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Affective Factors in Commercialization of Nanotechnology in Iran's Agricultural Sector

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ABSTRACT

The major purpose of this study was to examine the factors influencing the commercialization of nanotechnology in agricultural sector of Iran. The methodology used in this study involved a combination of descriptive and quantitative research. The total population for this study was 250 researchers in the field of nanotechnology in agriculture. Based on the perception of the respondents, about 65.75% of total common variance is explained by infrastructural, economic, informative, financial and cultural factors, where the majority of it has been explained by the infrastructural factor (24.29%).

Keywords: Nanotechnology, Commercialization, Agriculture, Affective factors, Iran.

INTRODUCTION

Today, generating knowledge along with its successful distribution and application has been recognized as a global issue. The commercialization of product and process innovations has become a necessity for better utilizing and transforming knowledge in many fields [1].

Nano technology as a new and emerging technology along with the biotechnology and information technology will undoubtedly be cover a spectrum of issues related to agriculture section.

Agriculture sector is no exception and the process of commercialization of new technologies such as nanotechnology is a fundamental basis for development of agriculture in developing countries.

Commercialization is a process which transforms knowledge obtained in universities and research organizations to products of supply in the market or industrial processes. This process necessitates the serious cooperation of higher education centers and research organizations affiliated to the state, agricultural and industrial companies, financial and investing organizations, entrepreneurs and scientific scholars [2].

Hosseini and Esmaeeli in their research entitled, determining challenges in commercializing nanotechnology in Iran's agricultural sector", have come to the this conclusion that main challenges related to development of nanotechnology in agriculture sector are weakness in infrastructures, production, business, management, economics, technical aspects, social issues, culture and research [3].

Ronald in his research reported that commercialization of nanotechnology is a revolution in products and services in society. Nevertheless, there exist barriers in addition to the global competition. These barriers include the gap between academic and applied researchers; the gap between the initial research budget and applied research, uncertainty of the Environmental Protection Organization's regulation potentials and threats of new scientific results in not being transformed to a sustainable enterprise [4].

Morgenthaler indicated that the reasons for slow outcomes of investing in nano-research has to due with this fact that funding for research in this field has mainly come from public sector and this has made the commercialization process very slow [5].

The results of study by Saxton show that the quick advancement of nanotechnology commercialization has provoked considerations regarding more attention to the health risks and safety related to nanotechnology. In fact, evaluation of the life cycle is considered a complete outlook on the environmental and sanitary effects and a necessity for a secure and prominent nanotechnology commercialization [6].

Scheufele and Lewenstein referred to issue of conceptual and cognitive beliefs, which are usually created by means of media, as an important factor in changing the perception of stakeholders about dangers and benefits and support for more funding in research and commercialization of nanotechnology [7].

Nanotechnology is one of the issues much debated in Iran today. The main reason is the widespread application of this technology in industries of various countries, while these countries have made large investments in this field. A number of these applications have reached the commercial stage and various others are in the process of commercialization. Thus, presence in this realm is inevitable for countries and our county is also not an exception to this rule. Regardless of the benefits and great appeal of nanotechnology, if it does not create assets for a country, all endeavors and investments made in this field will be nothing but a loss of resources. Extensive research has been carried out in the country in the field of nanotechnology; however

the manufacturing of these products and their application in various industries has faced many problems. Without a doubt, in order to facilitate this process, these barriers must be removed [8]. After 10-15 years of extensive attempts to identify nanotechnology and 5 years of massive governmental investments all across the globe, it cannot be specified whether the present time is too soon for investment. Many companies have passed their introductory and experimental processes. Wise, risk-taking investors are after suitable opportunities of investment. The market is developing. Many products in nanotechnology are being introduced. Our society is in an age of industrial growth in the realm of nanotechnology. From this day forth, 3-8 years from now, this industry will go towards its peak. Public stock companies in nanotechnology have shown promising achievements and allocate an index to themselves in one of the most certified stock exchanges of the world. Thus, the present time is appropriate and not too soon for investment and commercialization [9].

Naseri believes that commercializing knowledge related to Nano is put forth as an essential factor and commercializing Nano-products currently faces considerable challenges in Iran (especially in the agricultural sector). That is, the existence of such challenges causes delays in bringing these products into the market. Without a doubt, in order to facilitate the process of developing and commercializing nanotechnology in the country, these barriers must be academically removed from researchers, entrepreneurs and workmen's path [8].

Crawley also believes that commercialization and the creation of jobs by means of nanotechnology is an aim and ideal for various countries and companies across the world [10].

Enayati believes that the commercialization of nanotechnology has currently been transformed to one of the main policies and major plans of various countries. He also considers approaches such as supplying financial resources in the first stage of research, tax credibility, development of research complexes, tax exemptions, and the increase of investments in developing nanotechnology commercialization to be of great importance [11].

The major purpose of this study was to examine the perception of researchers in the field of nanotechnology about factors influencing the commercialization of nanotechnology in agriculture sector of Iran.

MATERIALS AND METHODS

The methodology used in this study involved a combination of descriptive and quantitative research and included the use of factor and descriptive analysis as data processing methods.

The research population included researchers in the field of nanotechnology in Iran (N=250). The data collected by interviewing the respondents and analyzed by using factor analysis technique.

Measuring respondents' attitudes towards factors influencing the commercialization of nanotechnology in agriculture sector of Iran has been achieved largely though structured questionnaire surveys. Five factors were presented in a 5-point Likert format. The variables and their measurement scale are presented in Table1.

Table 1: Variables and their measurement scale

Variables	Measurement Scale
Economic Factors	Five- point Likert
Infrastructural Factors	Five- point Likert
Informative Factors	Five- point Likert
Financial Factors	Five- point Likert
Cultural Factors	Five- point Likert

Content and face validity were established by experts consisting of faculty members at Science and Research Branch, Islamic Azad University, and some experts in the field of nanotechnology. Minor wording and structuring of the instrument were made based on the recommendation of the panel of experts.

A pilot study was conducted to determine the reliability of the questionnaire for the study. Computed Cronbach's Alpha score was 85.0%, which indicated that the questionnaire was highly reliable.

To determine the appropriateness of data and measure the homogeneity of variables about factors influencing the commercialization developing agricultural biotechnology from the viewpoints of biotechnology experts in Iran, the Kaiser-Meyer-Olkin (KMO) and Bartlett's test measures were applied. These statistics show the extent to which the indicators of a construct belong to each other. KMO and Bartlett's test obtained for these variables show that the data are appropriate for factor analysis (table 2). The Kaiser criterion also was utilized to arrive at a specific number of factors to extract. Based on this criterion, only factors with Eigen-values greater than one were retained.

Table 2: KMO measure and Bartlett's test to assess appropriateness of the data for factor analysis

KMO	Bartlett's test	
0.798	Amount 1653	Sig. 0.000

RESULTS

The average age of the respondents was 32 years old, including 64.8 percent male and 35.2 percent female. Of those responded, 23.7 percent studied in the field of agriculture and 16.1 percent studied in the field of biotechnology.

Table 3 represents components of each factor, as well as, portion of each factor from the total common variance. As one may observe, about 65.75% of total common variance is explained by these five factors, where the majority of it has been explained by the infrastructural factor.

Table 3: Number of extracted factors and variance explained by each factor

Factor	Variable	Percentage of Variance
Infrastructural	government investment in the realm of nanotechnology, financial and moral support of researchers, increase in the producer's income in order to create motivation, increase in the export of products, support of people's moral ownership in the realm of nanotechnology, technical training in the field of transforming and developing nanotechnology, and the appropriate use of foreign academic and educational opportunities…	24.29
Economic	providing the budget for introducing products and creating sales markets, cooperation and financial support of organizations and related institutions, improving people's income security, the existence of dynamic and productive markets, increasing production values, increasing production sales with suitable quality…	13.26
Cultural	creating a consumer belief related to nanotechnology's commercialization benefits, the existence of constructive collaboration between researchers and investors, awareness towards commercialization of nanotechnology, commercialization of nanotechnology being proportionate with the country's cultural and social conditions, acculturation related to the commercialization of nanotechnology, institutionalizing society's culture in accepting the commercialization of nanotechnology, convincing the managers of the ministry of agriculture for the necessity of commercializing nanotechnology…	11.37
Informative	Investment of the private sector in the realm of nanotechnology, the press and media's attention to acculturation and news transmission, creating an appropriate social culture related to economic development resulting from the commercialization of nanotechnology…	9.40
Financial	Appropriate financial and credential system in research organizations, providing a budget for the establishment of research and scientific parks, facilitating the sales of products with suitable prices in the market…	7.39
Total		65.75

The factor analysis is shown in tables 3. In determining factors, factor loadings greater than 0.50 were considered as to be significant. As anticipated, the first factor accounts for 24.29 percent of variance. A relevant name for this on loading's pattern is "infrastructural factor".

The second factor contains variables relating to "economic factor". This factor explains 13.26 percent of the total variance. The name assigned to the third factor is "cultural factor". This factor explains 11.37 percent of the total variance of factors influencing the commercialization of nanotechnology in agricultural sector of Iran.. The forth factor is associated mostly with the variables related to "informative factor". These variables explain 9.40 percent of total variance. The last factor was "financial factor" with 7.39 percent of variance of factors influencing the commercialization of nanotechnology in agricultural sector of Iran.

DISCUSSION AND CONCLUSION

From an economic perspective, public and private investment, intellectual property rights, cooperation of organizations and various institutions and investment in the field of research and production and sales of products can be an important factor in commercialization of nanotechnology in agriculture sector. The result is in accordance with research by Ronald [4].

From an educational perspective, training in the field of commercialization of nanotechnology, making use of academic opportunities, studying the existing conditions and training in line with achieving ideal conditions and holding educational workshops are of great significance and can be effective in accelerating the commercialization of nanotechnology. Zieminski and Warda; and Hosseini and Esmaeeli pointed out to the importance of educational activities in commercialization process in nanotechnology [2, 3].

The results of this study emphasized on the importance of cultural and social factors and in this regard, the existence of constructive collaboration between researchers and investors plays a critical role.

The importance of training about nanotechnology and the process of commercialization should not be ignored, otherwise it would be difficult to change the attitudes of stakeholders. It is apparent that there is still need to further research about other factors that could enhance the commercialization of nanotechnology in agriculture sector.

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