Original Article

Overcoming Biases: Unlocking the Potential of Genetically Modified Crops to Transform Agriculture in Uganda

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ABSTRACT

Genetically Modified (GM) crops possess the power to revolutionize agriculture by addressing food security challenges, driving economic growth, and promoting environmental sustainability. Yet, in Uganda, their adoption remains limited due to deep-rooted biases and misconceptions among farmers, policymakers, and the public. This study investigates the origins of these barriers, focusing on how misinformation, cultural beliefs, and political influences shape negative attitudes toward GM crops. Using the survey on farmers and qualitative interviews with policymakers, it was found that misinformation breeds fear, while cultural narratives reinforce scepticism, and political inertia amplifies resistance, collectively stalling progress. By confronting these challenges, GM technology's immense potential can be unleashed, paving the way for transformative benefits such as higher crop yields, climate resilience, and improved livelihoods. Further, empowering farmers and stakeholders through targeted education can dispel myths, while transparent and inclusive policy frameworks can foster trust and collaboration. Stakeholder engagement that values diverse perspectives is essential to building consensus and driving acceptance of GM innovations. This study highlights the need for coordinated efforts to bridge knowledge gaps, address policy shortcomings, and foster trust among all actors in Uganda's agricultural landscape. Overcoming these biases is crucial to unlocking GM crops' ability to revolutionize farming, enhancing productivity and resilience in the face of climate change while securing economic and food security gains for future generations. With the right strategies, Uganda can embrace GM technology as a transformative tool, enabling its agricultural sector to thrive sustainably and empowering farmers to meet both current and future challenges.

INTRODUCTION

Agriculture remains the backbone of Uganda's economy, with the majority of the population relying on subsistence farming for their livelihoods. However, the sector faces persistent challenges, including low productivity, pest infestations, poor soil fertility, and vulnerability to climate change. These factors contribute to food insecurity and limit Uganda's potential to achieve sustainable agricultural growth. One promising solution to these challenges is the adoption of genetically modified (GM) crops, which have been shown to improve yields, reduce the need for chemical inputs, and enhance resistance to pests and diseases. Despite their potential, GM crops remain a contentious issue in Uganda, largely due to widespread misconceptions, socio-cultural resistance, and biased perceptions influenced by both local and global anti-GMO narratives (Mbabazi *et al*., 2021). This bias obstructs the country from fully realizing the benefits of biotechnology in agriculture.

One major gap in the current discourse on GM crops in Uganda is the lack of comprehensive awareness campaigns and inclusive public dialogues. While the scientific community emphasizes the safety and benefits of GM technology, many farmers and stakeholders continue to harbour fears and reservations, largely because they lack accurate information. Research by Ssali, & Nampala (2022) highlights that misinformation, coupled with the absence of coherent government policies, worsens the public's wariness of GMOs. Additionally, the rejection of the National Biotechnology and Biosafety Bill by the Ugandan parliament in 2017 has further delayed the development of a regulatory framework that could facilitate the safe deployment of GM crops (Nsubuga, & Naluwairo, 2023). These gaps underscore the need for targeted strategies that not only address scientific and policy issues but also confront the underlying biases that impede technological adoption.

Several issues are at the heart of the GM crop debate in Uganda. Misinformation, often propagated by anti-GMO activists, plays a significant role in shaping negative perceptions among the public. For instance, fearmongering about the health risks associated with GMOs, despite evidence from global health organizations supporting their safety, remains prevalent (FAO, 2022). Additionally, socio-cultural factors, such as traditional farming practices and the strong influence of local leaders, contribute to resistance to adopting new technologies. Political instability and delays in passing biosafety laws further complicate the issue, creating uncertainty among potential investors and stakeholders in the agricultural biotechnology sector. Addressing these multifaceted issues requires a holistic approach that combines scientific education, policy advocacy, and community engagement to dismantle the biases preventing the adoption of GM crops in Uganda.

The primary objective of this study was to investigate the factors contributing to the biases and misconceptions surrounding genetically modified crops in Uganda and propose strategies to overcome them. By exploring the socio-economic, cultural, and political dimensions of the GM crop debate, this research aimed to identify pathways to enhance public acceptance of biotechnology. Specific objectives included assessing the level of awareness and knowledge among farmers and stakeholders, evaluating the role of media in shaping public opinion on GMOs, and analysing the impact of political and regulatory actions on the adoption of GM technology. Furthermore, the study explored the potential benefits of GM crops in addressing agricultural challenges and improving food security, which could incentivize stakeholders to embrace biotechnology as a viable solution.

APPROACH AND METHODOLOGY

A mixed-methods approach was employed in the study to capture both quantitative and qualitative data. The methodology combined surveys and interviews to gain a comprehensive understanding of the factors influencing biases against GM crops.

Table 1: Showing Distribution of Participants by Category in South-Western Uganda

Category	Number of Participants
Farmers (South-western Uganda)	150
Agricultural Extension Workers	30
Policymakers (Local/National)	15
NGO Representatives	20
Media Professionals	10
Total	**225**

As seen in Table 1, the survey was administered to farmers and stakeholders to quantify levels of awareness, knowledge, and perceptions of GM crops. In-depth interviews were conducted with policymakers, agricultural extension workers, and NGO representatives to explore their views on the regulatory environment and potential strategies for overcoming bias.

The study was conducted among key stakeholders in the agricultural sector of Uganda, including farmers, agricultural extension workers, policymakers, and representatives from non-governmental organizations (NGOs). The study population was recruited using purposive sampling to ensure that participants had relevant knowledge or influence regarding genetically modified (GM) crops. Farmers were selected from key agricultural regions, particularly in South-western Uganda, known for their vulnerability to climate change and agricultural challenges. Agricultural extension workers, media professionals and policymakers were included to provide insights into regulatory and policy frameworks. Data collection techniques included structured questionnaires for the surveys and semi-structured interview guides for the interviews. The questionnaires were designed to assess participants' knowledge of GM crops, their perceptions of risks and benefits, and their willingness to adopt GM technology. The interviews focused on understanding the policy landscape, regulatory challenges, and socio-cultural factors that shape public opinion. Focus group discussions were also held with farmer groups to encourage open dialogue and gather diverse perspectives. Quantitative data from the surveys were analysed using descriptive statistics and regression analysis to identify correlations between factors such as knowledge levels and acceptance of GM crops. Qualitative data from interviews and focus group discussions were analysed thematically, allowing the identification of recurring themes and insights into the socio-cultural

and policy-related barriers to GM crop adoption. Triangulation was used to ensure the validity of the findings, combining results from both quantitative and qualitative analyses.

RESULTS AND DISCUSSION

Key Social, Cultural, and Political Factors Contributing to Biases against GM Crops

A total of 225 respondents, including farmers (150), agricultural extension workers (30), policymakers (15), NGO representatives (20), and media professionals (10), participated in the study to identify the social, cultural, and political factors that contribute to biases against genetically modified (GM) crops in South-western Uganda.

Health Concerns:

The study found that 70% of farmers and 60% of NGO representatives expressed the highest concerns about the health risks associated with genetically modified (GM) crops, reflecting deep-seated apprehensions in these groups. These concerns are often rooted in limited access to scientific information, misinformation, and historical fears regarding food safety. Many farmers in rural Uganda rely on traditional agricultural knowledge passed down through generations, and new technologies like GM crops are frequently viewed as foreign and potentially harmful. Misinformation, including rumours linking GM crops to health issues such as cancer, further exacerbates these fears. Without adequate educational outreach or public health campaigns to dispel these myths, farmers are more likely to avoid adopting GM crops due to caution and uncertainty.

For NGO representatives, particularly those focused on environmental sustainability and food sovereignty, their concerns are often shaped by their advocacy roles. Many NGOs historically align with anti-GMO campaigns, emphasizing the potential health risks associated with GM crops as part of a broader critique of corporate control in agriculture. These groups tend to advocate for more research,

stringent regulations, and caution in endorsing GM crops, reflecting a precautionary stance. The strong influence of these NGOs in shaping public opinion further amplifies farmers' concerns, creating a cycle of resistance and fear toward GM crops.

In contrast, policymakers, who made up 25% of the respondents, were the least concerned about the health risks of GM crops. This difference in perception likely arises from their greater access to scientific data and regulatory frameworks that support the safety of GM crops. Policymakers are often well-informed about international standards from bodies like the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), both of which have consistently found no evidence linking GM crops to health risks. Moreover, policymakers tend to prioritize the potential benefits of GM crops, such as higher yields and pest resistance, over unproven health concerns. Their involvement in drafting or debating biotechnology legislation provides them with a more nuanced understanding of the safety measures and regulations in place to protect public health.

This gap in perceptions between farmers, NGOs, and policymakers highlights the need for improved communication and educational initiatives to bridge these divides. Ensuring that health concerns are addressed with accurate, evidence-based information will help farmers make more informed decisions about GM crops and potentially reduce resistance to adopting this technology.

Misinformation:

The finding that 65% of both agricultural extension workers and farmers identified misinformation as a major barrier to adopting genetically modified (GM) crops underscores a significant knowledge gap among key agricultural stakeholders. Misinformation is especially prevalent in rural areas, where access to reliable scientific data is limited. Farmers often rely on informal networks, such as word of mouth, community discussions, or media sources, which may not provide accurate or

balanced information. This leads to myths and rumours about GM crops influencing farmers' decisions and fostering scepticism toward biotechnology.

A common misconception is that GM crops are harmful to human health or the environment, with exaggerated fears of diseases like cancer or infertility. Additionally, many farmers confuse genetically modified crops with hybrid varieties, further deepening their distrust. These misunderstandings discourage the adoption of GM crops, even though these crops could address significant agricultural challenges such as pest infestations or drought resilience.

Agricultural extension workers, who serve as intermediaries between scientific knowledge and farming communities, are acutely aware of the harm caused by misinformation. As educators on agricultural practices, technologies, and best practices, extension workers play a crucial role in promoting new farming methods. However, misinformation about GM crops often undermines their efforts, as they are forced to combat entrenched myths and misconceptions. Many farmers resist advice from extension workers due to pre-existing fears, making it challenging to change mindsets and convince farmers of the potential benefits of GM crops.

This issue is further compounded by anti-GMO campaigns, which sometimes deliberately spread misinformation or emphasize worst-case scenarios, overlooking the scientifically supported benefits of GM crops. Farmers are exposed to polarized perspectives, with some NGOs and media outlets focusing solely on risks and ignoring the broad scientific consensus about GM crops' safety and potential benefits. In environments where scientific literacy is low and access to formal education on biotechnology is limited, these skewed narratives become especially persuasive.

To address these challenges, there is an urgent need for well-structured public awareness campaigns that provide clear, evidence-based information on GM crops. These campaigns should directly address common misconceptions and offer transparent, scientifically backed responses to concerns about health, environmental impact, and economic viability. Additionally, agricultural extension worker training programs must be strengthened to ensure they have the resources and knowledge to effectively communicate with farmers, dispel myths, and build trust in GM crop technology. Without confronting pervasive misinformation, efforts to promote GM crops will continue to face significant resistance, even if the technology offers substantial potential for improving food security and agricultural sustainability.

Economic Concerns:

Farmers: For 55% of farmers, the economic dependence on GM seeds likely stems from fears that adopting GM crops would tie them to purchasing seeds from specific biotech companies each season. Unlike traditional seeds, which can often be saved and replanted, many GM seeds are patented and require farmers to buy new seeds annually. This could increase their costs and create reliance on large corporations, potentially reducing their financial autonomy and ability to choose freely.

NGO representatives: Similarly, 50% of NGO representatives express concern about the same issue, likely because they advocate for smallholder farmers' independence and sustainability. They may worry that reliance on GM seeds would limit farmers' access to a diverse range of crop varieties and increase corporate control over the food supply, which could hurt rural economies.

Policymakers: Only 20% of policymakers are concerned about this issue. This lower percentage could reflect different priorities or perspectives. Policymakers may see GM crops as beneficial for boosting agricultural productivity, improving food security, or driving economic growth, outweighing the potential risks of economic dependence.

Additionally, some policymakers may assume that proper regulations and policies can mitigate concerns over corporate control.

Cultural Attachment to Indigenous Crops:

The strong cultural attachment to traditional crops among 75% of farmers reflects their deep-rooted connection to local farming practices, indigenous crop varieties, and agricultural traditions passed down through generations. These crops are often tied to their identity, cultural heritage, and local diets. Farmers may also trust these crops for their adaptability to local conditions and view them as more reliable and familiar compared to genetically modified (GM) alternatives.

For 60% of NGO representatives, the attachment likely stems from their advocacy for preserving local agricultural biodiversity, promoting food sovereignty, and protecting smallholder farmers' livelihoods. They may view traditional crops as crucial for sustaining local communities, ecosystems, and traditional knowledge systems. This concern is linked to the potential risks of GM crops, which could displace traditional varieties and disrupt local agricultural practices.

Influence of Community and Religious Leaders:

The finding that **60% of both farmers and NGO representatives** were significantly influenced by community leaders suggests that local leaders play a critical role in shaping opinions about genetically modified (GM) crops. These leaders, often trusted figures in rural areas, may express scepticism or opposition toward GM technology, which can reinforce or amplify community-level biases against adopting GM crops. Their views, whether based on cultural, economic, or environmental concerns, heavily sway farmers and NGO representatives, leading to resistance or caution in embracing GM crops. This influence highlights the importance of local leadership in shaping agricultural innovation and public perceptions.

Policy Gaps:

65% of policymakers and 60% of agricultural extension workers identified the absence of clear policies as a key factor, highlighting how the lack of a well-defined regulatory framework for genetically modified (GM) crops creates uncertainty in the agricultural sector.

Policymakers: These stakeholders likely view clear policies as essential for guiding the use, regulation, and safety of GM crops. Without comprehensive laws or guidelines, there is confusion about how GM crops should be adopted, managed, or monitored. This absence may also lead to resistance because people—especially farmers and local communities—lack assurance about the long-term implications of using GM seeds, including issues like intellectual property rights, seed availability, environmental impacts, and health concerns.

Agricultural extension workers: As the primary link between research institutions and farmers, these workers often play a key role in promoting and explaining agricultural innovations. The absence of clear policies complicates their efforts to advise farmers about GM crops. Without a concrete policy structure, extension workers struggle to provide accurate information or promote confidence in GM technology. This ambiguity can lead to reluctance among farmers, NGOs, and other stakeholders to adopt GM crops, further contributing to resistance.

Both groups emphasize that well-defined policies are crucial to provide legal certainty, address potential concerns, and guide the safe and effective implementation of GM technology.

Anti-GMO Campaigns:

The observation that **60% of NGO representatives** and **50% of policymakers** noted the strong role of anti-GMO advocacy in shaping public opinion highlights the significant influence of organizations and movements opposing genetically modified organisms (GMOs).

NGO representatives: Many NGOs, particularly those focused on environmental sustainability, food

sovereignty, or public health, actively campaign against GMOs. They often raise concerns about the potential risks of GM crops, such as environmental degradation, loss of biodiversity, corporate control over food systems, and possible health hazards. These campaigns tend to resonate with local communities, especially where trust in large biotech corporations or government institutions is low. As a result, the NGO representatives see first-hand how anti-GMO advocacy efforts shape public resistance, creating a broad base of scepticism among farmers and consumers.

Policymakers: Half of the policymakers also acknowledge the impact of anti-GMO campaigns on public sentiment. These campaigns can make it harder for policymakers to promote GM technology, as they must address widespread fears and opposition generated by such advocacy. In some cases, policymakers may need to balance scientific evidence supporting GM crops with the public's deeply rooted concerns fuelled by anti-GMO activism. This strong influence can stall policy efforts or lead to more cautious regulatory approaches, as leaders respond to a public wary of GMOs due to persistent advocacy efforts.

The anti-GMO advocacy plays a critical role in fostering public scepticism, making it challenging to build widespread acceptance of GM crops. It influences both the opinions of communities and the decisions of policymakers.

Distrust in Government:

The shared **60% distrust in government institutions** among both policymakers and NGO representatives reflects a broad scepticism about the government's ability to effectively regulate or manage genetically modified (GM) crops.

Policymakers: This distrust may stem from internal concerns about bureaucratic inefficiency, corruption, or lack of transparency in policy implementation. Policymakers might worry that government actions related to GM crops are influenced by external pressures from corporate

interests, leading to decisions that do not align with the public good.

NGO representatives: For NGOs, distrust in government institutions is often linked to perceptions that the government prioritizes economic or corporate interests over environmental sustainability, food security, or smallholder farmers' welfare. They may view the government as failing to assess the risks of GM crops or as lacking the capacity to enforce necessary regulations.

This widespread distrust can fuel resistance to GM crops, as people question the government's ability to protect public interests. The results indicate that biases against genetically modified (GM) crops in Uganda are driven by a combination of social, cultural, and political influences:

Social factors: Community leaders, NGOs, and anti-GMO advocacy shape public opinion, fuelling resistance among farmers and the public.

Cultural factors: A strong attachment to traditional crops and farming practices creates scepticism about adopting new technologies like GM crops.

Political factors: Distrust in government institutions and the absence of clear policies contribute to confusion and hesitation in embracing GM crops.

To address these challenges, there is a need for public education to inform people about GM crops, clearer policies to provide regulatory guidance and trust-building measures to rebuild confidence in government institutions and GM technology.

Farmers: There is clear and widespread support for genetically modified (GM) crops among farmers, particularly in the areas of sustainable agriculture and economic development. Many farmers recognize the potential of GM crops to enhance agricultural sustainability by improving yields, reducing the need for chemical inputs, and offering greater resilience to pests and climate challenges. These benefits align with their desire for long-term

agricultural sustainability. However, the number of farmers who support GM crops for economic development is slightly higher, reflecting a keen interest in the immediate economic advantages that GM crops could provide, such as increased income and reduced production costs.

With just over 80 farmers supporting GM crops for economic development, it shows that many see GM technology as a tool for enhancing profitability and securing financial stability. This slight preference for economic development over sustainable agriculture suggests that while farmers are committed to ensuring their farming practices are environmentally sound, they are also highly motivated by the potential economic gains that GM crops could offer, such as improved market opportunities, higher productivity, and more consistent output. Thus, farmers appear to view GM crops as a dual solution—helping to achieve both sustainability in their agricultural practices and economic development goals.

Agricultural Extension Workers: A significant portion of agricultural extension workers demonstrates strong support for genetically modified (GM) crops in both sustainable agriculture and economic development. These professionals, who are directly involved in advising and educating farmers, recognize the benefits that GM crops can bring in addressing key agricultural challenges. For sustainable agriculture, many extension workers see the potential for GM crops to improve resilience against pests and diseases, reduce dependency on chemical inputs, and boost crop yields in environmentally sustainable ways. However, while the support for sustainable agriculture is notable, the slightly greater emphasis on economic development indicates a stronger focus on the economic impacts GM crops could have on farmers.

Around 25 agricultural extension workers back GM crops for economic development, compared to the 20 who prioritize sustainable agriculture. This suggests that while they value the environmental benefits, extension workers are more interested in the financial and productivity gains GM crops could offer. They likely see GM technology as a means to improve farm income, reduce operational costs, and enhance market competitiveness. By promoting GM crops, extension workers envision a path toward not only increasing yields but also creating greater economic opportunities for farmers, which is key to long-term agricultural development and stability in Uganda.

Policymakers: Among policymakers, there is balanced support for GM crops across both sustainable agriculture and economic development, with a slight preference for economic development. Policymakers recognize the transformative potential of GM crops in modernizing agriculture while addressing the economic challenges faced by the country. The nearly equal support for both categories reflects an understanding that GM crops offer multiple benefits. On one hand, policymakers see the environmental advantages of sustainable agriculture, such as improved crop resilience and reduced reliance on harmful chemical inputs. On the other hand, they are keenly aware of the significant economic opportunities that GM crops could provide, particularly in boosting agricultural productivity and contributing to economic growth.

The slight preference toward economic development, with 13 policymakers favouring this over 12 who support sustainable agriculture, suggests that policymakers prioritize the immediate financial and developmental gains. They likely view GM crops as a way to enhance food security, create jobs, and increase exports by making Uganda's agricultural sector more competitive on the global stage. By driving economic development through increased agricultural output, policymakers believe GM crops could help reduce the country's dependence on food imports and improve rural livelihoods. Their near-equal support for sustainable agriculture indicates a holistic approach, where they envision the integration of economic growth with environmental sustainability, ensuring long-term benefits for both farmers and the nation.

NGO Representatives: This group of NGO representatives shows a more divided stance on the adoption of genetically modified (GM) crops, with fewer respondents expressing support for both sustainable agriculture and economic development. NGOs tend to have more nuanced views, as they often prioritize social equity, environmental conservation, and the protection of smallholder farmers. While some within this group recognize the potential of GM crops to contribute to sustainable agriculture—through reduced pesticide use, increased yields, and enhanced resilience to environmental stress—only about 9 respondents show support for these benefits. This modest backing reflects a cautious approach, where concerns about long-term environmental impacts, such as biodiversity loss, remain prevalent.

Similarly, the number of NGO representatives supporting GM crops for economic development is also low, with approximately the same number (around 9) acknowledging its potential for boosting farmer income, increasing productivity, and fostering rural development. Despite recognizing these economic benefits, the majority of NGO respondents remain concerned about issues like corporate control over seed production, the displacement of traditional farming practices, and the potential economic dependency of smallholder farmers on biotech companies. Their divided opinion illustrates the need for more comprehensive policy frameworks that can address these socio-economic concerns, ensuring that the adoption of GM crops aligns with the broader goals of sustainable development, equity, and local community empowerment.

Media Professionals: Media professionals in this study showed balanced support for genetically modified (GM) crops, with an equal number backing sustainable agriculture and economic development, reflecting their role in presenting both sides of the GM debate. Seven respondents supported each category, indicating modest but balanced backing. Media professionals recognize GM crops' potential to contribute to sustainable agriculture, such as reducing pesticide use, enhancing crop resilience, and increasing yields. However, they remain cautious due to ongoing controversies surrounding GM technology. This modest support stems from the need to address diverse perspectives, including concerns from NGOs, policymakers, and farmers. Media professionals are aware of the economic opportunities GM crops offer, such as boosting productivity and improving food security, but also acknowledge the mixed public reactions. Their approach emphasizes the importance of balanced, well-informed discussions to guide public perception and foster understanding of GM crops' role in both sustainable agriculture and economic development in Uganda.

Evaluation of the Role of Existing Policies and Regulations

The evaluation of existing policies and regulations surrounding genetically modified (GM) crops among 225 respondents revealed notable differences in the perceptions and confidence levels across various stakeholder groups. The participants included farmers, agricultural extension workers, policymakers, and other relevant stakeholders, each providing valuable insights into how policies influence their attitudes toward GM technology. While some stakeholders exhibited greater trust in the current regulatory framework, others expressed scepticism due to perceived gaps in the policies, highlighting the complexity of introducing GM crops in Uganda.

Farmers, representing 120 of the respondents, showed a particularly low level of confidence in the existing regulatory framework. Approximately 65% of farmers voiced concerns about the lack of clear and supportive policies, especially after the rejection of the "National Biotechnology and Biosafety Bill" in 2017. This rejection created uncertainty regarding the future of GM technology in Uganda and deepened farmers' fears about potential legal repercussions if they adopted GM

crops. Many farmers felt vulnerable to market barriers, legal challenges, or societal backlash without a robust government-backed policy, making them hesitant to embrace GM technology. As a result, 70% of farmers surveyed expressed concerns about the potential risks associated with GM crops, ranging from health and environmental implications to economic factors such as market access and livelihoods.

This lack of clarity in the regulatory environment left farmers unsure about how to navigate the complex issues surrounding GM crops. The uncertainty created by the absence of clear policies, coupled with misinformation and conflicting narratives, further fuelled farmers' reluctance to adopt GM technology. The lack of legal safeguards meant that farmers were hesitant to take risks without concrete regulations to provide a sense of security.

In contrast, agricultural extension workers, accounting for 30 respondents, demonstrated a more favourable outlook on the current policies. About 60% of extension workers expressed confidence in the existing regulatory framework, believing that it sufficiently addressed safety concerns related to GM crops. These extension workers, who are responsible for educating farmers and facilitating the adoption of agricultural technologies, felt that the regulations provided a solid foundation for managing potential risks. They saw the regulations as an essential tool for ensuring the safe and responsible use of GM technology in agriculture.

However, extension workers did acknowledge the limitations of the current regulatory environment. While they trusted the policies to some extent, they also recognized that the framework needed more comprehensive guidelines to support the adoption of GM crops. The extension workers stressed the importance of clearer policies that could better guide their outreach efforts and ensure that farmers received accurate, evidence-based information. They argued that a stronger regulatory framework would not only help clarify the benefits and risks of

GM crops but also address the misinformation that often undermines the adoption process.

Policymakers, comprising 15 respondents, echoed the concerns of extension workers regarding the inadequacies of the current regulatory framework. Approximately 80% of policymakers recognized the shortcomings in the existing policies, citing a lack of clarity and coherence as major obstacles to the successful adoption of GM crops. They emphasized the need for a more unified and comprehensive approach to GM crop regulation, which could address safety concerns and provide clearer guidelines for all stakeholders involved. Policymakers believed that a more robust regulatory framework would enhance the credibility of GM technology, providing the necessary guidance to both farmers and extension workers to make informed decisions.

Similarly, representatives from non-governmental organizations (NGOs), making up 20 respondents, expressed concerns about the current regulatory environment. Around 75% of these NGO representatives indicated that the existing policies did not adequately support the adoption of GM technology. They argued that without better regulatory support, farmers were unable to access tools and technologies that could significantly improve agricultural productivity and food security. These representatives called for more proactive government policies that could facilitate the wider acceptance of GM crops and support the agricultural sector in addressing challenges such as food insecurity and climate change.

Media professionals, comprising 10 respondents, also acknowledged the ambiguity in the regulatory environment. Approximately 65% of media respondents reported that the lack of clear information regarding GM crops made it difficult for them to report on the technology accurately. The ambiguity surrounding GM crop regulations hindered their ability to communicate the facts, challenges, and benefits of GM crops to the public, leading to a skewed portrayal of GM technology in

the media. Media professionals emphasized the importance of a clear regulatory framework that could provide them with the necessary information to report on GM crops in an informed and balanced manner.

The contrasting views among farmers, extension workers, policymakers, NGOs, and media professionals underscore the complexity of introducing GM crops in Uganda. Farmers, who are directly impacted by agricultural policies, expressed significant concerns about the lack of clear regulations, which contributed to their reluctance to adopt GM crops. While agricultural extension workers and policymakers showed greater trust in the existing regulatory framework, they also recognized the need for more comprehensive and clearer guidelines to address the challenges in implementing GM technology. NGO representatives and media professionals similarly called for stronger regulatory support to facilitate the wider adoption of GM crops and improve public understanding of the technology.

In conclusion, the findings from the evaluation indicate that the current regulatory environment surrounding GM crops is a significant factor influencing the perceptions and acceptance of GM technology in Uganda. The lack of clear, comprehensive, and supportive policies has contributed to farmers' uncertainty and reluctance to adopt GM crops. This uncertainty is exacerbated by conflicting narratives and misinformation surrounding GM technology. Agricultural extension workers, policymakers, NGOs, and media professionals all agree that more robust and transparent regulations are necessary to address the challenges and concerns faced by various stakeholders. Clearer policies will help bridge the gap between scientific advancements in biotechnology and practical applications on the ground, fostering greater trust and confidence in GM technology.

A reassessment of the policy landscape is needed to ensure that the regulatory framework meets the diverse needs of all stakeholders involved in the agricultural sector. This will help create a more supportive environment for the adoption of GM crops, ultimately contributing to the advancement of agriculture and food security in Uganda. Strengthening the regulatory framework, providing more comprehensive guidelines, and ensuring better communication of the benefits and risks of GM crops will play a pivotal role in shaping public perception and facilitating the wider acceptance of GM technology.

The Role of Advocacy Efforts

Advocacy efforts have significantly influenced perceptions and acceptance of genetically modified (GM) crops, particularly among farmers. A notable 85% of farmers reported that their views were shaped by anti-GMO campaigns, which often emphasized health risks and environmental concerns, fostering fear and scepticism. This led to widespread hesitation toward GM technology. In contrast, only 45% of farmers felt adequately informed about the potential benefits of GM crops, such as increased yields, pest resistance, and improved food security, highlighting the imbalance in information exposure.

Agricultural extension workers expressed frustration, with around 70% acknowledging that their efforts to educate farmers about GM crop benefits were undermined by the dominant anti-GMO narrative. They found it challenging to present balanced, evidence-based information against the backdrop of anti-GMO campaigns. Further, NGO representatives had mixed views on advocacy efforts. While 60% supported pro-GM advocacy, they acknowledged that anti-GMO initiatives overshadowed their outreach efforts. These campaigns, which focused heavily on health and environmental risks, dominated the public conversation, limiting opportunities to promote GM technology's benefits, such as enhanced food security and agricultural sustainability. Likewise, the media also played a role, with approximately 80% of media professionals reporting that they

covered more anti-GMO protests and concerns than scientific discussions supporting GM crops. This focus on controversy reinforced scepticism and fear rather than facilitating informed debate. The study highlighted that the dominance of anti-GMO narratives has entrenched biases among farmers, policymakers, and the public, making it difficult to foster a nuanced understanding of GM technology. The lack of balanced advocacy has complicated the acceptance of GM crops in Uganda.

In summary, both policies and advocacy efforts are critical in shaping perceptions of GM crops. The lack of clear and confident regulatory frameworks has increased farmers' apprehension about GM technology. The dominance of negative advocacy has deepened these concerns, limiting the ability of stakeholders to assess GM crops' full potential. The study calls for a more coordinated, science-based approach, with clear policies and balanced advocacy, to foster informed public discourse and unlock the benefits of GM technology for agriculture and food security in Uganda.

CONCLUSION

A multi-faceted approach is essential for fostering the acceptance and adoption of genetically modified (GM) crops in Uganda. Establishing clear regulatory frameworks, engaging stakeholders in policy development, and implementing targeted education programs can build confidence and dispel misconceptions. Collaborative advocacy efforts and transparent communication of research findings will further enhance public trust and counter misinformation. Encouraging active participation from farmers, NGOs, and media professionals ensures inclusive and science-based decision-making. By integrating these strategies, Uganda can create a supportive environment for GM technology, driving agricultural innovation, improving food security, and promoting sustainable farming practices.

Recommendations to Address Biases and Promote Informed Decision-Making

Develop Comprehensive and Clear Regulatory Frameworks

To build stakeholder confidence, especially among farmers, the government should establish clear regulatory frameworks for genetically modified (GM) crops, detailing safety protocols, legal implications, and adoption procedures. Clear regulations help farmers understand their rights and responsibilities, reducing fears about potential legal issues and fostering a secure environment for considering GM technology. Regular updates and consultations with stakeholders, including farmers, extension workers, and NGOs, are essential during policy development. Engaging stakeholders in discussions ensures their concerns are addressed, builds trust, and aligns regulations with their needs. This collaborative approach promotes transparency, fosters ownership, and increases compliance support. Together, these efforts can boost confidence and encourage GM crop adoption in Uganda.

Implement Targeted Education and Outreach Programs

Agricultural extension services should implement education programs to provide farmers with balanced, accurate information about genetically modified (GM) crops. These initiatives must address both benefits, like increased yields and pest resistance, and potential risks, relying on evidence-based research to dispel myths and misinformation. Workshops, community meetings, and farm demonstrations offer effective platforms for knowledge-sharing and open dialogue among farmers, extension workers, and researchers. These interactive settings help farmers voice concerns and ask questions, promoting a nuanced understanding of GM technology. Empowered with this knowledge, farmers can confidently adopt GM crops, enhancing productivity and food security.

Foster Collaborative Advocacy Efforts

To counter negative narratives about genetically modified (GM) crops, pro-GM advocates, NGOs,

and media professionals must collaborate on unified messaging strategies that highlight benefits while addressing safety concerns. Joint campaigns can amplify supportive voices, counter misinformation, and promote the positive impacts of GM technology on food security, sustainability, and environmental conservation. Engaging media professionals through workshops can enhance their understanding of GM science, enabling accurate and balanced reporting. These efforts foster informed public discourse, reshape perceptions, and encourage acceptance of GM crops, cultivating constructive dialogue and paving the way for broader adoption of biotechnology in agriculture.

Enhance Research and Communication on GM Technology

Investing in research on the impacts and benefits of genetically modified (GM) crops is crucial for informing agricultural stakeholders. Presenting findings in accessible formats, such as reports, infographics, and community presentations, ensures clear communication with non-experts. Partnerships between research institutions, universities, and agricultural organizations are vital for disseminating findings and building trust among stakeholders, incorporating diverse perspectives into the research process. Accessible, comprehensible research empowers farmers, policymakers, and consumers to make informed decisions about adopting GM technology. This informed approach fosters acceptance of GM crops, driving agricultural productivity and food security in the region.

Encourage Stakeholder Participation in Policy Development

Engaging diverse stakeholders—including farmers, agricultural extension workers, NGOs, and industry representatives—in policy development is vital for creating inclusive and effective regulations on genetically modified (GM) crops. Platforms such as forums and focus groups enable stakeholders to voice concerns, share experiences, and influence policies affecting their lives. This participatory approach fosters ownership and investment, resulting in more relevant and robust outcomes.

Stakeholder involvement enhances transparency and early identification of challenges and solutions, promoting support for and adherence to regulations. Collaborative efforts ensure that policies are scientifically sound, socially acceptable, and practical, reflecting the needs of all parties. By fostering mutual understanding and respect, this inclusivity facilitates the successful implementation and acceptance of GM technology, significantly advancing agriculture and improving food security in the region.

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