



## Research Article

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# Public Knowledge, Attitudes, and Willingness to Use Genetically Modified Foods in Ogun State, Nigeria

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## Abstract

The increasing focus on genetically modified (GM) foods has sparked significant debate, particularly in developing countries like Nigeria, where food security remains a pressing issue. This study aims to assess public knowledge, attitudes, and willingness to use GM foods in Ogun State, Nigeria, in light of the federal government's endorsement of some GM crops to enhance agricultural productivity and nutritional quality. A descriptive survey design was employed, targeting adults aged 18 years and above across four divisions of Ogun State: Ijebu, Egba, Remo, and Yewa. A total of 1,104 participants were selected using stratified random sampling. Data were collected through a structured questionnaire designed to evaluate knowledge, attitudes, and willingness regarding GM foods. The findings indicate that 70.9% of respondents had heard of GM foods, but only 39% accurately distinguished them from hybrids. Willingness to purchase GM foods was high, particularly among those who perceived them as healthier or more affordable. Regional differences were observed, with participants from Remo exhibiting the highest acceptance levels. Concerns regarding health risks and environmental impacts were prevalent, highlighting the need for targeted educational initiatives to address misconceptions and improve public understanding. This study provides insights into the perceptions of GM foods in Ogun State, emphasising the importance of education in fostering acceptance. It appears that while there is general willingness to adopt GM foods, significant knowledge gaps and persistent misconceptions must be addressed to facilitate informed decision-making and support the integration of GM technologies into sustainable agricultural practices.

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## Introduction

The growing focus on genetically modified (GM) foods has generated intense debate globally (Cabelkova, 2024; Ghimire et al., 2023), particularly in developing nations like Nigeria, where food security issues persist (Wudil et al., 2023). In Nigeria, the federal government's endorsement and introduction of four new TELA® maize varieties – SAMMAZ 72T, 73T, 74T, and 75T – into the agricultural landscape in 2024, is suggested to improve agricultural productivity, tackle food scarcity, and enhance nutritional quality (Alliance for Science, 2024; Oyekunle et al., 2023). However, public acceptance of GM foods and food choices in general, depends on a mix of knowledge, attitudes, socio-cultural beliefs, and tradition, as is the case in Nigeria (Omoyajowo et al., 2024). Understanding these dynamics locally is vital for policymakers and stakeholders to promote (or otherwise) GM technologies in agriculture.

Research indicates that knowledge of consumers about GM foods could significantly impact their views and acceptance. For instance, individuals with higher levels of education and awareness tend to exhibit more favourable attitudes towards GM foods (Mustafa et al., 2023). Conversely, misinformation and poor understanding could lead to scepticism and resistance, as seen in various regions across Africa (Mustafa et al., 2023). In Ogun State, Nigeria, where agriculture is vital for the local economy, there is sparsity of such data. It is essential to assess the current state of public knowledge regarding GM foods, the divisional variations in such knowledge across Ogun State, and how it shapes consumer attitudes and willingness to adopt these innovations.

Previous studies have highlighted the importance of regional perceptions in shaping consumer

behaviour towards GM foods. For instance, research conducted in urban areas of China revealed that despite limited knowledge, a significant portion of the population expressed a willingness to purchase GM products (Huang et al., 2006). Similarly, in Europe and the United States, consumer attitudes towards GM foods vary widely, influenced by cultural, ethical, and health-related concerns (Popek & Halagarda, 2017).

This variability underscores the necessity of localised studies that consider the unique socio-economic and cultural contexts of different regions. In Ogun State, the agricultural landscape is characterized by a mix of traditional farming practices and modern agricultural techniques. However, the extent to which farmers and consumers are informed about GM foods remains unclear, so this study aims to fill this gap. By analysing regional perceptions and preferences, this research seeks to provide valuable insights that can inform educational campaigns and policy decisions regarding the adoption of GM technologies in Nigeria.

As the global population continues to grow and the challenges of food security intensify, understanding public perceptions of GM foods becomes increasingly critical (Bodirsky et al., 2020). Cabelkova (2024) noted that factors such as gaps in knowledge, media misinformation by media, concerns about ethical issues, and trust in regulatory bodies shape public perception of GM foods. This present study will contribute to the existing body of knowledge by exploring the factors that influence consumer acceptance of GM foods in Ogun State, Nigeria, thereby facilitating a more informed dialogue on the future of agricultural biotechnology in the region. The objective of this study was thus, to assess the public knowledge, attitude and willingness to use genetically modified foods in Ogun State, Nigeria.

## Material and methods

### *Research design*

This study employed a descriptive survey design to evaluate public knowledge, attitudes, and willingness to use genetically modified (GM) foods in Ogun State, Nigeria. This design is particularly suited for capturing the perceptions of the public, as it allows for the collection of quantitative data through structured questionnaires.

### *Participants*

The target population consisted of adults aged 18 years and above who were residents of Ogun State during the data collection period from January 2024 to June 2024. This demographic was chosen to ensure a comprehensive understanding of the general public's views on GM foods, as they represent the primary consumers of agricultural products. A total of 1,104 adults participated in the study. A stratified random sampling technique ensured representation across the four divisions of Ogun State: *Ijebu*, *Egba*, *Remo*, and *Yewa*. From each division, two local governments were randomly selected, and within each local government, 138 participants were randomly selected, resulting in a balanced representation of the population across the divisions. The study protocols were reviewed and approved by the Institutional Review Board (TASUED/DRER/20/119). Informed consent was obtained from participants prior to voluntary participation in the study.

### *Research instrument*

The study employed a questionnaire titled “Public Knowledge, Attitude, and Willingness to Use Genetically Modified Foods”. The instrument was

structured into four sections namely, A, B, C and D. Section A was designed to collect information on respondents' sex, age, level of education, area of residence (rural/urban), religion, occupation, and sources of agricultural information. Section B was designed to elicit responses on knowledge of genetically modified foods and comprised three sub-sections (general knowledge, knowledge of benefits, and knowledge of risk) with 10, 8, and 4 items respectively in each sub-section. The 22 items were adapted from a previous study (Mustafa et al., 2023). Section C included 18 items designed to assess respondents' attitudes towards GM foods, with items adapted from two relevant studies (Egbe et al, 2019; Rathod & Hedao, 2022). Section D consisted of 8 items that were used to assess the willingness of respondents to use GM foods, with items adapted from a previous related study (Mustafa et al., 2023).

The reliability of the research instrument was assessed by carrying out a pilot trial on initial 50 participants randomly selected, and the outcome did not necessitate any major alteration. The Cronbach alpha reliability indices for the sections and sub-sections of the Questionnaire are General Knowledge (0.70), Knowledge of Risks (0.70), Knowledge of Benefits (0.80), Attitude (0.80), and Willingness to Use (0.80). These values indicate acceptable reliability levels, suggesting that the instrument is consistent in measuring the constructs.

### *Statistical analysis*

Data analysis involved descriptive statistics, including frequencies and percentages to summarize demographic information and responses using Statistical Package for Social Sciences, Version 22.

## Results and Discussion

### *Characteristics of participants*

The mean age of the participants was 41 years, and 345 (31.4%) of them were 45 years or older. About 47.4% of our study participants are males. A total of 606 (55.1%) of the participants had completed secondary school, and 506 (46%) of them were married. More than half (57.5%) of them lived in rural areas, and 96.1% were religious, being either Christian or Muslim. In addition, 62% of them were engaged in occupations related to trade and services, and almost two thirds (65.5%) reported that they got their agricultural information from social media. The characteristics of participants are shown in Table 1.

**Table 1.** Characteristics of Study Participants

| Characteristic                                       | Frequency* | Percentage |
|------------------------------------------------------|------------|------------|
| Male                                                 | 521        | 47.4       |
| Married                                              | 506        | 46.0       |
| Rural Settlement                                     | 632        | 57.5       |
| Age $\geq$ 45 years                                  | 345        | 31.4       |
| Minimum of Secondary School Education                | 606        | 55.1       |
| Occupation: Educational & Professional               | 418        | 38.0       |
| Occupation: Trade & Services                         | 682        | 62.0       |
| Religion: Christianity                               | 607        | 55.2       |
| Religion: Islam                                      | 450        | 40.9       |
| Religion: Others                                     | 43         | 03.9       |
| Source of agricultural information: social media     | 721        | 65.5       |
| Source of agricultural information: radio/television | 379        | 34.5       |

\* Some values do not add up to 1104 participants due to missing data

### *Knowledge of genetically modified foods*

Table 2 indicates a moderate overall awareness of GM foods, with about 71% having heard of them. However, the data indicate a need for clearer

public information: roughly half had direct experience with GM foods – seeing (53.1%) or consuming (51.6%) – and merely 39% accurately distinguished GM foods from hybrids. Only 46% recognised that GM foods are commercially available in Ogun State, while over half (59%) claimed at least a moderate understanding and expressed a desire for additional information.

### *Knowledge of risk of genetically modified foods*

Respondents generally perceived GM foods as safe, over 60% did not believe they cause allergies; 11.5% were uncertain, and a small fraction, 5.5%, remained neutral (Table 3a). However, regarding the cost of GM seeds, almost half of the participants perceived them as expensive for farmers. Also, concerns emerged regarding ecological impacts: around 45% feared gene flow to indigenous crops, potentially causing a loss of indigenous germplasm, and approximately 40% were worried about the development of superpests. In Table 3b, divisional variations in uncertainty and risk perception were evident when considering scientific understanding of long-term impacts and potential gene transfer, and the effects of continuous cultivation of GM crops on soil nutrients. In response to the question regarding what scientists know about the long-term impacts of GM foods, majority of respondents across the divisions demonstrated a high level of trust into scientific process. Our survey also explored the public's beliefs regarding the possibility of gene transfer from GM herbicide-resistant crops to weeds. The responses ranged from 43% agreement in Ijebu to 59% in Egba who believed that it is possible for weeds to acquire herbicide-resistant genes, leading to an average of 49.5% across all divisions. Furthermore, our results showed average

(51.5%) level of agreement across all divisions to the issue of whether growing the same GM foods every season may lead to nutrient depletion.

### *Knowledge of benefits of genetically modified foods*

The results presented in Table 4 show that the public opinion on the benefits of GM foods was

mixed. While many acknowledged advantages such as faster growth and higher yields (with 45–50% in favour), perceptions of other benefits (taste, nutritional value, climate resilience, and cost) varied considerably. Less than half (45%) of participants believe that GM foods grow faster; 42% consider GM foods to be tastier; 47% believe that GM foods are resistant to diseases and pests; 35% think GM foods are more resistant to harsh

**Table 2.** General Knowledge of Genetically Modified (GM) Foods

| Variable                                                            | Yes (%)   | No (%)    | I do not know (%) |
|---------------------------------------------------------------------|-----------|-----------|-------------------|
| Ever heard of GM foods                                              | 780(70.9) | 224(20.4) | 96(8.7)           |
| Ever seen a GM food                                                 | 584(53.1) | 383(34.8) | 133(12.1)         |
| Ever eaten a GM food                                                | 568(51.6) | 333(30.3) | 199(18.1)         |
| Is GM food the same as Hybrid food?                                 | 373(33.9) | 425(38.6) | 302(27.5)         |
| Do we have GM foods available for public consumption in Ogun State? | 503(45.7) | 315(28.6) | 282(25.6)         |
| Do you need more information on GM food?                            | 653(59.4) | 267(24.3) | 180(16.4)         |

**Table 3a.** Knowledge of Risk of Genetically Modified Foods

| Variables                                                                        | True (%)  | False (%) | Don't know (%) | Neutral (%) |
|----------------------------------------------------------------------------------|-----------|-----------|----------------|-------------|
| People won't be allergic to GM Food                                              | 675(61.4) | 239(21.7) | 126(11.5)      | 60(5.5)     |
| GM food seeds are so expensive to farmers                                        | 545(49.5) | 301(27.4) | 183(16.6)      | 71(6.5)     |
| GM genes may escape to indigenous crops causing loss to our indigenous germplasm | 493(44.8) | 260(23.6) | 241(21.9)      | 106(9.6)    |
| Pests may become resistant resulting in superpests                               | 443(40.3) | 330(30.0) | 327(29.7)      | 0(0)        |
| People won't be allergic to GM Food                                              | 675(61.4) | 239(21.7) | 126(11.5)      | 60(5.5)     |

**Table 3b.** Knowledge of Risk of Genetically Modified Foods by Ogun State Divisions

| Variables                                                                                    | Yewa      | Egba      | Remo      | Ijebu     | Total     |
|----------------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|
| <b>What do scientists know about the long-term impacts of GM foods?</b>                      |           |           |           |           |           |
| Scientists know everything (%)                                                               | 167(66.8) | 207(82.8) | 213(85.2) | 244(69.7) | 831(75.5) |
| I am not sure (%)                                                                            | 83(33.2)  | 43(17.2)  | 37(14.8)  | 106(30.3) | 269(24.5) |
| <b>Weeds may acquire herbicide-resistant genes from GM herbicide-resistant crops?</b>        |           |           |           |           |           |
| Yes, it is possible (%)                                                                      | 116(46.4) | 148(59.2) | 129(51.6) | 151(43.1) | 544(49.5) |
| No, it is impossible (%)                                                                     | 91(36.4)  | 74(29.6)  | 27(10.8)  | 120(34.3) | 312(28.4) |
| I do not know (%)                                                                            | 43(17.2)  | 28(11.2)  | 94(37.6)  | 79(22.6)  | 244(22.2) |
| <b>Growing the same GM foods, every season may result in the depletion of soil nutrients</b> |           |           |           |           |           |
| Yes, it is possible (%)                                                                      | 123(49.2) | 167(66.8) | 136(54.4) | 140(40.0) | 566(51.5) |
| No, it is impossible (%)                                                                     | 68(27.2)  | 49(19.6)  | 26(10.4)  | 84(24.0)  | 227(20.6) |
| It may not deplete all nutrient (%)                                                          | 26(10.4)  | 15(6.0)   | 48(19.2)  | 42(12.0)  | 131(11.9) |
| I don't know (%)                                                                             | 33(13.2)  | 19(7.6)   | 40(16.0)  | 84(24.0)  | 176(16.0) |

conditions; while 41% perceive GM foods as more nutritious. Economic implications are also significant, with 44% believing that GM foods are cheaper; and 45% believing that GM foods can help eradicate hunger and boost the economy. The survey indicates that 51% of participants believe that GM crops resistant to pests can reduce pesticide use, while 53% think that GM crops are resistant to herbicides and pesticides. These findings highlight a mixed understanding of the benefits of GM foods among the population.

consider purchasing GM foods if they contained less pesticide residue. Religious and regulatory endorsements had limited influence on purchasing decisions. The need for regulation and proper labelling was emphasised, with 37% to 53% respondents supporting tighter regulations on GM foods. Willingness to buy and consume GM foods available in the market was moderate (52%) across all divisions. The promotion of GM foods presents ethical challenges regarding transparency, informed consent, and fairness. Consumers require clear,

**Table 4.** Knowledge of Benefits of Genetically Modified Foods

| Variables                                          | Yes (%)   | No (%)    | I don't know (%) |
|----------------------------------------------------|-----------|-----------|------------------|
| Do GM Food grow faster?                            | 497(45.2) | 296(26.9) | 307(27.9)        |
| Are the yields of GM foods higher?                 | 468(42.5) | 342(31.1) | 290(26.4)        |
| Are GM foods tastier?                              | 467(42.5) | 327(29.7) | 306(27.8)        |
| Are GM foods resistant to diseases & pests?        | 520(47.3) | 338(30.7) | 242(22.0)        |
| Are GM foods more resistant to harsh climate?      | 383(34.8) | 381(34.6) | 336(30.5)        |
| Are GM foods more nutritious?                      | 453(41.2) | 368(33.5) | 279(25.4)        |
| Are GM foods cheaper?                              | 486(44.2) | 358(32.5) | 256(23.3)        |
| Can GM foods eradicate hunger and boost economy?   | 491(44.6) | 359(32.6) | 250(22.7)        |
| GM crops resistant to pest reduce use of pesticide | 559(50.8) | 302(27.5) | 239(21.7)        |
| GM crops are resistant to herbicides and pesticide | 583(53.0) | 255(23.2) | 262(23.8)        |

#### *Attitude towards genetically modified foods by Ogun State Divisions*

In Table 5, attitudinal responses across all divisions in Ogun State suggest cautious optimism. A majority expressed readiness to purchase GM foods if they were healthier (59% - 86%) or cheaper (32% - 75%) than conventional options. On average, 70% of participants indicated a preference for GM foods based on health benefits. This trend continued with price considerations: an average of 58% across all divisions stating that they would buy GM foods if they were cheaper.

Environmental concerns also played a significant role in shaping attitudes towards GM foods: 48% - 70% of respondents across all four divisions would

unbiased information on both benefits and risks to make informed choices. Aggressive marketing by large agribusinesses can prioritise profit over public welfare and environmental safety.

Furthermore, market dominance may disadvantage small-scale farmers, exacerbating socio-economic disparities. Environmental and cultural impacts, such as threats to biodiversity and conflicts with traditional values, also raise concerns. Robust regulatory frameworks and ethical oversight are essential to ensure the promotion of GM foods respects consumer rights, promotes social justice, and safeguards the environment.

Awareness and education regarding GM foods emerged as critical factors influencing public perception. Across divisions, 48-74% of respondents

**Table 5.** Attitude Towards Genetically Modified Foods by Ogun State Divisions

| Variable                                                                                    | Yewa      | Egba      | Remo      | Ijebu     | Total     |
|---------------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|
| I would buy GM foods if it was healthier than other foods                                   | 147(58.8) | 187(74.8) | 215(86.0) | 219(62.6) | 768(69.8) |
| I would buy GM foods if it was cheaper than other foods                                     | 187(74.8) | 80(32.0)  | 183(73.2) | 187(53.4) | 637(57.9) |
| I would buy GM foods if it contains less pesticide residue than other foods                 | 175(70.0) | 121(48.4) | 159(63.6) | 167(47.7) | 622(56.5) |
| I would buy GM foods if it were grown in a more environmental-friendly way than other foods | 78(31.2)  | 118(47.2) | 165(66.0) | 163(46.6) | 524(47.6) |
| I would buy GM foods if head of my religion approves it                                     | 75(30.0)  | 106(42.4) | 85(34.0)  | 133(38.0) | 399(36.3) |
| I approve of GM foods if more tightly regulated                                             | 93(37.2)  | 97(38.8)  | 133(53.2) | 150(42.9) | 473(43.0) |
| I approve of GM foods if properly labelled                                                  | 149(59.6) | 106(42.4) | 164(65.6) | 164(46.9) | 583(53.0) |
| I approve of GM foods if developed indigenously                                             | 130(52.0) | 92(36.8)  | 161(64.4) | 129(36.9) | 512(46.5) |
| I approve of GM foods if developed by foreign biotech companies                             | 121(48.4) | 109(43.6) | 139(55.6) | 129(36.9) | 498(45.3) |
| I do not approve of GM foods under any circumstances                                        | 133(53.2) | 96(38.4)  | 115(46.0) | 113(32.3) | 457(41.5) |
| I support the use of GM foods in Ogun State as a customer                                   | 195(78.0) | 114(45.6) | 145(58.0) | 123(35.1) | 577(52.5) |
| I am willing to buy and consume GM foods available in the market                            | 168(67.2) | 106(42.4) | 152(60.8) | 150(42.9) | 576(52.4) |
| I endorse and recommend the use of GM foods                                                 | 163(65.2) | 108(43.2) | 148(59.2) | 150(42.9) | 569(51.7) |
| If I had a farm, I will promote the growing of GM foods                                     | 157(62.8) | 96(38.4)  | 158(63.2) | 150(42.9) | 561(51.0) |
| More awareness should be created among the public regarding GM foods                        | 194(73.6) | 122(48.8) | 175(70.0) | 167(47.7) | 648(58.9) |
| I support the genetic modification of foods to prolong their shelf life                     | 163(65.2) | 98(39.2)  | 147(58.8) | 152(43.4) | 580(50.9) |
| I support the genetic modification of foods to enrich their nutritional content             | 176(70.4) | 97(38.8)  | 181(72.4) | 165(47.1) | 619(58.3) |
| I think product label should contain info about GMO content of the product                  | 157(62.8) | 95(38.0)  | 174(69.6) | 153(43.7) | 579(52.6) |

believed that more awareness should be created among the public regarding GM foods, indicating a strong desire for increased knowledge and understanding.

#### *Willingness expressed towards genetically modified foods in Ogun State*

A notable finding in Figure 1 is that a majority of respondents expressed a willingness to buy GM foods (64.4%, 86.4%, 74.4%, 55.7% from Yewa, Egba, Remo, and Ijebu, respectively) indicating their readiness to purchase these products. This results in an average willingness of 68.9% across all divisions, suggesting a generally positive attitude towards the consumption of GM foods in Ogun State. Furthermore, when asked about their

willingness to eat GM foods, the responses were similarly favourable, culminating in an average of 69.8%. The survey also explored the willingness to engage in the commercial aspects of GM foods, such as selling and growing them. The willingness to sell GM foods was reported at 80.8% in Yewa, and 50.0% in Remo, but lower in Egba (46.4%) and Ijebu (40.3%), with an overall willingness of 53.1%. This disparity suggests that while there is a strong inclination to buy and consume GM foods, the commercial acceptance may be hindered by regional differences in perception. Similarly, the willingness to grow GM foods was reported at 54.4% in Yewa, 48.4% in Egba, 52.8% in Remo, and 44.6% in Ijebu, leading to an overall willingness of 49.5%. The survey also assessed

attitudes towards GM technology more broadly. The willingness to embrace GM technology was reported at 50.8% in Yewa, 45.2% in Egba, 70.4% in Remo, and 46.0% in Ijebu, resulting in a total of 52.5%. This indicates a moderate level of acceptance of GM technology, with Remo showing a notably higher willingness compared to the other divisions.

Regarding regulatory perspectives, the survey revealed that 41.2% of respondents in Yewa, 25.6% in Egba, 53.6% in Remo, and 29.4% in Ijebu believe that GM foods should not be banned in Nigeria, leading to an overall agreement of 36.7%. This suggests a significant portion of the population supports the continued availability of GM foods, although opinions vary by region. In addition, the perception of government support for GM foods was assessed, with a total of 49.8% respondents expressing belief in the government's willingness to promote GM foods. Moreover, when asked about their willingness to apply GM

technology, overall 51.2% respondents indicated a positive response.

This present study provides a comprehensive overview of public knowledge, attitudes, and willingness to use genetically modified (GM) foods in Ogun State, Nigeria. Most participants had heard of GM foods, and over half had seen or consumed them, reflecting moderate exposure to these products. However, misconceptions persist, as almost a third of participants equated GM foods with hybrid foods, highlighting a need for clearer public education. Misconceptions about genetically modified (GM) foods, such as conflating GM technology with traditional hybridisation, persist due to a combination of factors including the inherent complexity of genetic science, limited public exposure to detailed agricultural education, and the pervasive spread of misinformation on social media platforms (Frewer et al., 2013). When scientific concepts are communicated in overly technical or ambiguous terms, the fundamental

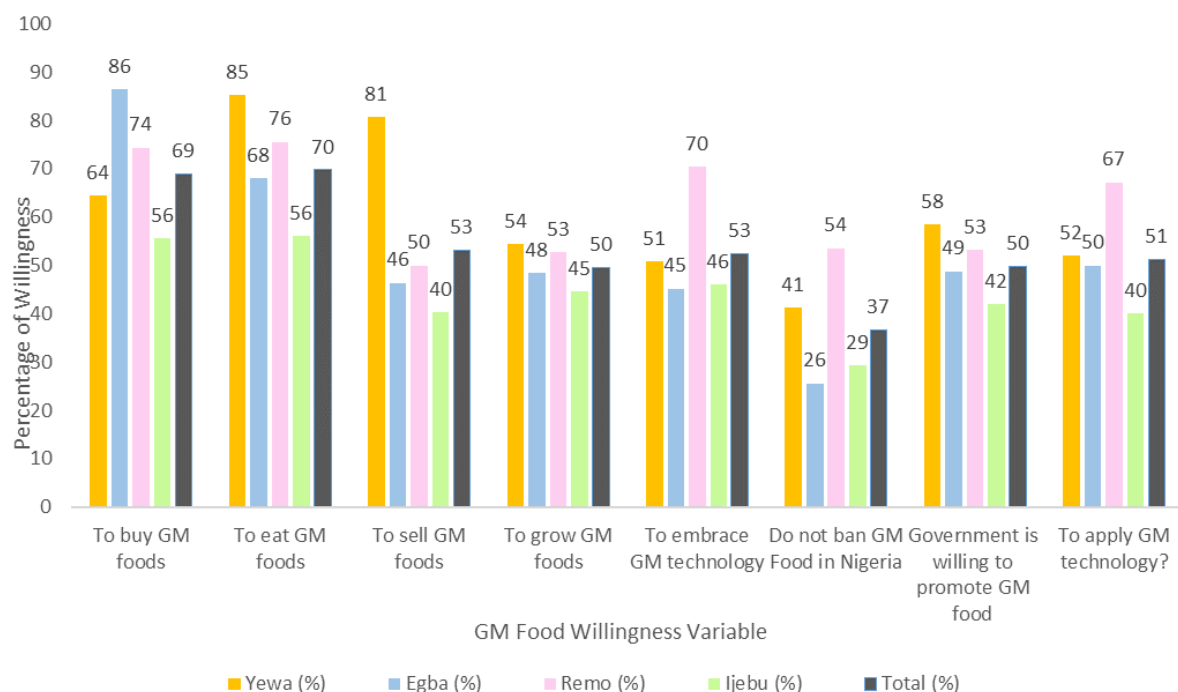


**Figure 1.** Willingness Expressed Towards Genetically Modified Foods in the Four Divisions of Ogun State

differences between the precise genetic modification characteristic of GM foods and the broader, conventional process of hybridisation are often lost on the general public (Quist & Chapela, 2001). The willingness to purchase GM foods was notably high, with more than two thirds of participants expressing readiness to buy them, particularly if they were perceived as healthier or more affordable. Regional differences emerged, with participants from Remo showing the highest willingness to embrace and apply GM technology, while concerns about health risks and environmental impacts were prevalent across all divisions. Additionally, a substantial portion of participants believed that scientists possess comprehensive knowledge about the long-term impacts of GM foods, yet uncertainty remained regarding potential gene transfer to weeds and soil nutrient depletion, with almost half of them expressing concern about the possibility of gene transfer.

Our study participants, the majority of whom had at least a secondary education and identified as religious, exhibited a moderate overall awareness of genetically modified (GM) foods. However, they expressed a need for clearer public information and demonstrated varying levels of risk perception. For instance, some believed that GM genes could escape into indigenous non-GM crops, raising concerns about potential harm. While gene flow between GM crops and wild relatives is possible, Quist and Chapela (2001) indicate that its occurrence is generally low under controlled conditions. Nevertheless, the persistence of such concerns among participants suggests a gap between scientific evidence and public perception, highlighting the need for more effective science communication. Strengthening public understanding of biosafety measures is

crucial in alleviating fears and aligning public perception with scientific findings. The Food and Agriculture Organisation (FAO, 2020) highlights that many countries have implemented stringent biosafety regulations to mitigate such risks, yet awareness of these measures remains limited.

Addressing this knowledge gap through targeted science communication efforts can help bridge public concerns with established scientific principles. On the other hand, some communities and researchers express concern that these regulations might not be sufficient, particularly in regions with weak enforcement (Chagwena et al., 2019; Almohammadi, 2017). Consequently, the debate over GM gene escape is often influenced by varying degrees of knowledge about both the science, and the governance of GM technology.

Although less than half of our participants were aware that GM foods grow faster, yield higher outputs, resist pests and diseases, tolerate harsh climates, and could help eradicate hunger, their views are not entirely unfounded, as scientific literature provides supporting evidence. Many believed that GM crops offer tangible benefits, notably pest resistance and a reduced reliance on chemical pesticides, a perspective echoed by Klümper and Qaim (2014), who reported that GM crops typically exhibit more rapid growth rates and higher outputs than non-GM varieties, primarily owing to their engineered traits. This is further illustrated by *Bt* crops, which are genetically engineered to express a specific protein from the bacterium *Bacillus thuringiensis*, thereby conferring pest resistance and enhancing crop survival and productivity (ISAAA, 2017), a development that has proved particularly beneficial in areas suffering from high pest-related crop losses. Moreover, Fedoroff et al. (2010) observed that GM varieties resistant to infections caused by fungi,

viruses and bacteria significantly reduce crop loss (Pérez-de-Castro et al., 2012). Although proponents argue that increased yields and reduced losses could play a key role in eliminating hunger – as further suggested by Klümper and Qaim (2014) – concerns about equitable access and long-term ecological impacts persist. In this context, our participants' partial awareness of the benefits of GM foods underscores the need for more effective science communication to better align public perceptions with established scientific evidence and foster an informed dialogue on the role of GM technology in global food security.

In our study, almost half of the participants have little or no understanding of GM foods, considering it to be harmful or controversial. This is consistent with Frewer et al. (2013), who highlighted that a large segment of the general population possesses little to no knowledge of how GM foods or its benefits, contributing to widespread apprehension. Also, most of our participants only get information about GM foods on social media, which is susceptible to spreading misinformation. Poor understanding can amplify the spread of misinformation, where GM foods are often incorrectly associated to health risks or ecological hazards without scientific evidence.

Further research by Hossain et al. (2003) points out that individuals with lower levels of education or exposure to scientific information are more likely to oppose GM foods. This opposition is frequently driven by emotional responses or cultural values rather than evidence-based evaluations of the technology. Interestingly, our results also resonate this. In regions where GM food labelling is mandatory, public opinion surveys show that consumers may avoid GM products even when they are priced lower than non-GM alternatives (Boccia et al., 2018).

In terms of attitude towards GM foods, majority of our study participants would buy GM foods if cheaper and possessed less pesticide residue, and would be willing to consume it if available in the market and if properly labelled. Studies indicate that people are willing to buy GM foods if they are cheaper than non-GM alternatives (Colson & Huffman, 2011; Huang et al., 2006; Lusk et al., 2005). Price sensitivity is a critical factor, particularly in low-income populations, where affordability often outweighs concerns about food origin. Lusk and colleagues found that consumers in the U.S. and Europe showed increased willingness to buy GM foods when presented as cost-effective options. Another key factor driving acceptance is the potential for reduced pesticide use for GM foods. For instance, a study by Onyango et al. (2004) shows that individuals who were informed about the lower levels of pesticide residues in GM foods expressed a greater willingness to purchase them. This aligns with the finding that many consumers prioritize health and safety, and GM crops engineered to be pest-resistant are perceived as safer due to reduced chemical use. Labelling also plays a crucial role in consumer acceptance. Studies show that clear and transparent labelling helps build trust in GM products. Boccia et al. (2018) observed that people were more likely to purchase GM foods if clearly labelled and had assurances of safety from government regulatory agencies. That study affirmed that appropriate labelling informs and gives consumers autonomy to make informed decisions based on their personal beliefs. This suggests that labelling policies may be an effective way of closing the gap between consumer concerns and the potential benefits.

Our findings are indicative of a largely positive attitude towards GM foods, especially when

perceived benefits like health and economic advantages, outweigh perceived risks. This aligns with extant literature that stresses the impact of consumer perceptions of benefits and risks as significant precursors to their attitudes towards GM foods (Rabbanee et al., 2021).

A notable aspect of the present study is the divisional variation in attitudes and willingness to engage with GM foods. For instance, participants from Remo Division were most willing to purchase GM foods, suggesting that local cultural and socio-economic factors may play a crucial role in shaping perceptions. Our finding is consistent with previous studies that have highlighted demographic differences in consumer acceptance of GM foods, where younger consumers and those with higher education levels tend to exhibit more favourable attitudes (Javid & Al-Hashimi, 2019; Rabbanee et al., 2021; Siddiqui et al., 2022). We also found that a significant portion of our participants expressed a desire for more information about GM foods, indicating a gap in knowledge that could be addressed through targeted educational initiatives.

Our study also underscores the importance of perceived risks associated with GM foods. While many respondents acknowledged potential benefits, concerns about health implications, environmental impacts, and ethical considerations were prevalent. This reflects a broader trend observed in consumer behaviour studies, where perceived risks often overshadow perceived benefits, leading to resistance against GM foods (Cabelkova et al., 2024; Rabbanee et al., 2021).

Another study by Singh et al. (2024) noted that consumers frequently place priority on health and safety concerns more than the possible benefits of GM foods, which may cause them to be sceptical and reluctant to adopt GM products. The findings

suggest that addressing these concerns through transparent communication and education about the safety and regulatory processes surrounding GM foods could enhance public acceptance. Accordingly, Ngo et al. (2024) reported that when consumers have adequate knowledge about GM technology and trust in regulatory bodies, it helps to mitigate their perceived risks and promote their willingness to buy GM foods. Moreover, the influence of social and cultural factors on consumer attitudes cannot be overlooked.

We noted that religious beliefs significantly impacted willingness to purchase GM foods, with many respondents expressing hesitance unless endorsed by religious authorities. Our finding is corroborated by research indicating that religious and cultural values play a decisive role in determining people's perceptions and acceptance of GM products. For example, Siddiqui et al. (2022) noted that consumers frequently rely on their cultural backgrounds and religious education when making food choices, especially pertaining to GM products. This highlights the need for stakeholders in the GM food industry to engage with community leaders and religious organisations to foster trust and acceptance (Frewer et al., 2013). Guzik et al. (2022) suggested that when the concerns are addressed and when the GM food messaging are aligned with community values, they could significantly promote public trust and willingness to adopt the technology.

In our present study, willingness to buy and eat GM foods was high, while there were moderate levels of willingness to sell and grow GM foods. Only a minority felt that GM foods should be banned. These findings align with research indicating that many consumers are open to purchasing GM foods, particularly when they are associated with tangible benefits like lower prices

or enhanced nutritional value (Yue et al., 2015). Klerck and Sweeney (2007), in their study, showed that consumers, especially in developed countries, expressed willingness to buy GM products, with health and environmental benefits being key motivating factors. For instance, Shigi and Seo (2023) found that consumers' acceptance of GM foods is significantly influenced by their perceived benefits, such as reduced pesticide use and improved food security. In contrast, the willingness to sell and grow GM foods among producers and retailers tends to be more cautious, suggestibly, often influenced by regulatory concerns and market dynamics (Gajdić et al., 2021). According to Burton et al. (2001), some farmers and sellers show moderate level of willingness to engage with GM crops due to fears over public perception, possible market restrictions, and regulatory bottlenecks. Notably, farmers are more likely to embrace GM crops when they are sure of the economic and ecological benefits, such as pest resistance and yield increases, but may express hesitance due to uncertainties about acceptance in the market or long-term ecological impacts. Retailers, on the other hand, appear to be moderately receptive to selling GM foods because of consumer demand but may proceed cautiously due to concerns about possible backlash from anti-GM groups or consumers with strong preferences for organic foods. Boccia et al. (2018) observed that retailers were more willing to stock GM foods if clear labelling and strong regulatory frameworks were in place, which gave assurance to consumers about the safety and quality of the products.

To address the above challenges and misconceptions regarding GM foods, we propose a series of targeted interventions. First, educational campaigns tailored to debunk prevalent myths

about GM foods should be implemented, utilising clear and accessible science communication methods to enhance public understanding. Second, robust regulatory frameworks that ensure transparent labelling and safeguard consumer safety must be developed and rigorously enforced. Third, incentives should be provided for local farmers to adopt GM crops, coupled with systematic monitoring of environmental impacts to promote sustainable agricultural practices.

Moreover, forging partnerships between government agencies, non-governmental organisations (NGOs), and religious leaders is essential to bolster public trust. These collaborative efforts, alongside improved science communication strategies—such as expert-led public forums, interactive workshops, and transparent media outreach—will help align public perceptions with established scientific evidence and foster a more informed dialogue on the role of GM technology in food security. In addition, scholars and policymakers should employ a multifaceted strategy: enhancing science communication by translating complex genetic concepts into accessible language, implementing targeted educational campaigns that clarify the distinctions between GM and hybrid crops, and engaging community leaders—including trusted local and religious figures—to disseminate accurate information (Boccia et al., 2018; Siddiqui et al., 2022). Additionally, transparent regulatory practices and clear labelling standards are critical in building consumer trust and counteracting misinformation, as these measures help bridge the gap between public perception and established scientific evidence (FAO, 2020).

## Conclusion

This study highlights the multifaceted nature of public perceptions regarding genetically modified

(GM) foods in Ogun State, Nigeria. While there is a notable level of awareness and willingness to consider GM products, significant gaps in understanding persist, particularly concerning the distinction between GM foods and hybrid varieties. These findings underscore the need for targeted educational initiatives to address misconceptions and improve public knowledge. By bridging these knowledge gaps, stakeholders can foster greater acceptance and informed decision-making about GM technologies, ultimately supporting their integration into sustainable agricultural practices.

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### Authors' contributions

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Conceptualization; Data curation; Analysis; Investigation; Administration; Resources; Validation; Visualization; Writing -original draft; and Writing -review & editing.

#### F.T. Ojo:

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### Conflict of interest

Authors declare no conflict of interest.

### References

- Alliance for science (2024). Nigeria approves commercial release of GM maize varieties - alliance for Science. <https://allianceforscience.org/blog/2024/01/nigeria-approves-commercial-release-of-gm-maize-varieties/> (Accessed on March 02, 2025).
- Almohammadi N (2017) The role of public relations and mass media in influencing public attitudes to genetically modified (GM) and organic foods. *International Journal of Internet Education*, 16(1):67-125.
- Boccia F, Covino D, Samacchiaro P (2018) Genetically modified food versus knowledge and fear: a noumenic approach for consumer behaviour. *Food Research International*, 111:682–688.
- Bodirsky BL, Dietrich JP, Martinelli E, Stenstad A, Pradhan P, Gabrysch S, Mishra A, Weindl I, Rolinski S, Baumstark L, Wang X, Waid JL, Lotze-Campen H, Popp A (2020) The ongoing nutrition transition thwarts long-term targets for food security, public health and environmental protection. *Scientific Reports*, 10(1):1-14.
- Burton M, Rigby D, Young T, James S (2001) Consumer attitudes to genetically modified organisms in food in the UK. *European Review of Agricultural Economics*, 28(4):479-498.
- Cabelkova I (2024) Understanding public perception of genetically modified food: navigating misinformation and trust. *Food Science & Nutrition Technology*, 9(3):1-5.
- Cabelkova I, Sanova P, Hlavacek M, Broz D, Smutka L, Prochazka P (2024) The moderating role of perceived health risks on the acceptance of genetically modified food. *Frontiers in Public Health*, 11:1-12.
- Chagwena DT, Sithole M, Masendu D, Chikwasha V, Maponga C (2019) Knowledge, attitudes and perceptions towards genetically modified foods in Zimbabwe. *African Journal of Food, Agriculture, Nutrition and Development*, 19(3):14752-14768.
- Colson G, Huffman WE (2011) Consumers' willingness to pay for genetically modified foods with product-

- enhancing nutritional attributes. *American Journal of Agricultural Economics*, 93(2):358-363.
- Egbe NE, Bukar AB, Adebayo AA (2019) Assessment of public awareness, attitudes toward and acceptance of genetically modified foods in the city of Kaduna, Kaduna State, Northern Nigeria. *Nigerian Journal of Biotechnology*, 36(1):103-112.
- FAO (2020) FAO GM foods platform: Are we effectively evaluating food safety? Background paper for the platform community meeting. Rome.
- Fedoroff NV, Battisti DS, Beachy RN, Cooper PJ, Fischhoff DA, Hodges CN, Lobell DB (2010) Radically rethinking agriculture for the 21st century. *Science*, 327:833-834.
- Frewer LJ, van der Lans IA, Fischer AR, Reinders MJ, Menozzi D, Zhang X, van den Berg I, Zimmermann KL (2013) Public perceptions of agri-food applications of genetic modification—A systematic review and meta-analysis. *Trends in Food Science & Technology*, 30(2):142-152.
- Gajdić D, Mesić Ž, Petljak K (2021) Preliminary research about producers' perceptions of relationship quality with retailers in the supply chain of organic food products in Croatia. *Sustainability*, 13(24):1-41.
- Ghimire BK, Yu CY, Kim WR, Moon HS, Lee J, Kim SH, Chung IM (2023) Assessment of benefits and risk of genetically modified plants and products: current controversies and perspective. *Sustainability*, 15(2):1-25.
- Guzik P, Szymkowiak A, Kulawik P, Zajac M (2022) Consumer attitudes towards food preservation methods. *Foods*, 11(9):1-14.
- Hossain F, Onyango BM, Schilling BJ, Hallman WK (2003) Public perceptions of biotechnology and acceptance of genetically modified food. *Journal of Food Distribution Research*, 34(3):36-50.
- Huang J, Qiu H, Bai J, Pray C (2006) Awareness, acceptance of and willingness to buy genetically modified foods in Urban China. *Appetite*, 46(2):144-151.
- ISAAA (2017) Global status of commercialized biotech/GM crops in 2017: biotech crop adoption surges as economic benefits accumulate in 22 years. ISAAA Brief No. 53. ISAAA: Ithaca, NY.
- Javid MA, Al-Hashimi AR (2019) Significance of attitudes, passion and cultural factors in driver's speeding behavior in Oman: Application of theory of planned behavior. *International Journal of Injury Control and Safety Promotion*, 27(2):172-180.
- Klerck D, Sweeney JC (2007) The effect of knowledge types on consumer-perceived risk and adoption of genetically modified foods. *Psychology & Marketing*, 24(2), 171-193.
- Klümper W, Qaim M (2014) A meta-analysis of the impacts of genetically modified crops. *Public Library of Science One*, 9(11):1-7.
- Lusk JL, Jamal M, Kurlander L, Roucan M, Taulman (2005) A meta-analysis of genetically modified food valuation studies. *Journal of Agricultural and Resource Economics*, 30(1):28-44.
- Mustafa AS, Ssenku JE, Nyachwo EB, Ruto GC, Bunani N, Musimami G, Maseruka R, Anywar G (2023) Assessing knowledge and willingness to use genetically modified crops in Uganda. *Agriculture & Food Security*, 12(1).
- Ngo TCT, Phan TYN, Le TNT (2024) Impacts of knowledge and trust on consumer perceptions and purchase intentions towards genetically modified foods. *PLoS One*, 19(10):1-24.
- Omoyajowo K, Omoyajowo K, Akinola AA, Ogunyebi A, Alao R, Makinde O, Orekoya O, Makengo B, Akinola O, Jatau S, Ukoh S, Raimi MO (2024) Are genetically-modified foods made for the common good? The perspectives of the Victoria Islanders. *Global Journal of Environmental Science and Sustainability*, 1(1):110-123.

- Onyango B, Nayga RM, Schilling BJ (2004) Role of product benefits and potential risks in consumer acceptance of genetically modified foods. *AgBioForum*, 7(4):202-211.
- Oyekunle M, Adamu RS, Ndou Beyene Y, Abdulmalik MM, Oikeh SO (2023) Efficacy of drought-tolerant and insect-protected transgenic TELA® maize traits in Nigeria. *Transgenic Res* 32:169–178 (2023).
- Pérez-de-Castro A, Vilanova S, Cañizares J, Pascual L, Blanca JM, Díez MJ, Prohens J, Pico B (2012) Application of genomic tools in plant breeding. *Current Genomics*, 13(3):179-195.
- Popek S, Halagarda M (2017) Genetically modified foods: Consumer awareness, opinions and attitudes in selected EU countries. *International Journal of Consumer Studies*, 41(3):325–332.
- Quist D, Chapela IH (2001) Transgenic DNA introgressed into traditional maize landraces in Oaxaca, Mexico. *Nature*, 414:541-543.
- Rabbanee FK, Afroz T, Naser MM (2021) Are consumers loyal to genetically modified food? Evidence from Australia. *British Food Journal*, 123(2):803-819.
- Rathod D, Hedao RP (2022) Assessment of knowledge and attitudes on genetically modified foods among students studying life sciences. *Cureus*, 14(12):1-9.
- Shigi R, Seo Y (2023) Consumer acceptance of genome-edited foods in Japan. *Sustainability*, 15(12):1-11.
- Siddiqui SA, Asif Z, Murid M, Fernando I, Adli DN, Blinov AV, Golik AB, Nugraha WS, Ibrahim, SA, Jafari SM (2022) Consumer social and psychological factors influencing the use of genetically modified foods—a review. *Sustainability*, 14(23):1-22.
- Singh P, Verma M, Singh A (2024) Studies on benefits of organic food products in human life during covid-19. *Journal of Scientific Research and Reports*, 30(5):744-751.
- Wudil A, Ali A, Aderinoye-Abdulwahab S, Raza HA, Mehmood HZ, Sannoh AB (2023) Determinants of food security in Nigeria: Empirical evidence from beneficiaries and non-beneficiaries rice farmers of the Kano River Irrigation Project. *Frontiers in Sustainable Food Systems*, 7:1-11.
- Yue C, Zhao S, Cummings C, Kuzma J (2015) Investigating factors influencing consumer willingness to buy GM food and nano-food. *Journal of Nanoparticle Research*, 17:1-19.