



Biotechnology and Genetically Modified Crops Awareness in Selected Communities in Calabar South LGA, Nigeria

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ABSTRACT

Biotechnology is widely applied in the Nigerian life; the skill is employed in agriculture, medicine, environment and industries. Laws and policies were promulgated but are the public conscious of these developments? This survey investigated the knowledge level among the inhabitants of Calabar South Local Government Area (LGA) to advancements in biotechnology. Three staged random sampling method was used in the survey; three wards were randomly selected from 11 wards, then three streets were selected from the chosen wards and 25 households per street resulting in 225 randomly selected respondents. Chi square test was used to analyse the variation in responses. One hundred and ninety five respondents returned questionnaires; the age of more than 86% of the respondents ranged from 16 to 45 years and they had attained some education. About 80% of respondents learnt of biotechnology from informal sources, such as radio, television and from relatives or friends. There was significantly high level of awareness on the general principles of biotechnology; respondents agreed biotechnology is biological process, helpful in food and drug production, improves organisms better than using older methods but disagreed on the safety as food. There were polarised responses on the consciousness on genetically modified crops; respondents were equally divided for and against on their opinions on definition, utilisation and development of GMC. There is need to intensify awareness campaigns on utilisation and development of biotechnology and genetically modified crops in Calabar South LGA and Nigeria to improve acceptability of the technologies.

Keywords: biotechnology awareness; random sampling; Calabar South; genetically modified crop

INTRODUCTION

Any process that utilizes part of an organism or the entire organism in production, to improve crops and farm animals, or to develop microorganisms for specific applications in agriculture, industries, medicine and environment is known as biotechnology (UNCBD, 1992). The scope of this science ranges from application in brewing and fermentation technologies, in *in vitro* propagation, drug formulation and transfer of genes across species boundaries; a process known as genetic engineering. The drug formulation includes production of antibiotics, vaccines and hormones.

Biotechnology is making great impacts in many aspects of life and activities in Nigeria and several policies are propounded to guide safety and the framework of biotechnologies operations. For example, the bio-safety bill was passed into law in June, 2011 by the Nigerian Senate (Nicely and Nzeka, 2013) and the country signed the bio-safety bill and established the National Biosafety Management Agency (NBMA) in April 2015 (Scott and Olaito, 2016). These steps were taken to ensure that Nigerians have access to and benefit from safe, ethically sound and profitably use biotechnology-based products and services in the assurance of high quality health services, food security and safe environment in line with global best practices.

Biotechnology has provided opportunities to increase outputs in agricultural production, to conserve and protect the environment through the reduced dependence on noxious pesticides and inorganic fertilizers, and to employ

environment-friendly crops such as insect-resistant and herbicide-tolerant species and to clean the environment through the use of microorganisms and crops that can absorb toxic impurities, such as from oil spillage and use crops to fix soil nitrogen for other species in rotation farming systems. Biotechnology has helped in the increase of food production on available land, which is under intense competition for need of land for urbanisation and industrialisation. Also, it uses crop breeding methods to increase production of legumes crops to improve the quality of organic matter available as food, also influence the structure and fertility of the soil (Soetan, 2011).

The development of genetically modified (GM) organisms, in particular GM crops has changed the face of crop production. Many GM crop species have been developed in USA, Canada, Asia and South America by employing genetic manipulation techniques. Crops such as maize, soybean, rice, wheat, potato, cotton and tomato have one or a few genes transferred from plasmids, viruses, bacteria and ordinarily incompatible species (Myers, 2001; Lu and Snow, 2005). The technology has risks factors, which have generated lots of public discourse. In USA and Mexico, organic crops were contaminated with engineered genes despite efforts to maintain crop production free of GM genes (Ehrenfield, 2001; Stabinsky and Sarno, 2001). Also, there is the concern that weed species could become much more difficult to manage if they acquire herbicide resistance and thereafter produce seeds, or occur in a wider range of habitats because of the spread of certain transgenes. Farmers may face *super-weeds* that will not respond to herbicides through unintentional spread of gene encoded in crops. Similarly, non-target insect populations may decline in the environment because plants had been developed with genes with insecticidal properties. In several other countries, for example, in the UK, public education is greatly intensified and ethical issues openly debated to develop an appropriate mindset among the populace of the benefits and risks of new technology, then evaluate viable alternatives before introduction of the technology (Lachmann, 1999; Nielsen, 2001; von der Weid and Tardin, 2001).

The question 'have the efforts put into biotechnology development at policy formulation levels, in high technology laboratories and global participation and funding permeated to local people in the manner of awareness of the benefits and risks in Nigeria?' Calabar is metropolis with two university campuses and more than 200 secondary schools, where it is expected that the populace would be abreast with matters related to biotechnology. The Area is inhabited by multi-lingual, multi-ethnic and multi-nationalities from most regions of Nigeria, and most of the people are civil servants, traders and farmers. The farmers are mainly low income earners involved in cultivation of cassava, yams, plantain and banana, maize, cocoyam and vegetable crops, some farmers keep poultry, goats and other livestock. There are other people who are fishermen and women or involved in fish culture.

The objective of this study was to appraise the awareness level of the inhabitants of Calabar South Local Government Area of Cross River State, Nigeria on subjects associated with biotechnology development in Nigeria.

METHODOLOGY

The study area: The study was carried out in the Calabar South Local Government Area (LGA), Cross River State, Nigeria (Figure 1). The area is located on Latitude 4° 30' N and Longitude 8° 45' E, it shares boundary in the North with Calabar Municipality, in the south and west it is bounded by the Atlantic Ocean, in the east by Akpabuyo LGA. The LGA has 11 political wards and land mass of over 1200 Sq Km and population of more than 125, 600 people (NPC, 1998). The Area has tropical humid rainforest vegetation, with annual rainfall of about 2915 mm; Calabar South LGA has rains all year round, which intensifies soil erosion and coastal flooding (Udoimuk *et al.*, 2014). The average monthly temperature is moderate; about 26.5 °C with a minimum of 24 °C in the mid-year, daily temperature ranges from 23 to 31.7 °C, the relative humidity is about 84%. The soils in the Area is acidic (pH 4.6 – 5.0), low in organic matter, with total nitrogen of 1.0 – 1.9 g /Kg, available phosphorus of 5.8 – 11.9 mg /Kg, exchangeable calcium of 0.4 – 2.8 cmol /Kg and exchangeable sodium of 0.2 – 0.4 cmol /Kg (Amalu, 1998).

Research and sampling technique: The research design used for the survey was three staged random sampling technique; three wards were randomly selected from 11 political wards in Calabar South LGA; ward 2, ward 3 and ward 6 were selected, then three streets were randomly selected from each of the three wards. The streets selected from ward 2 were Edgerly Road, Hawkins Road and Chambly Road. From ward 3, Palm Street, Okodi Street and St. Mary Street were randomly selected, and from ward 6, Frazer, Dr Dean and Ikono Streets were selected. The third stage of random selection was, from each of the nine streets, 25 households were randomly selected for the survey. A total of 225 (3 x 3 x 25) respondents were issued questionnaires, from which, 195 respondents returned the instrument distributed. Respondents were expected to agree or disagree to well structured questions.

The chi square test was used to analyse the variation in responses; the formula for computing the calculated chi square (X^2_{Cal}) value was

$$X^2_{Cal} = \sum \frac{(O - E)^2}{E}$$

Where; O is the observed value corresponding to response of the respondents and E is the expected values based on the hypothesis that there would be no variation in the responses. Degree of freedom (df). $df = v - 1 = 5 - 1 = 4$; v is the number of classes.

RESULTS

One hundred and sixteen (116) male respondents participated in the process against seventy nine (79) female respondents (Table 1). Thirty two (32) respondents were single, 60 were married, 74 were divorced, 28 were widows and one of the respondents was a widower. The respondents whose age ranged from 10 to 15 years were 18; the respondents within the age range 16 to 25 years were 39; those whose age ranged from 26 to 35 years were 76; those whose age ranged from 36 to 45 years were 52 and from 46 to 55 years were 10, none of the respondents was above 55 years old. With respect to the level of education, 39 had no formal education; 67 had a maximum of primary school education; 64 of the respondents had attended secondary school education; 25 persons had attended tertiary education and none of the respondents had post graduate education.

The religious affiliation of the respondents was tested (Table 1), 38 or 49% of the respondents were adherents of the African religion, the number of Christians were 83 or 42.56%; 19 persons were Moslems, while 55 respondents had no specified religious affiliation. With respect to the employment status, 103 (or 52.8%) respondents were students, 19 traders, one tailor, four drivers, 30 public/civil servants and 38 farmers.

The study also evaluated the respondents self appraisal on his or her awareness about biotechnology (Table 2); 98 (or 50.26%) claimed they had knowledge about biotechnology at the period the survey was carried out; 60 (or 30.8%) persons claimed they had benefitted from products developed from biotechnology and 20 asserted that they were aware of the health and environmental risks of biotechnology. With respect to the how long ago the respondents became aware of biotechnology, 20 persons knew of biotechnology in less than two years before the survey, 25 persons had learnt of biotechnology between three to five years ago, 32 or 31.68% had known of biotechnology between six and eight years ago, 24 respondents knew of biotechnology in nine to eleven years, while none of the respondents claimed to have known of biotechnology in at least 12 years before the survey.

Several sources were evaluated to have provided the information on biotechnology (Table 2). About 28 (or 29.47%) of the respondents read from newspapers; 20 had information from radio, 16 or 16.84% of the respondents became aware of biotechnology from magazines and or journals, 27 or 28.4% learnt of biotechnology from friends and or relatives, four respondents learnt from lessons in schools. No respondent admitted that he or she had attended seminar or lecture that discussed biotechnology.

Respondents were asked questions on the principles on general biotechnology to test their knowledge (Table 3). One hundred and sixty five persons agreed that biotechnology refer to techniques that apply to biological processes, against 27 persons who disagreed, the chi square test was significant at 5% probability. Also, 183 persons agreed that biotechnology helps in food and drug production, while 12 persons disagreed; 129 respondents against 63 persons agreed that biotechnology helps in improving living things in ways that are more difficult than with older techniques. One hundred and two (102) against 87 respondents agreed that biotechnology exploited genetic resources, while, 6 respondents did not know the difference. One hundred and twenty eight (128) against 67 respondents agreed that biotechnology added, removed and or changed genetic makeup of organisms. Sixty-six (66) persons asserted that biotechnology only applies in industries and not in agriculture, against 125 respondents who disagreed with the opinion. One hundred and seventy five (175) respondents were aware that biotechnology was useful tools for enhancing agriculture, whereas 20 did not agree.

In comparing differences between plants developed through biotechnology and plants developed through traditional breeding methods, 133 respondents agreed that there were no differences and 60 thought there were differences, likewise, 132 respondents said biotechnology was different from conventional breeding methods, while 64 persons disagreed. Twenty eight respondents said there were no dangers in consuming crops produced through biotechnology, 165 respondents disagreed.

The survey analysed respondents' knowledge on genetically modified crops (GMC) and how GMC were used in Nigeria (Table 4). Eighty-two (82) respondents asserted that GMC were safe, while 75 opined they were not safe and thirty-eight did not know. One hundred and two respondents agreed that GMC used were limited to

agriculture and industries, 80 respondents disagreed and 13 did not know if usage was limited to these sectors. Sixty-six respondents opined that GMC appropriate for developing countries only, 86 disagreed and 43 expressed no opinion. With respect to the health risk of GMC, 112 respondents agreed that GMC have potential risk on human health, 81 disagreed. Ninety-six (96) persons agreed that GMC have genes that can increase yield in crops, whereas, 78 persons disagreed and 21 had no idea. Fifty-nine respondents were of opinion that GMC are grown in the USA and other developed countries; 104 respondents had counter opinion and 32 persons did not know the answer.

In respect of GMC resistance to pests and insects, 102 respondents agreed that GMC were resistant to insects and other pests, whereas 82 opined that they were not resistant. Eighty-one respondents agreed that GMC do not need herbicide application during cultivation, 91 disagreed. Only 47 persons agreed that genetically modified crops were eaten in African countries; whereas, 122 respondents disagreed and 26 had no idea whether GMC were eaten in Africa or not. One hundred and eight respondents agreed that GMC were safe for the environment, while 79 disagreed and only eight persons had no idea that GMC were eaten. Seventy seven respondents agreed that GMC were widely grown in Africa, 81 disagreed and 37 were not aware that GMC were grown in Africa; the X^2 value was not significant. One hundred and six (106) respondents agreed that GMC have been developed in Nigeria and 85 respondents disagreed. One hundred and three respondents believed that GMC have negative effects on humans and environment and 85 disagreed. On the issue if the Nigerian National Assembly has passed laws on the usage and safety of genetically modified crops, 93 persons agreed that there are such laws while 97 persons disagreed. Also, 108 respondents said the attitude of Nigerians to how GMC are used was encouraging whereas 84 disagreed. On food security in Nigeria, 92 respondents posited that production of GMC was a positive way to guarantee food security, while 98 disagreed. Fifty-nine (59) persons said there are regular GMC based public lectures and demonstrations while 128 respondents argued against regular lectures. Eighty persons agreed that food security was defined as availability of adequate and quality food for everybody at all times, while 105 disagreed, ten did not know. One hundred people agreed that development of seeds through genetic manipulation was more expensive than through conventional methods, but 94 persons disagreed; and 106 people agreed that food produced through genetic manipulation should be labelled by law, 85 people disagreed.

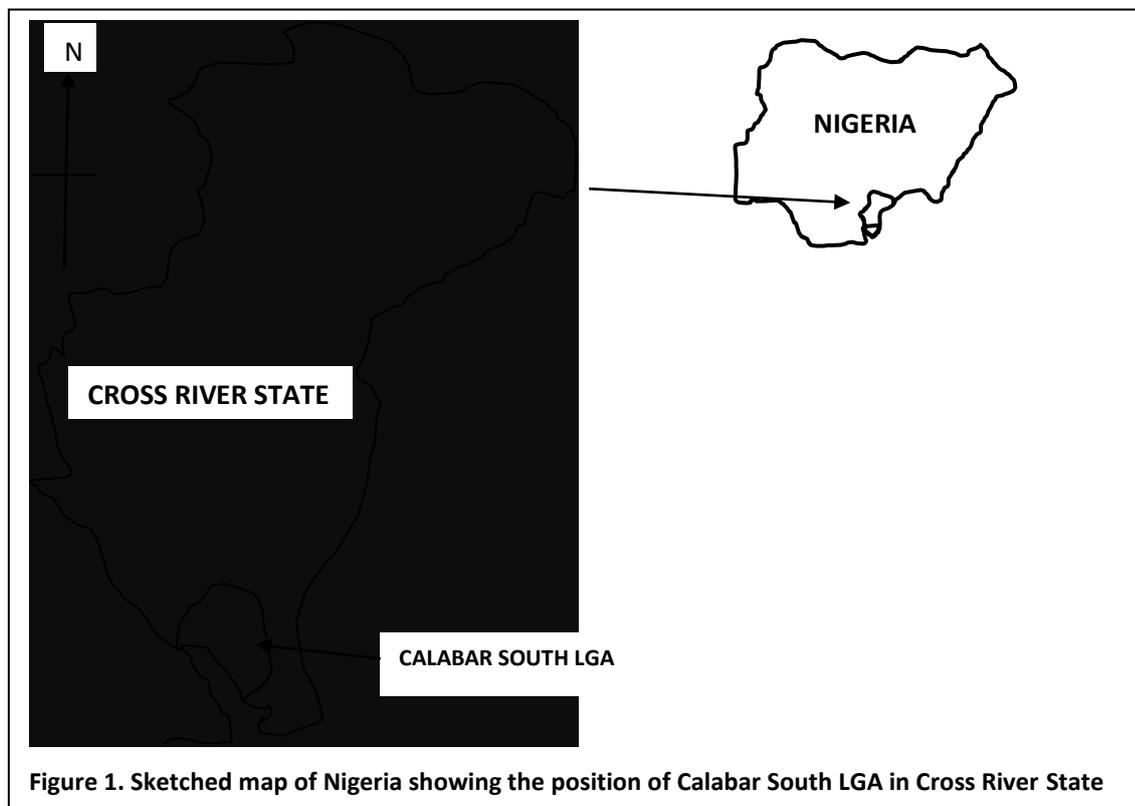


Figure 1. Sketched map of Nigeria showing the position of Calabar South LGA in Cross River State

Table 1. Respondents' bio-data

sn	Variable	Frequency	Percentage
1	Sex		
	i. Male	116	59.49
	ii. Female	79	40.51
	Total	195	100.00
2	Marital status		
	i. Single	32	16.41
	ii. Married	60	30.77
	iii. Divorced	74	37.95
	iv. Widowed	28	14.36
	v. Widower	1	0.51
	Total	195	100.00
3	Age		
	i. 10-15 years	18	9.23
	ii. 16-25 years	39	20.00
	iii. 26-35 years	76	38.97
	iv. 36-45 years	52	26.67
	v. 46-55 years	10	5.13
	vi. 56 and above	0	0.00
	Total	195	100.00
4	Education		
	i. Non formal	39	20
	ii. Primary	67	34.36
	iii. Secondary	64	32.82
	iv. Tertiary	25	12.82
	v. Post Graduate	0	0
	Total	195	100
5	Religious Affiliation		
	i. African Traditional	38	19.49
	ii. Christianity	83	42.56
	iii. Islamism	19	9.74
	iv. Others	55	28.21
	Total	195	100.00
6	Employment Status		
	i. Students	103	52.82
	ii. Traders	19	9.74
	iii. Mechanics	0	0
	iv. Tailors	1	0.51
	v. Drivers	4	2.05
	vi. Public/Civil Servants	30	15.38
	vii. Farmers	38	19.49
	Total	195	100.00

Table 2. Respondents' claim about biotechnology awareness

sn	Variable	Number of Respondents	Per cent
1	Knowledge on Biotechnology	98	50.26
2	Benefitted from Biotechnology products	60	30.77
3	Aware of Health/Environment risks of biotechnology	20	10.26
4	Duration since having knowledge of biotechnology		
	i 0 - 2 years	20	19.80
	ii 3 - 5 years	25	24.75
	iii 6 - 8 years	32	31.68
	iv 9 - 11 years	24	23.76
	v 12 years and above	0	0.00
		101	100.00
5	Source of information about biotechnology		
	i Newspaper	28	29.47
	ii Radio	20	21.05
	iii Magazines/Journals	16	16.84
	iv From friends/relatives	27	28.42
	v From School lessons	4	4.21
	vi Seminars/Lectures	0	0.00
		95	100.00

DISCUSSION

Biotechnology has solutions to most of human problems, for example, it has helped to increase crop and farm animal productivity and has the potential of producing enough food to feed the world. GM cassava is currently being tested in Nigeria and the challenges associated with biotechnology use discussed in the country (Ogbonna, 2013; Abideen, 2013). Biotechnology can also create problems that will be difficult for human beings to handle. These hypotheses were tested through structured questionnaires and interviews in the Calabar South LGA in Cross River State, Nigeria.

Of the 195 respondents, more than 86% were aged between 16 and 45 years old and about the same proportion were in one school or another, ranging from primary to tertiary educational institution, which indicated an appropriate catchment for the survey. The respondents were well knowledgeable in the general principles of biotechnology. Most of the respondents knew that biotechnology is technique based on the application of biological processes, helped in food and drug production, improves living things better than with older methods and is a genetic process, this is commendable. However, the number of respondents who thought products developed through biotechnology were useful in industries and not in agriculture was quite high, although this question tested the alert cognitive status of the respondents. This showed deficiency in the information available to them.

On the knowledge on genetically modified crops, there was a mixed response, for example 165 persons disagreed that no danger in eating crops produced through biotechnology, while 75 disagreed that genetically modified crops were safe to be eaten. High number of respondents (66) agreed that GMC were suitable for developing countries only, and 59 were aware of cultivation in USA and other developed countries. Most respondents did not associate genetically modified crops with crops developed through biotechnology, which is responsible for the polarity in answers comparing biotechnology and genetically modified crop production.

In respect of industrial development, there have been tremendous improvements as results of biotechnology advancements. For example, production of better quality wine and other alcoholic beverages have been achieved by improvement in genetic modification of microorganisms and bioprocesses. Similar achievements have been reported in genetic modification to enhance bio-gas, bio-biodiesel and bio-ethanol production, genetic engineering has been used to produce second and third generation energy crops for efficient production of renewable energy which are friendly to the environment and acceptable GM foods are available all over the world (Ogbonna, 2013). Therefore, respondents who had asserted otherwise were not well-educated about these developments.

CONCLUSION AND RECOMMENDATIONS

Biotechnology is an area of study that is not well understood by many people, especially people in sub-Saharan Africa because of many ethical issues connected with some aspects of the field, particularly when the issues involve human cells, organs and life. It would be senseless to join in discourse on biotechnology and difficult to use its products wisely without informed knowledge. This study clearly showed that people in Calabar South LGA need further education on the subject.

Table 3. Analysis of Respondents' Awareness on General Biotechnology Principles

sn		SA	A	SD	D	N	TOT	X^2_{Cal} value
1.	Biotechnology is a term for any technique based on application of biological processes	65	100	9	18	3	195	180.4
2.	Biotechnology helps in production of food and drugs	67	116	3	9	0	195	267.4
3.	Biotechnology helps in improving living things in ways difficult with older procedures	32	97	37	26	3	195	125.2
4.	Biotechnology exploits genetic resources	33	69	36	51	6	195	55.85
5.	Biotechnology allows humans to add, remove or change genetic makeup of organisms	45	83	35	32	0	195	91.23
6.	Biotechnology helps in the production of genetically modified crops	58	129	2	6	0	195	319.0
7.	Biotechnology is ONLY applicable in industries and NOT in agriculture	31	35	79	46	4	195	75.74
8.	Biotechnology is the latest in the line of increasingly powerful tools for enhancing agriculture	68	107	6	14	0	195	223.1
9.	Plants developed by biotechnology are NOT different from plants developed through traditional breeding methods	55	78	45	15	2	195	96.36
10.	Biotechnology is fundamentally different from other techniques, e.g. selection and hybridization	42	89	50	14	0	195	122.5
11.	There is NO DANGER in consuming crops produced through biotechnology	8	20	89	76	2	195	168.2
	TOTAL	524	1040	301	260	20		

Key: SA = Strongly agree; A = Agree; SD = Strongly disagree; D = Disagree; N = No idea. TOT = Total; Tabulated X^2 value = 9.49; df = 5 - 1 = 4

Table 4. Analysis of Knowledge on Genetically Modified Crops and Their Utilization in Nigeria

sn		SA	A	SD	D	N	TOT	X^2_{Cal} value
1.	Genetically modified crops are safe for consumption	26	56	33	42	38	195	12.92
2.	Genetically modified crops are used in Agriculture and industries ONLY	54	48	41	39	13	195	25.28
3.	Genetically modified crops are ONLY appropriate for developing countries	27	39	45	41	43	195	5.128
4.	Genetically modified crops have potential risks on human health	51	61	37	44	2	195	51.95
5.	Genetically modified crops contain genes that can help increase yield in crops	38	58	36	42	21	195	18.05
6.	Genetically modified crops are widely grown in the USA and other developed countries	22	37	56	48	32	195	18.26
7.	Genetically modified crops are resistant to insects and other pests of crops	45	57	38	44	11	195	30.00
8.	Genetically modified crops do not need herbicides during cultivation	38	43	43	48	23	195	9.487
9.	Genetically modified crops are eaten by people in many African countries, e.g. Kenya etc.	15	32	68	54	26	195	47.69
10.	Genetically modified crops are safe for the environment	52	56	33	46	8	195	38.56
11.	Genetically modified crops are widely grown in Africa	35	42	37	44	37	195	1.487
12.	Genetically modified crops have been developed in Nigeria	56	50	29	56	4	195	51.90
13.	Genetically modified crops have negative effects on man and environment	46	57	46	39	7	195	37.08
14.	The Nigerian National Assembly has passed laws on safety and utilisation of genetically modified crops	42	51	32	65	5	195	52.15
15.	The attitude of Nigerians toward the utilisation of Genetically modified crops is encouraging	48	60	29	55	3	195	55.74
16.	Production of Genetically modified crops is a positive way to guarantee food security in Nigeria	44	48	46	52	5	195	37.95
17.	There are regular public lectures and demonstrations on Genetically modified crops and usage	24	35	55	73	8	195	67.03
18.	Food security is the availability of adequate and quality food for everybody at all times	33	47	48	57	10	195	34.51
19.	Seeds developed through genetic manipulation are more expensive to produce than seeds developed through conventional methods	46	54	36	58	1	195	53.54
20.	By law, food produced through genetic manipulation should be labelled	40	66	34	51	4	195	54.46
	TOTAL	782	997	822	998	301		

Key: SA = Strongly agree; A = Agree; SD = Strongly disagree; D = Disagree; N = No idea; TOT = Total; Tabulated X^2 value = 9.49; df = 5 - 1 = 4

In memoriam Nneoyi Ina Ofem passed away after actively participating in the design, analysis and interpretation of the questionnaire and other research findings. May his soul rest in peace, Amen.

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