KNOWLEDGE AND PERCEPTION OF GENETICALLY MODIFIED FOODS AMONG AGRICULTURAL SCIENTISTS IN SOUTH-WEST NIGERIA.

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 ISSN 1923-6654 (print)
ISSN 1923-6662 (online). Available at http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html

Abstract: This study examined the perception of risks and benefits of Genetically Modified (GM) foods among agricultural scientists in south-west Nigeria. Using a pre-tested questionnaire, data were collected from one hundred and fifty four selected scientists. The main sources of information of the respondents were journals (83.80%), internet (75.30%), periodicals (65.50%), and colleagues (63.00%). Half of the respondents felt that GM foods were of high utility and the other half disagreed with this view. Fifty-three per cent of the scientists had higher perceptions of risk associated with GM foods. Most of the respondents perceived that GM has no negative effect on the environment, therefore were in support of the introduction of GM foods in Nigeria. The result revealed that respondents' perception was related to the age (β=0.15; $p<0.05$), religion (β=0.15; $p<0.05$), educational level (β=0.20; $p<0.05$), years of working experience (β=0.13; $p<0.05$), information sources (β=0.14; $p<0.05$), awareness (β=0.17; $p<0.05$), and knowledge (β=0.41; $p<0.01$). The study concluded by recommending that awareness campaign that will provide most people with right information on the benefits and the possible risks inherent in biotechnology should be embark upon by the decision makers and also, seminars, workshops and conferences should be held to keep scientists abreast all the latest developments in the field of biotechnology.

Keywords*:* benefits; genetically modified foods; perception; risks; scientists

I. INTRODUCTION

Nigeria is a low-income economy and Africa's most populous country with an estimated population of over 140 million. About two-third of the Nigeria people are poor, despite living in a country with vast potential oil-wealth, fertile land, and favorable weather for agriculture [1]. People of Nigeria have been falling deeper into poverty and food insecurity. It is estimated in 1980 that 27 percent of Nigerians lived in poverty. In 1999, 70 percent of the population had income of less than $1 per day and the figure has risen since then [2]. Agriculture is Nigeria's second largest source of national wealth, after oil and a dominant economic activity in term of employment and linkages with the rest of the economy. Approximately 75 percent of Nigeria's land is arable, of which about 40 percent is cultivated [2]. The United Nations Food and Agriculture organization rates the productivity of Nigeria's farm land as low to medium but with medium to good productivity if properly managed with use of appropriate varieties of crops and land management practices. Development effort in the past three decades has sought to promote aggregate output to feed the growing population, provide raw materials for industries as well as export. Therefore to increase food yield per hectare, attention should be shifted to the use of biotechnology and genetically modified crops as an alternative. Biotechnology includes a wide range of technologies which may be applied in food and agriculture sectors. It includes technologies such as gene modification and transfers, the use of molecular markers, development of recombinant vaccines and DNA-based methods of diseases characterization and diagnosis, in-vitro vegetative propagation of plants, embryo transfer and other reproductive technologies in animals and fish [3].

Biotechnology involves the selection and improvement of microorganisms with the aims of improving process control, yields and efficiency, as well as the quality, safety and consistency of bio-processed products. Biotechnology through the use of GM technology could be converted into higher per capita income, job creation, and reduction in poverty, increase in food security, and self sufficiency in food production. Genetically modified organisms (GMOs) according to FAO **[**4**]** are organisms in which the genetic material has been altered in a way that does not occur naturally. It allows selected individual genes to be transferred from one organism into another between inter-related species. Such methods are used to create genetically modified plants, which are then used to grow genetically modified food

crops. The development of biotechnology in the agricultural sector and in the food industry has offered the opportunity to increase crop and animal production, decrease production costs and improve food quality and safety. Genetic modification is increasingly used in the development of new foods and related products. Generally, the use of genetic modification is widely advocated by food producers and food technologists for financial, quality-related, and environmental reasons. For instance genetic modification is being used to develop crops that can withstand extreme environmental conditions such as viral resistant cassava, rice and sweet potatoes, nematode resistant bananas, and fungal resistant potatoes. Genetic modification is useful in the effort to reduce poverty, improve food security, reduce malnutrition and improve the livelihood of poor people. GM foods offer a viable option to achieving food security and self-sufficiency. The cultivation of genetically modified crops has expanded rapidly since they were first grown commercially in the United States in 1996. They covered 58 million hectares in 2002 **[**5**]**. In 2003, about 68 million hectares were planted with GM crops by 7 million farmers in 18 countries. The principal crops are herbicide and insecticide resistant soy-bean, maize, and cotton **[**6].

However, as the detrimental social and environmental changes are occurring in developing countries (Nigeria inclusive), a revolution in biotechnology and its products will be a tool for improving the health, well being and the style of living of the privileged and creating more wealth in advanced countries [7]. Modern biotechnology as an important technological innovation that will eventually have a profound impact on human livelihood and welfare [1] however, faces the problem of acceptance by the people. The introduction of biotechnology base on genetic modification has generated and attracted a great deal of scientific attention and media coverage on their benefits and risks [8]. Many people around the world have expressed reservation on the perceived effects of GM technology could have on the environment [9]. However, knowledge about products often amount to its visualization in the aisles of food stores and to the information given by commercials [10].

Marris [11] while justifying the need to study the public attitudes to genetically modified foods, reported that the public concerns need to be taken into account by all the operators of the GM industry, including research and development, marketing, and distribution. The governments and international bodies also need to take these concerns into account when elaborating risk-related regulations and dealing with trade disputes by providing a neutral platform for people to exchange views and experiences on biotechnology and its products and to allow stakeholders to better understand and clarify the issues and concerns about agricultural biotechnology. It is therefore important to study the awareness, knowledge and perceptions of scientists toward GM foods. Given the roles that scientists play in influencing farmers' adoption of agricultural innovation and conducting research, their perceptions on genetically modified foods may be critical for the overall acceptance of genetically modified foods in Nigeria. This paper contributes to the broad biotechnology discourse by analyzing the perceptions of scientists toward genetically modified foods. The main objective of the study is to examine the risks and benefits perception of consumers toward GM foods in selected institutions in South-West Nigeria. The specific objectives are to: (1) Examine respondents' levels of awareness of GM foods. (2) Determine the knowledge of biotechnology among the respondents (3) Identify the respondents' sources of information about GM foods. (4) Determine respondents' perceptions of benefits, risks of GM foods and effects on the environment.

II. METHOD

The study was carried out in South-west Nigeria. South-west Nigeria has six states: Ekiti, Lagos, Ondo, Ogun, Osun and Oyo States. It is bounded by the Atlantic Ocean in the South, Kwara State in the North and Republic of Benin in the West. The Southwest region, which has a land area of about 114, 271 square-kilometre (about 12% of total land mass of Nigeria), lies between latitude 4° 20' and 9° 23' North of the equator and longitude 2° 25' and 6° 31' East. One hundred and fifty four scientists were purposefully selected from faculties of agriculture from the University of Agriculture, Abeokuta (UNAAB), Olabisi Onabanjo University, Ago-Iwoye (OOU), University of Ibadan, (UI), Federal University of Technology, Akure (FUTA), Nigerian Institute of Horticulture,(NIHORT), Cereal Research Institute of Nigeria (CRIN), International Institute of Tropical Agriculture, (IITA), Cocoa Research Institute of Nigeria (CRIN), Forestry Research Institute of Nigeria (FRIN), Institute of Agricultural Research Training (IAR&T), National Cereal Research Institute (NCRI) and Nigerian National center for Genetic Resources and Biotechnology (NACGRAB) were selected for the research. A pre-tested questionnaire was employed to elicit information from the respondents. Descriptive statistics were used to analyze the personal characteristics of the respondents while Pearson Product Moment Correlation (PPMC) and Linear Regression Analysis (LRA) were used to determine the relationship between the study variables. The variables employed in this study are as follow:

Variables	Definition	Measurement
Age	Age in years	Continuous
Sex	As male or female	Nominal
Religion	Religion affiliation	Nominal
Educational Level	Highest Educational attainment	Nominal
Area of specialization	Field of specialization	Nominal
Working Experience	Working Experience in years	Continuous
Years of Involvement in GM Research	Years of Involvement in GM Research in years	Continuous
Knowledge	Knowledge questions	Dummy
Source of Information	Source of Information on GM foods	Dummy
Awareness	Awareness	Dummy
Benefits	Scientists Perceived Benefits	5-ponit Likert scale
Risk	Scientists Perceived Risk	5-ponit Likert scale
Effects on the Environment	Perceived Effects on the Environment	5-ponit Likert scale

Table 1: Variable definition

III. RESULTS AND DISCUSSION

Personal characteristics of the Scientists. The age of the respondents ranged between 21 years and 70 years with mean age of 36.75 years. More than one third of the scientists (41.56%) were in the age range of 31-40 years which implies that they are still within the active and economically productive age bracket. Age was seen as a factor in determining the perception of public towards GM foods. This agrees with Siegrist *et al.* [12] who reported that middle age, less affluent and those who live in suburban areas are more concerned with GM food. Majority of the scientist were male (66.20%) and 33.80 per cent were females. This implies that male dominate the scientists in the study area. This also agrees with the findings of Oladele and Akinsorotan [7]. Siegrist *et al.* [12] found out that women perceive lower benefits and are less likely to accept gene technology than men. Most of the respondents were Christians (72.10) and 27.90% were Muslims. Hossain and Onyango [13] reported that religious belief as a personal attribute influenced perception of biotechnology. Majority (68.20%) of the respondents were married which implies that they are in a better position to contribute to debate relating to food security. The educational attainments of the respondents are Bachelors degree (27.30%), Masters Degree (35.70%) and PhD (22.70%). This shows a considerable level of education among the scientist and will also enhance their research ability. This will also affect their perception. According to Traill *et al.* [14] a high level of education is associated with the acceptance of GM benefits, however low level of education leads to high levels of perceived risks. The fields of specialization of the respondents included agronomy (18.80%), plant genetic (14.90%), agricultural economics and extension (13.60%), and crop protection (13.00%). The working experience of the respondents varied among the respondents with majority (65.58%) having between 1-10 years work experience. This also buttress the fact that majority of them are still between the productive age brackets and are in a position to carry out research. About 19.00% had between 11-20 years work experience. The result of the study indicated that 53.90% of the respondents were not involved in GM research. About 16.88 percent of the respondents have spent less than two years on GM research and 29.61% have been working on GM for more than three years. This agrees with the fact that the National Biotechnology Development Agency (NABDA) was established in 2001 as an institutional framework for implementing the National Biotechnology Policy. Research in this area started officially in 2001 in Nigeria.

Variables	Frequency	Percentage	Mean	SD
Age				
21-30	48	31.17		
31-40	64	41.56	36.75	9.57
41-50	22	14.29		
51-60	18	11.69		
61-70	2	1.30		
Sex				
Male	102	66.20		
Female	52	33.80		
Religion				
Christianity	111	72.10		
Islam	43	27.90		
Marital status				
Single	49	31.80		
Married	105	68.20		
Educational Level				
BSC	50	30.40		
PGD	14	9.10		
MSC	55	35.70		
PHD	35	22.70		
Area of Specialization				
Food Science/Biotechnology	13	8.40		
Agric Econ/Extension	21	13.60		
Plant Breeding/seed Technology	23	14.90		
Environmental Science	7	4.50		
Agronomy	29	18.80		
Animal Breeding	4	2.60		
Fisheries and Aquaculture	2	1.30		
Animal Science	10	6.50		
Nutrition/Biochemistry	9	5.80		
Crop Protection/Plant Physiology	20	13.00		
Genetic Resource/Biotechnology/Tissue Culture	5	3.20		
Forestry/Wildlife	8	5.20		
Molecular/Environmental Biology	3	1.90		
Years of working Experience				
1-10	101	65.58		
11-20	28	18.18		8.9
21-30	20	12.99	10.14	
31-40	5	3.25		
Years of Involvement in GM Research				
Never Involved	83	53.90		
1-2	26	16.88	1.77	2.45
3 years and above	45	29.61		

Table 2: Personal Characteristics of Scientists (n = 154)

Sources	Frequency	Percentage
Radio	79	51.30
Internet	116	75.30
Local T.V	66	42.90
Fellow researchers	97	63.00
Newspaper	104	67.50
Periodicals	101	65.500
Magazines	78	50.60
Journals	129	83.80
Friends/peers	64	41.60

Table 3: Scientists Sources of Information (n = 154)

Scientists Sources of Information. Table 3 shows the sources of information of respondents. The information available is a critical factor in influencing perception. Napier *et al* [9] reported that exposure to information about genetically modified foods affects peoples' orientation and perception towards such products. Information is seen as an important factor in consumers' understanding of science and technology [15]. Lang *et al*. [16] observed that public fears about bioengineering would be overcome if the public were given more information. The main sources of information of the respondents were journals (83.80%), internet (75.30%), periodicals (65.50%), and fellow researchers (63.00%). These sources of information are the common sources used by the academics in the course of their research. This also revealed that scientists are information and Communication Technology (ICT) compliant [7].

Awareness of GM Food Products among the Scientists. High awareness was reported for rice rich in vitamin A (68.20%), bacterial blight disease rice resistant (52.60%), early ripening tomato (69.50%), tomatoes rich in carotenoids (55.80%), potatoes with enhanced protein (58.40%), potatoes resistant to nematodes (59.1%), high starch content potato (57.10%), balanced amino-acids in seeds (50.60%), hybrid protein maize (55.80%), early ripening banana (62.30%), and black sigatoka resistant banana(57.80%). This is because rice, tomatoes, potatoes, maize and banana are common foods among Nigerian households. However, tuberculosis curing tobacco (16.20%), cholera curing tobacco (13.60%), tuberculosis curing potatoes (22.70%), tobacco that can grow in waterlogged condition (24.70%), rice producing hepatitis A antibodies for use in vaccines (21.40%), and cholera curing potatoes (23.40%) had least awareness by the scientists. Awareness is an important factor in determining people's perception of GM food. Napier *et al*, [9] reported that when people are aware that genetically modified foods products have been consumed without adverse consequences, perception of genetically modified foods products is influenced in positive manner.

Scientists' knowledge of GM Foods. Table 5 showed the knowledge of scientist as regard Biotechnology and genetically modified foods. The scale scores ranged between 8.0 and 13.0 (X = 10.06, SD = 1.14). The result revealed that the scientists have some knowledge of Biotechnology and genetically modified foods but low to a greater extent. Knowledge about specific GM products and the underlying production process according to Costa-Font *et al*. [17] become essential in order to shape attitudes. It has been claimed that the negative attitudes to GM foods depend on the low level of public knowledge about GM. Response to knowledge items as adapted from Hallman, *et al*. [18], House, *et al*. [19] and Knight [20] shows that 75.50% of the respondents agreed that human genes cannot be changed by eating GM foods. Majority (79.90 %) of the scientists correctly responded that conventional tomatoes do contain genes as genetically modified tomatoes. Most of the scientists (64.90%) agreed that eaten genetically modified fruit could not modify their genes. Additionally, 67.50% correctly indicated that tomatoes genetically modified with genes from catfish would not taste fishy and 32.5.0% incorrectly thought that tomatoes genetically modified with genes from catfish would probably taste fishy.

Items	Aware (%)	Not Aware (%)	Mean	SD
Yellow mottle virus resistant rice	51 (33.10)	103 (66.90)	1.67	0.47
Rice rich in vitamin A	105 (68.20)	49 (31.80)	1.32	0.47
Bacterial blight disease Rice resistant	81 (52.60)	73 (47.40)	1.47	0.50
Golden rice	68 (44.20)	86 (55.80)	1.56	0.50
Rice producing hepatitis A antibodies for use in vaccines	33 (21.40)	121 (78.60)	1.79	0.41
Early ripening Tomato	107 (69.50)	47 (30.50)	1.32	0.46
Ring spot virus resistant Papaya	73 (47.40)	81 (52.60)	1.53	0.50
Tomatoes rich in carotenoids	86 (55.80)	68 (44.20)	1.44	0.50
Tobacco that can grow in waterlogged condition	38 (24.70)	116 (75.30)	1.75	0.43
Cholera curing tobacco	21 (13.60)	133 (86.40)	1.86	0.34
Tuberculosis curing tobacco	25 (16.20)	129 (83.800)	1.83	0.37
Potatoes with enhanced protein	90 (58.40)	64 (41.60)	1.42	0.49
Potatoes resistant to Nematodes	91 (59.10)	63 (40.90)	1.41	0.49
Potatoes resistant to feathery mottle virus	45 (29.20)	109 (70.80)	1.71	0.46
Cholera curing potatoes	36 (23.40)	118 (76.60)	1.77	0.43
Blight resistance potatoes	69 (44.80)	85 (55.20)	1.55	0.50
Tuberculosis curing potatoes	35 (22.70)	119 (77.30)	1.77	0.42
Potatoes with high starch content	88 (57.10)	66 (42.90)	1.43	0.50
Balanced Amino Acids in Seeds	78 (50.60)	76 (49.40)	1.50	0.50
Baccilus thuingensis(Bt) soybeans	59 (38.30)	95 (61.70)	1.62	0.49
Bt rice	42 (27.30)	112 (72.70)	1.73	0.45
Bt cotton resistant to bollworm and tobacco budworms	58 (37.7)	96 (62.3)	1.62	0.49
Hybrid quality protein Maize	86 (55.80)	68 (44.20)	1.44	0.50
Acid tolerant Maize	65 (42.20)	89 (57.80)	1.58	0.50
Acid soil tolerant Papaya	60 (39.00)	94 (61.00)	1.61	0.50
Papaya resistant to ring spot	59 (38.30)	95 (61.70)	1.62	0.49
Early ripening Banana	96 (62.30)	58 (37.70)	1.38	0.49
Banana containing hepatitis vaccine	39 (25.30)	115 (74.70)	1.75	0.45
Banana resistant to black sigatoka	89 (57.80)	65 (42.20)	1.42	0.50

Table 4: Awareness of GM Food Products among the Scientists (n = 154)

Scientists Perceived Benefits of GM Foods.

Table 6 shows the respondents' perceptions of benefits of GM foods. The scale scores ranged between 10 and 46 with a mean of 30.74. Half of the respondents felt that GM foods were of high utility and the other half disagreed with this view. The result of the study agrees with the findings of Ayanwale [21] where more than one-third perceived that biotechnology could help secure food self-sufficiency and anther one-fifth also felt that the innovation could improve human health. The result also suggests that the few Nigeria who knew of biotechnology had a good idea of its advantage. The possibility of using biotechnology to combat food insecurity and poverty and improve health is possibly more relevant to Nigerians. Specifically, 58.50% reported that GM crops have higher nutritional content and 23.30% disagreed with this view. Further, 31.00% of the respondents opined that GM foods are inexpensive and 45.50% reported that GM foods are expensive. It is believed that GM foods have greater shelf-life than conventional foods (44.10%) and 36.40% disagreed with this view. The findings show that 55.30% of the respondents considered GM foods as having higher quality compared with conventional foods and 31.10% had contrary view. Some of the respondents (46.10%) argued that GM crops require less chemical applications than conventional crops and 38.30% disagreed with this view.

Knowledge items	Correct (%)	Incorrect (%)
Human genes can be changed by eating GM foods	116 (75.5)	38 (24.7)
GM vegetables are bigger than conventional vegetables	56 (36.4)	98 (63.6)
Is it possible to transfer animal gene into plant	67 (43.5)	87 (56.5)
Genetic modification is possible using biotechnology	145 (94.2)	9 (5.8)
There are some bacteria which live in water	133 (86.40	21 (13.6)
Conventional tomatoes do not contain genes, while genetically modified tomatoes do	123 (79.9)	31 (20.1)
If a person eats a genetically modified fruit, their genes could be modified as a result	100 (64.9)	54 (35.1)
The father's genes determine whether the child is a girl.	104 (67.5)	50 (32.5)
The yeast used to make beer contains living organisms	130 (84.4)	24 (15.60
It is impossible to transfer animal genes into plants	73 (47.4)	81 (52.6)
Tomatoes genetically modified with genes from catfish would probably taste "fishy"	104 (67.5)	50 (32.5)
Genetically modified foods are created using radiation to create genetic mutations	57 (37.0)	97 (63.0)
The cloning of living things produces genetically identical copies	126 (81.8)	28 (18.2)

Table 5: Scientist Knowledge of GM Foods (n = 154)

Scientists Perceived Risk of GM Foods.

Table 7 shows the scientists' perceptions of risk towards GM foods. Scale scores ranged between 13 and 38 with a mean of 26.91 and standard deviation of 5.12. Fifty-three per cent of the scientists had higher perceptions of risk associated with GM foods. This is in line with Adeoti and Adekunle [1] which posited that though, people are in favour of the introduction of GM crops but do not consider the current state of Nigeria's institutional preparedness satisfactory for the approval and release of GM crops. The result further agrees with the findings of Napier *et al.* [9] which indicated that respondents tended to perceive some risks associated with the production and consumption of genetically modified foods.

Another plausible explanation that has been advanced is that medical applications of the technology offer tangible direct benefits to consumers whereas the first generation of GM foods has offered only indirect benefits [22]. Distrust of regulation agencies in the face of repeated food scares, such as "mad cow" or "foot and mouth" diseases is often cited as a cause underlying consumers' negative reception of biotechnology foods [22]. The result further revealed that 27.90% of the scientists considered the consumption of GM foods as being risky and 50.00% viewed its consumption as less risky. Half of the respondents agreed that GM foods are nutritionally deficient and 18.1% disagreed with this view. It is believed that GM foods are morally wrong and pose uncontrollable risks to human beings (22.50%) but 63.60% did not share this view.

Statements	SA (%)	A (%)	S (%)	D (%)	SD (%)	M	Sd
GM foods have higher nutritional yields/content	24 (15.60)	66 (42.90)	28 (18.20)	25 (16.20)	11 (7.100)	3.43	1.15
GM foods are inexpensive in the markets	13 (8.40)	36 (23.40)	35 (22.70)	44 (28.60)	26 (16.90)	2.78	1.22
GM foods have greater shelf life than the conventional Foods in markets	25 (16.20)	43 (27.90)	30 (19.50)	52 (33.80)	4 (2.60)	3.21	1.16
GM foods have better quality than conventional foods	24 (15.60)	62 (40.30)	20 (13.80)	39 (25.30)	9 (5.80)	3.34	1.18
GM foods are safer than conventional foods	12 (7.80)	33 (21.400)	34 (22.10)	48 (31.20)	27 (17.50)	2.71	1.21
GM foods have medical benefits than conventional foods	10 (6.50)	35 (22.70)	32 (20.80)	60 (39.00)	17 (11.00)	2.75	1.12
GM crops require less chemical application both in the field and in the store	23 (14.90)	48 (31.20)	24 (15.60)	38 (24.70)	21 (13.60)	3.10	1.31
GM foods have better taste than conventional foods	12 (7.80)	44 (28.60)	36 (23.40)	50 (32.5)	12 (7.80)	2.96	1.11
Production of GM food is cost effective	26 (16.90)	53 (34.4)	24 (15.60)	47 (30.50)	49 (2.60)	3.33	1.15
GM foods are more durable than conventional foods	23 (14.90)	44 (28.60)	30 (19.50)	45 (29.20)	12 (7.80)	3.14	1.22

SA= Strongly Agree; A= Agree; S= Slightly Agree; D= Disagree; SD= Strongly Disagree; M= Mean; Sd=standard deviation

Table 6: Scientists Perceived Benefit of GM Foods (n = 154)

Statements	SA (%)	A (%)	S (%)	D (%)	SD (%)	M	Sd
GM foods are toxic to human beings	7 (4.50)	31 (20.10)	29 (18.80)	48 (31.20)	39 (25.30)	3.53	1.20
The use of genetic modification in food is dangerous to human health	7 (4.50)	41 (26.60)	34 (22.10)	46 (29.90)	26 (16.90)	3.28	1.16
Eating GM foods is risky	6 (3.90)	37 (24.00)	34 (22.10)	57 (37.00)	20 (13.00)	3.31	1.10
There is nutritional deficit in GM foods	3 (1.90)	27 (17.50)	22 (14.30)	77 (50.00)	25 (16.20)	3.60	1.02
GM foods are morally wrong and hold uncontrollable risk.	7 (4.50)	29 (18.80)	20 (13.00)	63 (40.90)	35 (22.70)	3.58	1.16
Producers of GM foods are interested in Consumers' health	21 (13.60)	58 (37.70)	33 (21.40)	27 (17.50)	33 (21.40)	3.28	1.19
I am concerned about the health risks of GM foods	36 (23.40)	59 (38.30)	30 (19.50)	24 (15.60)	5 (3.20)	3.62	1.10
GM foods do not pose any health risk	3 (1.90)	41 (26.60)	32 (20.80)	61 (39.60	17 (11.00)	2.69	1.05

SA= Strongly Agree; A= Agree; S= Slightly Agree; D= Disagree; SD= Strongly Disagree; M= Mean; Sd=standard deviation

Table 7: Scientists Perceived Risk (n = 154)

Statements	SA (%)	A (%)	S (%)	D (%)	SD (%)	M	Sd
GM foods are potentially better for the environment.	10 (6.50)	54 (35.10)	49 (31.80)	33 (21.40)	8 (5.20)	3.16	1.06
There will be long-term environmental effects of the use of GM crops.	17 (11.00)	72 (46.80)	22 (14.30)	26 (16.90)	17 (11.00)	2.70	1.20
Genetic modification of plant can harm the environment.	10 (6.50)	44 (28.60)	31 (20.10)	48 (31.20)	21 (13.60)	3.17	1.17
Producers consider the environmental effects of GM foods.	7 (4.50)	73 (47.40)	33 (21.40)	34 (22.10)	7 (4.50)	3.25	1.00
Genetic modification provides crops that are tolerant to salinity.	12 (7.80)	62 (40.30)	41 (26.60)	33 (21.40)	6 (3.90)	3.27	1.01
GM crops are resistance to pest.	27 (17.50)	64 (41.60)	35 (22.70)	20 (13.00)	8 (5.20)	3.53	1.09
GM crops are resistance to diseases.	24 (15.60)	71 (46.10)	30 (19.50)	22 (14.30)	7 (4.50)	3.54	1.06

SA=Strongly agree; A=Agree; S=Slightly agree; D=Disagree; SD=Strongly D=Disagree; M=Mean; Sd=Standard deviation

Table 8: Scientists Perceived Effects on the Environment (n = 154)

Scientists Perceived Effects on the Environment. Scientists' responses to perceptual statements on the effect of GM on the environment are presented in Table 8. The scale scores ranged between 8.0 and 29.0 with a mean of 19.46 and standard deviation of 4.14. More than half of the scientists have score greater than the mean score hence perceived that GM has no negative effect on the environment, therefore are in support of the introduction of GMFs in Nigeria. Result of the study showed that 6.00 % of the scientist strongly agreed that GM foods are potentially better for the environment, 35.00 % agreed that GM foods are potentially better for the environment, and 32.00% of the scientists slightly agreed that GM foods are potentially better for the environment. On the other hand, 21.00% of the scientists disagreed that GM foods are potentially better for the environment while 5.00% strongly disagreed. The result of the study further showed that the response of scientists to the long-term environmental effects of the use of GM crops varied with 11.00% strongly agreed. Furthermore, 6.00% of the scientist strongly agreed that Genetic modification of plant can harm the environment and 20.00 % slightly agreed that Genetic modification of plant can harm the environment.

Bivariate relationships between study variables among the scientists. Table 9 shows the bivariate relationship between the study variables among the scientists. There was significant relationship between scientists perception of the benefits of GM foods and sex ($r = 0.19$, $P < 0.05$) and years of involvement in GM research ($r = 0.18$, $P < 0.05$). Thus, scientists' perception of the benefits of GM foods had positive correlation with sex and years of involvement in GM research. This implies that the sex of the scientists influence their perception. Also the result implies that the year of involvement in GM related research influence their perception. As the years of involvement increases, the scientists will be gaining more knowledge and understanding of genetic modification. There were significant relationships between scientists perceptions of the risks of GM foods and age ($r = 0.31$, $P < 0.01$), marital status ($r = 0.21$, $P < 0.01$), educational level ($r = 0.28$, $P < 0.01$), working experience ($r = 0.30$, $P < 0.01$) and years of involvement in GM ($r = 0.22$, $P < 0.01$). This implies that as the age of respondents increases, their perception of risks of GM foods also increase. The sex of the respondents also influences their perception of risks. It was observed that female are more concerned with the risks associated with GM foods while male are more concerned with the benefits ([9]; [23]; [9]; [22]; [12]).

Further, knowledge is significantly and positively related to age ($r = 0.18$, $P < 0.05$) and working experience ($r = 0.16$, $P < 0.05$). This means that increases in age and working experience is likely to enhance knowledge in GM research.

	1	2	3	4	5	6	7	8	9	10	11	12
1	-											
2	-0.09	-										
3	0.53**	-0.01	-									
4	0.02	-0.01	-0.01	-								
5	0.49**	-0.03	0.33**	0.05	-							
6	.92**	-.02	0.46**	-0.03	.51**	-						
7	0.11	-0.14	0.15	-0.10	0.23**	0.19*	-					
8	-0.01	-0.19*	0.04	-0.07	-0.05	-0.03	0.18*	-				
9	0.31**	-0.06	0.21**	0.01	0.28**	0.30**	0.28**	0.33**	-			
10	-0.18*	-0.04	0.01	-0.04	-0.02	-0.20**	0.21**	0.49**	0.42**	-		
11	.18*	.09	.15	.09	-.02	.16	-.12	.03	-.10	-.14	-	
12	-0.08	0.02	-0.01	-0.12	0.05	-0.04	-0.26**	-0.18*	-0.27**	-0.25**	.09	-
M	36.74	1.34	1.68	1.28	5.38	10.14	1.77	30.74	26.91	19.46	12.38	45.83
SD	9.57	.47	.47	.45	1.40	8.92	2.45	7.29	5.12	4.14	1.90	5.87

(*p<0.05;*p<0.01) 1=Age; 2= Sex; 3= Marital status; 4= Religion; 5= Educational level; 6=Working experience; 7=Years of involvement; 8=Benefit; 9=Risk; 10= Effect on environment; 11= Knowledge; 12=Awareness; M= Mean; SD=Standard Deviation

Table 9: Bivariate Relationships between the Study Variables (n = 154)

Regression analysis showing the relationship between perception and other study variables. The results of the study as shown in Table 10 seek to identify variables that influenced scientist perception of genetically modified foods in the study area. According to Kamaldeen and Powell [24], commercial introduction and adoption of any technologies such as GM foods can be promoted or hampered by public perceptions, understanding and acceptance. The result revealed that there was a significant relationship between perception and the age (β=0.15; $p<0.05$). This implies that the age of respondents influence their perception of GM foods. Results showed that older scientists have higher perception of GM food. This was supported by the finding of Onyango *et al*. [23] who reported that, compared to younger respondents (20-29 years old), mature (50-59) and mid age (30-49) tend to favour genetically modified organisms and biotechnology for the benefits it delivers. Perception of GM foods is also related to the religion of the respondents (β=0.15; $p<0.05$). This implies that the religion of the respondents influenced their perception of GM foods. This agrees with the findings of Verdurme and Vigene [25] who reported that Christians are more concerned with the integrity of God's creation and humanity's relationship with God and the Muslims focus on the dietary codes, if GM foods contain genes from perceived unclean animals like pigs. Further, perception of GM foods is related to educational level of the scientists (β=0.20; $p<0.05$). This implies that educational level of respondent influence their perception of genetically modified foods, that is, those with higher education compared to those with less have positive perception of GM foods. Perception of GM foods among the scientist was related to years of working experience (β=0.13; $p<0.05$) and information sources (β=0.14; $p<0.05$). Exposure to information about genetically modified foods affects peoples' orientation and perception towards such products [9]. The more frequent the scientists are exposed to the sources of information about GM foods the higher their perception. The result further revealed that there is a significant relationship between perception of GM foods and awareness (β=0.17; $p<0.05$). The results revealed that higher awareness will lead to higher perception among the scientist.

Variable	β-value	t-value	p-value	Decision
Age	0.15	2.22	0.02	S
Sex	0.09	1.31	0.19	NS
Religion	0.15	1.99	0.04	S
Educational level	0.20	2.32	0.02	S
Institution	0.10	1.28	0.20	NS
Income	0.12	1.36	0.18	NS
Years of involvement in GM Research	0.09	1.18	0.24	NS
Working experience	0.13	1.79	0.05	S
Information sources	0.14	1.99	0.04	S
Awareness	0.17	2.01	0.04	S
Knowledge	0.41	5.26	0.00	S
R	0.60			
R^2	0.36			
df	10			
Adjusted R	0.31			
F- value	7.10			

Table 10: Regression analysis showing the relationship between perception and other study variables

IV. CONCLUSION AND RECOMMENDATIONS

Based on the result of the study, journals, internet, periodicals, and researchers are the main sources of information about genetically modified foods among the respondents. High awareness was recorded in modified rice, tomatoes, potatoes, maize and banana. Scientists have some knowledge of Biotechnology and genetically modified foods but low to a greater extent. Half of the respondents felt that GM foods are of high utility and the others disagreed with this view. Most of the respondents perceived that GM has no negative effect on the environment, therefore are in support of the introduction of GMFs in Nigeria. The age, religion, educational level, years of working experience, information sources, awareness and knowledge of scientists influence their perception of genetically modified foods. The study therefore recommends that awareness campaign that will provide most people with right information on the benefits and the possible risks inherent in biotechnology should be embark upon by the decision makers and also, seminars, workshops and conferences should be held to keep scientists abreast all the latest developments in the field of biotechnology.

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