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PERCEPTION AND AWARENESS OF GENETICALLY MODIFIED (GM) CROPS AMONG UNIVERSITY STUDENTS IN LIFE SCIENCES

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ABSTRACT

This study adopted a descriptive survey research design to investigate the perception and awareness of genetically modified (GM) crops among university students in life sciences. The study was carried out at the University of Port Harcourt and Imo State University. The population of the study is 106 students from the department of Plant Sciences, Faculty of Science, University of Port Harcourt and 112 students from the department of Plant Sciences, Faculty of Science Imo State University. A sample size of 100 students was used for the study. Stratified sampling techniques were used for the study. The instrument used in this study to collect data from respondents was a structured questionnaire constructed by the researcher titled perception and awareness of genetically modified (GM) crops among University students in life sciences (PAGMCUSLS) with 30 items. Face and content validity was used for the study and reliability coefficient of 0.84 was obtained. Mean and Standard Deviation were used to answer the research questions while Z-test was used to answer the hypotheses. The study found that genetically crops undergo rigorous testing than conventional crops before approval; genetically Modified crops can help address food security issues. Based on the findings, the researchers recommended that Universities should integrate more comprehensive courses on biotechnology, genetic engineering, and sustainable agricultural practices into their curricula for life science students.

Keywords: Genetically Modified Crops, Student Perception, Awareness Levels, Life Sciences Education, Biotechnology Acceptance, Risk and Benefit Assessment.

I.INTRODUCTION

The creation of genetically modified (GM) crops, which are intended to increase agricultural output, resistance to pests and diseases, and tolerance to environmental stressors, is the result of technological advancements that have transformed agriculture. Crops classified as genetically modified have had their genetic makeup changed using genetic engineering methods to express desired characteristics like improved nutritional value, extended shelf life, and resistance to herbicides, Griffiths & Jones [1]. Genetically modified crops have gained widespread acceptance since their introduction in the mid-1990s, especially in the US, Brazil, Argentina, Canada, and India. However, their acceptance and usage remains a subject of intense debate, particularly concerning health, environmental, and ethical implications.

In order to comprehend the science underlying genetic alteration and its ramifications, university students majoring in the life sciences are expected to have a solid understanding of genetics, biotechnology, and molecular biology. Since they are future scientists, educators, legislators, and knowledgeable people who could have an impact on public opinion and biotechnology policy, their knowledge of and perception of GM crops is vital. Fostering educated decision-making, encouraging sustainable farming methods, and supporting advancements in food security all depend heavily on a young population that is scientifically literate, Lee & Kim [2].

Even though life science majors are thought to have an educational edge, multiple studies have found that people's awareness and attitudes about genetically modified crops vary. Given its potential to alleviate food insecurity and reduce the use of agricultural chemicals, several students voice their support for genetically modified technology. Others, swayed by false information, moral dilemmas, or insufficient curricular coverage, show skepticism or outright opposition.

Their perspectives and comprehension of the subject are further shaped by their cultural background, media representation, institutional policies, and personal values, Gupta & Raine [3].

According to Wojcik & Kielbasa [4], examining university students' awareness and perceptions, particularly those in the life sciences, provides insight into the future workforce's readiness to engage with and promote evidence-based innovations in agriculture and biotechnology. In developing nations like Nigeria, the introduction of genetically modified crops continues to elicit mixed reactions due to a lack of public education, regulatory concerns, and health and biodiversity fears.

Numerous agricultural issues, such as low crop yields, pest and disease infestations, drought, and inadequate soil fertility, affect Nigeria and many other developing nations. Some of these issues can be resolved with genetically modified (GM) crops, which increase crop resilience, boost yield, and guarantee food security. Nigeria's acceptance of genetically modified crops is especially important given the country's expanding population, which the UN estimates will surpass 400 million people by 2050 United Nations, [5] and necessitates creative methods of agricultural production.

Crop losses can be minimized and the demand for chemical pesticides reduced by genetically modifying crops to withstand pests and diseases. For example, Bt cotton and Bt cowpea (sometimes called pod borer-resistant cowpea) were certified for commercial release in Nigeria in 2018 and 2019, respectively. These GM cultivars are made to resist significant pests as the Maruca vitrata pod borer in cowpea, a staple legume in Nigeria, and the bollworm in cotton (National Biosafety Management Agency [6].
Moreover, GM crops support nutritional and food security. In order to combat the pervasive hunger in the nation, modified crops might be designed to have larger concentrations of vital nutrients. Vitamin A-enriched maize and rice are examples of biofortified genetically modified crops that show potential in addressing the micronutrient shortages that are common in rural regions, Adenle et al [7]. Additionally, GM technology is essential for adapting to climate change. Due to its heavy reliance on rainfall, Nigerian agriculture is extremely susceptible to changes in the climate. Under shifting climatic conditions, farmers can obtain more consistent harvests from genetically modified crops that are designed to withstand drought and high temperatures. FAO [8].

Because of this, GM technology is crucial to Nigeria's climate-smart agriculture. Furthermore, it is impossible to ignore the economic potential of genetically modified crops. GM crops can raise farmer incomes and lower poverty levels, particularly for smallholder farmers, by improving yields and lowering input costs (such as those of pesticides and herbicides) Bawa & Ogunbiyi [9]. Nigeria's agricultural industry and economy benefit from the commercialization of genetically modified crops, which also opens doors for agricultural biotechnology research, development, and investment. Nigeria has advanced far in creating regulatory frameworks to guarantee the safe application of genetically modified technology, notwithstanding worries regarding biosafety and ethical ramifications. The nation's dedication to safely regulating genetically modified organisms (GMOs) is evidenced by the creation of the National Biosafety Management Agency (NBMA) in 2015.

Crops that have undergone genetic modification (GM) have been created to solve a number of worldwide agricultural, nutritional, and environmental issues. These crops are modified to have desired characteristics that improve their nutritional value, hardiness, and productivity through the use of contemporary biotechnology. Increased agricultural productivity, better food security, environmental preservation, and economic growth are all advantages of genetically modified crops:

- Higher Crop Yields and production: The notable rise in agricultural production is one of the main advantages of genetically modified crops. Because GM crops are frequently engineered to withstand pests, illnesses, and herbicides, growers can increase yields while minimizing losses. For instance, numerous nations have seen significant productivity increases as a result of the introduction of insect-resistant Bt cotton and Bt maize James, [10]. These crops lessen the need for expensive, potentially hazardous chemical pesticides that could endanger human health and the environment.
- Improved Nutritional Content: GM technology has been used to make crops more nutritious, which helps combat malnutrition in areas where access to a variety of meals is restricted. Golden rice is a noteworthy example; it was created to produce beta-carotene, a precursor of vitamin A, with the goal of lowering vitamin A shortage in underdeveloped nations. Tang et al [11]. Likewise, GM crops that have been biofortified to increase their iron, zinc, and protein content are being created.

- Pest and Disease Resistance: Genetically modified crops can be designed to be naturally resistant to particular pests and diseases, which lessen the need for artificial chemical controls. This reduces environmental contamination, promotes sustainable agriculture, and helps farmers financially by cutting production costs. Bt crops dramatically lower pest-related damage and pesticide consumption, according to studies, Zilberman & Qaim, [12].
- Abiotic Stress Tolerance: GM crops can be altered to resist abiotic challenges including salt, drought, and extremely high or low temperatures. This helps to stabilize food production and safeguard livelihoods, which is especially advantageous in areas vulnerable to climatic fluctuation. For instance, in sub-Saharan Africa, where rainfall is erratic, drought-tolerant maize has showed promise, Edgerton et al [13].
- Environmental and Ecological Benefits: Genetically modified crops help reduce greenhouse gas emissions and pollution in the environment by lowering the demand for chemical inputs like pesticides and herbicides. Herbicide-tolerant genetically modified crops also make conservation tillage possible, which maintains soil structure and lessens erosion, Barfoot & Brookes, [14].
- Economic Benefits for Farmers: GM crop adoption has been associated with higher farmer incomes, particularly for smallholders in developing nations. Better economic returns result from increased yields and lower input costs. A worldwide survey indicates that GM technology has raised farm income by more than $18 billion a year, with farmers in underdeveloped nations benefiting the most, Barfoot & Brookes, [15].

  In developing nations like Nigeria, genetically modified (GM) crops have the potential to increase agricultural output, guarantee food security, and lessen the consequences of climate change. However, there are a number of obstacles to the use of GM crops in Nigeria, including those related to regulations, the economy, the environment, and culture.
- Policy and Regulatory Difficulties: The absence of strong and open regulatory frameworks to direct the safe introduction and oversight of genetically modified crops is one of the most urgent issues. Although Nigeria has made strides with the establishment of the National Biosafety Management Agency (NBMA) under the National Biosafety Management Agency Act of 2015, concerns remain about the agency's capacity to enforce biosafety regulations effectively Adenle, [16]. To make sure that GM technology doesn't negatively impact the environment or public health, rules must be updated frequently and interagency coordination must be strengthened.
- Public Perception and Misinformation: The acceptability of genetically modified crops in Nigeria is severely hampered by widespread public mistrust, which is fueled by a lack of knowledge and false information. Even though there isn't any scientific proof to back up these beliefs, many Nigerians link genetically modified crops to health hazards like cancer, infertility, or genetic diseases. Oyekale [17]. Resistance to GMOs is further fueled by cultural beliefs and concerns about "tampering with nature" Olawuyi & Adetunji, [18].
- Lack of Farmer Education and Technical Capacity: The majority of Nigeria's agricultural workforce consists of smallholder farmers, many of whom lack the technical know-how necessary to successfully grow genetically modified crops. Crop failures or environmental damage could result from the misuse or underutilization of biotechnology if proper training is not received, Nwankwo et al [19]. The need for this kind of instruction is greatest in rural regions, where extension services are typically insufficient.
- Environmental and Biodiversity Concerns: According to environmentalists, Nigeria's rich agricultural biodiversity may be lost if GM crops are widely adopted. Cross-pollination between local and genetically modified crop varieties, for example, may change genetic features and decrease resistance to pests and diseases, Adenle [20].
- Intellectual Property and Economic Concerns: Farmers' autonomy and seed sovereignty are called into question by global biotech companies' control over genetically modified seeds. Restrictive licensing arrangements associated with GM seeds frequently make it impossible for farmers to save seeds for later planting, which increases their reliance on seed firms, Aerni [21]. The situation of Nigeria's already poor rural farmers may get worse as a result.
- Infrastructure and Funding Limitations: Significant investments in biotechnology infrastructure, labs, and qualified staff are necessary for the creation and uptake of genetically modified crops. Nigeria's capacity to produce domestic genetically modified solutions and lessen dependency on foreign technologies is hampered by a lack of financing for scientific research and agricultural development, Adenle et al. [22].

Notwithstanding the possible advantages of genetically modified crops, Nigeria needs to resolve a number of issues to guarantee their safe and fair implementation. These include investing in biotechnology infrastructure, raising public awareness, strengthening regulatory competence, and guaranteeing equitable business practices. Leveraging GM technology while protecting livelihoods, the environment, and human health requires a fair, open, and inclusive strategy.
In conclusion, tackling Nigeria's agricultural issues requires the use of genetically modified crops. They provide a long-term way to boost farmers' incomes, increase food security, adapt to climate change, and advance economic growth. Increasing public knowledge and governmental control will be crucial to optimizing the benefits of genetically modified crops as the country continues to develop its biotechnology capabilities.

Therefore, the purpose of this study is to evaluate university students studying life sciences' awareness, perception, and comprehension of genetically modified crops. It also aims to identify the factors that impact their attitudes and offer solutions to fill knowledge gaps so that biotechnology in agriculture can be used more responsibly and with greater acceptance.

II.STATEMENT OF THE PROBLEM

There is still a lot of curiosity and worry about how university students, especially those studying the life sciences, perceive and understand genetically modified (GM) crops. Many students still have a vague or incomplete awareness of the possible advantages and disadvantages of genetically modified crops, even in light of the growing significance of biotechnology in agriculture and food production. There are a number of reasons for this knowledge gap, such as a lack of exposure to thorough biotechnology education, the impact of media representations, society and cultural values, and individual prejudices influenced by ethical issues.

Some students worry about the safety, ecological impact, and ethical ramifications of genetically modified crops, while others acknowledge the potential of these crops to address global food security and environmental issues. Students' varied and frequently divisive opinions underscore the need for more focused educational programs that offer precise, fact-based explanations of the science underlying genetically modified technology.

Additionally, there aren't many studies that thoroughly look at the variables affecting students' beliefs, like their exposure to global viewpoints, scientific literacy, academic background, and socioeconomic background. Developing successful teaching practices that can cultivate an informed and receptive student population capable of critically assessing GM crops within the larger framework of agricultural sustainability and food security requires an understanding of these aspects.

By examining university life science students' awareness and attitudes about genetically modified crops, determining the factors influencing these perceptions, and offering suggestions for enhancing biotechnology and GM technology teaching, this study seeks to close these gaps.

Aim and Objectives of the study

The aim of this study is to investigate the perception and awareness of genetically modified (GM) crops among University students in life sciences. Specifically the study intends to:

1. To assess the level of awareness of genetically modified (GM) crops among university students in life sciences.
2. To examine the perception of university students in life sciences toward the safety, benefits, and risks of GM crops.
3. To identify the factors influencing students' awareness and perception of genetically modified crops.

Research Questions

1. What is the level of awareness of genetically modified (GM) crops among university students in life sciences?
2. How do life science students perceive the safety, benefits, and potential risks associated with genetically modified crops?
3. What factors influence the awareness and perception of GM crops among university students in life sciences?

Hypotheses

1. There is no significant difference between students in the department of Plant science and Biotechnology, University of Port Harcourt and students in the department of Plant science and Biotechnology, Imo State University's level of awareness of genetically modified crops
2. There is no significant difference between students in both Universities perceived safety, benefits, and potential risks associated with genetically modified crops
3. There is no significant difference between students in Universities factors influencing their awareness and perception of genetically modified crops

III.METHODOLOGY

This study adopted a descriptive survey research design to investigate the perception and awareness of genetically modified (GM) crops among University students in life sciences. The study was carried out at the University of Port Harcourt and Imo State University. The population of the study is 106 students from the department of Plant Sciences, Faculty of Science, University of Port Harcourt and 112 students from the department of Plant Sciences, Faculty of Science Imo State University. A sample size of 100 students was used for the study. Stratified sampling techniques were used for the study. The instrument used in this study to collect data from respondents was a structured questionnaire constructed by the researcher based on the four-point Likert scale of SA, A, D, SD titled perception and awareness of genetically modified (GM) crops among University students in life sciences (PAGMCUSLS) with 30 items. Face and content validity was used for the study and reliability coefficient of 0.84 was obtained. Mean and Standard Deviation were used to answer the research questions while Z-test was used to answer the hypotheses.

IV.RESULTS

Research Question 1: What is the level of awareness of genetically modified (GM) crops among university students in life sciences?

Table 1: Level of Awareness of Genetically Modified (GM) crops

S/N	Items **Level of Awareness of Genetically Modified (GM) crops**	SA	A	D	SD	M	SD	Total No of Respondents
1	Genetically Modified crops can help address food security issues	85	15	-	-	3.85	0.38	100
2 12.	Genetically Modified crops are completely safe for human consumption.	80	20	-	-	3.80	0.41	100
3 13.	Genetically Modified crops are harmful to the environment.	70	30	-	-	3.70	0.45	100
4 16.	GM crops can cause allergic reactions in humans.	50	50	-	-	3.50	0.53	100
5 17.	The DNA from GM crops can alter human genes when consumed.	56	44	-	-	3.50	0.51	100
6 18.	GM technology is only used for plant crops and not animals.	83	10	-	-	3.76	0.57	100
7 19.	GM crops undergo more rigorous testing than conventional crops before approval.	92	8	-	-	3.92	0.34	100
8 20.	All genetically modified foods must be labeled as such in stores.	72	28	-	-	3.72	0.44	100
9	Genetically modified crops are the same as crops grown using chemical fertilizers and pesticides.	63	27	-	-	3.63	0.43	100
10	GM crops can be engineered to resist pests and diseases without the need for chemical sprays.	60	40	-	-	3.60	0.50	100
	Grand Mean					3.70	0.45	

Table 1 shows that with the mean score of 3.70, the study found that genetically crops undergo rigorous testing than conventional crops before approval; genetically Modified crops can help address food security issues

Research Question 2: How do life science students perceive the safety, benefits, and potential risks associated with genetically modified crops?

Table 2: Perceived safety, benefits and potential risks associated with genetically modified crops

S/N	Items **Perceived safety, benefits and potential risks associated with genetically modified crops**	SA	A	D	SD	M	SD	Total No of Respondents
1	I believe GM crops are safe for human consumption.	89	11	-	-	3.89	0.33	100
2	I believe GM crops are safe for the environment.	80	20	-	-	3.80	0.40	100
3	GM crops can help reduce hunger and food insecurity in developing countries.	73	27	-	-	3.73	0.44	100
4	GM crops can improve agricultural productivity and farmer income.	78	22	-	-	3.78	0.41	100
5	GM crops can be engineered to have better nutritional value.	85	15	-	-	3.85	0.36	100
6	I am concerned that GM crops may cause unforeseen health problems in the future	70	30	-	-	3.70	0.46	100
7	GM crops may lead to loss of biodiversity.	76	20	4	-	3.76	0.53	100
8	GM crops may negatively impact small-scale and organic farmers.	65	35	-	-	3.65	0.48	100
9	I worry that multinational companies control too much of the GM crop market.	60	40	-	-	3.60	0.51	100
10	More research should be done before GM crops are widely adopted.	97	3	-	-	3.97	0.27	100
	Grand Mean					3.76	0.41	

Table 2 shows that with the mean score of 3.76, the study found that genetically modified crops are safe for human consumption; can be engineered to have better nutritional value and can improve agricultural productivity and farmer income.

Research Question 3: What factors influence the awareness and perception of GM crops among university students in life sciences?

Table 3: Factors influencing the awareness of Genetically Modified (GM) crops

S/N	Items **Factors influencing the awareness of Genetically Modified (GM) crops**	SA	A	D	SD	M	SD	Total No of Respondents
1	My academic courses have significantly increased my awareness of GM crops.	98	2	-	-	3.98	0.21	100
2	Media sources (TV, social media, online news) shape my perception of GM crops.	90	10	-	-	3.90	0.31	100
3	My cultural background influences how I view genetically modified crops.	88	12	-	-	3.88	0.33	100

4	Religious beliefs affect my perception of the acceptability of GM crops.	71	29	-	-	3.71	0.46	100
5	Discussions with peers and lecturers have helped me understand the science behind GM crops.	79	21	-	-	3.79	0.40	100
6	Scientific journals and publications are a major source of my knowledge about GM crops.	77	23	-	-	3.77	0.42	100
7	My university provides adequate learning opportunities to explore biotechnology and GMOs.	94	6	-	-	3.94	0.26	100
8	Personal interest in food and health issues motivates me to learn more about GM crops.	86	14	-	-	3.86	0.34	100
9	Exposure to debates or controversies about GM crops affects how I perceive them.	74	26	-	-	3.74	0.44	100
10	I trust scientific authorities and government agencies to provide accurate information on GM crops.	69	31	-	-	3.69	0.48	100
	Grand Mean					3.82	0.36	

Table 3 shows that with the mean score of 3.82, the study found that students' academic courses have significantly increased their awareness of GM crops; their schools provided adequate learning opportunities to explore biotechnology and GMOs and media sources (TV, social media, online news) has shaped their perception of genetically modified crops.

Hypotheses

1. There is no significant difference between students in the department of Plant science and Biotechnology, University of Port Harcourt and students in the department of Plant science and Biotechnology, Imo State University's level of awareness of genetically modified crops

Table 4: Table of analysis of difference between students in the department of Plant science and Biotechnology, University of Port Harcourt and students in the department of Plant science and Biotechnology, Imo State University's level of awareness of genetically modified crops

Group	Mean	Standard Deviation	N	Df	Standard Error	Z (Cal)	Z (Tab)	Decision
University of Port Harcourt	3.92	0.34	55	98	0.09	4.66	1.96	Rejected
Imo State University	3.50	0.53	45					

There is no significant difference between students in the department of Plant Science and Biotechnology, University of Port Harcourt and Imo State University's level of awareness of genetically modified crops. This result indicates a statistically significant difference in the level of awareness of genetically modified crops between the two universities. Specifically, students from the University of Port Harcourt have a higher level of awareness compared to their counterparts at Imo State University. This could imply better curricular coverage, more exposure to biotech innovations, or stronger research orientation in the University of Port Harcourt.

2. There is no significant difference between students in Universities factors influencing their awareness and perception of genetically modified crops

Table 5: Table of analysis of difference between students in Universities factors influencing their awareness and perception of genetically modified crops

Group	Mean	Standard Deviation	N	Df	Standard Error	Z (Cal)	Z (Tab)	Decision
University of Port Harcourt	3.97	0.27	50	98	0.12	3.08	1.96	Rejected
Imo State University	3.60	0.51	50					

There is no significant difference between students in Universities regarding factors influencing their awareness and perception of genetically modified crops. The result shows a significant difference in influencing factors between the two groups. This suggests that different variables such as media exposure, teaching methods, research facilities, or public discourse play varying roles in shaping students' awareness and perceptions of genetically modified crops. It indicates a need for harmonized sensitization strategies across institutions.

3. There is no significant difference between students in both Universities perceived safety, benefits, and potential risks associated with genetically modified crops

Table 6: Table of analysis of difference between students in both Universities perceived safety, benefits, and potential risks associated with genetically modified crops

Group	Mean	Standard Deviation	N	Df	Standard Error	Z (Cal)	Z (Tab)	Decision
University of Port Harcourt	3.98	0.21	60	98	0.12	2.41	1.96	Rejected
Imo State University	3.69	0.48	40					

There is no significant difference between students in both universities regarding perceived safety, benefits, and potential risks of genetically modified crops. Students from the University of Port Harcourt perceive genetically modified crops as safer and more beneficial, with possibly lower perceived risks compared to students from Imo State University. This difference could be linked to differences in academic exposure, public engagement, or trust in science. It underscores the need for targeted educational interventions at Imo State University to improve scientific literacy and address misconceptions.

V.DISCUSSION OF FINDINGS

Research Question 1: What is the level of awareness of genetically modified (GM) crops among university students in life sciences?

The current study supports findings of Amin et al. [22], who found that although over 60% of life science students had a basic understanding of the underlying biotechnology and over 75% of them had heard of genetically modified crops, there were still misunderstandings about their safety and environmental effects. Similarly, scientific students were more familiar with GM technology, according to Onyango & Nayga [23]. But awareness did not always equate to a favorable outlook or a thorough comprehension of the laws governing genetically modified crops and their possible health effects. Obidiegwu et al. [24] claim that because Nigerian life science undergraduates were exposed to genetics, biotechnology, and plant breeding courses, their understanding of genetically modified crops was comparatively high. To increase understanding and lessen skepticism, the study did stress the necessity of increased hands-on exposure to and involvement with contemporary worldwide biotechnology developments. Although university students enrolled in agriculture-related programs were aware that genetically modified crops existed, Kimenju & De Groote [25] discovered that many of them lacked a thorough understanding of biosafety procedures, gene editing methods, and policy frameworks. Higher awareness among Nigerian life science students was associated with a greater likelihood of supporting the implementation of genetically modified crops for food security, according to Akinwumi & Bamgbose [26].

Research Question 2: How do life science students perceive the safety, beneficial potential risks associated with genetically modified crops?

According to Pellegrini & Fernandez [27], GM crops were viewed by life science students at Latin American institutions as a means of lowering the environmental impact of agriculture by using fewer pesticides. Even scientifically literate groups maintain a balanced perspective that takes into account both promise and danger, as evidenced by Ferdowsian et al.'s [28] observation that science students in the United States expressed anxiety over the possibility of unknown genetic interactions and the lack of long-term independent studies. Spector et al. [29] revealed that students in biological and environmental sciences had a high level of knowledge about GM technology. According to Sulaiman & Rahman [30], the majority of students knew about genetically modified crops, particularly their potential to improve food security and lower the need for pesticides.

Research Question 3: What factors influence the awareness and perceptions of genetically crops among University students in life sciences?

James [31] discovered that students frequently had a more negative opinion of GM crops in nations with strong agricultural traditions or cultural aversions to biotechnology; they also found that students in nations with well-defined regulations regarding GM crops tended to have more favorable opinions regarding the safety of GM technology. Students from nations with unclear or lax laws, on the other hand, frequently voiced worries about uncontrolled genetic testing and the opaqueness of regulatory procedures. According to Zahran et al. [32], students who belonged to academic or social organizations that were either adamantly in favor of or against genetically modified crops frequently had similar opinions. Ehlers & Ferl [33] findings showed that students who had taken specialized biotechnology courses had increased awareness of the benefits of GM crops, including disease resistance and improved nutritional content.

VI.CONCLUSION

In conclusion, the perception and awareness of genetically modified (GM) crops among university students in life sciences are shaped by a variety of interrelated factors. The findings from various studies underscore the significant role of academic background, scientific literacy, cultural beliefs, and media exposure in influencing students' views. Students with strong biological science education and a deeper understanding of biotechnology tend to have more positive perceptions of GM crops, recognizing their potential benefits, such as improved crop yield, disease resistance, and the ability to address global food security challenges.

However, factors such as ethical concerns, environmental impact, and societal implications often lead to more skeptical or negative views. For instance, students from cultures with strong agricultural traditions or those engaged in environmental protection may express reservations about the long-term ecological consequences of GM crops. Misinformation and the portrayal of GM technology in media whether positive or negative also significantly influence students' perceptions, further highlighting the importance of accurate information in shaping attitudes.

Moreover, regulatory frameworks and personal values, such as prioritizing sustainability or technological innovation, play critical roles in shaping how students view GM crops. Students exposed to international perspectives through study abroad programs or collaborative research also show more favorable views, possibly due to the global discourse on GM crops and their potential to address challenges like food security and climate change.

Ultimately, the awareness and perception of GM crops among life science students are not homogenous but are influenced by a complex interplay of scientific education, social, cultural, and ethical considerations, and global perspectives. As biotechnology continues to evolve and GM crops become more prevalent in agricultural practices, fostering a well-informed student body through balanced education on both the benefits and risks of GM technology will be crucial in shaping future leaders and decision-makers in the field.

In light of these findings, it is evident that universities and educational institutions have a responsibility to promote critical thinking and provide comprehensive education on GM crops. This will not only improve students' scientific understanding but also equip them with the tools to engage in informed debates and contribute to the broader conversations about the role of biotechnology in sustainable agriculture and food production.

VII.RECOMMENDATIONS

Based on the conclusion, the following recommendations were made:

1. Universities should integrate more comprehensive courses on biotechnology, genetic engineering, and sustainable agricultural practices into their curricula for life science students.
2. To counteract misinformation and media bias, universities should initiate public awareness campaigns or community outreach programs that promote open discussions about GM crops.
3. Universities should encourage life science students to participate in international collaborations, study abroad programs, or global research projects related to biotechnology and GM crops.

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