension system" and "the government's efforts to expand the extension network" have played an important role in the emergence of a private extension. The most important roles of the private extension are: providing timely input to increase production; providing extensional educational and consulting services for agricultural production; developing market awareness; facilitating the production process; marketing the products; increasing information on how farmers have access to financial facilities; and developing the infrastructure for warehousing and export (Saravanan, 2001). Chowdhury and Kabir (2024) found out that Agricultural extension and advisory services (AEAS) have undergone significant changes globally, including reduced public funding and the introduction of new approaches, aimed at improving agricultural productivity, net farm income, and food security. Caloffi et al. (2022) stated that advisory services are more effective than innovation vouchers and as effective as policy mixes in increasing SMEs' propensity to innovate and engage in R&D collaborations. Conversely, policy mixes are more effective than each instrument in increasing productivity. Hence, merely providing SMEs with technology and innovation advice is not sufficient to elicit productivity improvements; SMEs also need to act on such advice by working with external providers of knowledge-intensive services to implement efficiency-producing changes. Gboko et al. (2021) stated that the ratio of advisors per producer in the private advisory system is too high, and the means of transport for advisors are inadequate. The training received by the advisors is strongly oriented toward

mastering technical subjects related to certification requirements, while soft or process topics that would provide them with knowledge and skills required to co-produce with farmers is neglected. Regarding the front office dimension, advice to cocoa producers is largely prescriptive and fails to co-produce knowledge that is relevant to their needs. Faure et al. (2011) pointed out that In West Africa, advisory services for family farms have been promoted to better address producers' needs. Results revealed that the intervention method needs to be continuously adapted to take into account changes in financial capabilities and human resources available for providing advisory services, (ii) the nature and the quality of advisory activities are closely related to the skills of advisors and managers of advisory services, (iii) the governance mechanisms steering advisory services reveal the social relations between the stakeholders and influence the content of the advice, and (iv) the funding mechanisms are pivotal in defining the rules of governance. Lessons learned are drawn from this analysis that may serve to support advisory services.

Since the beginning of the operations of these companies, 2,653 companies have been formed in different provinces of Iran, of which 2,130 companies are currently active, in which 17,714 agricultural graduates are providing PESs. In Tehran province, so far, 200 companies have been able to organize 593 agricultural graduates to provide services to farmers (Ebrahimi, 2008). However, no program or action has been taken to develop the professional competencies of the extension agents working in these companies. Evaluating and upgrading the experts' competencies will ensure the quality and the provision of extension services. Even though ACTESCs have been established to provide PESs to villagers and farmers, some issues have caused their performance to deviate from the desired and expected level. Among these issues are inappropriate professional combination of the staff, inadequate compliance of the experts with the conditions of the private extension, low number of the experts, farmers' unwillingness to pay for consulting fees, low wages, expectations beyond the engineers' capabilities, delay in preparing contracts, lack of initial financial support, distrust of the executive departments of the Ministry of Agriculture toward the companies, inconsistent tariffs, and a lack of adequate support from Agricultural and Natural Resources Engineering Organization (Mahboobi et al., 2016). In fact, ACTESCs are an efficient and decentralized private service system with the participation of agricultural graduates and with the goals of increasing farmers' access to the knowledge, technology, and inputs required to meet their informational and technical needs and applying these new technologies to improve the management of their farms. The experts and graduates working in these companies have employment licenses from the Agricultural and Natural Resources Engineering Organization and their main task is to provide consulting, extensional educational, and technical services to farmers. Given the expansion of agricultural consulting, technical, and engineering services companies as new actors in the structure of Iran's private agricultural extension system and the transfer of part of government extensional educational activities to young graduates working in these companies as well as the transfer of new missions to these companies and lack of a comprehensive study in the statistical population under study, the main question is what competencies do the extension experts working in these companies need from their own perspective and perception? Therefore, this study was conducted with the general aim of analyzing the professional competencies required by the experts of ACTESCs to provide PESs. It is expected that as the results of this research are clarified, policymakers

and managers will be able to address the deficiencies of the competencies required by the experts working in these companies.

Professional competencies

Just as other organizations, ACTESCs to survive and compete need qualified experts, who can rely on their competencies to cope with current and future missions and prevent the firm from being eliminated from the competition. In today's evolving world, the required professional competencies are changing rapidly. Definitions and uses of the term "Professional competencies" vary from organization to organization based on the intended goals and objectives (Lee, 2006). But in general, professional competencies are considered part of the employees' performance and reflect the individual's areas of knowledge, attitude, and skills in such a way that enables him/her to act effectively and successfully in his/her profession (Zorzi et al., 2002; Konig and Lauermann, 2016). Gray and Stark (2007) have determined the indicators of educators' job performance in the form of educational planning, teaching, creating a suitable learning environment, evaluating, and providing feedback to learners. Also, in private extension, professional competencies refer to the ability to perform all tasks effectively by the status of the extension experts. Individual, knowledge, and other job-related competencies are among the competencies required by agricultural extension agents (Roberts, 2006). In fact, identifying and evaluating competencies is a way to determine the extension professionals' internship and training needs (Diaz et al., 2019). Agricultural extension agents' perception of the required professional competencies has been reflected in several studies. Coats (1998) considers perception as a process, involving individuals' feelings and abilities to arrive at truths about the environment. Morse et al. (2006) state that the changing needs of the educators are a function of the changing needs of the client because the farmers' needs change with the technological, economic, social, and environmental changes. According to the theory of social perception, the social knowledge acquired by a person automatically through the perception gained from natural courses affects his/her behavior unwantedly (Ferguson and Bargh, 2004). Therefore, based on the theory of social perception, when the experts working in the (ACTESCs) understand the lack of competencies needed to provide educational services to farmers, their behavior will change to acquire these capabilities. Therefore, for (ACTESCs) to be able to function properly in providing services, the experts working in these companies must gain the necessary professional competencies. Numerous studies have been conducted on the professional competencies required by agricultural extension experts. In a study, Alizadeh et al. (2016) suggested that the competencies required by the experts are communication skills, professional behavior, and personality traits. The results of Rajabi et al. (2012) showed that the required competencies for agricultural conservatory teachers include professional competencies (educational, managerial, planning), personal (individual and social), and specialized skills (scientific and practical). Ghimire (2011) suggested that the professional competencies required by agricultural extension agents include needs assessment, teaching and learning principles, presentation mechanisms, and evaluation systems. However, the results of Hoseini and Khodabande (2010) indicate that young graduates working in consulting, technical, and agricultural engineering services companies do not have the necessary experience and skills to conduct training courses. In the view of Wu and Lin (2011), the professional competencies of educators include the competencies: needs assessment, planning development,

teaching preparation, practical teaching, evaluation of teaching, teaching management, consulting competence, public relations promotion, interpersonal communication, and project collaboration. In the study of Megan et al. (2012), it was indicated that agricultural extension agents with less than 5 years of experience need more professional development in terms of data collection. While agricultural extension agents with more work experience need more analysis and reporting. In the study of Murphy and Bruening (2006), the competencies required by agricultural extension staff were identified to be communication, technical knowledge, program design, monitoring, and evaluation. Mulder (2017) considers disciplinary and interdisciplinary, self-management and career-management, professional-personal, social-professional and integrated learning competencies as the 5-Component Future Competency (5-CFC) model. In the study of Liles et al. (2004), seven competencies, including organizational, thematic and technical-specialized knowledge, planning, professionalism, communication, human relations, and leadership, are considered the required competencies for agricultural extension agents. Diaz et al. (2019) identified extension agents' evaluation competencies in 10 factors: evaluation planning, evaluation design, situation analysis, data collection, development of evaluation techniques and tools, data analysis, data use, communication reporting and evaluation, and social and political evaluation processes. In the study of Koundinya et al. (2018), establishing and maintaining collaboration/partnership, development and communication, project and organization management, interaction with owners/interpersonal skills, facilitator leadership, and development and maintaining a vision for the future were identified as the core competencies for successful watershed management. The studies conducted in Iran showed that private extension experts do not have the necessary skills regarding organic agriculture and they do not provide services in this regard (Karimi and Niknami, 2020; Mohammadian and Niknami, 2022). A review of the previous theoretical foundations provided the necessary basis for presenting the research theoretical framework (Figure 1). Despite numerous studies conducted, this study is the first attempt to develop a model of professional competencies required by extension agents (ACTESCs) to provide a private extension in Iran. Accordingly, the following research hypotheses were considered for the present study:

- Individual competencies play a significant role in providing PESs.
- Extensional-educational competencies play a significant role in providing PESs.
- Technical competencies play a significant role in providing PESs.
- Communication competencies play a significant role in providing PESs.
- Economic competencies play a significant role in providing PESs.

Research method

Study area

Tehran province with an area of about 12,981 square kilometers is located between 34 to 36.5 degrees north latitude and 50 to 53 degrees east longitude. This province has 16 counties, 45 cities and 78 villages from the north to Mazandaran province, from the south to Qom province, from the southwest to Markazi province, from the west to Alborz province and from the east to Semnan province
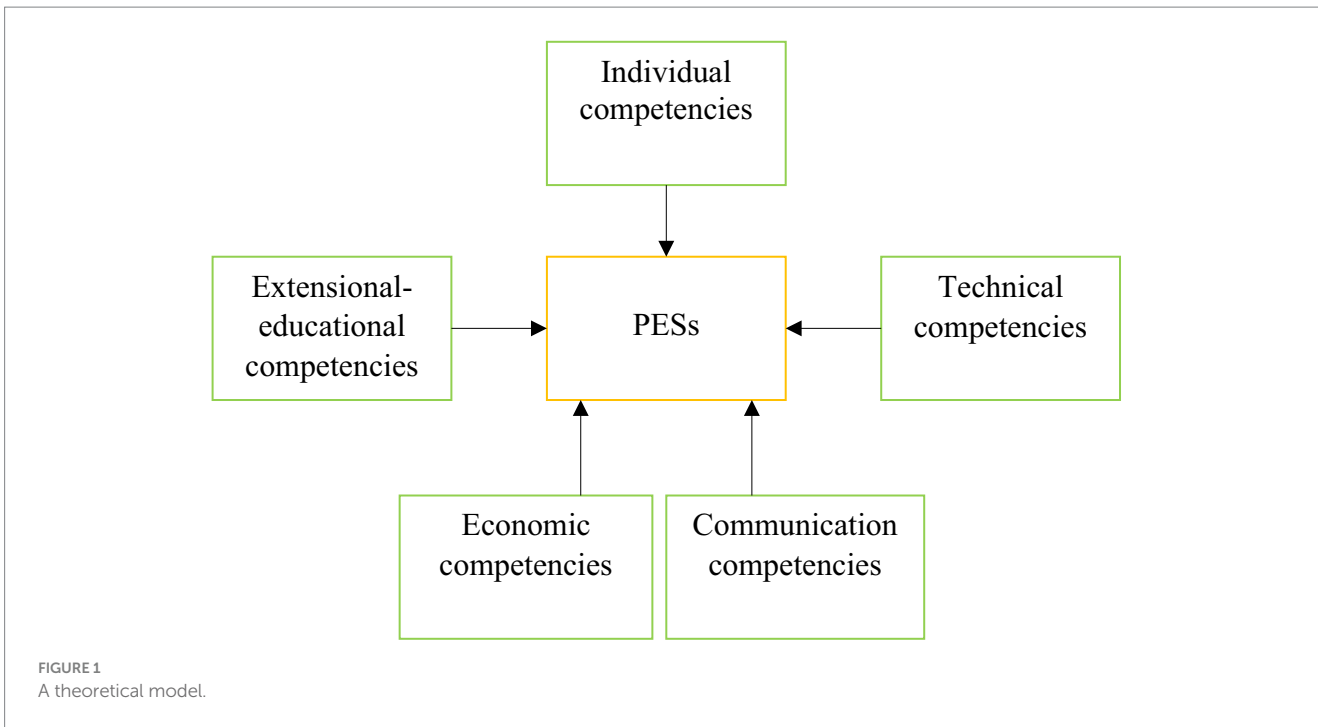
FIGURE 1
A theoretical model.
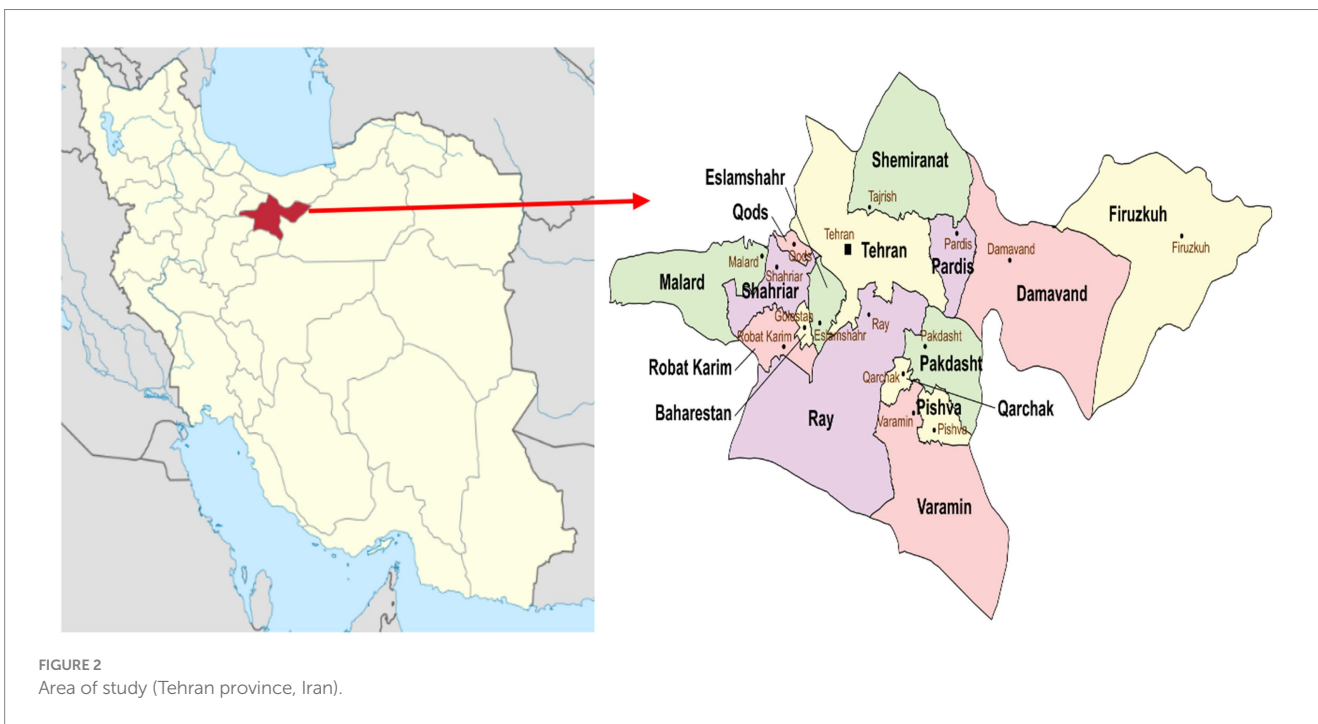
FIGURE 2
Area of study (Tehran province, Iran).

(Figure 2). With 20% of the country's population, this province occupies 40% of the total consumer market of the country (OAJT, 2020).

Data collection

This research was conducted by a survey method. The information collected is a combination of library and field studies. The statistical population of the study consisted of 593 experts from 200 consulting services companies in Tehran province, from which 229 people were selected as the sample through Cochran's formula. To increase reliability, 240 questionnaires were distributed, but in the end, 234 completed questionnaires were received (Table 1). To increase the response rate, the respondents were thanked for the time they took to complete the questionnaire by visiting the respondents in person and motivating them with a gift (pen). Because the studied population was homogeneous, therefore the simple random sampling method was

TABLE 1 Statistical population and the sample.

No	Counties	Companies	The population	The sample size
1	Tehran	63	254	108
2	Pakdasht	13	31	13
3	Damavand	12	28	12
4	Varamin	8	20	9
5	Shar-e-Ray	9	23	10
6	Shahriar	2	8	3
7	Savojbolagh	9	30	13
8	Eslamshahr	19	44	19
9	Firuzkuh	13	32	14
10	Robat Karim	15	35	15
11	Pishva	13	25	11
12	Shemiranat	7	16	7
	Total	200	593	234

Source: Authors' survey.

TABLE 2 Reliability and validity of the measurement instrument.

Latent constructs	Items	1	2	3	4	5	6	Alpha Cronbach	Composite reliability	AVE
Communication 1	4	0.795						0.716	0.789	0.633
Economic 2	5	0.378	0.798					0.725	0.774	0.638
Extensional-educational 3	5	0.257	0.332	0.382				0.743	0.761	0.665
Individual 4	2	0.237	0.335	0.260	0.835			0.708	0.712	0.698
Technical 5		0.260	0.779	0.442	0.279	0.799		0.797	0.747	0.639
PESs 6	5	0.261	0.279	0.392	0.239	0.419	0.816	0.732	0.720	0.666

Source: Authors' survey.

appropriate for the assignment. In the field stage, the data collection tool was a researcher-made questionnaire. The questionnaire contained 21 questions to assess the individual, extensional-educational, technical, communication, and economic competencies as the independent constructs and 4 questions for the dependent variable of "providing PESs" and was designed using the five-point Likert scale (very low = 1, low = 2, average = 3, high = 4, and very high = 5). Items were selected based on literature review and previous research. Then, the prepared questionnaire was given to a number of faculty members, researchers, and experts and was edited based on their opinions. Accordingly, the face and content validities of the questionnaire were confirmed. In the next stage, the pre-test study was conducted outside the study population in order to assess the reliability by completing 30 questionnaires. The Average Variance Extracted (AVE) index was calculated to determine the validity of the constructs. AVE index is used as one of the model fit criteria in the partial least squares structural equation model in SMART PLS software. The AVE measure represents the average variance shared between each construct with its indicators. In simpler terms, AVE shows the degree of correlation of a structure with its indicators, the higher the correlation, the better the fit. Fornell and Larcker believe that convergent validity exists when AVE is greater than 0.5. To calculate the reliability of the questionnaire, Cronbach's alpha coefficient and combined reliability were used, which were determined using the Confirmatory Factor Analysis (CFA) (Table 2). The Partial Least Squires-Structural Equation Modeling (PLS-SEM) was used to analyze the data and test the research model. For this end, SPSS and SmartPLS3 software were used. The PLS-SEM technique makes it possible to simultaneously examine the relationship between independent and dependent multiple constructs s and to answer the research questions in a single, systematic, and comprehensive analysis. This is a distribution-free method and works well in conditions where the sample size is small. The PLS-SEM analysis should be performed in two stages including measurement model and structural model evaluation. In the measurement model of reliability analysis, convergent and divergent validities of the constructs were used. To evaluate the structural model, the coefficient of determination (R^2), i.e., the explanatory power, Q^2, i.e., the predictive relevance, and the values of the path coefficients of the model were calculated (Chin, 2010).

Results

The results showed that the studied experts' minimum and maximum ages were 27 and 50 years, respectively, and the mean

TABLE 3 Frequency distribution of studied dimensions.

Constructs	Very low		Low		Fair		High		Very high	
Competencies	Existing	Required	Existing	Required	Existing	Required	Existing	Required	Existing	Required
Individual			29.1		63.2		7.7	17.1		82.9
Educational-extensional	4.3		17.9		43.6		25.2	29.9	9	70.1
Technical			17.9		33.8	0.4	37.6	33.8	10.7	65.8
Communication			8.5	3.4		15.8	91.5	49.1		31.6
Economic			8.5		12.4		79.1	28.6		71.4
Providing PESs			18.8		79.1	1.7	2.1	86.3		12

Source: Research findings. The values in the table are in percentage.

age was 33.94. The experts' minimum and maximum number of years of work experience were 1 and 15, respectively. The education levels of the experts working in the (ACTESCs) were 55.7% bachelor's degree, 37.8% master's degree, and 6.5% doctorate. To review the experts' existing and required competencies working in the agricultural consulting, technical, and engineering services companies to provide PESs, they were asked to express their views in this regard in the form of a Likert scale. The results showed that 29.1, 63.2, and 7.7% of the respondents had low, moderate, and high levels of individual competencies, respectively. 17.1 and 82.9% of the experts stated that the required level of competency in the individual dimension was high and very high, respectively. The existing educational and extensional competencies were very low, low, moderate, high, and very high in 4.3, 17.9, 43.6, 25.2, and 9% of the respondents, respectively. The required extensional-educational competency was high in 29.9% and very high in 70.1% of the respondents, respectively. 17.9, 33.8, and 37.6%, 10.7% of the respondents, respectively, reported that their current technical competence was low, medium, high, and very high. The required technical competency was average, high, and very high in 0.4, 33.8, and 65.8% of the respondents, respectively. The existing communication skills of experts were low in 8.5% and high in 91.5%. The required communication skills were low in 3.4%, medium in 15.8%, high in 49.1%, and very high in 31.6% of the respondents. The economic competencies were low, medium, and high in 8.5, 12.4, and 79.1% of the respondents, respectively. While the required economic competencies in 18.8, 79.1, and 2.1% of the respondents were low, medium and high, respectively. Regarding the current situation of the private extension, 18.8% were assessed as weak, 79.1% as moderate and 2.1% as good. While the need to provide desirable PESs by consulting, technical and agricultural engineering services companies was expressed by 1.7% of the respondents as average, by 86.3% as very good, and by 12% as excellent (Table 3).

Measurement of factor loadings

The reliability of each item refers to the value of factor loadings of each of the observed variables; i.e. they are used to determine the extent to which the measurement indicators (the observed variables) are acceptable for measuring the hidden variables. For this end, i.e., validation of the research model, the Confirmatory Factor Analysis (CFA) is used. The most important goal of the CFA is to determine the power of a pre-defined factor model with a set of observed data. In other words, this method seeks to determine whether the number of factors measured is compatible with what was expected based on the conceptual model. It tests the degree of compatibility between the theoretical and experimental constructs s of the research. Therefore, if each time the factor is higher than 0.4 and the value of t is higher than 1.96, then the indicator has the necessary accuracy to measure the hidden constructs or factors. At first, the model was implemented with 23 items, but due to the low factor loading, items a2, a3, b1, b3, c4, d3, g3 were excluded. By excluding these indicators, the model was implemented again and the acceptable factor loadings were extracted. The results of the factor loadings are provided in Table 4.

TABLE 4 Values of factor loadings for indicators of each construct in the form of a modified measurement model.

Construct	Items	Factor loading	t
Individual	Power of expression and reasoning ability, a1	0.596	3.069
	Having professional ethics, a4	0.801	5.458
Educational-extensional	Ability to implement extension methods and techniques, b2	1.000	1.000
Technical	Having the required new, valid, and compatible technical knowledge, c1	0.796	12.227
	Having the required experience and practical skills, c2	0.556	5.862
	Ability to implement and advance farm projects, c3	0.704	8.915
Communication	Human and social communication skills, d1	0.738	6.436
	Electronic communication skills, d2	0.848	10.280
Economic	Farm management skills, e1	0.712	14.440
	Ability to analyze cost–benefit, e2	0.706	13.586
	Familiarity with methods of marketing agricultural products, e3	0.729	12.812
	Familiarity with agricultural insurance laws and financing methods, e4	0.632	9.313
Providing PESs	Transferring information, knowledge, and new agricultural technology, g1	0.833	22.276
	Providing expert advices, g2	0.802	27.855
	Providing soil, water, phytopathology, pressurized irrigation, and mechanization testing services, g3	0.457	6.146
	Providing services and distribution of agricultural inputs, g5	0.460	5.262

Source: Research findings. $t \geq 1.96$ is significant.

Model fit

The validity check index of the Stone-Geisser Criterion (Q^2) determines the predictive power of the model (Table 5). Models that have an acceptable structural fit must be able to predict the indices of the endogenous constructs of the model. This is if, in a model, the relationships between constructs are properly defined, the constructs can sufficiently affect each other's characteristics and thus the hypotheses are properly confirmed. In the study of Henseler et al. (2009), which was conducted on the intensity of predictive power of the model for endogenous constructs, three values of 0.02, 0.15, and 0.35 were determined as weak, medium, and strong predictive powers, respectively.

According to Table 4, the value of Q2 is calculated by the use of 1-SSE/SSO, which equals to 0.134 for communication constructs, 0.331 for economic constructs s, and 0.161 for educational constructs s, 0.189 for technical constructs, and 0.295 for private extension. As the results of the above table show, it can be seen that the common validity index of hidden constructs is positive and moderate to strong. Thus, the developed model has a suitable and acceptable adequacy.

Hypotheses test

According to the data analysis algorithm in the PLS method, after investigating the fit of the measurement and structural models as well as the general model, the research hypotheses are tested by examining the significance coefficients (t-values) of each path as well as the standardized factor coefficients related to the paths. If the value of the

TABLE 5 Common validity check index of latent constructs.

Constructs	1-SSE/SSO
Individual	0.161
Educational-extensional	1
Technical	0.189
Communication	0.134
Economic	0.331
Providing PESs	0.295

Source: Research findings.

significance coefficient of each path is higher than 1.96, then the relevant path is significant at the confidence level of 95% and the related hypothesis is confirmed. Based on the model tested in the case of standard coefficients, Figure 3 and the numbers located on the lines indicate the path coefficient and the relationship between the hidden variables. To investigate the significance of the path coefficient, it is necessary to consider the t-value of each path (Table 6).

The experts' individual competencies who are working in the agricultural consulting, technical, and engineering services companies play a significant role in providing PESs. According to the results of the research model, the estimated path coefficient is 0.006 and $t = 0.154$. As a result, the individual competencies do not play a significant role in providing PESs.

The experts' educational-extensional competencies who are working in the agricultural consulting, technical, and engineering services companies play a significant role in providing PESs. According to the results of the research model, the estimated path
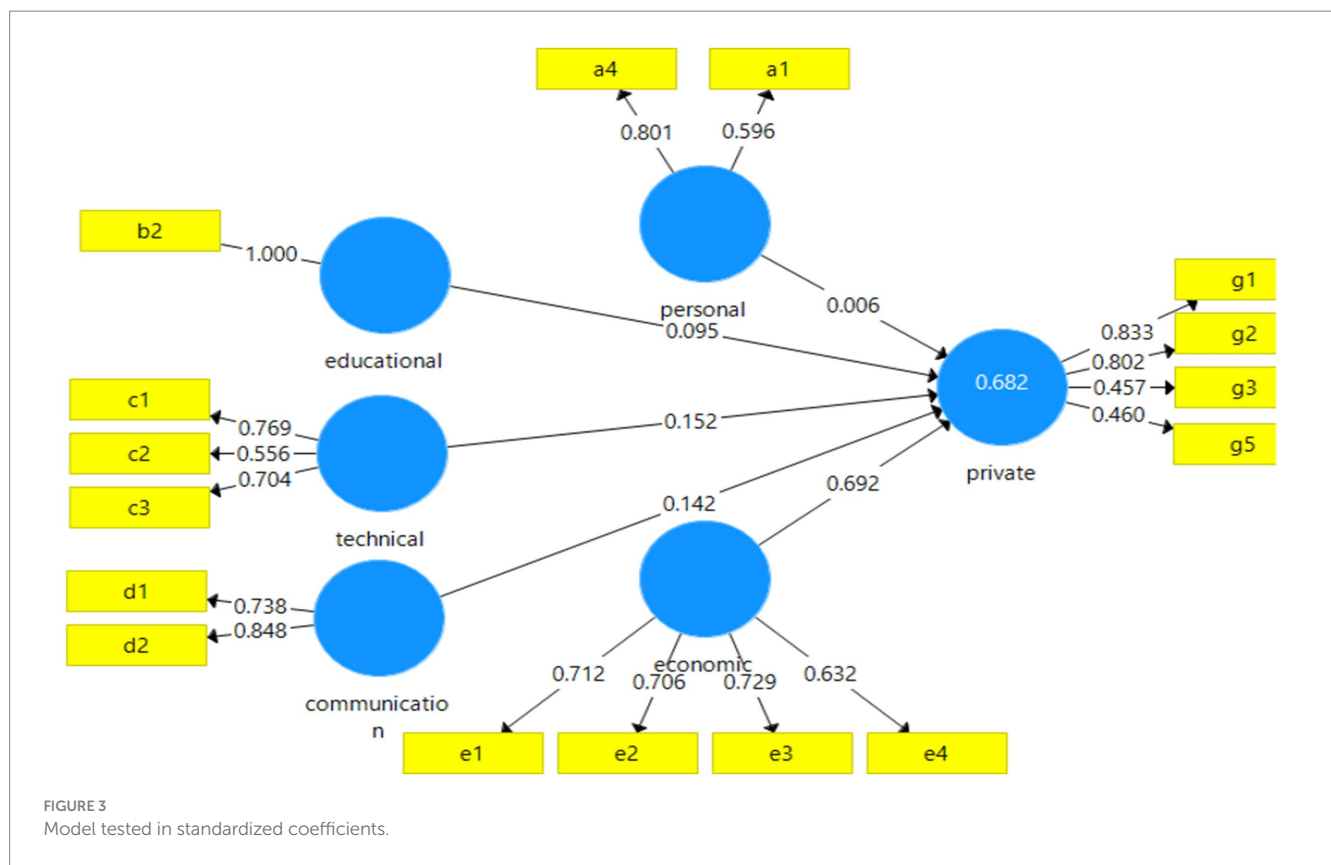
FIGURE 3
Model tested in standardized coefficients.

TABLE 6 Results of the structural model test for testing the research hypotheses.

Hypotheses	Path	Path coefficient	t	Result
H1	Individual ➡ Providing PESs	0.006	0.154	Reject
H2	Educational-extensional ➡ Providing PESs	0.095	1.780	Reject
H3	Technical ➡ Providing PESs	0.152	3.435	Confirm
H4	Communication ➡ Providing PESs	0.142	3.531	Confirm
H5	Economic ➡ Providing PESs	0.692	15.421	Confirm

Source: Research findings. $t \geq 1.96$ is significant.

coefficient is 0.095 and $t = 1.780$. As a result, the educational-extensional competencies do not play a significant role in providing PESs.

The experts' technical competencies who are working in the agricultural consulting, technical, and engineering services companies play a significant role in providing PESs. According to the results of the research model, the estimated path coefficient is 0.152 and $t = 3.435$. As a result, the technical competencies play a positive and significant role in providing PESs.

The experts' communication competencies who are working in the agricultural consulting, technical, and engineering services companies play a significant role in providing PESs. According to the results of the research model, the estimated path coefficient is 0.142 and $t = 3.531$. As a result, the communication competencies play a positive and significant role in providing PESs.

The experts' economic competencies who are working in the agricultural consulting, technical, and engineering services companies play a significant role in providing PESs. According to the results of

the research model, the estimated path coefficient is 0.692 and $t = 15.421$. As a result, the economic competencies play a significant role in providing PESs. As a result, given $R^2 = 068$, it can be said that technical, communication, and economic competencies explain a total of 66% of the changes in providing the PESs. The remaining 34% of the other changes are related to the competencies that have not been examined in this study.

Discussion

In Iran, in order to downsize the government and transfer the affairs to the private sector, since 2007 a non-governmental network of consulting, technical, and agricultural engineering services companies was established and operated as an independent system consisting of human, physical, and communication resources and pursue objectives including: meeting farmers' technical and information needs; providing technical services and

specialized consulting; preparation and distribution of inputs needed by farmers; commercialization of production through reforming management and production process; creating an extensive network of technical services, engineering and consulting; technical supervision on farms to produce healthy products; improving the level of farm management and productivity of the factors of production; assistance in marketing and marketing of agricultural products; assistance in how to finance; reducing the government ownership in the executive activities of the agricultural sector; and creating opportunities for agricultural graduates' employment. Undoubtedly the prerequisite for the fulfillment of the mentioned objectives is that the human resources working in the consulting, technical, and agricultural engineering services companies have the professional competencies needed to provide PESs.

The results did not confirm the first hypothesis, i.e., the required individual competencies do not have a significant effect on providing PESs. Meanwhile, the power of expression and the ability to reason as well as having professional ethics play a significant role in individual competencies and performing educational-extensional missions. This is not consistent with the results of Nurul (2015). Investigating the second hypothesis also indicated that the educational-extensional competencies do not play a significant role in providing PESs. However, the ability to implement and apply educational-extensional methods and techniques plays a significant role in advancing the extension experts' activities. While Diaz et al. (2019) showed that educational-extensional competencies play a significant role in becoming professional and providing better services by the extension experts. Confirming the third hypothesis showed that technical competencies play a significant role in providing private promotion services. Having the required new, valid, and consistent technical knowledge, having the required experience and practical skills, and the ability to implement and advance farm projects can contribute significantly to the formation of technical competencies in extension agents. This result is consistent with the viewpoints of Argabright et al. (2019), Liles et al. (2004), and Murphy and Bruening (2006). Confirmation of the fourth hypothesis showed that communication competencies play a significant role in providing PESs. Human and social communication skills and electronic communication skills play an important role in networking and improving communication skills in extension experts. This result is consistent with the viewpoints of Mulder (2017), Tarekegne et al. (2017), and White and Scanga (2019). Considering the cultural conditions of Iran, to provide services to female farmers as clients, it is suggested to use female experts. Using female experts will attract participation, empower women, improve the situation of rural households, and better carry out private extension programs for rural women. This result is consistent with the opinions of (Niknami and Bandrez, 2013; Khosravi et al., 2014). Confirmation of the fifth hypothesis showed that economic competencies play a significant role in providing PESs. Among the various competencies, this component explained the greatest effect of the predictive power on providing the PESs. The farm management skills, the ability to analyze the cost–benefit of each activity, familiarity with methods of marketing agricultural products, and familiarity with the agricultural insurance laws and financing methods can play a significant role in the formation of economic competencies in the extension agents of the companies. This result is consistent with the views of Gray (2011).

Conclusion

According to the research results, the respondents' perception of the experts' professional competencies in the individual dimension who are working in the consulting, technical, and agricultural engineering services companies in the status quo was mainly at a low to moderate level, while the highest level of the required competency was expressed to be high and very high. In the educational-extensional dimension, the competency level was reported to be low to moderate in the status quo, while the required competency in this dimension was expressed to be high and very high. In the technical dimension, the experts' existing competency was higher than the average, however, the required competency in this dimension was reported to be high and very high. In the communication dimension, the experts' level of existing competencies was mentioned to be high, but the level of the required competency in this dimension was expressed to be higher than the average. In the economic dimension, the respondents' existing competency was mentioned to be at a moderate to high level, while the level of the required competency in this dimension was reported to be high and very high. In the context of private extension, the level of the current services was evaluated at a weak to average level, while experts believed that the level of PESs should reach a very good to excellent level. In fact, the respondents expressed that there is a lot of need for the enhancement of these competencies and providing PESs in these companies. This result indicates that experts found that professional competencies are a multidimensional and interdisciplinary phenomenon and lack of professional competencies leads to inefficiency and entropy in achieving the company's goals. Therefore, creating these professional competencies according to the experts' own wishes will empower them, guarantee quality in providing services, benefit these companies from competent human resources, and upgrade PESs.

According to the results of this study, in Iran, due to the limited budget and resources required for government extension, the diverse needs of commercial farmers, the inadequacy of government services for small-scale farmers, and the existence of demand from some farmers, the development of Agricultural Consulting, Technical, and Engineering Services Companies are recommended to provide and expand private extension services. The private extension requires skilled and reliable experts. ACTESCs must clearly and accurately state the list of required competencies when hiring experts. The results of this study determined the required competencies of company experts in three groups including technical, communication, and economic skills. Serious attention to these three factors will affect the level of competencies of experts. Therefore, ACTESCs should provide conditions for continuous training and gaining the necessary experience for experts in these cases to improve their job performance. Also, ACTESCs from experts should make professional evaluations and based on the results, they should predict the necessary training programs and opportunities. According to the survey, the lack of research on the effects of ACTESCs on the provision of private extension of sustainable and organic agriculture is evident. Therefore, it is suggested to carry out wider studies regarding the required competencies of the experts of these

companies according to the new missions and expectations. Also, identify the obstacles facing ACTESCs to provide private extension services.

Limitations and future research

Our study on the professional competencies Model required by experts of ACTESCs to provide private extension services has several limitations that warrant consideration. The first and foremost is the issue of generalizability. Our research was geographically confined to ACTESCs in Iran., and caution must be exercised when extending the findings to other cultural or educational contexts. The distinct characteristics of the Iran extension educational system, sociocultural factors, and technology infrastructure might limit the study's external validity, emphasizing the need for additional research in diverse settings to ascertain the broader applicability of our results. This study also has some other limitations. One can mention the lack of similar research conducted in Tehran province, the use of a questionnaire as the research tool, the possibility of making mistakes by the respondents when answering the questions, the cross-sectional nature of the research, and the inability to fully control all unwanted variables. Recognizing these limitations underscores the need for caution when interpreting our results. Future research endeavors could address these constraints by employing more diverse samples, incorporating longitudinal designs, and utilizing a mix of assessment methods to provide a more comprehensive understanding of the professional competencies Model required by experts of ACTESCs to provide PESs.

Future implications

The findings of this study provide insight so that the ACTESCs can be designed around forming a professional competency-based model for fostering PESs. This professional competency model for ACTESCs adds to the overall theoretical body of literature focused on PESs. The study utilized Structural Equation Modeling to capture professional competencies that need to be in ACTESCs in Iran. Since it is the first study reported on the professional competencies Model required by experts of ACTESCs to provide private extension services, the findings should be replicated with additional samples to establish firm conclusions. Of course, the study is restricted to particular variables, while other factors might be involved in the strengthening or reduction of Professional Competencies.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Author contributions

MN: Methodology, Supervision, Validation, Writing – review & editing. SF: Conceptualization, Data curation, Formal analysis, Investigation, Resources, Software, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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