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ARTICLE

ANALYSIS OF FACTORS AFFECTING ON BIOTECHNOLOGY-BASED ENTREPRENEURSHIP IN AGRICULTURE SECTOR OF IRAN

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ABSTRACT

The major purpose of this study was to determine factors affecting on biotechnology-based entrepreneurship in agriculture sector of Iran. The total population was all experts working in agricultural research centers through Iran that 170 were selected using random sampling technique as sample of the study. By using factor analysis, six factor containing 33 variables determined about 63.58 percent of variance of biotechnology-based entrepreneurship in agricultural sector. The results of the study show that the factors were categorized into six component, namely educational, infrastructural, human resources, economic, commercial, and policy making ordered by the magnitude of their impact.

KEY WORDS
Biotechnology, Entrepreneurship, Agriculture, Iran

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INTRODUCTION

Despite great advances in agricultural productivity and economic well-being in much of the world over the past 50 years, food insecurity and poverty continue to be serious issues in many regions [1, 2]. Moreover, in 2008, the world entered a period of deepening uncertainty and economic downturn that impacted significantly on the future security of food production and distribution systems [3].

In developing countries, there is a need for continued focus on optimizing agricultural output in conjunction with conserving the natural resources base via improved crops and crop management systems. The implications of climate change make it necessary to integrate considerations regarding adaptation, uncertainty, vulnerability and resilience into agricultural research programs and strategies. The various biotechnologies available have the potential to play a significant role in achieving these aims [4].

Biotechnology is the use of scientific and engineering principles in the biological materials processing of agents in order to provide goods and services for human use. There has been a strong tie between its existence and societal development. In other words, history has it that biotechnology has been principally associated with food, addressing such provision, and as such, acting as solutions to solving problems related malnutrition and famine in societies. Nonetheless, biotechnology has recently been coupled with the development of vital drugs [5].

Recent advances in agricultural applications of modern biotechnology show a significant potential to contribute to sustainable gains in agricultural productivity, reducing poverty and enhancing food security in developing countries. As these innovations are increasingly adopted, impact assessment becomes a critical tool for addressing potential socio-economic and environmental costs and benefits [6].

In the history, man had invented modern technologies to make his life easier. These modern technologies need new skills that make specialists to be able to use them. The specialists are establishing commercial institutes in order that they can use their skills based on this modern technologies to produce goods or present services in order to new opportunities for job be established, so technology and job has always moved toward together i.e. whenever the men invented a modern technology, there also have been produced some opportunities to make use of them, even though, having job in contemporary era has become a new structure, but it is thousands of years that mines' structures are been presented. So the following relationship is always confirmed:

New Technology = New Opportunity = New Job [7].
The biotechnological revolution has been characterized by the rapid pace of discovery in the biological sciences, and a tremendous impact on both fundamental and applied research. Biotechnology is multidisciplinary encompassing microbiology, chemistry, biochemistry, genetics, molecular biology,

immunology, cell and tissue culture and physiology, as well as engineering. Proponents around the world project a positive future in which biotechnology overcomes food shortages, improves the environment, heals or eliminates disease and leads to a prosperous and healthy society [8].

The application of biotechnology in agriculture offers a wide range of potential benefits, yet many of these benefits will not be realized unless a number of important policy issues are resolved. These issues relate to the particular characteristic of modern biotechnology and its interface with conventional agricultural research, the proprietary nature of new technologies and its effects on industry structure, biosafety and consumer acceptance considerations and the role technological inputs play in the biotechnology diffusion process. Each issue raises important policy challenges and choices as to how the country may best deal with them. The policy implications arising from the proposed country typology suggest that there is a major sparcity of information on the current situation and attitudes to new biotechnology in developing and emerging economies. While a small number of countries are forging ahead in developing specific biotechnology products and designing policies specific to their environment, the vast majority of countries will continue, for the foreseeable future, to rely on importing modern biotechnology from abroad [6].

Furthermore, the natural food products are unable to get in future. In the same way there are several new techniques are developed in the present decade. The present situation of agricultural production faces the challenge of enhancing crop production and providing nutritionally adequate diets for the increasing population, under uncertain climatic extremes, water scarcity, in limited (and degraded at many places) land area, with more requirement of water, and in many cases with poor quality water and air, and rapid erosion of natural biodiversity. To maintain the food quality in relation to its huge production, the food security is also an important factor. The food production, quality and food security can be maintained by introducing small science in the present century. Thus small science have such a big impact, this is nothing but biotechnology [9].

According to the study by Tonukari (2004), biotechnology is now one of the hot areas driving the stock markets as well as a frontier of knowledge and job creation. Just as the provision of research grants is a major issue, entrepreneurship and financing for biotechnology companies should also be high on government policy and educational agenda. Biotechnology can only be entrenched in developing countries with the establishment of a strong research base and entrepreneurial culture. Developing countries' scientists who summon enough courage to take part in these ventures will become part of the business elite of the future. Finally, any country that can assist its scientists and entrepreneurs in successful biotechnology start-ups will enjoy economic growth.

According to the mentioned studies and regarding to the importance of biotechnology-based entrepreneurship in agriculture sector, it is essential to identify its effective factors. The purpose of this study is to outline the factors affecting on biotechnology-based entrepreneurship in agriculture sector of Iran.

MATERIALS AND METHODS

Research methodology applied in this study was descriptive and quantitative methods. The main goal of the study was to identify factors affecting on biotechnology-based entrepreneurship in Iran agriculture sector. The statistical population included agricultural experts working at the research institutes through Iran and having knowledge and information or practical experience on Biotechnology was considered as a criterion for selecting these respondents. Applying stratified sampling technique, 170 agriculture experts were selected. The data were collected through a well-structured questionnaire.

The content validity of questionnaires was measured by a group of biotechnology specialists. It was modified according to comments and suggestions of the judgment group. In order to investigate the reliability of research questionnaire, 25 agricultural experts were randomly selected and they completed the questionnaire. Cronbach's alpha for the respondents' questionnaires were 0.87 respectively. Cronbach's alpha coefficient, a measure of internal consistency, was used to estimate the reliability of the survey questionnaire. This coefficient ranges in value from 0 to 1 and 0.87 indicating an acceptable level of reliability.

In current study, descriptive and inferential statistics were used to analyze the collected data. Descriptive statistics included frequency values and inferential statistics included exploratory factor analysis technique. The main objective of this technique is to classify a large number of variables into a small number of factors based on relationships among variables. For this purpose 42 variables were selected for the analysis. To determine the appropriateness of data and measure the homogeneity of variables about biotechnology-based entrepreneurship from the viewpoints of agricultural 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 1]. 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.

Findings

The results of descriptive statistics indicated that agriculture experts who participated in the study ranged in age from 27 to 58 years. The mean age of respondents was 38.6 years. 86.3% of experts were male and the rest (13.7) were female. Experts were asked to report their scientific and educational degree: 45.2% of respondents were post graduate; 30.6% were assistant professor; 15.7% had associate professor degree; and 8.5% were professor. 43.8% of respondents had a master's degree and 56.2% had completed PhD degree. Also experts were asked to indicate the number of years of job experience that they possessed. Years of job experience ranged from 3 to 30 years (M=13.5; SD=7.1).

In this study, from all 42 variables, 33 variables were significantly loaded into six factors. These factors explained 63.58 percent of total variance in components of biotechnology-based entrepreneurship. According to the Kaiser criterion, six factors with eigen-values over one were extracted. The eigen-values and percentage of variance explained by each factor are shown in table 2. Eigen-values drive the variances explained by each factor. Sum of squares of factor's loadings (eigen-values) indicates the relative importance of each factor in accounting for the variance associated with the set of variables being analyzed. According to table 2 eigen-values for factor 1 through 6 are 5.51, 4.62, 4.17, 3.63, 3.01 and 2.39, respectively.

Table 1: KMO measure and Bartlett's test to assess appropriateness of the data for factor analysis

KMO	Bartlett's test of sphericity	
0.884	Approx. chi	square Sig.
	$2.896 * 10^3$	0.000

The percentage of trace (variance explained by each of the five factors) is also shown in [Table 2]. The traces for factor 1 through 6 are 15.49, 13.03, 11.80, 10.17, 8.55 and 6.81 respectively. The total percentage of the trace indicates how well a particular factor accounts for what all the variables together represent. This index for the present factors shows that 65.85 percent of the total variance is represented by the variables contained in the factor matrix.

Table 2: Number of extracted factors, eigen-values and variance explained by each factor

Factors	Eigen-value	% of variance	Cumulative % of variance
1	5.511	15.487	15.487
2	4.621	13.032	28.519
3	4.171	11.805	40.324
4	3.634	10.174	50.498
5	3.010	8.549	50.047
6	2.388	6.806	65.853

The Varimax rotated factor analysis is shown in [Tables 3-8]. In determining factors, factor loadings greater than 0.50 were considered as to be significant. The classification of the factors into six components was displayed in [Table 3]. The variables were classified in educational, infrastructural, human resources, economic, commercial, and policy making. As anticipated, the first factor accounts for 15.487 percent of variance and 6 variables were loaded significantly. These variables were presented in [Table 3].

Table 3: Variables loaded in the first factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Educational component	Training M.Sc. and Ph.D. studentsinthe field ofbiotechnology	0.683
	Introducing successful entrepreneurs in other high-technologies	0.756
	Planning abroad training courses for biotechnology faculty	0.864
	Holding workshops in the field of biotechnology transfer to businesses	0.854
	Educational programsaboutbiotechnologybusinesses forstudents	0.861
	Utilizationof academic and industryexpertsforscientificconsultations	0.637

A relevant name for this on loading's pattern is "educational component". Eigen-value of this factor is 5.511, which is placed at the first priority among the components for biotechnology-based entrepreneurship in agricultural sector in Iran.

The second factor contains 6 variables relating to "infrastructural component". The eigen-value for this factor is 4.621 which explain 13.032 percent of the total variance [Table 4].

Table 4: Variables loaded in the second factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Infrastructural component	Accessto thetools, equipmentandlaboratoriesequipped withBiotechnology	0.784
	Creating databases and networking knowledge for development of biotechnology	0.855
	Utilizing entrepreneurial experience in other high-technologies	0.749
	Biotechnology standardization in areas of research, production and development	0.752
	Access to the methods of R&D in the field of biotechnology in other countries	0.786
	Establishing advanced R&D systems in order to create bio-innovations	0.856

The name assigned to the third factor is "human resources component". This factor with eigen-value of 4.171 explains 11.805 percent of the total variance of biotechnology-based entrepreneurship in agricultural sector [Table 5].

Table 5: Variables loaded in the third factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Human resources component	Biotechnology experts with entrepreneurial characteristics and skills	0.777
	Biotechnology researchers and experts empowered with the ability to find new ideas	0.727
	Experienced administrators with the ability of managing biotechnology activities	0.710
	Educators and teachers familiar with the concepts of entrepreneurship and businesses	0.638
	Experienced research team to develop R&D activities in biotechnology	0.615

The fourth factor is associated mostly with the variables related to economic affairs. Thus this factor can be named as "economic component". These variables explain 10.174 percent of total variance [Table 6].

Table 6: Variables loaded in the fourth factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Economic component	Participation of government and private sector investment in biotechnology	0.637
	Reform of banks and insurances regulations to provide services to bio-entrepreneurs	0.749
	Infrastructure in order to attract foreign investment and pushing them to biotechnology	0.792
	Granting tax benefits to investment funds specialized in the field of biotechnology	0.814
	Encourage banks and financial institutions to provide facilities for bio-entrepreneurs	0.806
	Reduced tax rate for companies and institutions in the field of biotechnology	0.838

The fifth factor is associated with the variables related to business development. Thus, this factor can be named as "commercial component". The eigen-value for this factor is 3.010, which explain 8.549 percent of the total variance [Table 7].

Table 7: Variables loaded in the fifth factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Commercial component	Developing techno-markets for exchange bio-products between innovators with investors	0.617
	Identification of potential domestic and foreign markets in the field of biotechnology	0.797
	Encourage SMEs to participation in design and implementation of biotechnology programs	0.814
	Creating demand-driven R&D institutes in the field of biotechnology	0.866
	Creating professional networks between bio-producers and SME	0.765

The name assigned to the six and last factor is "policymaking component". This factor with eigen-value of 2.388 explains 6.806 percent of the total variance [table 8].

Table 8: Variables loaded in the first factor using varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loadings
Policymaking component	Coordination and cooperation between governmental organizations in the field of biotechnology	0.796
	Reforming commercial laws in order to development of biotechnology businesses	0.766
	Material and intellectual support of the development of new ideas in the field of biotechnology	0.739
	Predict the necessary provisions for rapid absorption and application of biotechnology innovations	0.832
	Support for the holding of training programs and human resource development in biotechnology	0.789

Discussion

Biotechnology is the application of scientific techniques to modify and improve plants, animals, and microorganisms to enhance their value. Agricultural biotechnology is the area of biotechnology involving applications to agriculture. Agricultural biotechnology has been practiced for a long time, as people have

sought to improve agriculturally important organisms by selection and breeding. This study is to investigate the factors affecting on biotechnology-based entrepreneurship in agriculture sector of Iran.

Based on the finding of this study, the variables were categorized into six groups, namely educational, infrastructural, human resources, economic, commercial, and policy making components ordered by the magnitude of their impact. The results revealed that six components containing 33 variables determined about 65.85 percent of total variance in biotechnology-based entrepreneurship in agricultural sector.

In assessment of factors affecting on biotechnology-based entrepreneurship, educational component was found out to be first and the most important factor influencing the biotechnology-based entrepreneurship in agricultural sector. Therefore designing training programs for technology-based entrepreneurial development will be very helpful.

Based on the studies of Indian department of science & technology, Technology-based Entrepreneurship Development Program (TEDP) is a program in which training is given on specific products/technologies/processes, which have commercial viability and which have been developed by R&D labs or other academic institutions. This program provides state-of-the-art inputs to the entrepreneurs about the technology to be employed and they can also develop their skills in application of the technology [10].

According to the findings, infrastructural component were placed at the second most important factor affecting biotechnology-based entrepreneurship in agricultural sector in Iran. Also the results of the study show that human resources, economic, commercial, and policy making components also influence the biotechnology-based entrepreneurship in agricultural sector of Iran.

CONFLICT OF INTEREST
There is no conflict of interest

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