

Analysis of Socio-Cultural Obstacles for Dissemination of Nanotechnology from Iran's Agricultural Experts perspective

S. M. Mirdamadi, S. Esmaili, and S. A. Tohidloo

Abstract—The main purpose of this research was to analyze Socio-Cultural obstacles of disseminating of nanotechnology in Iran's agricultural section. One hundred twenty eight out of a total of 190 researchers with different levels of expertise in and familiarity with nanotechnology were randomly selected and questionnaires completed by them. Face validity have been done by expert's suggestion and correction, reliability by using Cronbach-Alpha formula. The results of a factor analysis showed variation for different factors. For cultural factors 19/475 percent, for management 13/139 percent, information factor 11/277 percent, production factor 9/703 percent, social factor 9/267 percent, and for attitude factor it became 8/947 percent. Also results indicated that socio-cultural factors were the most important obstacle for nanotechnology dissemination in agricultural section in Iran.

Keywords—Agriculture, Iran, Nanotechnology, Public Perception, Social-Cultural Obstacles,

I. INTRODUCTION

AGRICULTURE as an important production part of each society plays a vital role [1]. At present time, more than one billion hectare of the world's lands is dedicated to cultivate crops. If this efficiency is maintained for agricultural plants and given the growth of population by 2050, there should be available three billion hectares of lands to be dedicated to cultivate crops worldwide. This means that we should devastate two billion hectares of forest lands which be considered as human heritage to cultivate more marginal lands [2].

Undoubtedly, providing food needs for multi billion populations of future decades will require a drastic change into existing capacities. In spite of their great role in the rising rate of plants' productivity, eugenic and traditional improvements will not be able to guarantee supplying foods needed for future generation. Then, new technologies have been considered [3].

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During recent decade, some countries have made huge progresses in every respect specifically new technologies such as Nanotechnology, biotechnology, IT and knowledge - based technology [4]. Nano sciences and technology has occupied the center of these new and promising technologies. It should be noted that any development of other branches of new technologies are directly subjected to the progresses of Nano sciences and technologies. Nanotechnology provides capabilities required for making deepest changes into whole of dimensions of human society. The biggest changes whether in the realms of health and hygiene, industry and economy or agriculture and environment as the main fields of activities of human advanced societies will bring about by Nanotechnology during the next 50-year period? Convergence of the above-mentioned fields of new technology through Nanotechnology is considered as a coming horizon for the next 50-year period [4].

With the help of new tools for molecular treatment of diseases, rapid diagnosis of diseases, upgrading plant's capability for absorption of nutrients, Nanotechnology can bring about fundamental modifications in the agriculture and food industries. Intelligent sensors and rapid transportation systems can help the viruses of agriculture industry to combat against pathogenic agents. Meanwhile, Nanotechnology will indirectly protect environment by renewable resources and decreases the amount of pollution and removes existing pollution using catalyst filters [5].

However, Nanotechnology is comparatively new and therefore will confront numerous hindrances, gaps and challenges specifically at next decade. Developing countries are confronted a series of problems and difficulties and then development of technology is a hard task for them. The lack of national feelings and pride and public support of the leaders and policy-makers and the lack of technology and renovation culture are viewed as the major difficulties by [6].

Reference [7] mention that the lack of infrastructures required for development of new technologies, lack of rules and regulations needed for development of new technologies and lack of targeted researches are the most important problems and difficulties of dissemination and expansion of Nanotechnology in the country.

Reference [8] considers the lack of effective legal and national tools and mechanisms required for securing and maintaining of material and intellectual rights of scientists, scholars, inventors, innovators and discoverers of the country,

insignificancy of the part of private sector in the research activities and providing for its expenses and the lack of necessary mechanisms for information in the science and technology domains as the most important difficulties and barriers for development of science and technology in the country.

Reference [9] considers the lack of collaboration and international, proper and uninterrupted scientific exchanges with experienced and capable countries and lack or shortage of general knowledge of society about the role, position, advancements, achievements and the applications of new sciences and techniques as fundamental difficulties that management system of science and technology development are confronted with.

Reference [10] specify the weakness of communication between researchers and the lack of morale for doing collective tasks among them and the weakness of communication between academic and research centers and managers of country's production and industry affairs and the lack of exact and comprehensive informatics systems as the barriers of biotechnology development in the country.

Reference [11] acknowledges that cultural issues are one of the most important issues in the technology arena. Reference [12] believes that the way of keeping informed of the public on Nanotechnology is the most important issue on dissemination of Nanotechnology.

Reference [13] believes that the lack of appropriate legal substructure to protect intellectual property, entrepreneurship culture in the country, energetic and effective management, inadequate networking between entrepreneurs, researchers and investors are the major impediments that entrepreneurship process of Nanotechnology is confronted with. According to special staff for development of Nanotechnology (2004), the lack of appropriate legal substructure to protect intellectual property is seen as difficult and barrier of investment in Nanotechnology in Iran.

Reference [14] attributes the major difficulties of development of agriculture biotechnology existing in Iran to the weakness of communication between researchers and production administrators, lack of clarified rules and regulations and structural weakness of private sector.

Reference [15] asserts that the lack of understanding of customers and the lack of a consumption culture, the lack a constructive interaction among the researcher and capital holders (cultural-social) are the most important challenges of globalization of Nanotechnology in Iran.

Reference [16] stresses that lowered level of knowledge and understanding of the public on the benefits and the potentials of Nanotechnology, the shortage of financial assistance and the lack of required activities in support of shaping risk-taking funds, the lack of intellectual property, the lack of information and communication networks, opposition and lack of planning for active participation of private sector are considered as the most important barriers to develop Nanotechnology.

Reference [17] has examined the factors influencing dissemination and admission of agricultural technologies. The

results indicate that some factors such as state policies, technical consultation plans, development of infrastructures and access to the market and credit and educational policies play the most important role in the dissemination and admission of agricultural technologies.

In his study, [18] has dealt with some of threats and opportunities resulting from the influence of world's economic stagnation on developing Nanotechnology and has classified them under five major issues influencing Nanotechnology at 2009 as follows: (1) joint venture on Nanotechnology and turnover of capital, (2) acquisition of worthless intellectual properties, (3) investments and companies derived from universities, (4) clean technologies, and (5) applications of Nanotechnology.

Generally, according to above explanations, we can classify the barriers under four major ones as follows: weakness of communication among the researchers of Nanotechnology, lack of material and intellectual support of private institutes that work on Nanotechnology, lack of effective information systems on Nanotechnology in agricultural sector, lack of collaboration and international, uninterrupted and appropriate scientific exchanges with skillful and experienced countries that have a great and valuable experiences on Nanotechnology. So, this paper aims to study and analyze the cultural and social barriers of development of Nanotechnology from viewpoint of researchers of centers and national research institutions of ministry of agriculture.

II. MATERIALS AND METHODS

Present research in terms of application, supervision and controlling of non-experimental variables and in terms of data collection is considered as descriptive one. Knowledgeable researchers that either work on Nanotechnology or have research projects on Nanotechnology and cooperate with national research centers and institutions constitute a statistical society of present research.

This society has 190 members of which 123 members have been selected on the basis of simple random sampling according to Morgan's table for doing research. To enhance the accuracy and validity of findings, the number of participants increased to 128 persons. Questionnaire as a tool for data collection has two parts: (a) cultural-social barriers of Nanotechnology development and, (b) personal and professional peculiarities of researchers.

Permission required for questionnaire was issued by guidance counselors, advisors and authorized officials and was confirmed. The reliability of questionnaire, i.e. 0.823 was calculated by Chronbach's Alfa Coefficient. Collected data were analyzed by SPSS WIN₁₃ software.

III. RESULTS AND DISCUSSION

A. Personal and Professional Peculiarities of Researchers

Totally, 128 researchers were studied of which 85.2% are men and 14.8% are women. The findings of this research show that the average age of responders is 41 years old and the most frequency of age is within 36-40 years old. These findings also indicate that the average of work experience of the researchers is 14 years, while the most frequency of work experience is within 6-10 years. Collected data on research features of researchers indicate that on average 12.1 research and scientific articles were published nationwide. The majority of them have published 1-5 articles. On average, 7.2 research and scientific articles were published at international level. The majority of them have published 1-5 articles (43.7%). These researchers have completed 7.9 research plans on average.

B. Cultural-Social Barriers of Dissemination of Nanotechnology in Agriculture Sector from Researcher's Viewpoint

The results obtained by research conducted on the most important cultural-social barriers of dissemination of

TABLE I^A
PRIORITIES OF CULTURAL –SOCIAL BARRIERS OF
NANOTECHNOLOGY DISSEMINATION

| Issue | Av. ^A | S.D. | C.V. | Priority |
|--|------------------|-------|-------|----------|
| the lack of collaboration, international, uninterrupted and appropriate scientific exchanges with those countries that have a great and valuable experiences on Nanotechnology | 4.254 | 0.692 | 0.162 | 1 |
| the lack of effective information systems on Nanotechnology | 3.730 | 0.833 | 0.223 | 2 |
| distrusting of senior managers of Ministry of Agriculture against the capabilities and the role of Nanotechnology in economic development of the country | 3.816 | 0.855 | 0.224 | 3 |
| oversight and carelessness of the press and Radio & Television Organization to propagate and introduce Nanotechnology | 3.396 | 0.839 | 0.247 | 4 |
| The lack of material and intellectual support of private institutions that work on Nanotechnology | 3.548 | 0.866 | 0.249 | 5 |
| the lack of collaboration and interaction of state organization | 3.661 | 0.944 | 0.257 | 6 |
| the lack of deep appreciation of officials of Ministry of Agriculture against the importance of Nanotechnology | 3.846 | 0.996 | 0.258 | 7 |
| the lack of effective information for introduction of people who are active in the realm of Nanotechnology | 3.500 | 0.918 | .0262 | 8 |

TABLE I^B
PRIORITIES OF CULTURAL –SOCIAL BARRIERS OF
NANOTECHNOLOGY DISSEMINATION

| Issue | Av. ^A | S.D. | C.V. | Priority |
|---|------------------|-------|-------|----------|
| inadequate knowledge, examination and studying on Nanotechnology | 3.656 | 1.007 | 0.275 | 9 |
| the lack of work team culture among the researchers | 3.825 | 1.081 | 0.282 | 10 |
| the lack of appropriate social culture among the public to familiarize with achievements & capabilities of Nanotechnology | 3.472 | 1.022 | 0.294 | 11 |
| the weakness of communication between researchers | 3.382 | 1.008 | 0.296 | 12 |
| the lack of timely information of the public | 3.328 | 1.004 | 0.301 | 13 |
| the lack of or lowering of public knowledge on Nanotechnology | 3.640 | 1.106 | 0.303 | 14 |
| the lack of Nanotechnology and renovation at social level | 3.492 | 1.078 | 0.308 | 15 |
| the lack of proper culture at public level on Nanotechnology | 3.261 | 1.005 | 0.308 | 16 |
| nonobservance of intellectual properties | 3.425 | 1.080 | 0.315 | 17 |
| the lack of propagation of entrepreneurship culture of Nanotechnology | 3.480 | 1.125 | 0.323 | 18 |
| The lack of appropriate understanding of customers against Nanotechnology | 3.585 | 1.239 | 0.345 | 19 |
| not to take into consideration of development of human resources | 3.520 | 1.235 | 0.350 | 20 |
| the lack of national pride and determination on production and renovation of Nanotechnology in reliance on research | 2.992 | 1.110 | 0.370 | 21 |
| lack of establishment of science and Nanotechnology culture and lack of its admission by the public | 2.881 | 1.077 | 0.373 | 22 |
| disproportion between Nanotechnology and culture and social conditions of the country | 2.812 | 1.127 | 0.4 | 23 |
| the lack pride and public support of the leaders and policy-makers of Nanotechnology | 2.991 | 1.278 | 0.427 | 24 |
| negative propagation on the consequences of Nanotechnology | 2.608 | 1.204 | 0.461 | 25 |

^B1= very low, 2= low, 3= medium, 4= high, 5= very high

Nanotechnology in agriculture sector are shown in Tab.1.

The lack of collaboration and international, uninterrupted and appropriate scientific exchanges with skillful and experienced countries that have a great and valuable experiences on Nanotechnology, lack of effective information systems on Nanotechnology in agricultural sector, distrusting of senior managers of Ministry of Agriculture against the capabilities and the role of Nanotechnology in economic development of the country, oversight and carelessness of the

press and Radio & Television Organization to propagate and introduce Nanotechnology (at agriculture sector) and the lack of material and intellectual support of private institutions that work on Nanotechnology are the most important impediments mentioned by the researchers. The lack of pride and public support of the leaders and policy-makers of Nanotechnology and negative propagation on the consequences of Nanotechnology as other barriers are of little importance.

C. Factor Analysis

The listed barriers were examined by factor analysis. Initial statistical calculations confirmed the relative fitness of data required for factor analysis. KMO¹'s value is equal to 0.705 and its Bartlett's value is equal to 1514/991 that became significant at the level of 1 percent. This proves the fitness of correlation between the variables applied for factor analysis. Extracted factors with their special value, percent of variance

TABLE II
EXTRACTED FACTORS

| Factors | Special Value | % of Variance of special value | Accumulated % of Variance |
|-----------------|---------------|--------------------------------|---------------------------|
| 1 st | 4.284 | 19.475 | 19.475 |
| 2 nd | 2.891 | 13.139 | 32.614 |
| 3 rd | 2.481 | 11.277 | 43.891 |
| 4 th | 2.135 | 9.703 | 53.594 |
| 5 th | 2.039 | 9.267 | 62.861 |
| 6 th | 1.968 | 8.947 | 71.808 |

and their accumulated percent of variance are reflected in Tab.2.

According to the findings of the Table (2), all six factors explain 71.808 percent of total variance. It proves high percent of variance explained by these factors. The first factor with special value of 4.284 explains individually 19.475 % of total variance.

But the position of variables (25 main variables) among the factors assuming positioning of variables with factor load of

TABLE III^A
THE VARIABLES OF EACH FACTOR AND COAFCANT VALUES
RESULTING FROM ROTATED MATRIX

| Factors | Variables | Coefficient Value |
|----------|--|-------------------|
| Cultural | the weakness of communication between researchers of Nanotechnology | 0.647 |
| | the weakness of communication between researchers of Nanotechnology | 0.797 |
| | inadequate knowledge, examination and studying on Nanotechnology | 0.629 |
| | the lack of material and intellectual support of private institutions that work on Nanotechnology | 0.636 |
| | the lack of appropriate understanding of customers against Nanotechnology | 0.758 |
| | the lack of work team culture among the researchers of Nanotechnology | 0.746 |
| | the lack of effective information for introduction of people who are active in the realm of Nanotechnology | 0.578 |

¹ Kaiser-Meyer-Olkin measure

greater than 0.5 the factors after rotation will be named as shown in Table 3.

TABLE III^B
THE VARIABLES OF EACH FACTOR AND COAFCANT VALUES
RESULTING FROM ROTATED MATRIX

| Factors | Variables | Coefficient Value |
|---------------|---|-------------------|
| managerial | the lack of effective information systems on Nanotechnology in agricultural sector | 0.660 |
| | distrusting of senior managers of Ministry of Agriculture against the capabilities and the role of Nanotechnology in economic development of the country | 0.800 |
| | the lack of deep appreciation of officials of Ministry of Agriculture against the importance of Nanotechnology | 0.781 |
| informational | the lack of collaboration and international, uninterrupted and appropriate scientific exchanges with those countries that have a great and valuable experiences on Nanotechnology | 0.643 |
| | the lack of or lowering of public knowledge on Nanotechnology | 0.671 |
| | the lack of timely information of the public | 0.601 |
| production | the lack of appropriate social culture among the public to familiarize with achievements and capabilities of Nanotechnology | 0.778 |
| | the lack of proper culture at public level on Nanotechnology | 0.677 |
| | the lack of national pride and determination on production and renovation of Nanotechnology in reliance on research | 0.574 |
| social | the lack of propagation of entrepreneurship culture of Nanotechnology at agriculture sector | 0.519 |
| | disproportion between Nanotechnology and culture and social conditions of the country | 0.875 |
| | lack of establishment of science and Nanotechnology culture and lack of its admission by the public | 0.790 |
| conceptual | the lack pride and public support of the leaders and policy-makers of Nanotechnology | 0.615 |
| | negative propagation on the consequences of Nanotechnology | 0.830 |

However, it should be considered that after rotation of variable, they were removed from the analysis due to its lower factor load (less than 0.5) and consequently insignificance of correlation between each other.

The main cause of this omission is that the common area of these variables was covered already by the most important factors and then they said factors could be summarized.

Given to examination of the variables constituting each factor and given to the variables positioned at each factor, the main factors of cultural-social barriers of dissemination of Nanotechnology in agriculture sector are enumerated as cultural factors, managerial factors, informational factors, production factors, social factors and conceptual factors.

IV. CONCLUSION AND RECOMMENDATION

Present research was conducted with the purpose of analyzing of social-cultural barriers of dissemination of nanotechnology in agriculture sector from the viewpoint of the researchers of national researches institutes and governmental centers in this field. The findings of this research indicated that, the barriers of disseminating of nanotechnology in agriculture sector in Iran are as: cultural factors, managerial factors, informational factors, production factors, social factors and conceptual factors.

These results also, indicated that cultural factor (weakness of communication between the researchers of nanotechnology, the lack of culture and innovation on nanotechnology among society, inadequate knowledge, studies on nanotechnology issues, lack of material and intellectual support of private institutes that work on nanotechnology and so on) is considered as the first factor and this is complied with the results obtained by [6], [15], [9] and [10]. The second factor is known as managerial factor. (barriers: lack of effective information systems on nanotechnology in agricultural sector, distrusting of senior managers of Ministry of Agriculture against the capabilities and the role of nanotechnology in economic development of the country, The lack of deep appreciation of officials of Ministry of Agriculture against the importance of nanotechnology and so on) and this is complied with the results obtained by [13], [9] and special staff for development of nanotechnology.

The third factor is known as information factor (barriers: The lack of or lowering of public knowledge on nanotechnology, the lack of timely information of the public, the lack of appropriate social culture among the public to familiarize with achievements and capabilities of nanotechnology and so on) and this is complied with the results obtained by [8], [9] and special staff for development of Nanotechnology. The fourth factor is production factor (barriers: The lack of national pride and determination on production and renovation of nanotechnology in reliance on research and The lack of propagation of entrepreneurship culture of nanotechnology at agriculture sector) and this is complied with the results obtained by [13] and [6]. The next one is known as social factor (barriers: Disproportion between nanotechnology and culture and social conditions of the country, Lack of establishment of science and nanotechnology culture and lack of its admission by the public) and this is complied with the results obtained by [18]. The last one is conceptual factor (barriers: The lack pride and public support of the leaders and policy-makers of nanotechnology and negative propagation on the consequences of nanotechnology) and this is complied with the results obtained by [14] and [6]. According to our findings and the results obtained by the research, the following suggestions should be taken into consideration to remove the above-mentioned barriers:

1. Propagation of nanotechnology through mass media;
2. Scientific exchanges with progressive countries;

3. Establishment of entrepreneurship centers, entrepreneurship training and propagation of Nanotechnology at agriculture sector;
4. Training of Nanotechnology experts at agriculture sector and delegating them to the abroad with predetermined and systematic goals.

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