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Perception of Extension Specialists about the Role of Extension in the Production and Adoption of the Genetically Modified Crops in Iran

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Abstract: Extension specialists were surveyed in order to explore their perception about the role of extension in the production and adoption of Genetically Modified (GM) crops in Iran. The methodology used in this study involved a combination of descriptive and quantitative research. The total population for this study was 120 extension specialists in Iran. Extension specialists believed that the first priority of extension should be to increase the participation of stakeholders in the development of GM crops. Based on the perception of the respondents, 46% of the variance in the perception of extension specialists about the production of GM crops could be explained by two variables of informing about the research activities and improving the linkages between public and private sector. The results show that 44% of the variance in the perception of extension specialists about the adoption of GM crops could be explained by two variables of informing the publics about advantages of GM crops and improving the linkages between public and private sector.

Key words: Adoption, agricultural extension, biotechnology, extension specialist, genetically modified crops, Iran

INTRODUCTION

Human population growth and increasing urbanization are putting a massive pressure in demand for food production in developing countries. Biotechnology could significantly contribute to increased global food security while supporting ecologically sound agricultural production[18].

Agriculture biotechnology can play an important role in increasing production and improving the quality of food produced by farmers. Many believe that biotechnology will secure growing world food needs as well as deliver a huge range of environmental, health and economic advantages[23].

Proponents of biotechnology tout biotechnology as providing additional food, fiber and medicines for human populations. Proponents envision biotechnology as providing this additional food, fiber and medical resources without increasing and possibly decreasing, human demands upon land and plant-fauna habitats[10].

A wide range of economic, social, physical and technical aspect of farming influences adoption of agricultural production technology. Wheeler[23] pointed the factors which influence the adoption of new innovations by farmers. She mentioned factors such as perception about risk and profitability; uncertainty and certainty about adoption; amount of required information and attitude about risk and uncertainty.

Several parameters have been identified as influencing the adoption behavior of farmers and social scientists investigating farmers who adopt the biotechnology showing the demographic variables, technology characteristics, information source, knowledge, awareness, attitude and group influence affect adoption behavior[14].

Successful adoption of biotechnologies in developing countries will depend on the availability of technologies appropriate for local agricultural conditions and policies that enhance the ability of poor farmers to obtain these technologies[1].

Agricultural Extension by its nature has an important role in the adoption of new technology and innovation. The trend from supply-driven extension to demand-driven extension requires a new approach which open the door for using biotechnology as an appropriate technology for farmers in developing countries.

Prior research: Extension organizations have a key role in brokering between biotechnologies, providers of those technologies and services and the client group they serve. In this role, they must be able to examine the appropriateness of various biotechnologies and to insure that biotechnology would reach and attend a large portion of farmers especially poor farmers in the developing countries.

Reece[20] pointed out that bigger farmers had been the first to benefit from the new varieties, but argued

there was evidence to suggest that smaller farmers also eventually could increase their incomes by means of the new varieties.

However, adoption of any new technology and innovations has not been an easy task for extension and sometimes has been counterproductive. Adoption is usually not spontaneous, the technology has to be taught and learned-adopted to existing experience and integrated into production. As is often the case with technological-innovation potential and expectations can outpace reality[6].

Badr[2] felt that any research agenda should be accompanied by training and education for farmers. He suggested that by seeing new technologies applied successfully in field experiments, small farmers would then try to use them. Kambikambi[9] believed that in some countries, small farmers were not able to make informed decisions about biotechnology because of poor understanding of the subject.

Rao and Rao[19] found a positive and significant association between age, farming experience, training, socio economic status, cropping intensity, aspiration, economic motivation, innovativeness, information utilization, information source, agent credibility and adoption.

Information is the most often cited impediment to the public's awareness and understanding of modern biotechnology. To complicate matters, certain basic facts seem to have been lost in the controversy, allowing misleading ideas to persist[21].

Marra *et al*.[13] indicated that quality and source of information influence on adopting the biotechnology by farmers. The information available is a critical factor in influencing farmers and it is provided through sources and channels such as extension officers, scientists, academics, private consultants and other farmers. These sources provide the content of interest to farmers while channels are the methods by which information is transferred[23].

Ekanem[5] in a study about the role of extension as a source of biotech food information reported that extension organizations could use the different communication mediums to informing the producers and consumers about the biotechnology.

Based on the reports by the United States National Research Council, extension can provide farmers with unbiased and correct information about the biotechnology and ensure that new technology is environmentally, economically and socially sound[8].

The knowledge gap is compounded by a lack of essential skills, particularly in communication and management that are required by extension workers if they are to effectively transfer technologies to farmers in a manner that leads to sustainability. It is important to realize that the information needs of extension workers include not only technical knowledge but also knowledge and skills that increase the effectiveness of delivery. Improving access to these vital extension skills will lead to better designed, delivered and supported technologies[3].

Evidence shows that even small efforts to informing farmers and increasing their knowledge about the biotechnology can have big results. However, the promise has yet to be realized due to the lack of information and access to this technology among rural communities. Therefore, it is necessary to remove the impediments faced by rural population and provide basic information in rural areas to enable the spread of biotechnology.

Extension organizations in fulfilling their tasks face several challenges in application of biotechnology. Potential challenges are listed below:

- Lack of training for agents
- Lack of knowledge and skills among agents
- Financial constraints
- Legislative, policy and regulatory impediments

The current situation in agriculture sector in Iran can not respond to the growing needs for food production. The majority of farmers in Iran are subsistence farmers and the main barrier to empowering them is their lack of knowledge of new methods and technologies.

In Iran, a radical approach to spread and to promote the adoption of biotechnology by farmers is underway. For instance, the establishment of the National Council for Scientific Research improves the status of biotechnology in the agriculture sector. The promising development was to include both agriculture and biotechnology among the top priorities for funding at the national level[7].

However, the application of biotechnology by farmers in Iran faces challenges and obstacles. Infrastructural obstacles, lack of good and skillful trainers and insufficient fund are among some of the challenges. There is no single appropriate way to introduce and promote biotechnology in the developing countries: constraints and opportunities vary from country to country and therefore require location-specific approaches.

Given the key role that extension specialists play in influencing farmer to adopt agricultural innovations, their views on individual innovations may be critical for overall adoption[23]. The research question for this study is: what are the perceptions of extension specialists

about the role of extension in the production and adoption of GM crops in Iran?

The overall purpose of this study was to examine the perception of extension specialists about the role of extension in the production and adoption of Genetically Modified (GM) crops. The following objectives were formulated to guide the study:

- Identify the personal characteristics of extension specialists
- Assess the level of extension specialists' knowledge about the GM crops
- Determine the appropriate extension activities for adopting the GM crops
- Assess the perceptions of extension specialists about the benefits of GM crops

MATERIALS AND METHODS

The methodology used in this study involved a combination of descriptive and quantitative research and included the use of correlation, regression and descriptive analysis as data processing methods. The total population for this study was 120 extension specialists in the Department of Extension, the Ministry of Agriculture that were involved in the biotechnology research and development.

A series of in-depth interviews were conducted with some senior experts in the Department of Extension of the Ministry of Agriculture and Biotechnology Research Institute (BRI) to examine the validity of questionnaire. A questionnaire was developed based on these interviews and relevant literature. The questionnaire included both open-ended and fixed-choice questions. The open-ended questions were used to gather information not covered by the fixed-choice questions and to encourage participants to provide feedback.

Content and face validity were established by a panel of experts consisting of faculty members at Islamic Azad University, Science and Research Branch and some specialists in the Biotechnology Research Institute (BRI). A pilot study was conducted with 15 specialists who had not been interviewed before the earlier exercise of determining the reliability of the questionnaire for the study. Computed Cronbach's Alpha score was 92.0%, which indicated that the questionnaire was highly reliable.

Independent variables in the study included extension factors influencing the production and adoption of GM crops. The dependent variables in this research study were the perception of extension specialists about the production and adoption of GM crops. For measurement of correlation between the independent variables and the dependent variables correlation coefficients have been utilized and include spearman test of independence.

RESULTS AND DISCUSSION

Table 1 shows the demographic profile and descriptive statistics. The results of descriptive statistics indicated that the majority of extension specialists were men, 42 years old on average and had an undergraduate degree with permanent employment status.

Information regarding the level of extension specialist knowledge about the GM crops is recorded in Table 2. As can be seen from this Table 2, the highest mean refers to the level of specialists knowledge about GM crops' research (mean = 2.88) and the lowest mean refers to knowledge about utilization of GM crops (mean = 2.55).

In order to finding the perception about the role of extension activities in influencing the adoption of GM crops, respondents were asked to express their views. Table 3 shows the respondents' means about the eleven statements. As can be seen the highest mean number refers to role of extension in increasing the participation of stakeholders in development of GM crops (mean = 3.53) and lowest mean number refers to adopting the policies which promote the use of GM crops (men = 2.70).

The perception of respondents about the benefits of adopting GM crops was displayed in Table 4. The highest mean refers to increasing food production (mean = 3.60) and the lowest mean refers to improving the quality of food products (mean = 3.23).

Table 1: Personal characteristics of respondents

Variables		
Sex	Women (12.5%),	Men (87.5%)
Age (years)	Mean = 42	
Work experience (years)	Mean = 14	
Degree	Undergraduate (77.5%)	Graduate (22.5%)
Employment status	Permanent (65%)	Contractual (35%)

Table 2: Means of respondents' views about their knowledge about GM crops (1 = Very little; 5 = Very much)

	Mean	SD
Knowledge about GM crops research	2.88	1.067
Knowledge about GM crops development	2.65	1.027
Knowledge about the utilization of GM crops	2.55	1.218

Table 3: Means of respondents' views about the role of extension activities in influencing the adoption of GM crops (1 = strongly disagree; 5 = strongly agree)

Statement	Mean	SD
Increasing Stakeholders participation in the development of GM crops	3.53	1.062
Holding Dialogue with opponents of GM crops	3.50	1.216
Informing about the development of GM crops	3.45	1.154
Informing about the research activities in GM crops	3.48	1.198
Holding Dialogue with the consumers	3.41	1.332
Informing the publics about advantages of GM crops	3.35	1.189
Improving the linkages between public and private sector	3.18	1.152
Developing the comprehensive programs for improving the quality of GM crops	3.20	1.265
Developing the appropriate mechanisms to transfer the research findings	3.18	1.279
Organizing the educational activities about GM crops	3.35	1.080
Adopting the policies which promote the use of GM crops	2.70	1.344

Table 4: Means of respondents' views about the benefits of adopting GM crops (1 = strongly disagree; 5 = strongly agree)

Statement	Mean	SD
Increasing food production	3.60	1.081
Conserving the high yield varieties	3.60	0.810
Improving the Resistance toward pests and diseases	3.58	0.958
Decreasing the cost of production	3.53	1.086
Improving food security	3.33	1.185
Protecting the environment	3.25	1.276
Improving the quality of food products	3.23	1.143

Relationship between variables: Spearman coefficient was employed for measurement of relationships between the perception of extension specialists about extension activities and production of GM crops. Table 5 shows the results which show that there were relationship between perception of respondents and the extension activities, except for two statements: "Holding dialogue with the opponents of GM crops and increasing the stakeholders participation in the development of GM crops".

Spearman coefficient was also employed for measurement of relationships between the perceptions of extension specialists about extension activities and adoption of GM crops. Table 6 shows that there were significant relationship between independent variables and dependent variable except for three statements; "holding dialogue with the consumers, holding dialogue with the opponents of GM crops and increasing the participation of stakeholders in the development of GM crops.

Regression analysis: Table 7 shows the result for regression analysis by stepwise method.

Table 5: Correlation measures between independent variables and production of GM crops

		Agricultural professional	
Independent variables	Dependent variable	R	Sig.
Holding dialogue with the opponents of GM crops	Production of GM crops	0130	0.424
Increasing Stakeholders participation in the development of GM crops	Production of GM crops	0.077	0.636
Informing about the development of GM crops	Production of GM crops	0.600	0.000**
Informing about the research activities in GM crops	Production of GM crops	0.620	0.000**
Holding dialogue with the consumers	Production of GM crops	0.319	0.048*
Informing the publics about advantages of GM crops	Production of GM crops	0.574	0.000**
Improving the linkages between public and private sector	Production of GM crops	0.617	0.000**
Developing the comprehensive programs for improving the quality of GM crops	Production of GM crops	0.535	0.000**
Developing the appropriate mechanisms to transfer the research findings	Production of GM crops	0.539	0.000**
Organizing the educational activities about GM crops	Production of GM crops	0.524	0.001**
Adopting the policies which promote the use of GM crops	Production of GM crops	0.480	0.002**

*: p<0.05; **: p<0.01

Table 6: Correlation measures between independent variables and adoption of GM crops

		Agricultural professional	
Independent variables	Dependent variable	R	Sig.
Holding Dialogue with the opponents of biotechnology	Adoption of biotechnology products	0.086	0.597
Increasing the Stakeholders participation in the development of GM crops	Adoption of GM crops	0.049	0.766
Informing about the development of GM crops	Adoption of GM crops	0.549	0.000**
Informing about the research activities in GM crops	Adoption of GM crops	0.572	0.000**
Holding dialogue with the consumers	Adoption of GM crops	0.271	0.095
Informing the publics about advantages of GM crops	Adoption of GM crops	0.559	0.000**
Improving the linkages between public and private sector	Adoption of GM crops	0.569	0.000**
Developing the comprehensive programs for improving the quality of products	Adoption of GM crops	0.526	0.000**
Developing the appropriate mechanisms to transfer the research findings	Adoption of GM crops	0.529	0.000**
Organizing the educational activities about GM crops	Adoption of GM crops	0.516	0.001**
Adopting the policies which promote the use of GM crops	Adoption of GM crops	0.464	0.003**

**: p<0.01

Table 7: Multivariate Regression Analysis (production of GM crops as dependent variable)

	B	Beta	T	Sig.
Constant	-0.043	------	-0.085	0.933
Informing about the research activities in GM crops	0.411	0.387	2.308	0.028
Improving the linkages between public and private sector	0.408	0.382	2.281	0.029

$R^2 = 0.46$

Table 8: Multivariate Regression Analysis (Adoption of GM crops as dependent variable)

	B	Beta	T	Sig.
Constant	0.017	------	-0.033	0.974
Informing the public about advantages of GM crops	0.418	0.400	2.493	0.018
Improving the linkages between public and private sector	0.389	0.370	2.305	0.028

$R^2 = 0.44$

Independent variables that were significantly related to perception of extension specialists about role of extension in the production of biotechnology were subjected to regression analysis. The result indicates that 46% of the variance in the perception of extension specialists about the production of GM crops could be explained by two variables of informing about the research activities and improving the linkages between public and private sector.

In order to finding the variance in the perception of extension specialists about the adoption of GM crops, stepwise regression analysis was used. Table 8 displays the results and it indicates that 44% of the variance in the perception of extension specialists about the adoption of GM crops could be explained by two variables of informing the publics about advantages of GM crops and improving the linkages between public and private sector.

CONCLUSION

As the regression analysis showed, informing about the research activities and improving the linkages between public and private sector caused 46% of variance on the perception of the extension specialists regarding the production of GM crops. This result is consistent with Ozor[15] conclusion in which there is need for greater public-private sector collaboration in relation to agricultural biotechnology and its application to problems in developing countries. The cooperation between public and private sector in India show a great success in the development of Bt hybrid and Bt OPV eggplants for different groups of farmers. Results provide initial empirical evidence for policy makers and researchers analyzing the economic feasibility of the public-private partnership in the R and D of GM crops in India[11].

The findings also show that informing the public about advantages of GM crops and improving the linkages between public and private sector caused 44% of variance on the perception of extension specialists regarding the adoption of GM crops. Traynor *et al.*[21] reported that the benefits of today's biotechnology products are not evident to consumers. The public will accept biotechnology only when individuals decide for themselves that biotechnology products will contribute to their personal well-being. To make such a decision, people will need greater awareness and understanding of how biotechnology will affect the environment, human health, local and national economies and the well-being of society.

Based on the results of the study, the highest mean about the level of extension specialists knowledge were about GM crops' research. Ozor and Igbokwe[16] reported that research in biotechnology provides reliable high yields and decreases the cost by offering farmers better quality product with resistance to diseases, pest and other stress factors.

The results of this study point out to the importance stakeholders' participation in the development of GM crops. Poor people should be included directly in the debate and decision making about technological change, the risk of that change and the consequences of no change or alternative kinds of change[17]. Developing countries should have policies which ensure the adoption of biotechnology by small farmers. Otherwise, larger farmers are likely to capture most of the benefits through early adoption of the technology[12].

Implications: The role of biotechnology in agriculture has been the subject of intense debate among stakeholders. The perception of extension professionals about the production and adoption of GM crops was discussed in this article. The results demonstrated that extension specialists believed that adoption and production of GM crops to a great extent depend upon informing the public about advantages of the GM crops and increasing partnership between public and private sector.

In order to improve the awareness and understanding about the GM crops, agricultural extension should provide the accurate information about benefits, risks and impacts to the publics through variety of communication tools.

Based upon the results of this study, it is apparent that there is need to increase the level of stakeholders' participation in the development of GM crops. Public involvement will enhance the adoption of GM crops which would eventually lead to more investment in the research and development.

REFERENCES

1. Ameden, H., M. Qaim and D. Zilberman, 2005. Adoption of Biotechnology in Developing Countries. Natural Resource Manag. Policy, 27: 329-357. http://www.springerlink.com/content/g0815x1374278118/
2. Badr, A., 2002. What should be the role and focus of biotechnology in the agricultural research agendas of developing countries? Proceeding of the 8th Conference on FAO Biotechnology Forum, Nov. 13-Dec. 11, Food and Agriculture Organization of United Nations, Rome. http://www.fao.org/biotech/C8doc.htm
3. Bell, M., 2004. Improving the impact of research: using e-learning to improve agricultural extension. Asian Development Report, Report of the Regional Workshop, Bali, Indonesia.
4. Chimmiri, N., K.W. Tudor and A.D. Spaulding, 2006. An analysis of mclean county, illinois farmers' perceptions of genetically modified crops. AgbioForum, 9: 152-165. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=964990.
5. Eknanem, E., 2006. Consumer trust in extension as a source of biotech food information. J. Exten., 44. http://www.joe.org/joe/2006february/rb2.shtml.
6. Gelb, E. and G. Bonati, 1998. Evaluating Internet for Extension in Agriculture. The Journal of Agricultural Education and Extension, 5: 211-216. DOI: 10.1080/13892249885300321
7. Ghareyazie, B., 1999. Iran: Hopes, Achievements and Constraints in Agricultural Biotechnology. http://www.cgiar.org/biotech/rep0100/ghareyaz.pdf.
8. Hoban, T., 1989. Biotechnology: Implications for extension. J. Exten., 27. http://www.joe.org/joe/1989fall/a7.html.
9. Kambikambi, T., 2002. What should be the role and focus of biotechnology in the agricultural research agendas of developing countries? Proceeding of the 8th Conference of FAO Biotechnology Forum. Food and Agriculture Organization of United Nations, Rome. http://www.fao.org/biotech/C8doc.htm
10. Kershen, D.L., 1999. Biotechnology: An essay on the academy, cultural attitudes and public policy. AgbioForum, 2: 137-146. http://www.biotech-info.net/biotech_essay.html.
11. Kolady, D.E. and W. Lesser, 2006. Who adopts what kind of technologies? The case of Bt eggplant in India. AgBioForum, 9: 94-103. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=946411.
12. Leisinger, K.M., 1999. Disentangling Risk Issues. In: Biotechnology for Developing-Country Agriculture: Problems and Opportunities, Persley, G.J. (Ed.). IFPRI, Washington DC., USA. http://www.ifpri.org/2020/focus/focus02/focus02_05.asp
13. Marra, M.C., B. Hubbell and G.A. Carlson, 2001. Information quality, technology depreciation and Bt cotton adoption in the Southeastern US. J. Agric. Resourc. Econ., 26: 158-175. http://ageconsearch.umn.edu/bitstream/31158/1/26010158.pdf.
14. Oladele, O.I., 2005. A Tobit analysis of propensity to discontinue adoption of agricultural technology among farmers in Southwestern Nigeria. J. Central Eur. Agric. 6: 249-254. http://www.agr.hr/jcea/issues/jcea6-3/pdf/jcea63-7.pdf
15. Ozor, N., 2008. Challenges and impacts of agricultural biotechnology on developing societies. Afr. J. Biotechnol., 7: 322-330. http://www.academicjournals.org/AJB/abstracts/abs2008/19Feb/Ozor.htm.
16. Ozor, N. and E.M. Igbokwe, 2007. Roles of agricultural biotechnology in ensuring adequate food security in developing societies. Afr. J. Biotechnol., 6: 1597-1602. http://www.academicjournals.org/AJB/PDF/pdf2007/18Jul/Ozor%20and%20Igbokwe.pdf
17. Pinstrup Anderson, P. and M. Cohen, 1999. Modern Biotechnology for Food and Agriculture: Risks and Opportunities for the Poor. In: Agricultural Biotechnology and the Poor, Persley, G.J. and M.M. Lantin (Eds.). An International Conference on Biotechnology. CGIAR, Washington DC., USA. http://www.cgiar.org/biotech/rep0100/Ppanders.pdf
18. Qaim, M., 1999. Potential benefits of agricultural biotechnology: An Example from the mexican potato sector. Rev. Agric. Econ., 21: 390-408. http://harvest01.oit.umn.edu/node/6342?t=subject%3A%22Mexico%22&path=resources%2Fall
19. Rao, P.P. and V.G.K. Rao, 1996. Adoption of rice production technology by the tribal farmers. J. Res. ANGRAU, 24: 21-25.

20. Reece, D., 2002. What should be the role and focus of biotechnology in the agricultural research agendas of developing countries? Proceeding of the 8th Conference of FAO Biotechnology Forum. Food and Agriculture Organization of United Nations, Rome.
21. Traynor, P., M. Adonis and L. Gil, 2007. Strategic approaches to informing public about biotechnology in Latin America. Elect. J. Biotechnol., 10: 169-177. DOI: 10.2225/vol10-issue2-fulltext-12. http://www.ejbiotechnology.info/content/vol10/issue2/abstract/12/index.html
22. USDA., 2008. Adoption of biotechnology and its production impacts. Economic Research Service, Washington DC.
23. Wheeler, S., 2005. Factors Influencing Agricultural Professionals' Attitudes Toward Organic Agriculture and Biotechnology. Center for Regulation and Market Analysis, University of South Australia. http://een.anu.edu.au/e05prpap/wheeler.pdf.