

Rice Seedling Nursery: The new approach to develop local small enterprises

Vivero de Plántulas de Arroz: un nuevo enfoque para desarrollar pequeñas empresas locales

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ABSTRACT

Farmland fragmentation is a significant factor influencing the sustainability of crop production. In this respect, the development of rice seedling nursery centers (RSNC) is an underlying and key strategy to keep the sustainability of rice production in small paddies. The development of RSNCs aims to reduce production costs, facilitate the seedling nursery process, and contribute to producing healthy and rigorous rice seedlings that are appropriate to be planted by transplanters. The present research explored the factors influencing the development of these support centers in Guilan province, Iran using an interview and survey methodology. The statistical population was composed of 34 executives of RSNCs across Guilan province. Data were collected by in-depth face-to-face interviews with the research panel using a self-design questionnaire. They were then analyzed statistically. The final results show that the managerial-policymaking, knowledge-skill, and economic factors were the most to least important factors influencing the development of RSNCs in the study site. So, to ensure the sustainability of rice production, especially in small-scale paddies, the organizations in charge of rice production must consider 'developing and enforcing efficient insurance regulations'. 'Technically supporting RSNCs via the production of high-quality paddy seeds with optimal purity,' 'enhancing the technical-skill knowledge of RSNC executives via holding technical training courses,' 'forcing RSNCs to use the technical supervision of experts', and 'supporting the suppliers of high-quality seedling boxes and substrate'.

Keywords: paddy, rice seedling, paddy farming, transplanting, greenhouse seedling nursery.

RESUMEN

La fragmentación (o parcelación) de las tierras de cultivo es un factor importante que influye en la sostenibilidad de la producción de cultivos. En este sentido, el desarrollo de centros de viveros de plántulas de arroz (CVPA) es una estrategia subyacente y clave para mantener la sostenibilidad de la producción de arroz en pequeños arrozales. El desarrollo de CVPA tiene como objetivo reducir los costos de producción, facilitar el proceso de vivero de plántulas y contribuir a producir arroces sanos y resistentes que sean apropiados para ser plantados por el equipo de trasplantadores. Como tal, la presente investigación exploró los factores que influyen en el desarrollo de estos centros de apoyo en la provincia de Guilan, Irán, utilizando un Metodología de entrevistas y encuestas. La población estadística estuvo compuesta por 34 ejecutivos de CVPA en toda la provincia de Guilan. Los datos se recopilaron mediante entrevistas presenciales en profundidad con el panel de investigación utilizando un cuestionario de diseño propio, luego se analizaron estadísticamente. Los resultados finales muestran que los factores administrativos y de formulación de políticas, conocimientos y habilidades y factores económicos fueron los factores de mayor a menor importancia que influyeron en el desarrollo de CVPA en el sitio de estudio. Por lo tanto, para garantizar la sostenibilidad de la producción de arroz, especialmente en arrozales a pequeña escala, es necesario que las organizaciones a cargo de la producción de arroz consideren "desarrollar y hacer cumplir regulaciones de seguros eficientes", "apoyar técnicamente a los CVPA a través de la producción de alta calidad semillas de arroz con una pureza óptima", "mejorar el conocimiento de habilidades técnicas de los ejecutivos del CVPA mediante la realización de cursos de capacitación técnica", "obligar a los CVPA a utilizar la supervisión técnica de expertos" y "apoyar a los proveedores de cajas de plántulas y sustrato de alta calidad".

Palabras clave: arroz, plántulas de arroz, cultivo de arroz, trasplante, vivero de plántulas en invernadero.

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Introduction

Rice is the staple food of over half of the world's population and most people in Asia, Africa, and parts of Europe, America, and India (Sarwar *et al.*, 2014). This grain is the main component of the food diet of people in the northern provinces of Iran and is the second major food of Iran after wheat (Heidari Kamalabadi *et al.*, 2018). Rice production plays a fundamental role in the rural, or even the urban, economy of rice-producing regions so that it has a significant share in the agricultural gross domestic product in many Asian countries (Sarwar *et al.*, 2014).

A major factor hindering agricultural development is the small size of farmland parcels (Raphael and Rejoice, 2017). Over the history and the consecutive generations of farmers, farmlands in many parts of the world have growingly been subject to fragmentation due to inheritance laws, land management policies, and sometimes, natural factors (Luo and Timothy, 2017). Smallholding and dispersion of farmlands are among the main challenges of agricultural development and the improved agricultural productivity (Asiama *et al.*, 2019). It should, however, be noted that over 70 percent of the global food is produced in small-scale farms (< 2 ha), close to 90% of which are located in Asia, whereas farm size is shrinking in most countries (Fan and Chan-Kang, 2005; Huang and Ding, 2016). The mean farm size has been reported to be < 0.5 ha in China, Indonesia, and Red River Delta in Vietnam, < 1 ha in other parts of Vietnam, nearly 1 ha in Japan, and 1-2 ha in other Asian countries (Yagi, 2012). In Iran, the mean size of paddy fields is reportedly 0.9 ha (Statistical Center of Iran, 2018).

The research literature has extensively discussed the relationship between farm size and production rate. In his classic work, *Small is Beautiful*, published in 1974, E.F. Schumacher argues that farm size has a reverse relationship with production rate, which was then advocated by many researchers (Byerlee and Deininger, 2013). On the contrary, various research has shown that "small is not necessarily beautiful," and farm size has a directly correlates with production (Fan and Chan-Kang, 2005; Raphael and Rejoice, 2017).

The small size of farmland parcels causes the growing migration of labor, the youth's reluctance to work in the agricultural sector, the reduction of crop yields, and consequently, a decline in income (Rezaei and Ghahramani, 2017). Similarly, paddy growing regions of Iran have undergone radical

transformations in their agricultural structure in recent years. Crop imports, land fragmentation by the law of inheritance, the lack of support for smallholders to provide them with proper housing, and as a result, the allocation of a part of the farmland for housing have been some variables with profound impacts on land-use changes (Allahyari *et al.*, 2013). Land fragmentation has, thus, been a source of agronomic and social problems in rural areas. A factor involved in agricultural mechanization development in small paddies of Iran is the inability of smallholders to afford agricultural machinery, so the farmers have had no choice but to growingly rely on agricultural mechanization service centers, especially given the increasing unavailability of adequate human resources. The same trend has also been reported in the leading rice-producing countries, e.g., China and India (Huang and Ding, 2016).

The expansion of agricultural support centers such as mechanization service centers has facilitated the access of small rice farmers to support services and has reduced the costs of rice production and labor and capital requirement; as a result, social and economic sustainability of crop production in small-scale farms has been improved (Yousefzadeh and Firouzi, 2016). Among crops, rice is strongly dependent on labor. Preparing the nursery and growing rice seedlings are among the labor-intensive and time-consuming rice production processes (Dhital, 2017). In addition, seedling production is not economical given the costs of purchasing seedling boxes and preparing good soil for small paddies. Therefore, the allocation of the production of healthy and vigorous rice seedlings to service companies, called rice seedling nursery centers (RSNCs), is a supporting action to maintain the production sustainability of this strategic crop in small-scale paddies (Chiu *et al.*, 1999). These centers, which are specialized in rice seedling production, can reduce the final cost of crop production and production risks. Additionally, incorrect management of rice seedling production and, consequently, the production of weak seedlings cause paddy farmers to incur huge losses every year (Sarwar *et al.*, 2014).

RSNCs are technical agricultural centers that provide farmers with seedling production and mechanized operation services. These centers are organized within private companies or cooperatives and operate at two scales. At the small scale, rice seedlings are produced and supplied for mechanized planting, and at the large scale, they

provide mechanized services for tillage, planting, cultivating, and harvesting. The establishment of greenhouse rice seedling production centers, aimed to supply healthy and robust seedlings and perform mechanized planting of rice, was first proposed in Guilan province, northern Iran, in 2011. The rationale for this proposal was to provide an approach to sustain rice production on small-scale paddies. Presently, RSNCs in this province are responsible for producing rice seedlings for the farmers who intend to use mechanized planting. In this respect, these centers use specialized equipment. Figure 1 depicts the process of rice seedling production in these specialized paddy farming service centers.

Given the law of inheritance and unwanted fragmentation of paddies in Guilan province, the need is growing for the support services of these firms to sustain the cultivation of paddy as the staple food of the people in coastal areas of the Caspian Sea and the supplier of a part of people's needs in Iran. Evidence, however, shows that there are a total of 34 rice seedling production centers

in this province, some of which are semi-active for various reasons. So, for the sustainability of rice production in small-scale fields, it is necessary to investigate the effective factors underpinning the sustainable development of RSNCs scientifically. A literature review shows that no research has ever been conducted on identifying these factors. Thus, the present study aims to identify the managerial-policy-making, knowledge-skill, and economic factors determining the development of RSNCs in Guilan province. The results can contribute to regional and macro planning.

Materials and Methods

Selecting Site and Sample

The present study was conducted to explore the factors influencing the development of rice seedling nursery centers (RSNCs) from the perspective of their executives in Guilan province, Iran. Figure 2 represents the study site in northern Iran.

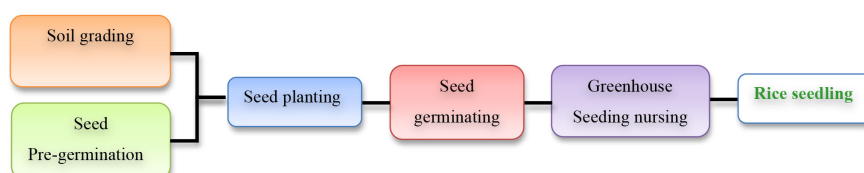


Figure 1. The process of seedling production in a rice seedling nursery center.

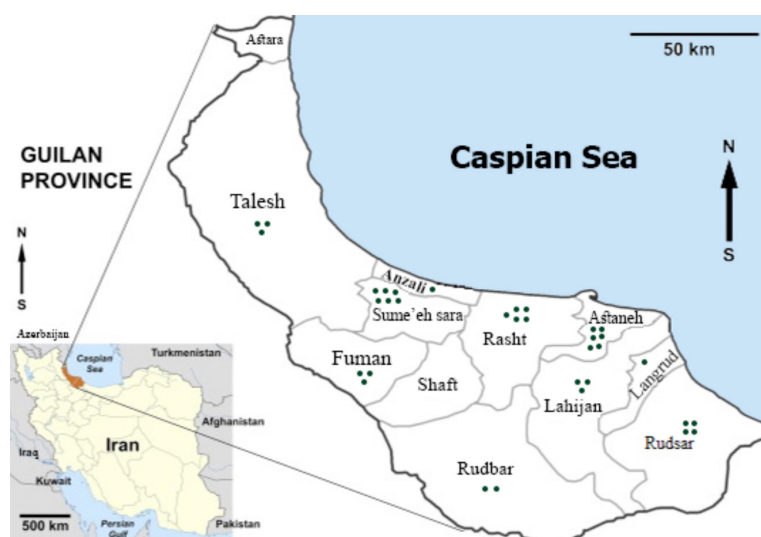


Figure 2. The study site, including the number of rice seedling nursery centers (RSNC) in different counties that participated in the research.

The specific objectives of the research are as follows:

- a. Studying the general features of RSNCs in the study site.
- b. Identifying managerial-policy-making, knowledge-skill, and economic factors influencing the development of RSNCs in Guilan province.
- c. Ranking the factors influencing the development of RSNCs.

The research is a quantitative study regarding the dominant paradigm as data were collected with semi-structured interviews and questionnaires. It is an applied study in terms of goal and variable control. Finally, it is a field study in terms of the data collection method. The questionnaire was filled out preferably through face-to-face interviews with the RSNC executives.

According to the statistics of the Jihad-e Agriculture Organization of Guilan province, there are 34 RSNCs in this province. So, based on Figure 2, the census sampling technique was used to determine of 34 centers. Figure 2 presents the number of RSNCs in different counties of the study site which participated in the research.

1.2. Data collection

In the first phase, the factors influencing the development of RSNCs were solicited by asking an open-ended question: "What factors do you think are affecting the development of rice seedling nursery centers across Guilan province?" The research panel in this phase was composed of five expert RSNC executives and three experienced faculty members.

However, there is a consensus that qualitative inquirers need to demonstrate credible studies. To this end, several authors identify common procedures for establishing validity in qualitative projects (e.g., Lincoln and Guba, 1985). Qualitative researchers routinely employ member checking, triangulation, thick description, peer reviews, and external audits. Researchers engage in one or more of these procedures and report results in their investigations (Creswell and Miller, 2000). In this case, we visited nursery centers, crosschecking the result by other managers as triangulation and repeating the results in several cases. Moreover, the factors recognized at interviews were crosschecked by experts and university members.

The final questionnaire was developed by reviewing the literature in a library study and the content analysis of the collected answers. The questionnaire was composed of the factors influencing the development of RSNCs, including managerial-policy-making factors, knowledge and skill factors, and economic factors within 26 items scored on a five-point Likert scale (1 = very low, 2 = low, 3 = relatively, 4 = high, and 5 = very high).

1.3. Data Analysis

The demographic and skill-related features of the RSNC executives and the specifications of their organizations were categorized by the statistics of mean, frequency, and frequency percentage. The analysis of the questionnaire data to measure these factors was also performed in this software package using the statistics of mean, standard deviation, and variation ratio. The variation ratio was used to check the data distribution on a nominal and ordinal scale. In other words, the ratio is used to examine the homogeneity or heterogeneity of the responses provided by the participants. This index in research with qualitative variables expresses which variable is agreed upon to a greater extent. It is obtained from the following equation (Pansalan and Uriarte, 1987):

$$VR = 1 - \frac{f_{\max}}{f_{\text{total}}} \quad (1)$$

in which

VR = variation ratio

f_{\max} = maximum frequency in the responses

f_{total} = total frequency (total number of participants)

The research employed Kendall's W coefficient of concordance to determine the consensus of the research group (RSNC executives). It is a scale to determine the agreement of several rater groups related to N objects/individuals. By this statistic, one can find the rank correlation between K sets of ranks. If we suppose that the i^{th} factor is ranked r_{ij} by the j^{th} individual of the research panel, assuming m factors and n members in the research panel, the total rank of this factor will be calculated by Eq. (2) as follows:

$$R_i = \sum_{j=1}^m R_{i,j} \quad (2)$$

The mean of this total ranks is, then, determined by

$$\bar{R} = \frac{1}{n} \sum_{i=1}^n R_i \quad (3)$$

In this case, the sum of squared deviations from means is defined as below:

$$S = \sum_{i=1}^n (R_i - \bar{R})^2 \quad (4)$$

So, the scale of Kendall's W test is calculated as below:

$$W = \frac{12S}{m^2(n^3 - n)} \quad (5)$$

The value of this statistic ranges from 0 to 1. A zero value means there is no agreement among the participants, while 1 means complete unanimity among them. If Kendall's W is significant at the 1% or 5% probability level, the participants' opinions are unanimous.

The Friedman test was used for the group comparison of the factors (managerial-policymaking, knowledge-skill, and economic). The Friedman test is a statistical test used to compare several groups and rank them by means. This test is non-parametric and equivalent to the variance analysis with repeated or intra-group measures among parametric tests. The Friedman test compares the means of ranks among K variables or groups. For this test, data are arranged in a table of K rows and N columns in SPSS. Rows represent participants (here is the sample), and columns represent different situations (here are the factors). SPSS first calculates chi-squared (χ^2) by Eq. (6):

$$\chi_r^2 = \frac{12}{NK(K+1)} \sum R_j^2 - 3N(K-1) \quad (6)$$

in which

K = the number of samples.

N = the number of factors.

R_j^2 = the square of ranks in each group.

Based on the results of this test, the mean rank of each variable can be compared with the mean rank of other variables or groups. So, the groups can be easily ranked.

Results

Demographic and skill-related features of RSNC executives and the specifications of their organizations

Based on the results in Table 1, less than 6% of the participant executives were younger than 30 years old, and the majority of them (85%) were in the age range of 30-50 years. Regarding the educational level, 41% had a bachelor's degree, and about 3% had a degree lower than a diploma. Also, the educational field of over half of the executives (64.7%) was related to their activity field. About a quarter of the executives (24%) had participated in relevant practical training courses. Almost 41% of the executives had 3-5 years of experience in this field, and about 32% had 5-7 years of experience. The production capacity of 20.59% of the RSNCs was lower than 10,000 boxes per year, and about 58% had a capacity of 10,000-30,000 boxes per year. The maximum annual service providing a level of 47% of the RSNCs was for an area of 15-50 ha/year, and only 8% could serve an area of 150-200 ha/year.

Results of the first phase

In the first phase of the research, 25 factors influencing the development of RSNCs in Guilan province were identified. Following consultation with agricultural management and mechanization experts, these factors were categorized into three groups: managerial-policymaking, knowledge-skill, and economic (Figure 3).

Factors affecting the development of RSNCs

This section presents the results for the managerial-policymaking, knowledge-skill, and economic factors separately.

Managerial-policymaking factors influencing RSNC development

According to the ranking of the managerial-policymaking factors influencing RSNC development (Table 2), 16 factors were derived from responses provided by the RSNC executives to the question of the first phase. These factors were ranked by the consensus of the respondents and using the variation

Table 1. Demographic and skill-related characteristics of the executives of rice seedling nursery centers and the specifications of the organization managed by them.

Characteristics	Classification	Frequency	Percentage
Age of manager (year)	40-30	17	50.0
	50-40	12	35.3
	60-50	3	8.8
Level of education	High school	1	2.9
	Diploma	13	38.2
	Associate	2	5.9
	Masters	14	41.2
	Bachelor's degree	3	8.8
Related education	P.H.D	1	2.9
	yes	12	35.3
Participate in applied courses	no	22	64.7
	yes	8	23.5
Experience (years)	no	26	76.4
	1-3	9	26.4
	3-5	14	41.1
Production Capacity per Year	5-7	11	32.3
	10000-3000	7	20.5
	30000-10000	20	58.8
Cultivated area (ha)	50000-30000	7	20.5
	50-15	16	47.0
	100-50	10	29.4
	150-100	5	14.7
	200-150	2	8.8

Table 2. Statistical comparison of managerial-policymaking factors influencing the development of rice seedling nursery centers in Guilan province, Northern Iran.

Factors	Mean	SD	VR
Enhancing insurance coverage to cover possible damages	4.91	0.28	0.09
Managing the supply of highly pure seeds	4.79	0.47	0.18
Specifically supporting RSNCs for the development of complementary services	3.61	0.73	0.32
Efforts of institutions in charge of improving the degree of mechanization of rice seedlings	3.64	0.73	0.38
Equipping and renovating paddy fields	3.58	0.82	0.41
Monitoring and controlling the performance of RSNCs	3.38	1.1	0.41
Reducing the diversity of rice cultivars to avoid interferences during the production process	4.32	1.00	0.44
Devising a regional macro-plan to develop RSNCs	3.11	0.84	0.44
Establishing and strengthening rice seedling producers foundations and organizations	4.29	0.71	0.5
Supporting related research to improve productivity and reduce the risk of rice seedling production	2.64	0.77	0.53
Praising RSNCs with optimal performance	2.67	0.91	0.59
Pricing rice seedlings by the organizations in charge in a timely manner	2.32	1.00	0.59
Barriers to obtaining bank facilities	3.73	1.08	0.62
Planning and supporting the multi-purpose use of RSNCs	2.85	0.98	0.62
Access to skilled and temporary labor during the operation of RSNCs	3.20	1.40	0.71
Administrative barriers related to obtaining licenses and opening an RSNC	2.50	1.33	0.71
Coefficient of Kendall's W	0.17**		

** Significant at the $P < 0.01$ level.

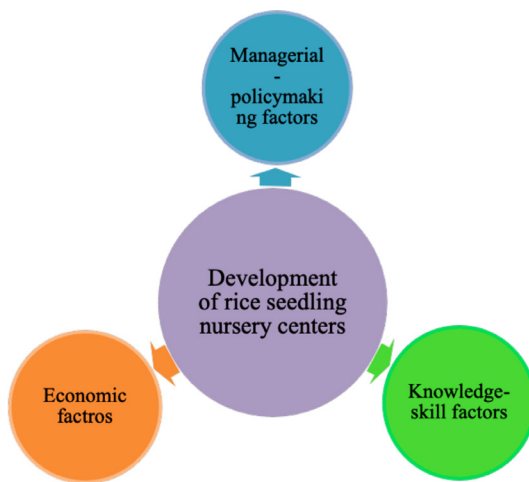


Figure 3. The categorization of the first phase results as to the factors influencing the development of rice seedling nursery centers in Guilan province, Northern Iran.

ratio (VR). Accordingly, the factor ‘enhancing insurance coverage to cover possible damages to RSNCs’ with a mean score of 4.91 and a VR of 0.09 was the most important managerial-policy-making factor determining the RSNCs development. The factor ‘managing the supply of highly pure seeds’ by the support of the responsible organizations and informing the farmers about the advantages of this type of rice seedlings was ranked the second most important managerial-policy-making factor with a mean score of 4.79 and a VR of 0.18. The third most important factor was ‘specifically supporting RSNCs for the development of complementary services (rice planting mechanization services, especially seedling planning)’ with a mean score of 3.61 and a VR of 0.32. The last rank was devoted to

‘administrative barriers related to obtaining licenses and opening an RSNC’ with a mean score of 2.5 and a VR of 0.71.

Knowledge-skill factors influencing RSNC development

Results in Table 3 indicate that ‘enhancing technical and agronomical knowledge of RSNC managers’ was the most important knowledge-skill factor influencing the development of RSNCs in Guilan province with a mean score of 3.79 and a VR of 0.41. The second most significant factor was ‘relevant education and experience in RSNCs’ with a mean consensus score of 3.76 and a VR of 0.44. ‘Enhancing technical and agronomical knowledge of agriculture experts’ was the next key factor influencing RSNC development, with a mean score of 3.17 and a VR of 0.56.

Economic factors influencing RSNC development

According to the results for the ranking of economic factors that influence the development of RSNCs in Guilan province (Table 4), ‘costs of high-quality seedling boxes’ with a mean score of 2.35 and a VR of 0.53 was the most influential economic factor of RSNC development from the perspective of RSNC executives. The second and third main influential factors were ‘costs of seedbed soil preparation’ with a mean consensus score of 3.11 and a VR of 0.65 and ‘costs of rice seedling nursery equipment and machinery’ with a mean score of 3.76 and a VR of 0.68, respectively. The participants assigned the last rank to ‘costs of energy

Table 3. The statistical comparison of the knowledge-skill factors influencing the development of rice seedling nursery centers in Guilan province, Northern Iran.

Factors	Mean	SD	VR
Enhancing technical and agronomical knowledge of RSNC managers	3.79	0.68	0.41
Relevant education and experience in RSNCs	3.76	0.81	0.44
Enhancing technical and agronomical knowledge of agriculture experts	3.17	0.90	0.56
Improving the technical knowledge of craftsmen in Guilan province	3.00	1.01	0.65
Promoting the effect of the advantages of rice seedling banks	3.73	1.16	0.68
Coefficient of Kendall's W	0.55**		

** : Significant at the $p < 0.01$ level.

Table 4. The statistical comparison of the economic factors influencing the development of rice seedling nursery centers in Guilan province, Northern Iran.

Factors	Mean	SD	VR
Costs of high-quality seedling boxes	2.35	1.12	0.53
Costs of seedbed soil preparation	3.11	1.38	0.65
Costs of rice seedling nursery equipment and machinery	3.76	0.95	0.68
Costs of energy inputs, e.g. electricity and fossil fuel	3.38	1.04	0.68
Coefficient of Kendall's W	0.19**		

** : Significant at the $p < 0.01$ level.

inputs, e.g., electricity and fossil fuel' with a means core of 3.38 and a VR of 0.68.

Comparison of the factors influencing RSNC development

Table 5 presents the final comparison of the influential factors that are in the development of RSNCs in Guilan province. Based on the Friedman test, the managerial-policymaking factors were ranked first among the influential factors. The second rank was assigned to the knowledge-skill factors and the third to the economic factors.

Discussion

'Enhancing insurance coverage to cover possible damages to RSNCs' (mean score = 4.91; VR = 0.09) was selected by the RSNC executives as the most significant managerial-policymaking factor underpinning the development of RSNCs in Guilan province. This VR and mean score implies the importance of this factor, among other factors. Agricultural activities are constantly exposed to many dangers due to their high reliance on nature and the dependence of the agricultural sector on climatic and environmental parameters (Horowitz and Lichtenberg, 1993). The producers of this sector are always facing the damages caused by climate change, pests, and diseases. Their economic activity is exposed to severe risks, and they are always worried about repaying various production expenses and even paying the necessary living expenses. Rice seedlings are very sensitive to environmental stresses, pests, and diseases during their growth period (Sarangi *et al.*, 2015). Thus, insurance of agricultural activities has always been considered and emphasized as a helpful solution among various supportive policies to deal with these risks and

enhance production (Castillo *et al.*, 2016). It is, therefore, necessary for the officials to consider the extension of insurance coverage to RSNCs as a specific managerial-policymaking strategy.

'Managing the supply of highly pure seeds' was ranked the second significant managerial-policymaking factor influencing the development of RSNCs with a mean score of 4.79 and a VR of 0.18. Seed selection is the fundamental step for good cultivation, and crop yield improvement is directly related to seed selection. So, selecting a good seed is crucial for enhancing yield per unit area. Seed quality comprises various factors, including high germ inability, cultivar purity, free of insects, mechanical damages, or weed seeds. When selecting seeds, factors like maturing time, yield, resistance to diseases and insects, seasonal responses, and sowing date can be considered (Liu *et al.*, 2017). High germinability and low impurity of paddy seeds are directly influential on the production of healthy seedlings and reduction of seedling production cost so that seeds with these qualities reduce losses and increase crop yield, thereby decreasing costs and increasing profitability of rice seedling nursery. This process, consequently, enhances the performance and sustainability of these agricultural support units.

'Specifically supporting RSNCs for the development of complementary services, especially rice planting mechanization services' with a mean score of 3.61 and a VR of 0.32 was ranked the third significant managerial-policymaking factor underpinning the development of RSNCs. Faster planting and the chance to take care of other cultivation operations, less work hardness, saving in time, higher crop yields, higher labor productivity, and lower production costs are among the advantages of mechanized crop planting systems (Almassi *et al.*, 2006). The development of mechanized rice planting enhances productivity, reduces wastage, and saves water use, time, and production costs. It seems that

Table 5. Final ranking of the factors influencing RSNC development in Guilan province, Northern Iran.

Factors		Rank
Managerial-policy-making factors		1
Knowledge-skill factors		2
Economic factors		3
$\alpha = 0.000$	$df = 2$	$\chi^2 = 59.471$
		$N = 34$

coordinating mechanization service companies and rice nurseries in different parts of Guilan province can be another approach consistent with the final goal of the managerial-policy-making factor and can be considered specifically by the Jihad-e Agriculture Organization of Guilan province.

'Efforts of institutions in charge of improving the degree of mechanization of rice seedlings' was ranked the fourth significant managerial-policy-making factor of the development of RSNCs in Guilan province with a mean score of 3.64 and a VR of 0.38. As was already mentioned, the rice seedling market as the output of RSNCs depends on the development of rice seedling planting mechanization. The realization of this goal requires specific attention to supplying infrastructure of mechanized rice planting, fostering trust by providing after-sale services for rice planting machinery, attempts to defragment paddies, and adoption of policies for guaranteed purchase of rice at a price consistent with the rate of inflation (Yousefzadeh and Firouzi, 2016). In addition, enhancing the mechanization degree and the expansion of agricultural machinery used in general and transplanters, in particular, can directly influence the development of RSNCs as a supplier of healthy rice seedlings required for the mechanized planting of rice.

Table 3 shows that 'enhancing technical and agronomical knowledge of RSNC managers' was ranked the most important knowledge-skill factor affecting the development of RSNCs with a mean score of 3.79 and a VR of 0.41. A research study on small-sized agricultural enterprises in the US (Tennessee and North Carolina) reports that training, extension, and research programs are necessary for those who launch their enterprises. The lack of experience and technical knowledge for the adoption of innovative activities within the agricultural enterprises are reported as the main shortages of those involved because knowledge and skill enhance production

and income of the enterprises, which is, in turn, a significant factor for the persistence of these enterprises (Muhammad *et al.*, 2009).

'Relevant education and experience in RSNCs' was placed in the second rank of the knowledge-skill factors influencing RSNC development with a mean consensus score of 3.76 and a VR of 0.44. This result implies the lack of interaction between educational institutions and the executive sector like the previous item. It is evident from the results that 65% of the participants, i.e., almost one-third of the RSNC executives, have an irrelevant educational background and 67% have less than five years of experience. This finding can be attributed to the fact that this industry started in Guilan province seven years ago, and it does not have a long history, so the lack of relevant experience is normal, but the lack of technical knowledge shows the need for plans to provide RSNC executives with technical training. In a study on factors influencing the development of entrepreneurship in agricultural cooperatives, Rajaei *et al.* (2011) found a significant relationship between the entrepreneurial level of the CEO of the agricultural enterprises and the educational level of the board members. Also, Strauss *et al.* (1991) concluded that agricultural training could influence technology adoption positively. This practice means that investment in enhancing the knowledge and skill of extension agents and trainers with the aim of training development can directly and significantly impact on enhancing farmers' agricultural activities (Onphanhdala, 2009).

According to Table 4, 'costs of high-quality seedling boxes' with a mean score of 2.35 and a VR of 0.53 and 'costs of seedbed soil preparation' with a mean score of 3.11 and a VR of 0.65 were ranked the first and second most important economic factors affecting RSNC development, respectively. These results indicate that production costs, most of which are related to input prices, are the most influential economic factor in developing of RSNCs. Demand for rice seedling, production scale, and production costs are also factors that RSNC executives should consider before initiating a cropping season (Chiu *et al.*, 1999). These factors mean that if input costs, especially key costs such as the cost of seedling box preparation, soil preparation, and equipment, are managed soundly, the way to developing this industry will be paved. It is noteworthy that the respondents were the executives of RSNCs and profit maximization is a goal of all production systems, so sound management of input costs will allow profit

improvement, which will motivate investment in the agricultural industry.

The final step of the data analysis indicated that the participants ranked the managerial-policy-making factors over the knowledge-skill and economic factors in influencing the development of RSNCs in the study site. This data reflects the need to consider these factors, especially insurance coverage and proper seed supply management, which can, in turn, minimize production risks and meet the economic outcomes expected by the executives of these support centers.

Also, the knowledge-skill factors were ranked higher than the economic factors in affecting the development of RSNCs. It should be remembered that, like the managerial-policy-making factors, these factors manifest themselves in an increase in economic productivity. Thus, issues like educational-extension and technical-agronomical issues should be paid attention to when dealing with rice production (Onphanhdala, 2009).

Conclusion

Today, small-scale farming is a challenge for agricultural sustainability. In this regard, the rice seedling nursery centers (RSNC) play a crucial role in the sustainability of small-scale paddy farming. According to the study results, they need to solve

several problems for their development, some of which are fundamental problems that high-level policy-makers must address. Institutional supports, such as specific insurance supports, are among the key factors that should be on the agenda of governmental policy-makers. The need for boosting the technical and agronomical knowledge of RSNC managers and planning for reducing production costs are also among the problems that require proper policy-making. In such a situation, where the private sector is developing most agricultural support service centers, policy-makers should pay more attention to this subject. Therefore, the following policy measures are recommended to support the development of RSNC centers: Focus on managerial and financial policies, like codifying and implementing specific insurance supports, planning for setting up the specific educational courses for RSNC managers, and allocating particular supporting loans and subsidies for setting up, operation and development of rice seed nursery centers.

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