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Full Length Research Paper

Role of agricultural extension services in generation and dissemination of agricultural biotechnology in Abia State, Nigeria

Akinnagbe, O. M.*, Ukaegbu, E. O. and Saddiq O. A. B.

Department of Agricultural Extension, Faculty of Agriculture, University of Nigeria, Nsukka, Nigeria.

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Agricultural biotechnology has demonstrated that it can play a role in raising the level of food, feed and fibre production. However, for agricultural biotechnology to be effective and beneficial to the target end-user, agricultural extension services must be effective in achieving high rates of adoption. This study was undertaken to ascertain the role of extension services in generation and disseminating agricultural biotechnology in Abia state, Nigeria. Data for the study were collected from 80 respondents (researchers, extension professionals and farmers), through the use of structured questionnaire and interview schedule. A multistage sampling technique was used to select the respondents. The results of the study reveal that, the major role of extension services includes; improving the linkages between public and private sectors involvement in agricultural biotechnology, involvement of end users (farmers) to participate in issues relating to biotechnology research and development, and developing the appropriate mechanisms to transfer the research findings on agricultural biotechnology to the end users. The research determines that, the three groups of respondents (researchers, extension professionals and farmers) held similar opinions in regard to the role of extension services in facilitating the adoption of biotechnology.

Key words: Agricultural extension, role, dissemination, adoption, agricultural biotechnology.

INTRODUCTION

Human population growth and increasing urbanization are putting a massive pressure in demand for food production in developing countries. According to Oladele and Akinsorotan (2007), there are about 790 million undernourished people in developing countries whose food intake is insufficient to meet basic energy requirements on a continuous basis. Biotechnology therefore represents one of such novel approaches with the capacity of changing the face of agriculture so as to meet the increasing and varying needs for food, livestock feed and fibre production (Penn, 2003).

Agricultural biotechnology can play an important role in increasing production and improving the quality of food produced by farmers. Biotechnology promises to contribute to world food demands as well as deliver a range of environmental, health and economic advantages (Wheeler, 2005). Agricultural biotechnology has the potential to make crop breeding and crop management systems more efficient thereby generating improved crop varieties and higher yields.

According to FAO (2004), agricultural applications of biotechnology cover fields as diverse as traditional fermentation technologies used in food processing (that is, the process of bioconversion of organic substances by micro-organisms and/or enzymes of microbial, plant or animal origin), to the use of gene transfer techniques from one plant or animal species to another. It equally

*Corresponding author. E-mail: wolexakins@yahoo.com or oluwole.akinnagbe@unn.edu.ng. Tel: +2348035399151.

may include the ability to: manipulate genetic material and transfer genes between organisms in order to promote desired traits and suppress unwanted ones, propagate disease free planting materials in the laboratory to support traditional breeding techniques. Other areas of agricultural biotechnology include; genomics (mapping of complete organism genomics), and bioinformatics (computer processing of masses of genetic data) (Glover, 2001). Since the origins of organized extension services in second half of the 19th century, the aim of extension has been to accelerate the adoption of improved practices, and application of new technologies in agriculture (l'Agriculture in Davis et al., 2004; Anderson and Feder, 2004). For more than a century, extension worldwide primarily followed a linear transfer-of-technology approach, involving adoption of science-based technologies (Rogers, 1995). In this role, extension functioned on the basis of an expert consultant, offering the presumed best solution (Severs et al., 1997). As technological advances in agriculture become increasingly more complex, participatory extension approaches such as the Farmer Field Schools (FFS) and Farmer-Group approach are emerging methodologies for technology validation and dissemination in Nigeria. Participatory approaches calls for a shift from the status quo (Akinnagbe and Ajayi, 2010).

Research has shown that majority of the information that the public receive about agricultural biotechnology comes from the media and from non-objective sources which could promote or hinder biotechnology issues (Hallman and Metcalfe, 1995). Such information fuels the debate without providing consumers much in the way of balanced and science-based information. Most often, the general public and farmers in particular are not informed about the nature of the biotechnology, its potential benefits and risks, and rarely do they participate in deciding on what crops or problems agricultural biotechnology research and development should focus on. The questions therefore are; What are the role of extension services in generation and dissemination of agricultural biotechnology? What are the perceived benefits of agricultural biotechnology?

The purpose of the study was to ascertain the role of agricultural extension services in generation and dissemination of agricultural biotechnology in Abia state, Nigeria and also to ascertain the perceived benefit of agricultural biotechnology.

MATERIALS AND METHODS

The study was carried out in Abia state, one of the 36 states in Nigeria. It lies between the latitudes of 4°41' and 6°14' north and longitudes of 7° 10' and 7°30' east. It occupies about 5834 square kilometers with a population of around 2,833,999 made up of 1,434,193 males and 1,399,806 females (NPC, 2007). Researchers, extension professionals and farmers constituted the population for the study. A multistage sampling technique was used in the selection of the respondents.

The first stage involves the selection of researchers from research institute and university. Twenty (20) researchers of National Root Crops Research Institute (NRCRI) Umudike were purposively selected because of their involvement in agricultural biotechnology. Also, five staff each from the Departments of Crop Science, Animal Science, Micro-biology and Agricultural Extension of Michael Okpara University of Agriculture, Umudike (MOUAU) was purposively selected because of their research involvement in generation and dissemination of agricultural biotechnology, thus, making a total of 40 researchers from research institute and university.

The second stage involves selection of 20 extension professionals from Agricultural Development Programme (ADP) comprising the director, subject matter specialists, block extension specialists and extension agents.

The third stage involves the selection of farmers. Out of the 18 local government areas (LGAs) in the state, two LGAs (Ikwuano and Umuahia south) were purposively selected because of their closeness to the research institutes and the university community. From these LGAs, two communities each (Umudike and Amawom in Ikwuano LGA and Ohuhu and Ossa-Ibeku in Umuahia south LGA) were selected. From the selected four communities, five farmers were randomly selected from the list of 10 farmers presented by the community leaders, making a total of 20 farmers. In all, a total of 80 respondents were used for the study.

Data for the study were collected from the respondents through the use of questionnaire and structured interview schedule. To ascertain the role of agricultural extension services in generation and dissemination of agricultural biotechnology, a list of the possible role of agricultural extension services in generation and dissemination of agricultural biotechnology were provided to the respondents on a 4-point Likert type scale with response options (strongly agree = 4; agree = 3; disagree = 2; and strongly disagree = 1). The values on the Likert type scale were added to obtain 10, and divided by 4 to obtain a mean score of 2.5 which serves as the benchmark. Any variable with a mean score equal or higher than 2.5 was considered as the expected role of agricultural extension services in generation and dissemination of agricultural biotechnology while variable with a mean score of less than 2.5 was not regarded as agricultural extension services role in agricultural biotechnology.

To ascertain the benefits of agricultural biotechnology, a list of possible benefits were given on a 5-point Likert type scale with response options (to a great extent = 5; to some extent = 4; to a little extent = 3; to a very little extent = 2; to no extent = 1). The values on the Likert type scale were added to obtain 15, and divided by 5 to obtain a mean score of 3.0 which serves as the benchmark. Any variable with a mean score equal or higher than 3.0 was considered as the benefit of agricultural biotechnology, while mean score value of less than 3.0 was not regarded as benefit of agricultural biotechnology.

Mean statistic, standard deviation and analysis of variance (ANOVA) were used to analyze the data. Statistical Package for Social Science (SPSS), version 16 constituted the software used for data analysis.

RESULTS

Role of agricultural extension services in generation and dissemination of agricultural biotechnology

Data in Table 1 show the range of perceptions on the role of agricultural extension services in generation and

Table 1. Mean score of respondents on perceived extension roles in dissemination of agricultural biotechnology.

Extension role	Mean (M)	SD
Improving the linkages between public and private sectors involvement in agricultural biotechnology	3.61*	0.746
Developing the appropriate mechanisms to transfer the research findings on agricultural biotechnology	3.41*	0.760
Involvement of end-users (farmers) to participate in issues relating to biotechnology research and development.	3.49*	0.849
Educating the end users to adopt the new innovation in order to achieve food security.	3.28*	0.886
Encouraging the development of positive attitudes amongst scientists of the knowledge, experience and capabilities of the local people in research and development process.	1.73	1.055
Encouraging the development of receptive attitude in farmers or local people to accept technological changes in their farming practices.	3.14*	0.868
Equipping the farmers with managerial skills through informal education and demonstrations to sustain proven biotechnology.	3.26*	0.838
Technology financing through donor agencies and procurement of essential machinery.	1.36	0.733
Linking farmers to the source of farm credit	1.31	0.805
Provision of accurate, unbiased, objective and research-based information on agricultural biotechnology.	3.13*	0.769
Provides specialists and researchers with information on farmers needs.	3.29*	0.732
Provides feedback on the effectiveness of biotechnology innovations	3.28*	0.800
Developing the appropriate mechanisms to transfer the research findings on agricultural biotechnology	3.31*	0.853
Increasing farmer household productivity through dissemination of improved desirable traits of biotechnology products	3.05*	0.825
Encouraging farmers to participate at local level development.	3.03*	0.821
Helping farmers to identify and analyze their production problems.	3.26*	0.746
Making the farmers to be aware of the opportunities to obtain increased income and attain a better standard of living.	3.25*	0.808
Informing the public about the development of the GM crops using different communication channels	2.99*	0.890
Application of advanced scientific knowledge to farming and home of the rural people	1.51	1.006
Overall improvement of the quality of life of the rural people within the frame work of the national economic social policies as a whole.	1.64	1.070
Provision of incentive to farmers through extension delivery systems provided with good information about GM crops.	3.06*	0.757

*Significant.

dissemination of agricultural biotechnology. These roles included: improving the linkages between public and private sectors involvement in agricultural biotechnology (M = 3.61); involvement of end users (farmers) to participate in issues relating to biotechnology research and development (M=3.49); developing the appropriate mechanisms to transfer the research findings on agricultural biotechnology (M=3.31), providing specialists and researchers with information on farmers' needs (M= 3.29), educating the end users to adopt new innovation on biotechnology in order to achieve food security (M = 3.28), providing feedback on effectiveness of biotechnology innovations (M=3.28), equipping the farmers with managerial skills through informal education

Table 2. Test of differences between perception of researchers, extension professionals and farmers on possible roles of extension in dissemination of agricultural biotechnology.

Extension role	Researcher		Extension		Farmer		F-value
	M	SD	M	SD	M	SD	
Improving the linkages between public and private sectors involvement in agricultural biotechnology	3.53	0.640	3.50	0.513	3.35	1.089	0.376
Developing the appropriate mechanisms to transfer the research findings on agricultural biotechnology	3.38	0.673	3.75	0.444	3.10	1.021	3.967*
Involvement of end-users (farmers) to participate in issues relating to biotechnology research and development.	3.22	0.800	3.65	0.587	2.90	1.021	4.257*
Educating the end users to adopt the new innovation in order to achieve food secure.	3.30	0.758	3.65	0.745	2.85	1.089	4.474*
Encouraging the development of positive attitudes in the scientists to appreciate the knowledge, experience and capabilities of the local people in research development process.	1.75	1.080	1.50	0.827	1.90	1.210	0.736
Encouraging the development of receptive attitude in farmers or local people to accept technological changes in their farming practices.	3.20	0.791	3.40	0.598	2.75	1.118	3.179*
Equipping the farmers with managerial skills through informal education and demonstrations to sustain accepted biotechnology.	3.33	0.572	3.60	0.681	2.80	1.196	5.298*
Technology financing through implementation of donor agency proposal and procurement of essential machinery.	1.28	0.554	1.35	0.813	1.55	0.945	0.940
Linking farmers to the source of farm credit	1.18	0.594	1.35	0.933	1.55	0.999	1.494
Provision of accurate, unbiased, objective and research based information on agricultural biotechnology.	3.30	0.758	3.20	0.523	2.70	0.865	4.559*
Provides specialists and researchers with information on farmers needs.	3.47	0.599	3.40	0.754	2.80	0.768	6.863*
Provides feedback on the effectiveness of biotechnology innovations	3.25	0.707	3.70	0.571	2.89	0.994	5.578*
Developing the appropriate mechanisms to transfer the research findings on agricultural biotechnology	3.10	0.778	3.45	0.510	2.90	1.165	2.223
Increasing farmer household productivity through dissemination of improved desirable traits of biotechnology products	3.00	0.751	3.50	0.513	2.70	1.031	5.383*
Encouraging farmers to participate at local level development.	3.16	0.638	3.20	0.894	2.60	0.940	3.902*
Helping farmers to identify and analyze their production problems.	3.26	0.685	3.65	0.489	2.85	0.875	6.585*
Making the farmers to be aware of the opportunities for important in farm in order to obtain increased income and attain a better standard of living.	3.31	0.766	3.45	0.605	2.95	0.999	2.151

Table 2. Continued.

Extension role	Researcher		Extension		Farmer		F-value
	M	SD	M	SD	M	SD	
Informing the public about the development of the GM crops using different communication channels	3.05	0.804	3.05	0.945	2.80	1.005	0.589
Application of advanced scientific knowledge to farming and home of the rural people	1.33	0.797	1.65	1.182	1.75	1.164	1.455
Overall improvement of the quality of life of the rural people within the frame work of the national economic social policies as a whole.	1.48	0.960	1.75	1.209	1.85	1.137	0.965
Provision of incentive to farmers through extension delivery systems provided with good information about GM crops.	2.97	0.743	3.20	0.696	3.10	0.852	0.613

*Significant overall F-value = 2.589; p≤0.05.

and demonstrations to sustain proven biotechnology (M=3.26), helping farmers to identify and analyze their production problems (M=3.26) and making the farmers to be aware of the opportunities for improvement in farm yields in order to obtain increased income and attain a better standard of living (M=3.25).

Other roles expected of extension services in dissemination of agricultural biotechnology includes: encouraging the development of receptive attitude in farmers or local people to accept technology changes in their farming practices (M=3.14), provision of accurate, unbiased objective and research base information on agricultural biotechnology (M=3.13), provision of incentive to farmers through extension delivery systems provided with good information about genetically modified (GM) crops (M=3.06), increasing farmers' household productivity through dissemination of improved desirable traits (M=3.05), encouraging farmers to participate at local level of biotechnology development (M=3.03) and informing the public about the development of the GM crops using different communication channels (M=2.99).

Differences between researchers, extension professionals and farmers on role of agricultural extension services in generation and dissemination of agricultural biotechnology

Data in Table 2 reveals that the overall test of difference in opinion of the researchers, extension professionals and farmers as regards the role of agricultural extension services in generation and dissemination of agricultural biotechnology was not significant (F=2.589; p≤0.05). This implies that, the three groups of respondents (researchers, extension professionals and farmers) hold the same opinion as regards the roles of extension services in generation and dissemination of agricultural biotechnology. This could be as result of the awareness and the perceived benefit of agricultural biotechnology in the increasing needs (food, feed and fibre) of people, which they perceived extension has a great role to play in informing, educating and advising.

Benefits of agricultural biotechnology

Table 3 shows the mean score and the standard deviation (SD) of respondents' perceived benefits of agricultural biotechnology. Among these benefits include: increase in productivity (M=4.44), increased yield (M=4.43), increased quality and shelf life of products (M=4.09), help in selection and breeding of new varieties of plants and animals (M=4.06) and improved resistance to pest and diseases (M=4.04). This implies that agricultural biotechnology research and development represents one of such novel approaches with the capability of changing the face of agriculture so as to meet the increasing and varying needs (food, feed and fibre) of people in the new millennium which is the role of agricultural biotechnology that has been acknowledged since its commercial introduction in 1996 (Penn, 2003).

Differences between researchers, extension workers and farmers' perception on the benefits of agricultural biotechnology

Data in Table 4 show the differences in perception of researchers, extension workers and farmers on the perceived benefits of agricultural biotechnology using analysis of variance (ANOVA). The result shows that, there was no significant differences (F=1.021; p≤0.05) on benefit of agricultural biotechnology as perceived by the

Table 3. Mean score of respondents on the benefits of agricultural biotechnology.

Perceived benefits of agricultural biotechnology	Mean (M)	SD
Increased yield	4.43*	1.077
Increased productivity	4.44*	1.017
Improved quality and shelf life of products	4.09*	1.150
Improved resistance to pest and diseases	4.04*	1.206
Adaptation of existing crops and livestock to different environment.	3.74*	1.166
Reduced water pollution through less of chemical input.	3.49*	1.312
Help to ease the strain on land resources.	3.83*	1.156
Reduced top soil erosion through the use of herbicide tolerant crops which encourage adoption of conservation tillage.	3.68*	1.281
Safer water supplies and higher quality drinking water and better environment for wild life through reduced chemical usage.	3.61*	1.297
Improves nutritional quality of staple food cassava.	4.03*	1.181
Removes food contaminants and toxins.	3.77*	1.187
Improves storage properties of fruits and vegetables.	3.54*	1.299
Makes plants more resistant to drought, flooding etc.	3.59*	1.260
Improves growth rate of crops and animals.	3.87*	1.304
Breeding crop varieties resistant to specific herbicide.	3.84*	1.277
Speeds up breeding programme for plants, livestock and fish.	1.76	1.398
Used to develop low cost disease free planting material.	1.63	1.216
Development of plants that are early maturing.	3.72*	1.387
Increases the financial returns for farmers.	3.80*	1.223
Reduction in cost of labour, energy and chemical.	3.44*	1.089
Energy usage on biotechnology crop is lower.	1.75	1.288
Reduced pest and disease incidence through the development of disease resistant crops.	3.90*	1.139
Protect the environment and biological diversity through reduced use of fertilizer and agro chemicals.	3.56*	1.146
Enhanced income earning power of small holder farmers.	3.72*	1.120
Provision of new tools for improving animal health.	3.73*	1.140
Help in selection and breeding of new varieties of plants and animals.	4.06*	0.985
Used for accurate diagnosis and control of diseases in plants and animal.	3.50*	1.232
Increases both quality and quantity of existing food products.	4.00*	1.067
Helps in diversifying agricultural production by speeding the development of new varieties.	3.89*	1.031
Accelerate the birth of the best possible stock through cloning.	3.64*	1.150
Biotechnology is used to protect endangered species	1.69	1.327
Increases the reproduction of strongest and healthiest animal.	1.74	1.250
Improve animal welfare that is less disease and longer life span.	3.75*	1.138
Improves animal production efficiency.	3.84*	1.148
Development of vaccine to protect poultry especially chicken from Newcastle disease.	3.81*	1.199

*Perceived benefit

Table 4. Test of differences between perception of researchers, extension professionals and farmers on benefit of agricultural biotechnology.

Parameter	ANOVA				
	Sum of squares	df	Mean square	F	Significance
Between groups	1.073	2	0.537	1.021	0.365
Within groups	39.938	76	0.525		
Total	41.011	78			

researchers, extension workers and farmers.

DISCUSSION

For agricultural biotechnology to raise the level of food, feed and fibre production in the country, agricultural extension services must be effective in achieving high rates of adoption of these biotechnology products. The majority of information that the public receives about agricultural biotechnology comes from the media or biotechnology companies like Monsanto, which promote it, or environmental organizations like Greenpeace (Hallman and Metcalfe, 1995). Such information fuels the debate without providing consumers much in the way of balanced, science-based information. As a result, many consumers have developed questions and concerns about the technology. Some argue that if consumers understood the science of the process, they would accept biotechnology more readily. Public education is a major task of extension worldwide, and is one potential strategy to inform diverse audiences about agricultural biotechnology as observed by Davis et al. (2003). If so, extension must take a proactive leadership role and formulate innovative strategies to address the issue of transferring the research findings on agricultural biotechnology and educating the end users to adopt innovations on biotechnology.

Also, agricultural extension has a great role in improving the linkages between public and private sectors involvement in agricultural biotechnology. Public-private partnership is more an effective mechanism for converting the potential of biotechnology in producing products that improve productivity and economic conditions of agriculture sectors (Seyed et al., 2011). In most developing societies, public sector investment is still the main source of finance for biotechnology research and development. For public research institutions in Africa to access scientific information and investments in genetic engineering, they will need to create strategic links with private companies in the industrialized countries. There is therefore a need for greater public-private sector collaboration in relation to agricultural biotechnology and its application to problems in the developing world (Ozor, 2008). This partnership could be strengthened by extension services through acting as conduits between farmers and researchers (Black, 2000; Botha et al., 2007; Hunt et al., 2012).

In a country's agricultural development process such as Nigeria, extension services are expected to help farmers identify and analyze their production problems, make them aware of the opportunities for improvement in farm yields in order to obtain increased income and attain a better standard of living. It is also through education and communication that extension services bring changes in farmers' knowledge, attitude and skills which help to put the farmers in a frame of mind conducive for adopting proven agricultural innovations (Agbamu, 2005). According to Trigo and Cap (2006), the adoption rate by farmers since the introduction of agricultural biotechnology, reflects farmer's satisfaction in both developed and developing countries. Extension services are therefore expected to provide functional, efficient and cost-effective advising to resource-poor farmers as a major pre-requisite to keeping food production at pace with population growth.

The results of the research in Table 2 further show that the respondents (researchers, extension professionals and farmers) hold the same opinion as regards the roles of extension services in generation and dissemination of agricultural biotechnology, indicating that that their opinion could be used for policy making. The particular areas they agree were: improving the linkages between public and private sectors involvement in agricultural biotechnology, encouraging the development of positive attitudes in scientists to appreciate the knowledge, experience, and capabilities of the people in research development process, technology financing through implementation of donor agency proposal and procurement of essential machinery, linking farmers to the source of farm credit, developing the appropriate mechanisms to transfer the research findings on agricultural biotechnology, and informing the public about the development of the GM crops using different communication channels.

Out of 35 possible benefits listed in the Table 3, 30 were considered to be possible benefits derived from agricultural biotechnology. Agricultural biotechnology results in increase in productivity, yield, quality and shelf

life of products. It also helps in selection and breeding of new varieties of plants and animals and improved resistance to pest and diseases. This implies that agricultural biotechnology has the potential to play a large role in more rapidly advancing agricultural productivity especially in developing countries while protecting the environment for future generations. According to Ozor and Igbokwe (2007), agricultural technology aimed toward fighting the persistent food crisis situations of many developing societies.

However, the respondents do not perceive that agricultural biotechnology could speeds up breeding programme for plants, livestock and fish. This could be as a result of the different experimental stages of plant and animal bleedings which could take years before the final result could be obtained. Also, the respondents did not consider disease resistant free planting material at low cost as a benefit of agricultural biotechnology. Of course, a disease free planting material will be costly than the local varieties.

The three groups of respondents hold the same opinion on the perceived benefit of agricultural biotechnology, indicating that their opinion do not vary on the benefit of agricultural biotechnology. The implication is that there opinion could be used for policy making implying that agricultural biotechnology can assist crop-breeders to improve the yields and quality of crops and their production under strenuous conditions. Plants can be made more tolerant of drought, heat and frost. They can be made more resistant to diseases and insect pests, reducing the input of agrochemicals. Genetic modification can also greatly facilitate the development of crops with improved storage properties and nutritional characteristics (proteins and vitamins).

Conclusion

The role of agricultural extension traditionally has been to provide research-based information to clientele on agricultural issues. Public concern about agricultural biotechnology is an important issue that extension services may find itself continuing to address as it chart its course in the 21st century. This paper examines role of agricultural extension services in generation and dissemination of agricultural biotechnology in Abia state, Nigeria. The results of the study reveal that, agricultural extension services have a great role to play in providing specialists and researchers with information on farmers' needs and equipping the farmers with skills through informal extension education and demonstration. Agricultural biotechnology represents promising technologies that can make a vital contribution to global food, feed and fibre security.

Based on the results of this study, the respondents (researchers, extension professionals and farmers) hold the same opinion that extension services should improve the linkages between public and private sectors involvement in agricultural biotechnology, providing accurate, unbiased, objective and research based information on agricultural biotechnology and developing the appropriate mechanisms to transfer the research findings on agricultural biotechnology.

The implication is that, if agricultural extension services perform these roles, and the public understand the science of the process and benefits of biotechnology, they would accept biotechnology more rapidly, and this could lead to more investment in the research and development which could help in reducing the food insecurity in the country.

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