

Public Perception on Labeling of Genetically Modified (GM) Foods in Ghana: Implications for Food Policy

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Authors' contributions

This work was carried out in collaboration among all authors. Author RAA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author JOA managed analyses of the study data and contributed to the writing of the paper. Authors JOA and KDA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Labeling of genetically modified (GM) food and other food ingredients from GM source has become an important national policy issues receiving serious attention not only in Ghana but globally. This paper focused on public perceptions of labeling of GM foods in Ghana as a way of garnering a view of the public understanding of the technology that has become so much controversial for which several millions of public sector money is spent on education in the last few years. The survey which elapsed over a period of three months, shows results that indicate a dearth of knowledge on the technology and yet a high demand for labelling of the products, even though not many people read the labels on food products. This leads to the question as to 'who is doing the listening'. The authors conclude that the limited knowledge and technology essentials among others explain why the public seems to reject the technology and call for labelling of the products in spite of the fact that labelling

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is nothing but a choice variable, which has nothing to do with safety measure. Modifying the present attitude of the opponents of the technology and the demanders of labelling ignoring the cost that may be involved require extensive education and awareness creations throughout the country using tailor made communication forms to address various different groups.

Keywords: Ghana; labelling; modification; perception; public.

1. INTRODUCTION

One of the many challenges of the 21st century is the ability of nations, particularly those of the developing regions of the world, to ensure food security for the teeming population. The UN FAO has reported that by the year 2050, the world's population would have risen to about 9 billion; yet global food production is expected to decline. To overcome this challenge food production will have to increase by twice the current production levels. This raises the question 'how can this objective be achieved in the face of climate change and declining access to agriculture land. One way around the issue is by the commercialization of genetically modified technologies including biotechnologies to engineer crops and animals that can withstand diseases and pests among other hardships of farmers. This appears to have become debatable in public domain where opponents of the technology argue that food manufactured with GMO ingredients are not safe because they are unnatural and therefore should be banned.

Several studies have been cited in the literature indicating efforts to provide information on the technology and therefore why it should be accepted into our food systems. What appears to be a least reached area but critical for decision-making is the issue of transparency about food sources and contents of food, especially processed foods or what may generally be referred to as labelling. Labeling of GM food and food ingredients have assumed center stage in the debate about the wholesomeness, safety and health issues in relation of humans. Opponents of the GM technology, particularly in the food industry argue that labelling food products allows for transparency and right to know what is been eaten. While these concerns are genuine and legitimate, they are more of choice issues than health or safety. This is because any food approved by the FDA and placed on the market is certainly wholesome and safe to consume. Nevertheless, the high level of misconception and misinformation in public domains amplifies the call for labelling. Investments in biotechnology and genetically

modified foods have the potential to enhance the food supply, especially related to nutrition, taste, price, and reduction of food waste. Taheripour et al. [1] argue that the non-use of GMO technology in agriculture would have negative consequences for the welfare of the US and global economy' due to reduced yield and increased environmental damage and food prices. In view of this, some argue for no label on GM foods on the market or it will be tantamount to food discrimination. It is believed that, if consumers understand the science of the technology behind genetic modification of foods, they will change their negative thoughts and this could motivate the scientific community to provide more and better technologies.

This paper aims at gaining a better understanding of public attitudes towards GM foods and labelling. The specific questions addressed in this paper include public understanding and knowledge of GMOs, factors and conditions driving GMO concerns and aversions; labels necessary for decisions on kind of food to purchase.

2. LITERATURE REVIEW

In view of the growing concern of the public, particularly among the several civil society groups, about labelling or not labelling genetically modified (GM) foods, governments all over the world are debating whether indeed such food products require labelling. In the context of the fact that most food products in the developing world, particularly Africa are sold fresh with little or no processing, many people are asking whether all food products will require labelling, given the fact that only a handful of the public are literate enough to read and understand what information such labels convey. These questions and perhaps others such as these about food labelling, particularly of GM foods are critical and require immediate research and policy attention in the countries where such food products are developed, promoted and traded as well as consumed.

Generally, food labeling refers to information (text, devices or pictures) displayed on food

products, for the purposes of facilitating consumer decisions during purchase and use of products. The general principle for labeling is to forestall false, misleading or deceptive presentation of prepackaged food and to prevent any erroneous impression regarding the character of the product in any respect [2]. Labeling information serves three main functions: It

- i) Provides information about food product: this comprises product names and descriptions, list of ingredients, net content/drained weight, product shelf-life, lot identification, grade/quality, details of manufacturer or distributor and country of origin.
- ii) Provides information about health, safety and nutrition of product: this includes instructions for safe handling, storage and use, nutrition information pertaining to composition per serving in nutritional information/facts table as well as for specific dietary uses.
- iii) Provides promotional information: It advertises and markets a food using vignettes, promotional information and claims such as organic, natural, low fat, high source of fiber, fair trade, halal, kosher, quality management system certifications etc [2,3].

Though labeling statements are ultimately driven by consumer welfare, over the years primarily governments have initiated labeling standards either proactively or in response to food industry initiatives that have the potential to mislead consumers. The balance between consumer needs and company labeling initiatives derives labeling standards to ensure that consumers are not exploited. In pursuit of this balance, government regulators have influenced the termination of some private labeling initiatives due to its potential to mislead the consumer [4].

The World Health Organization (WHO), Food and Agriculture Organization (FAO), and Organisation for Economic Co-operation and Development (OECD) considers genetically modified organisms for food, feed and processing (GMO-FFP) that have been approved in accordance with international guidelines for risk assessment of the same, as safe as its conventional counterpart [5,6]. Following a two and half decade long research, involving 130 research projects and 500 independent research

groups and commissioned by the EU, it is concluded that “biotechnology, and in particular GMOs, are not per se more risky than conventional plant breeding technologies” [7]. Such consensus among international organizations and the European Union on the safety of food and feed obviously suggests that labeling of food, feed and ingredients derived from GM, is not a health and safety issue but a question of choice. Despite, this consensus, even on approved GM foods, consumers continue to be apprehensive about the safety of GMOs. This concern is because of expressions of emotionalisms expressed by some scientific articles such as one by EFSA [8] on long-term toxicity of Roundup herbicide and a Roundup-tolerant genetically modified maize, which seems to have indicated that GMOs are cancerous.

Currently, this paper and others have been banned in scientific arguments due to the inadequacies found with the design, analysis and report of those studies. The [9] concluded upon investigating the scientific quality of the paper that [8] study as reported in the 2012 publication does not impact the ongoing re-evaluation of glyphosate, and does not see a need to reopen the existing safety evaluation of maize NK603 and its related stacks” [8]. National competent authorities from France, Germany, Belgium, Australia and New Zealand reach the same conclusions as [10] following their review [11,12,13]. Following a thorough investigation of the study, the journal of Food and Chemical Toxicology retracted the article on the inconclusiveness of the study results based on deficiencies in the study design [13]. While this is crucial to the scientific community as well as policy makers, it is important not to sweep this important issues under the carpet but to confront it and understand the perception of the public on the state of affairs.

2.1 Labelling of GM Food, Feed and Ingredients

Globally there is currently no agreement, standards or guidelines on labeling of foods derived from GMOs. After several years of discussion at the Codex Committee on Food Labeling no agreements was reached and therefore individual countries developed their labeling regimes to meet their country’s needs [2]. In the development of labeling systems and requirements, some governments around the world have developed mandatory or voluntary labeling regulation on the basis of process-based

or proof-based principle and the use of positive or negative labeling statements. While, mandatory labeling regulations require food products derived wholly or partially from GMOs to be labeled in accordance with guidelines, voluntary regulations provide guidelines for labeling foods derived from GMOs. With mandatory labelling, failure to comply with regulations attracts a penalty. In the case of voluntary labelling, the decision to label is taken by the food product manufacturer or distributor.

For labeling regulations based on proof-based labeling principle, food products are labeled as GM in accordance with the guidelines when it contains detectable GM material, whilst for process-based regulations food products are labeled in accordance with GM labeling guidelines when the food or part of it was developed using modern biotechnology techniques. The proof-based systems rely on authentic claims of applicants. Positive labeling highlights the GM content of food products, whilst negative labeling highlights the absence of GM content by employing symbols or statements such as "contains GMO" or "non-GM". Globally, there are varied variations to how these labeling regulations mentioned above are implemented on two additional levels; threshold levels and coverage of guidelines. The threshold levels related to the unintentional and technically unavoidable presence of approved GMOS arising from cross pollination/fertilization, volunteer plants, add mixing in machinery during planting and harvesting – low level presence. The current levels vary widely from 0.9%, 1%, and 5% to undefined levels (ref). The application of labeling regulations for the following also vary from country to country.

Mandatory labeling is argued not to have placed products on the shelf, thus consumers do not get to make a choice. Rather it is said to have delivered processor and retailer choice, as GM food products never make it to the market on account of processor and retailer decisions. The current market situation in the EU, Japan and Australia where GM foods are not ubiquitous on the market despite the enforcement of mandatory labeling regulations (which intends to give consumers a choice), gives credence to the aforementioned assertion [14,15]. For markets where anti-GMO advocacy and sentiments are very rife; it results in consumer skepticism, and the perception of positive GM food labeling statements as warnings.

The perceived sales loss due to consumer skepticism, and the impact of environmental and consumer advocacy campaigns against labelled products strongly influence processors and retailer decisions to use non-GM certified materials to avoid GM food labeling [16]. The situation is reported to be further influenced by a relatively marginal price difference between non-GM and GM raw materials, and fact that current traits of biotech crops are input traits, which do not bring direct benefit to the consumers, but rather farmers and biotech companies.

3. METHODOLOGY

The current study was exploratory, seeking to understand and explain public views about genetically modified foods and labelling. A purposive sample design was used given that the authors were interested in interviewing people who had some level of classroom or formal leaning and therefore could read labels on food products. This survey was conducted at three main supermarkets in Accra and its environ. The study, which occurred over a period of four months, surveyed 620 adults' customers of the selected supermarkets in Accra, Ghana. Enumerators stood outside of the supermarkets entrance to administer the structured questionnaire to clients as they enter and leave the supermarkets. Although the respondents were picked at random in this cross sectional exploratory study, many of them were first asked whether they have some level of education which permitted them to have the ability to read few sentences on the products they purchased in the supermarkets.

The questionnaire contained 35 questions, which included 5 on demographics, 5 on knowledge of GM food products, and 8 assessed purchasing behavior. Others were focused on labelling and ability to read labels and make sense of what was on the labels. Demographic questions included age, gender, residence, income, education and frequency of shopping at the supermarket. Other questions explored the shopper's levels of awareness of GM foods in supermarkets and labelling on food products in general and other specific questions on GM food labelling. Other questions about public opinions about how labelling would affect their food purchasing decisions and the effect of GM foods on health and the environment were explored. The majority of the responses were based on a 5-point Likert scale. The data from the surveys was analyzed using IBM SPSS Statistics for Windows, Version 22.0.

The results of the data analyzed showed that of the 620 adults interviewed; only 20 of the questionnaires were rejected. The 20 questionnaires were rejected because the interviewees did not provide answers to some key questions that were relevant for the analysis of the study. The income brackets were reclassified into low income, middle income and high-income groups.

4. RESULTS

The results of the demographic analyses indicate that of the 600 questionnaires employed in the analyses the majority (79.5%) were between 25 and 45 years old. The average age of the survey participants was 27 years old, with majority of them (65.3%) been females. The results of the analysis show that there was a fairly even distribution of income among the participants with about 33.2% classified as low income earners, 36.5% as middle-income earners and 30.7% high income earners. For education, the results indicate that about 27.5% had a high school certificate, 42.2% had a Bachelor's degree, and 13.5% had a Master's degree. The others include 3.2% who had a PhD and the rest of the respondents 13.3% had other certificates. In terms of frequency of visiting the supermarkets, about 13.6% said they visited the supermarket almost every 2 days, 30.5% cited once every week, another 18.2% cited ones every fortnightly and about 37.7% claimed they frequent the supermarket once every month.

Knowledge of GMOs is an area of interest because it affects consumer or public opinions, attitudes, and behaviors toward the organism bioengineered. The survey questionnaire requested respondents to state the extent of knowledge they have about GM foods. Of the total 132 people who answered the question in the survey, about 21.4% said they knew nothing at all about GM foods, while majority of the participants (32.0%) said they had very little knowledge about the GM technology. Another 21.4% said they have "some amount of knowledge" while another 21.0% claimed they had "a fair amount" of knowledge of the GM foods. Only a small number of respondents (5.2%) said they had "a great deal" of knowledge about GM foods.

On the extent of the respondents' knowledge about the safety of GMO as food, 1.8% more than half of the total respondents who have knowledge about GM foods agreed (in different degrees) to the safety of GMO as food. While the

remaining 48.2% of the total respondents who have knowledge about GM foods disagreed (in different degrees) to the safety of GMO as food. 14.4% of the respondents "strongly agreed" to the safety of GMO as food. 37.4% answered the "somewhat agreed to the safety of GMO as food while 29.2% and 19% responded, they "somewhat disagreed" and "strongly disagreed" to the safety of GMO as food respectively. Although the total percentage of respondents who agree, either 'somewhat' or 'strongly', to the safety of GMO as food is greater than respondents who disagree, respondents who "strongly disagree" with the safety of GMO as food were 24.2% more than the respondents who "strongly agree" to the safety of GMO foods.

Fig. 3 shows the responses of the respondents. The respondents were interviewed on their knowledge about the presence of GMO sourced foods on the Ghanaian markets. Series 1 refers to those who said yes to the question while series 2 refer to the no answers. Foods like Chicken and Apple had majority of the respondents, 87.2% respectively, answering "Yes" to knowing these foods may have GMO ingredients. Other foods such as rice and soya beans recorded high proportions of the respondents, 72.4% and 56.8% respectively, answering "Yes" (series 1) to knowing these foods may have GMOs. The rest of the selected foods: maize, tomatoes, pawpaw and cooking oil recorded a high proportionate "No" (series 2) response from the respondents about the respondents' knowledge of selected foods on the Ghanaian market. 65.5% of respondents answered "No" knowledge about maize, 65.4% also answered "No" knowledge to pawpaw while the "No" response for knowledge about cooking oil on the Ghanaian markets was noted at 54.7%.

The respondents (Fig. 4) were queried on their knowledge of the availability of GMO foods in the Supermarkets. While the highest proportion, 53.3%, answered "I don't know", 36.5% answered "Yes" and the remaining 10.2% answered "No" to the knowledge of GM foods in the supermarkets. Using this survey results, it is likely that majority of the public cannot tell whether or not food in the grocery or other sections of the supermarket contains ingredients of GMOs. While this could be due to the absence of GMO labelling laws and regulations in Ghana, the fact that majority of the shoppers in these supermarkets also do not read labels is also a possibility.

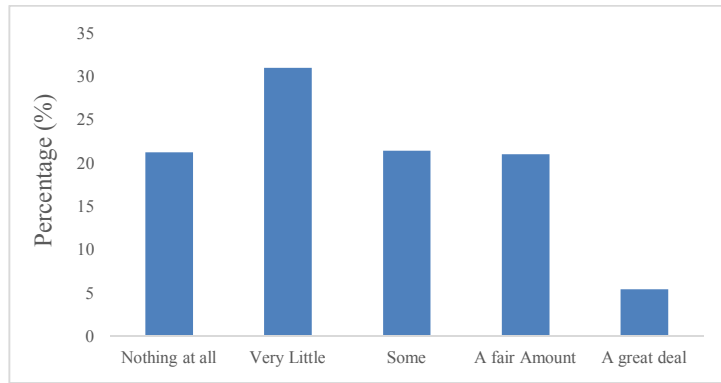


Fig. 1. Extent of knowledge about GM foods
 Source: authors own survey

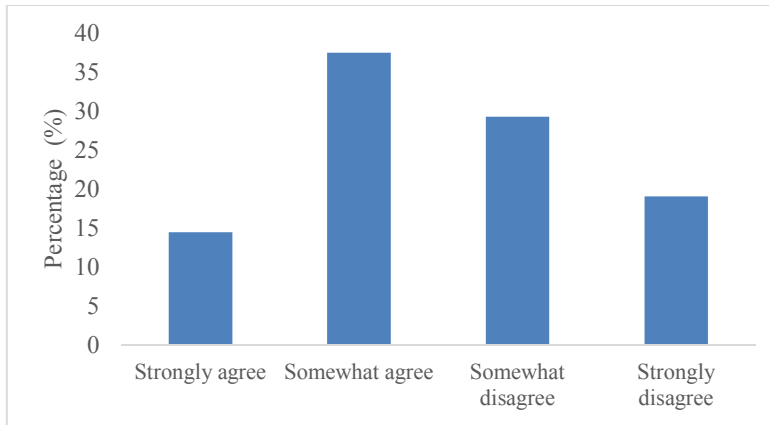


Fig. 2. Extent of knowledge about safety of GMO as food
 Source: authors own survey

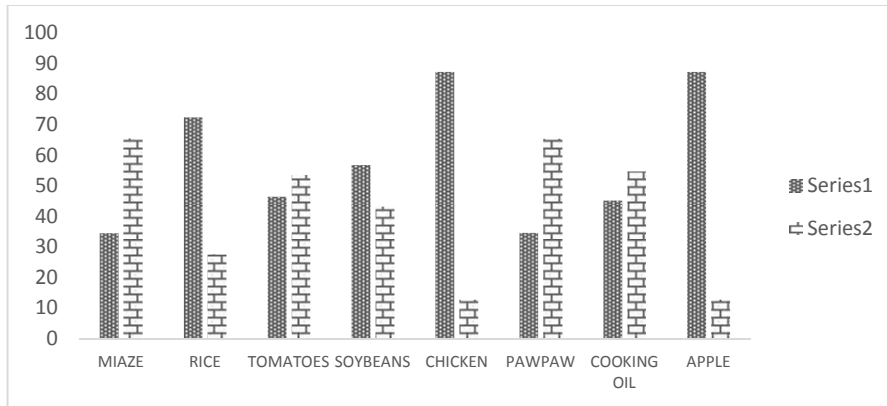


Fig. 3. Knowledge of selected foods on the Ghanaian markets
 Source: authors own survey

Studies have shown cases where consumers with high self-reported GMO knowledge have also shown lower willingness to pay for GM products compared with those with low self-reported knowledge. To explore the influence of

knowledgeability of GMOs on willingness to pay for a GM food, labelled or not labelled, the authors questionnaire requested participants cite their willingness to pay more for the GM food. An almost equal percentage of respondents cited

paying more or not paying more for GM food. The results show that just 0.5% more than half of the respondents disagreed, at different degrees, to pay more for GM foods. The results show that about 36.4% of respondents “somewhat agreed” to pay more for GM foods. The lowest percentage of the respondents, 11.2% “strongly disagreed” to paying more for GM foods while 13.1% of the respondents “strongly agree” to pay more for GM foods. There was no neutral position in terms of the responses from the survey participants. This is an indication that the survey participants have already made up their minds as to what they should go for should the GM crops be commercialized.

The fact that majority of the respondents seem not to be knowledgeable about the technology or GM foods raised an eye brow as to whether people or the public was really listening to the many discussions or debates on the subject in the country. In view of this, during the focus group discussions, participants were asked to indicate whether they were satisfied with their current levels of knowledge and awareness of the technology. The responses was largely was no as many claimed the government and the media were not doing enough to educate them on GMOs but rather, the media for example had focused on politics instead of focusing on the food that the voters were eating to survive. This suggests that the public need more education as they are not satisfied with their present knowledge on GMOs.

The Fig. 6 depicts the importance of labelling information of foods. Although 25.5% of the respondents, which ranked in the 90th percentile

answered that labelling information on foods were “not at all” important. The remaining respondents ranked the importance of labelling foods from “slightly important” to “extremely important”. About 23.4% of the total respondents answered that labelling information was “slightly important”. Respondents who ranked the importance of labelling information as “very important” and “extremely important” formed 19.6% and 17.4% of the total respondents respectively.

The respondents were asked to state whether they cared or did not care if the food they ate contained GM ingredients source. As depicted by Fig. 7 about 30 percent of the respondents said yes, they cared about the food source, while 50 percent claimed they did not care about the source of the ingredients of their food. Another 20 percent of the respondents who remained indifferent claim that they did not know whether they cared or did not care about the source of the ingredients of the food they eat.

Additionally, on the need to differentiate between GM foods and organically produced foods and others, the study sought the views of respondents on whether or not GM foods should be labelled. Fig. 8 of the survey indicates that about 71.4% of the respondents answered “Yes”. 8.4% answered “No” while the remaining 20.2% answered, “I don’t know”. Although majority of the people interviewed claimed they have little knowledge and understanding of biotechnology and GM foods, such a considerable percentage of the people said the food from such GMO sources should be labeled.

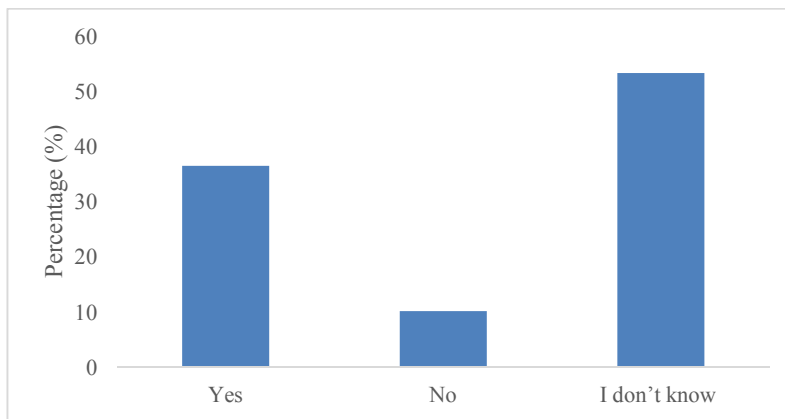


Fig. 4. Extent of knowledge about GM foods in the supermarkets
 Source: authors own survey

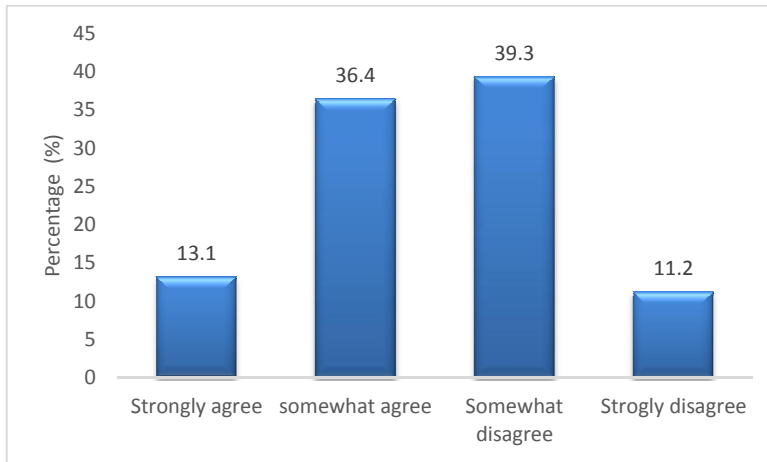


Fig. 5. Willingness to pay more for GM foods
Source: authors own survey

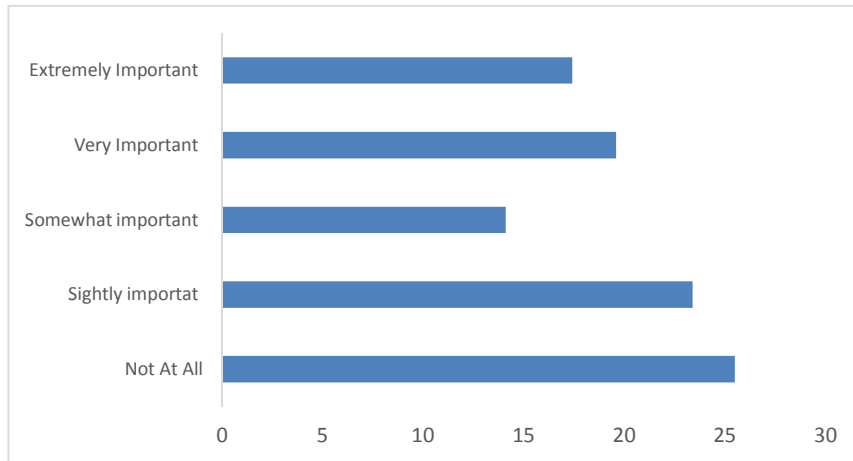


Fig. 6. Extent of importance labeling information to respondents
Source: authors own survey

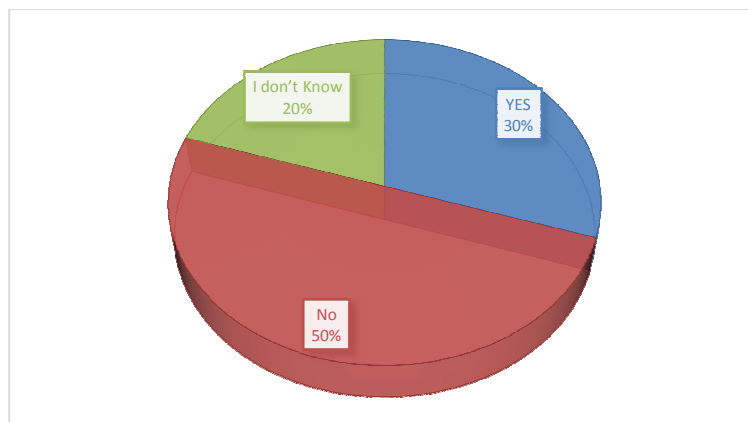


Fig. 7. Do you care or not the food you eat is GMF
Source: authors own survey

4.1 Mandatory or Voluntary Labelling

Globally there is currently no law or guidelines on labelling standards, particularly on labelling of GM foods, yet some countries have adopted the mandatory regime while other are practicing the voluntary system of labelling. In recent times there has been a public outcry by some environmental and civil society groups asking government to request food manufacturers processing foods from Ghana source to label their products before putting them on the market. The study probed further to know whether the respondents were in favor of voluntary labelling or mandatory labelling.

Fig. 9 shows that further probing of the choice of the people for mandatory or voluntary labelling regulations in Ghana, majority (57%) said the country should opt for mandatory labelling suggesting that all food processors and manufacturers in the country are compulsory should be required by law to label their GM food products. Between those for voluntary labelling and those who wanted to remain indifferent, 23% requested for voluntary labelling while the rest said they were not sure and wanted to remain indifferent. The FGD revealed that among the reasons cited for remaining indifferent include inadequate 'knowledge on labelling', 'absence of the products in the country', and 'too early to decide on that' as well as 'not no expert on that'. The distribution in terms of the responses indicate that even though the citizenry is likely to ask for labelling, the question of which form of regulation should governs the country's labelling regulation is still not quite sure among the public and a little more education will be required.

The questionnaire further probed the candidates who had responded yes to labelling GM foods in Ghana to elicit their reasons for asking for labelling. Fig. 10 shows that a high percent of those who want GM foods to be labelled cited food safety concerns as their reason for requesting that GM food should be labelled. The next reason for participants of the survey to request for GM labelling GM food is environmental, which conforms to reasons provides in other studies. Government openness in terms of transparency within government's departments and agencies whose working activities impinge on GM activities surprisingly came as the third most rated reason why GM foods should be labelled.

This provides a link to the regulatory agencies activities and the concerns of the public in seeking to know that there is transparency within the food system. The results show that equal number of participants want GM food labelled and they cited results inputs from the research community as reasons why they would want GM food to be labelled. According to the FGD, such moves from government would allow some transparency into the food chain and cure the problem of fear that has engulf many consumers in the country regarding eating any food from a GMO source. According to the study results the least considered reason for the respondents to request for labelling of GM foods is religious and ethical reasons. This clearly means that these two factors do not come into the equation in matters deciding whether to eat or not to eat GM foods.

5. DISCUSSION

The study revealed interesting information, which makes it important for stakeholders to have a critical look at the results. It makes it pertinent that the decision to label or not to label food produced from crops that are genetically modified (GM) using recombinant DNA technology such as biotechnology is a key issue, which must be addressed adequately, given the uncertainty between balancing the risks and benefits of using biotechnology in agriculture. In several ways, this paper will help provide more evidenced based information to stakeholders, particularly Ghanaian governments who have the daunting task of balancing all the issues at stake in the debate over commercializing and labelling GM foods in the country. It will help policy makers find tangible ways to resolve the perceived nexus between finding solutions to increasing high levels of food prices resulting from limited production as against sustainable food security using agricultural biotechnology.

The study result suggests that a large number of the respondents are not aware of GMOs or do not fully understand GM products or have a good knowledge of the technology and the foods derived from them. This is same for those with good knowledge of the traits, and effects of the GMO products. In spite of this the survey results show that a considerable number of the respondents are dissatisfied with the technology and therefore are calling for labelling of the technology. This requires a need for a massive and widespread education of the public on

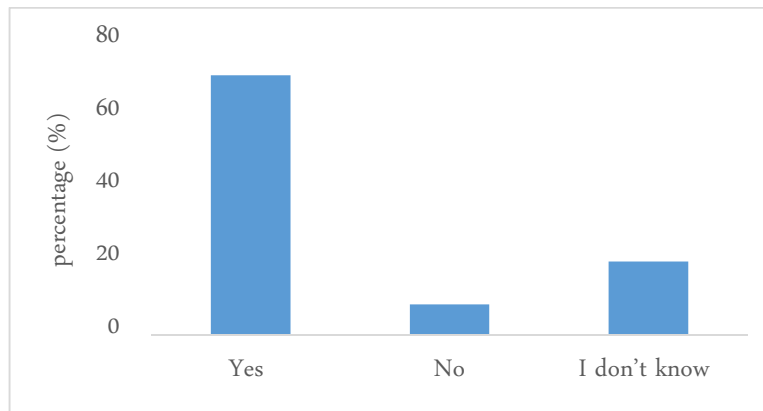


Fig. 8. Should GM foods be labelled?
 Source: authors own survey

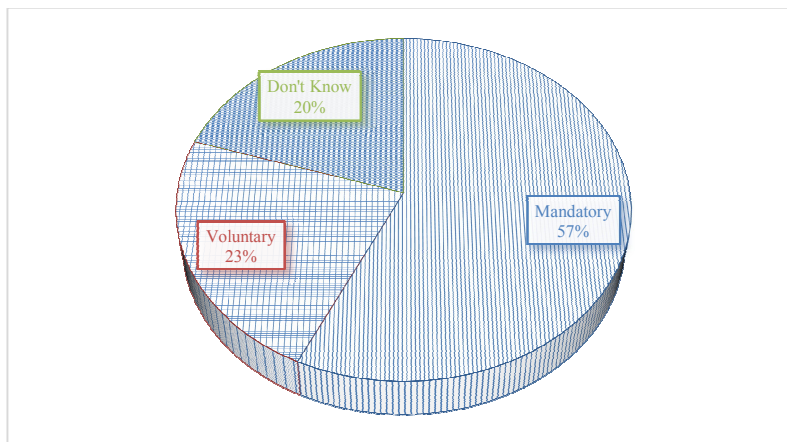


Fig. 9. Mandatory voluntary labeling
 Source: authors own survey

matters regarding food labelling, especially regarding GM foods. Research has shown that a better understanding of GM foods and the science of the technology influences consumers' attitudes towards the technology. It is important that such education consider both the pros and cons of biotechnology based on its scientific foundation.

The study shows that foods like rice, apple and chicken received high yes responses. These food products are mainly imported and therefore the high yes response could be that because they are as a foreign source the public perceive that they are likely to be of a GMO source. The same reason accounts for the high no for maize, pawpaw and perhaps cooking oils which the public perceives as locally produced. The results indicate that perception of the public regarding what food is GM and what food is not GM is

based on whether the food product is likely to be imported or not imported. This may be erroneous and deceptive. This confirms what happened during the FGD where majority of the people felt that anything big in terms of size of terms of food is of a GM source.

The study revealed how important information from the scientific research community is to them by indicating as one of the reasons for their quest for GM foods to be labeled. Sources of GMO knowledge need to be critically examined, because they have a major impact on what information consumers are exposed to as well whether or not they trust what they are hearing. The majority of consumers are relying on the internet and media sources (including television and magazines) for GMO-related information, yet this information can be inaccurate, incomplete, or misleading, depending on the news outlet. The

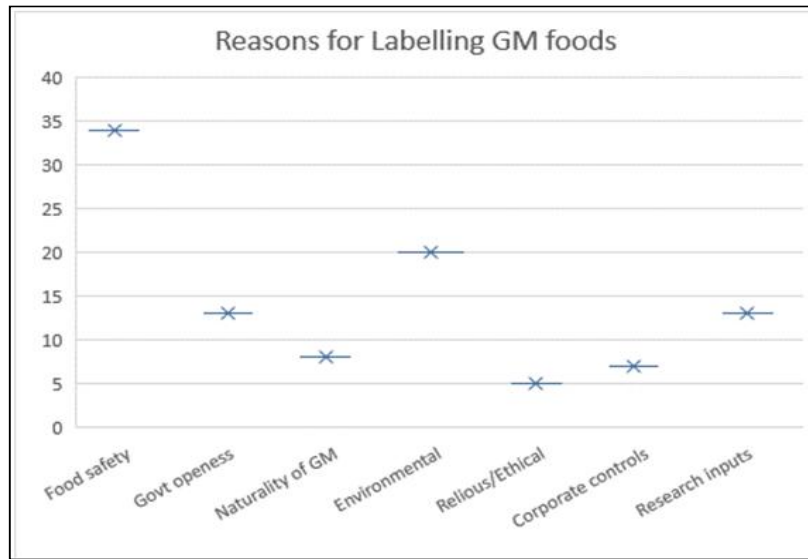


Fig. 10. Reasons for labelling GM food products in Ghana

education of those responsible for disseminating scientific knowledge through such public media sources is of crucial importance, because their explanations of biotechnology directly inform the public.

6. POLICY IMPLICATIONS

The reality that respondent's knowledge and awareness of GM foods are limited yet majority of them are asking for GM foods to be labelled is worrying as one is not sure of the reasons for requesting government to ensure that GM foods to be labelled. This worrying situation should send a signal to all citizenry and particularly policy makers about how cautious they need to tread in commercializing or not commercializing the food. The source of information and the content of such information requires scrutiny. The reason is that in most cases the debate about whether to label or not to label is founded on consumers' standpoint rather than scientific reports. This is because many policy makers are likely not have a good understanding of the science of the technology to make scientific decisions on commercialization, given the backgrounds of most policy makers in the country. Clearly, the intensity of the ongoing debate on the GM technology in the country does not match the understanding of the public according to this study. It is important for the food and food safety related organizations in the country to start serious advocacy work and not wait for the release of the GM crops developed before education starts.

An evidence based information in the hands of experts and advocacy groups with good understanding of the science and technicalities of the GM science are requirements for the success of GM food commercialization. Such efforts should not be left in the hands of the private sector alone or in the hands of foreign funders alone but perhaps a private sector –public sector efforts should be the way to go from here.

7. CONCLUSION

This paper is a part of a broader study designed to understand the GM Food environment in Ghana. it aimed at understanding the perception of the public concerning genetically modified foods and labelling and not to be used for scoring points in any debate on the subject. It explored the understanding of the public towards GM foods and labelling as a way of highlighting the need to bring on board the perceptions and interest of the public in design a labelling policy for the GM industry in Ghana. It aimed at gathering information from the public regarding their awareness, attitude and understanding of labelling genetically modified foods as a way of informing policy on the way to go when it comes to the commercialization of the GMO crops developed for inclusion into Ghana's food system. Although not a representative of the consuming population of Ghana, the current results provide some insight into the current state of Ghanaians level of awareness of the technology, perceptions of genetically modified foods, and attitudes towards the labeling of the foods derived from the GMO crops.

The results show that given the responses elicited from the survey participants, the current level of knowledge on the technology and awareness is low. This does not come as a surprise given that education and awareness on the technology is slow and weak. This is evident by the paucity of Radio and Television programmes as well as aired to educate target groups of the technology. With this low level of knowledge and awareness of the technology and its significance in the daily life of the people, one questions how decisions are formed on the subject during public discussions. Clearly this suggests that decisions of many people in the public is based on misinformation about the GM technology in the society. This leads to [17] conclusion that attitude of people toward GMF labeling are mainly informed by the non-scientific information and misinterpretation of scientific data and information. This often times leads to fear which non GM food manufacturers can exploit to sustain or increase their profit margins in the market. This may be because the inadequate scientific facts in the system.

Again the study indicates that while many people are likely to ask for labelling of the food products derived from GMO crops, very few of the respondents actually take time to read labels on food products, a sign of the indication that people might not read even if GM crops and food products are labelled. This may have cost implications, which could be avoided if possible. This support the views of those who advocate that the foods derived from GM sources should not be labeled as that may only increase cost of production and not necessarily bringing any benefits to the consumers.

CONSENT

As per international standard informed and written participant consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Taheripour F, Mahaffey H, Tyner WE. Evaluation of economic, land use and land-use emission impacts of substituting non-GMO Crops for GMO in the United States. *AgBioForum*. 2016;19:156–172.
2. Codex. The codex general standard for the labelling of prepackaged foods was adopted by the codex alimentarius commission at its 14th session, 1981 and subsequently revised in 1985 and 1991 by the 16th and 19th Sessions and amended by the 23rd and 24th Sessions, 1999 and 2001. [Online]; 2001. Available:<http://www.fao.org/docrep/005/Y2770E/y2770e02.htm#fn1> (Accessed on: January 29, 2019)
3. CFIA. Canadian Food Inspection Agency [Online] Guideline for Food Labelling and Advertising; 2011. Available:http://www.alimentheque.com/divers/GuideFoodLabellingAdvertising_CFIA_dec2011.pdf (Accessed on: March 15, 2019)
4. Fooducate 1862 – 2014: A Brief History of Food and Nutrition Labeling [Online]; 2014. Available:<http://blog.fooducate.com/2008/10/25/1862-2008-a-brief-history-of-food-and-nutrition-labeling/> (Accessed on: January 29, 2019)
5. OECD. Organization for Economic Co-operation and Development [Online] Safety evaluation of foods derived by modern biotechnology - concepts and principles; 1993. Available:<http://www.oecd.org/science/biotrack/41036698.pdf> (Accessed on: February 2, 2019)
6. WHO. World Health Organization [Online] Strategies for assessing the safety of foods produced by biotechnology; 1991. Available:<http://library.health.go.ug/download/file/fid/790> (Accessed on: February 2, 2019)
7. EU. European Union [Online] A decade of EU-funded GMO research (2001- 2010); 2010. Available:[http://www.researchgate.net/publication/233770770_A_decade_of_EU-funded_GMO_research_\(20012010\)](http://www.researchgate.net/publication/233770770_A_decade_of_EU-funded_GMO_research_(20012010)) (Accessed on: February 1, 2019)
8. EFSA. European Food Safety Authority [Online] Review of the Seralini et al. publication on a 2-year rodent feeding study with glyphosate formulations and GM maize NK603 as published online on 19 September 2012 in *Food and Chemical Toxicology*; 2012. Available:<http://www.efsa.europa.eu/en/efsajournal/pub/2910> (Accessed on: March 21, 2019)
9. EFSA GMO Panel Working Group on Animal Feeding Trials. Safety and

- nutritional assessment of GM plants and derived food and feed: The role of animal feeding trials. *Food and Chemical Toxicology*. 2008;46(Supplement 1):S2–S70. [PubMed] [Google Scholar]
10. VIB. [Online] VIB concludes that Seralini study is not substantiated; 2012. Available:<http://www.vib.be/en/news/Pages/VIB-concludes-that-Seralini-study-is-not-substantiated-.aspx> (Accessed on: March 21, 2019)
 11. BfR. Bundesinstitut für Risikobewertung (BfR) [Online] Feeding study in rats with genetically modified NK603 maize and with a glyphosate containing formulation (Roundup) published by Seralini et al; 2012. Available:<http://www.bfr.bund.de/cm/349/feeding-study-in-rats-with-genetically-modified-nk603-maize-and-with-a-glyphosate-containing-formulation-roundup-published-bei-seralini-et-al-2012.pdf> (Accessed on: March 21, 2019)
 12. ACSH. American Council on Science and Health [Online] Kenya to lift ban on GMOs; 2015. Available:<http://acsh.org/news/2015/08/13/kenya-to-lift-ban-on-gmos/> (Accessed on: April 21, 2019)
 13. HCB. Haut Conseil des Biotechnologies [Online] in response to referral1 of relating to the article by Seralini et al. (*Food and Chemical Toxicology*; 2012. Available:http://www.hautconseildesbiotechnologies.fr/sites/www.hautconseildesbiotechnologies.fr/files/file_fields/2015/06/30/121019etudeseraliniaviscshcb.pdf (Accessed on: March 21, 2019)
 14. FSANZ. Food Standards Australia and New Zealand (FSANZ) [Online] Response to Seralini Paper; 2012. Available:<http://www.foodstandards.gov.au/consumer/gmfood/seralini/Pages/default.aspx> (Accessed on: March 21, 2019)
 15. Wallace Hayes A. Editor in chief of food and chemical toxicology answers questions on retraction. *Food Chem. Toxicol.* 2014;65:394-395.
 16. Carter CA, Gruère GP. Mandatory versus voluntary labeling of genetically modified food, consumer choice, and autonomy: Reply. *Ag. Bio. Forum.* 2003;6(3). Available:<http://www.agbioforum.org>
 17. Borges BJP, Arantes OMN, Fernandes AAR, Broach JR, Fernandes PMB. Genetically Modified labeling policies: Moving forward or backward? *Frontiers in Bioengineering and Biotechnology*; 2018.

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