

Perception: A Determinant of Scientists' Participation in Agricultural Biotechnology Research and Development

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Abstract

The perception of scientists was assessed to determine how it affects their participation in agricultural biotechnology Research and Development. Six Universities were selected, comprising 2 Federal Universities, 2 State Universities, 1 University of Agriculture, 1 University of Technology. Nine Research Institutes were purposively selected to represent different research mandates. The total number of respondents for the study were 148. A structured questionnaire was used. Majority of the respondents (89.9%) were favorably disposed towards agricultural biotechnology. There is no significant relationship between sex ($\chi^2=2.97$, $p > 0.05$), marital status ($\chi^2=2.495$, $p > 0.05$), and qualification ($\chi^2=3.032$, $p > 0.05$) and scientists perception about agricultural biotechnology. Religion significantly affects scientists perception ($\chi^2=21.44$, $p > 0.05$). Scientists perception about agricultural biotechnology does not significantly affect participation ($r=-.024$, $p < 0.05$). Efforts to build capacity for agricultural biotechnology Research and Development must leverage on the positive perception about the innovation among scientists in the National Agricultural Research System.

Keywords: Perception, Research, Development, Biotechnology, Scientists, Agriculture

1. Introduction

Biotechnology as a scientific accession has generated much debate bothering around appropriateness, ethics, acclaimed potentials to deal with intractable farm problems and a host of other issues. It has created a divide among scientists, farmers, consumers, policy makers, and the industry. These pro-anti arguments have influenced the rate at which the technology is finding a fit in the agricultural research system. Perception among stakeholders is responsible for their position on either side of the divide. According to Chaturvedi, (2001) the first determinant of integration of biotechnology in the overall agricultural research system emanates from the very perception of the technology. Succinctly put by Abdalla, *et al*, (2003), the overall factor that determines the adoption of biotechnology is the attitude of governments and the public towards it. Perception about agricultural

biotechnology is informed by the nature and depth of understanding about the field. Aerni, (2001) underscored this by stating that better understanding of the different aspects that form public perception of the technology may help to improve understanding for certain positions and build new constructive dialogue that also reintroduces factual knowledge about the risks and benefits of agricultural biotechnology.

1.1 The Role of information in Shaping perception about Agricultural Biotechnology

Information is the key element in determining perceptions about agricultural biotechnology. The more reliable a particular source of information is considered, the stronger it is likely to influence perception. Oladele and Akinsorotan, (2007) found out that a significant relationship exists between sources from which such information is obtained and perceptions about the technology. Aerni, (2001) corroborates this position by observing that an individual's perception of the risks and benefits of a new technology is a very complex process, determined by the selected sources of information, interests and personal experiences. In the case of agricultural biotechnology, most people cannot count on personal experience, but must rely entirely on information they receive. Their sources of information can be rumors, experience of specialists in the field, statements by industry, government, public interest groups, the academia and media reports.

Alhassan, (2002) placed the responsibility for accurate perception of agricultural biotechnology on adequate awareness about the technology and proposed the following as important steps towards establishing a balance in delivering useful information about agricultural biotechnology to stakeholders:

1. Assisting the media through contribution of feature articles
2. Organizing special biotechnology and biosafety workshop
3. Sponsoring program on radio, television, etc.
4. Writing texts of documentaries for filming by the media.
5. Sponsoring documentaries through cash payment or provision of equipment.
6. NGO's that play advocacy role for biotechnology should be encouraged through sponsorship for their activities
7. NARI's activities in biotechnology should organize periodical tour of schools to sensitize and demystify the technology
8. Farmer organizations should benefit from public enlightenment activities.

1.2 Some Sources of Information for Agricultural Biotechnology Research

Some important sources of agricultural research information available to scientists in sub-Saharan Africa include journals, newsletters, magazines textbooks, internet, workshops, conferences, and seminars. Electronic sources constitute a vital resource for information on agricultural biotechnology. Apart from the internet, which provides access to technical information and scientific report on agricultural biotechnology, radio and television are sources that provide reports and updates about breakthroughs in the field of biotechnology in Africa and elsewhere in the world. Wambugi, (2005) observed that not a single ICT based forum in Africa fails to emphasize that Africa stands to be marginalized and excluded from the global economy if it does not partake of the digital revolution. While ICTs like the radio and television have developed considerably in Nigeria, the internet is still being developed. While some of the sources available to African scientists may not contain information with depth in terms of technicality, they serve as media for disseminating research results and stimulating interest for further research. Media like Newspapers provide a forum for advocacy activities in agricultural biotechnology research and development.

Workshops, Conferences and seminars provide fora where scientists, whether from the National Agricultural Research Institutes or Universities can meet to exchange notes and information on agricultural biotechnology. Michelsen, *et al.* (2003) suggested that opening up seminars and workshops in Universities and National Agricultural Research Institutes to a much wider public participation will allow for better participation. Such participatory approach in sharing of information in agricultural biotechnology will influence perception, promote problem solving and enhance the adoption and use of the products of research.

1.3 Perception about Agricultural Biotechnology in Developing Countries

Perception about agricultural biotechnology has not attracted much attention in the public domain in developing countries. This is not because the public is not interested in the technology and its potential benefits and risks; rather the relative quiet about the debate is because of general dearth in information. Aerni, (2001) in agreement with this position pointed out that attitude in developing countries is often neglected since it is assumed that a majority of the people in these countries is hardly informed about the advent of biotechnology. In addition, they

would probably be more concerned about everyday risks rather than potential long-term risks of a new technology. Interestingly, it is the perception of the political stakeholders rather than the perception of the public at large that counts in public policy. In turn, these political stakeholders also depend on a certain degree of public support. In other words, they are in need of public trust to enhance their freedom of political action

Extension systems have been identified as an integral element in shaping public perception about agricultural biotechnology. Hosseini *et al.*, (2008) established a relationship between extension activities in agricultural biotechnology and perception of the technology by extension specialists. This underscores the need to ensure that extension workers are given adequate information. The frequent contact between extension workers and farmers make extension services indispensable in the quest to achieve a widespread acceptance of the technology.

The general objective of this work was to evaluate scientists' perception as a determinant of their participation in agriculture biotechnology R&D in Nigeria. The following specific objectives were formulated to guide the study:

1. The identification personal characteristics of scientists participating in agricultural biotechnology research,
2. Identify sources of information of scientists about agricultural biotechnology R&D
3. The determination of scientists' perception about agricultural biotechnology and
4. The determination of their level of participation.

2. Research Methods

The study was a countrywide survey covering the whole of Nigeria. The country is located between latitudes 40°N and 140°N and between longitudes 30°E and 150°E. It is regarded as the largest country in West Africa occupying a total land area of 923, 773 square kilometers, out of which 13 000 square kilometers is covered by water. The total land boundary is 4047 kilometers square. Nigeria is bounded to the west by Benin republic, with a total land boundary of 773 kilometers, Cameroon to the east, with 1,690 kilometers, Niger and Chad in the north with 87 km and 1,497 km respectively and the Atlantic Ocean with a coastline of 960-km borders the south.

The population of the study is scientists in National Agricultural Research Institutes, Faculties of Agriculture, and Faculties of Veterinary Medicine in Nigerian Universities who are participating in the use of agricultural biotechnology applications for research.

Multistage sampling was used to draw samples from both Universities and National Agricultural Research Institutes.

Two Federal Universities and two State Universities were randomly selected from a list of Federal and State Universities respectively. In addition to these, one University each was selected from the four Universities of Technology, and three Federal Universities of Agriculture, bringing the total of selected Universities to six (6). Forty three scientists were purposively selected from the faculties of agriculture and veterinary medicine, based on participation in agricultural biotechnology research.

Nine Research Institutes were purposively selected based on their mandates. A total of 105 scientists were purposively selected from the Research Institutes, based on their participation in agricultural biotechnology research. The total number of respondents from the selected Universities and Research Institutes amounted to 148 scientists.

A structured questionnaire containing open and closed ended questions was used to obtain primary information on the activities of scientists in agricultural biotechnology research and the constraints they face. The questionnaire was subjected to face validity by scientists from various biosciences in the National Veterinary Research Institute, Vom, and the University of Ibadan, Nigeria.

Personal profiles covered age, sex, religion and marital status, while professional profiles included nature of employment (University or Research Institute), experience, and qualification. For variables like sex, qualification, and nature of employment, respondents merely indicated the category they belong i.e. sex: male, female; nature of employment: University, Research Institute and qualification: PhD, M.Phil, M.Sc and B.Sc. Qualification was ordered hierarchically (B.Sc., M.Sc., M.Phil, and PhD) for the respondents to indicate their highest level of attainment. Age was measured at interval level as actual years. A list of various sources/channels through which scientists receive agricultural biotechnology related information was provided and respondents required to rate the availability and use of these sources on a three point scale of 'often'=2 points, 'occasionally'= 1 point, and 'never'= 0 point.

Scientists' perception about agricultural biotechnology was determined through a list of statements. Respondents were required to respond on a 5 point scale of 'strongly agreed'=5, 'agreed'=4, 'undecided'=3, 'disagree'=2, and 'disagree'=1 for positive statements and the reverse for negative statements.

Participation was determined by providing a list of agricultural biotechnology laboratory/field applications, publication/documentation of biotechnology information, extension and training activities by scientists and participation in development activities in the area of agricultural biotechnology. Respondents indicated the frequency of participation in these activities, i.e. Always=2, Sometimes=1, and never=0.

3. Results and Discussion

Table 1 shows the personal characteristics of scientists and the descriptive statistics. There were more male scientists than females and more of the females were married. The modal age range for scientists is 36-45 years. With respect to professional profile, 48.6% had qualification up to the M.Sc level, are at the senior cadre, and have had work experience of over 10 years as researchers. Their major activity is conducting of research.

A chart was provided to find out the activities of respondents in agricultural biotechnology research and development activities. Percentages of participation in each activity were computed and results on table 2 show that activities with the highest percentage participation, include laboratory fermentation, with a cumulative 50% (either participating always or sometimes), tissue culture experiments (cumulative 48.6%), laboratory multiplication (cumulative 54.9%), and publication/ documentation in journals (65.5%).

Formal, technical sources of information for scientists in agricultural biotechnology research include journals, often used by 55.3% of scientists and occasionally used by 40.7%, technical reports, often used by 35.3% of respondents and occasionally used by 52.6%, newsletters often used by 30.7% and occasionally used by 62.7%, textbooks, often used by 56.7 and occasionally used by 32.0% as shown on table 3. This category of sources of information are considered as traditional. These are relevant for performance of scientists and are often used as basis for comparison or further research work. Other rather non-technical print media for agricultural biotechnology information include newspapers, often used by 30.7% and occasionally used by 56.7% and magazines often used by 30.7% and occasionally by used 59.4% of scientists.

Table 4 shows a list of perception statements, the mean perception scores of each statement and the mean deviation. Scores that exceeded the overall mean of 3.30 were indicative of positive response by scientists, while those that scored below the overall mean were considered to have negatively responded. Of the 26 statements provided, 17 had mean perception scores higher than the overall mean, while 9 had scores below the overall mean

Table five shows that more scientists are favorably disposed towards agricultural biotechnology with 89.9% indicating that they are favorably disposed to the technology. This may be the result of the growing consensus about the potential of the technology to address the growing challenge of food insufficiency in developing countries (UNESCO, 2003; Adekoya and Oladele, 2008; and Duduyemi, 2007). This expectation has generated quite some goodwill for the technology.

3.1 Relationship between Variables

Some personal characteristics were correlated with perception as shown on table 6. Sex does not significantly affect perception about agricultural biotechnology ($\chi^2=2.97$, $p > 0.05$). This validates the insignificant relationship between sex and participation ($\chi^2=2.285$, $p > 0.05$). Women have the same persuasion as men, as it is explained by Beintema and Marcantonio, (2009). It is important to note that the same study found out that women have a higher prevalence in fields related to life sciences and are comparatively lower in fields involving physical engineering and other areas traditionally thought of as hard sciences.

Other personal characteristics that do not affect perception about agricultural biotechnology include marital status ($\chi^2=2.495$, $p > 0.05$), qualification ($\chi^2=3.032$, $p > 0.05$) and specialization ($\chi^2=28.505$, $p > 0.05$). This is in contradiction with Oladele and Akinsorotan, (2007) who established a negative relationship between certain specializations and perception of agricultural biotechnology. Perception is an important contributor to attitude and can affect the participation of scientists. The qualification of respondents, which is from first degree upwards, places them in a position to be adequately knowledgeable about agricultural biotechnology and to form informed opinions about the technology. Religion is an important element in the formation of judgment about the ethical soundness or otherwise of issues. It significantly affects attitude to agricultural biotechnology ($\chi^2=21.44$, $p < 0.05$) as can be seen on table 6 below.

Correlation results on table 7 shows that there is no significant relationship between the perception of scientists about agricultural biotechnology research and participation ($r = -.024$, $p > 0.05$). Scientists work within

organizations mandate to carry out specific research activities. Irefin *et al.*, (2008) noted that attraction of scientists to research institutions may result from their specific mandates. It will be expected that such a scientist participates and contributes to the attainment of the research mandate establishing the particular research institution he or she works in. The choice of which areas of biotechnology research to work in within the mandate of the research organization may be the prerogative of the individual scientists.

Scientists in the Universities and Research Institutes differ significantly in their perception of agricultural biotechnology research ($T = -2.395$, $p < 0.05$). While scientists in the Universities are primarily vested with responsibility of teaching and a secondary responsibility of research, the converse is the case for scientists in the Research Institutes, they have primary mandate of conducting research. This variation in primary mandate between scientists in the Universities and those in the Research Institutes may be a possible explanation for the varying perception about agricultural biotechnology. This however does not contribute to any difference in their participation in agricultural biotechnology research as shown in the T-test result on table 7.

Of all the independent variables regressed against the dependent variable, only information use showed significant contribution to perception ($r = -3.044$, $p < 0.05$). Perception did not depend on age, sex, education, specialization, marriage or participation. Apprehension and skepticism can stimulate search for information about the technology and consequently explain this relationship.

4. Conclusions and Recommendation

All the personal profiles of scientists (sex, education, age, marital status and specialization) did not significantly affect perception about agricultural biotechnology R&D activities. Only religion correlated significantly with perception. In view of the fact that perception was not affected by participation, it can be concluded that religion possibly affected the choice of specific areas of participation, while not tampering with the overall participation of scientists.

In view of the critical role of information in shaping the position of scientists about specific areas of agricultural biotechnology, any effort at developing R&D capacity must include a comprehensive approach that would make information accessible to scientists in the National Agricultural Research System. Considering the relationship between information use and perception about the technology among the respondents, it is argued that much of the information might possibly be from opinions meant for advocacy, rather than from scientific sources. Scientists in developing countries must form positions about the technology based on empirical evidence derived from their own experiences rather than what is obtainable elsewhere. It is imperative for Africa to define its own needs and problems, pose its own questions and express its own doubts, and try to solve them using its own thinking methods and values.

Development of capacity for agricultural biotechnology research in Nigeria must focus on opening up channels for adequate human resources building, especially by placing scientific information at the reach of researchers in both Universities and Research Institutes. While it can be argued that there is already much information in books, journals and the so-called information super-highway (internet), the question must be asked about just how available, affordable and accessible these are to scientists in developing countries. There is need to further examine the dynamics of access to and use of biotechnology among scientists in Africa.

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Table 1. Personal Characteristics of Scientists

Variable	Description	Frequency	Percentages
Sex	Male	121	81.7
	Female	27	18.2
Marital Status	Men (Married)	109	73.6
	Men (Single)	12	8.1
	Female (Married)	22	14.9
	Female (Single)	5	3.4
Religion	Christianity	105	70.9
	Islam	40	27.0
	African Traditional Religion	2	1.4
	Free Thinkers	1	0.7
Marital Status	Men (Married)	109	73.6
	Men (Single)	12	8.1
	Female (Married)	22	14.9
	Female (Single)	5	3.4
Age	<25	1	0.7
	25-35	33	22.3
	36-45	79	53.3
	46-55	29	19.6
	>56	6	4.1
Employment	University	53	35.8
	Research Institute	95	64.2
Qualification	B. Sc.	37	25.0
	M.Sc	72	48.6
	M.Phil	4	2.7
	PhD	35	23.6
Experience (in years)	1-10	62	41.9
	11-20	70	47.3
	21-30	13	8.8
	31-40	2	1.4
	>40	1	0.7

Table 2. Activities of scientists in agricultural biotechnology R&D

Activities	Frequency of use		
	Always	Sometimes	Never
Type of Laboratory/field application of biotechnology			
Fermentation	30(20.3)	44(29.7)	74(50.0)
Artificial insemination	10(6.8)	27(18.2)	111(74.9)
Development of biofertilizers (pulses and cereals)	16(10.9)	31(20.9)	101(68.1)
Tissue culture	23(15.5)	49(33.1)	76(51.3)
Application of In-vitro techniques for breeding	14(9.5)	33(22.3)	101(68.1)
Ethnoveterinary vaccines	7(4.8)	27(18.2)	114(77.0)
Application of DNA maker techniques	12(8.2)	36(24.3)	100(67.5)
multiplication of livestock/plant materials	36(23.8)	46(31.1)	66(44.6)
Field trials of biotechnology products	20(13.5)	53(35.8)	75(50.6)
Genetic modification	10(6.9)	42(28.4)	96(64.8)
Publication/Documentation of biotechnology information			
Journal paper article on agrobiotechnology	36(24.3)	61(41.2)	51(34.4)
Newsletter publication	27(18.2)	57(38.5)	64(43.2)
Extension bulletin on agrobiotechnology	15(10.3)	59(39.8)	74(50.0)
Advocacy/opinion article in Newspaper/magazine	17(11.6)	59(39.8)	72(48.6)
Extension activities			
Participation in exhibition of biotechnology products	23(15.2)	47(31.7)	78(52.7)
Radio/Television programmes on agrobiotechnology	17(11.5)	53(35.8)	78(52.7)
Field demonstrations on agrobiotechnology	14(9.6)	52(35.1)	82(55.4)
Training			
Conferences/Workshops on biotechnology	28(19.0)	72(48.6)	48(32.4)
Seminars	35(23.6)	80(54.1)	33(22.3)
Special courses in biotechnology	11(7.5)	54(36.5)	83(56.0)
Development activities			
Securing of patent rights	10(6.8)	30(20.0)	108(72.9)
Grant aided project in biotechnology	4(2.7)	37(25.0)	107(72.2)
Input in national planning on agrobiotechnology	4(2.7)	40(27.1)	104(70.2)

Table 3. Sources of information for agricultural biotechnology research

Sources of information	Frequency/ percentages		
	Often	Occasionally	Never
Journals	83(55.3)	61(40.7)	4(2.7)
Newsletters	46(30.7)	94(62.7)	8(5.4)
Technical reports	53(35.3)	79(52.6)	16(10.8)
Newspaper	46(30.7)	85(56.7)	17(11.5)
Magazines	46(30.7)	89(59.4)	13(8.8)
Textbooks	85(56.7)	48(32.0)	15(10.1)
Telephones	21(14.0)	82(54.7)	45(30.4)
Internet	58(38.7)	67(44.7)	23(15.5)
TV	29(19.3)	100(66.7)	19(12.8)
Radio	36(24.0)	87(58.0)	25(16.9)
Workshops	32(21.3)	102(68.0)	14(9.5)
Conferences	37(24.7)	97(64.7)	14(9.5)
Seminars	50(33.8)	88(58.7)	10(6.8)

Source: *Field survey, 2008*

Table 4. Perception of Scientists about Agricultural Biotechnology

Perception statements	Perception Score	Mean Deviation \pm
Agricultural biotechnology research applications are too complicated	2.8741	1.27747
Agricultural biotechnology research applications are too expensive	2.1888	1.23876
Agricultural biotechnology research projects will not attract funding	3.8239*	1.04711
Use of agricultural biotechnology applications will jeopardize conventional agricultural research	3.8227*	1.17888
Applications involving agricultural biotechnology are not practicable in Nigeria	3.6993*	1.19291
Research should be limited to traditional agricultural biotechnology	3.9716*	1.20679
Efforts should be directed at adaptive agricultural biotechnology research not basic	3.0567	1.25796
Agricultural biotechnology research should be a private sector affair	4.0211*	1.10747
Nigeria should rely on international agricultural Research Institutes for biotechnology	4.1181*	1.19144
There is need for collaboration between NARIs and IARs in the development of agricultural biotechnology	1.6783	.93899
Products of agricultural biotechnology research may not survive the harsh environment in Nigeria	3.4155*	1.15619
Applications involving agricultural techniques do not conflict with my religious beliefs	2.2929	1.12842
Agricultural biotechnology research applications should exclude all forms of Genetic modification	3.3333*	1.28545
Biotechnology research is ethically wrong	3.9179*	1.18289
Agricultural biotechnology research will strengthen biodiversity	2.2394	.96704
Agricultural biotechnology is not environmentally friendly	3.9489*	2.75286
Agricultural biotechnology would enhance the use of marginal lands for crop production	2.2000	1.12012
Products for agricultural biotechnology research will have more pest problems	3.5143*	1.10906
Agricultural biotechnology research will lead to genetic contamination in farming systems	3.4892*	1.13806
Products that will be injurious to human and livestock health	3.6479*	1.03962
Food insecurity will be aggravated by research and development of agricultural biotechnology	3.8182*	1.16665
It can be used to enhance the nutritional quality of some crops	1.9929	.98548
Regulations are constraint to development of agricultural biotechnology	2.9353	1.20511
Conventional agricultural research is meeting the production needs of farmers sufficiently	3.6084*	1.05507
Agricultural biotechnology research will lead to loss of indigenous varieties	3.7203*	1.14698
Agricultural biotechnology research will jeopardize traditional seed stocks	3.6338*	1.18788

* > Overall mean (3.30) = Positive attitude

* < Overall mean (3.30) = Negative attitude

Table 5. Showing perception categories about agricultural biotechnology

Perception	Perception categories	Frequency	Percentage
Low	42 – 65	15	10.1
High	> 65	133	89.9

Table 6. Chi square table showing relationship between and some personal characteristics and perception

Variable	χ^2	DF	CC	P	Decision
Sex	.297	2	.862	3.28	NS
Marital	2.495	4	.646	.12	NS
Religion	21.448	6	.002	.12	S
Qualification	3.032	6	.805	.48	NS
Specialization	28.505	36	.809	.10	NS

Table 7. Perception and participation (PPMC)

Variables	Participation	Perception
Participation	1.00	-.024 .774
Perception	-.024 .774	1.00

Table 8. T-test analysis of the difference in perception between scientists in Universities and Research Institutes

Variable	T	DF	Significance	Mean Difference	Std. Error	Decision
Perception	-2.395	146	.018	-9.511	3.970	S

Table 9. Regression of Perception and some independent variables

Variables	STD ERROR	Beta β	t	Significance
(Constant)	.675		5.416	.000
Sex	.143	-.048	-.477	.635
Age	.009	.042	.366	.715
Marital status	.216	-.115	-1.056	.294
Religion	.135	.069	.663	.509
Education	.052	.005	.050	.960
Specialization	.012	-.117	-1.196	.235
Information	.011	-.345	-3.044	.003
participation	.007	-.160	-1.415	.160