

# Consumer Perceptions towards Introducing a Genetically Modified Banana (*Musa* spp.) in Uganda

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**Keywords:** acceptance, awareness, biosafety, GM food

## Abstract

The introduction of a genetically modified (GM) banana (*Musa* spp.) in Uganda is not without controversy. It is likely to generate a wide portfolio of concerns as the technology of genetic engineering is still in its early stages of development in Uganda. The purpose of this study is to show how consumers feel about GM banana biosafety risks and the potential challenges for marketing the product. The study analyzes socio-demographic characteristics, awareness and attitudes of banana-consuming households that would be affected by the introduction of a GM banana in Uganda. The study was conducted in different regions in Uganda where cooking bananas ('matooke', AAA-EA genome) are produced and consumed, including urban areas that are sole consumers of bananas. This allowed us to capture the heterogeneity in preferences across different population segments. The survey sample was drawn using a random multistage sampling procedure from the major banana-consuming regions in eastern, central, and southwestern Uganda. Respondents were stratified into rural and urban consumers of 'matooke' and received extra information about the GM banana. A total of 440 households were selected from current village listing for the survey. The results reveal that consumers trust local community leaders and public agricultural related organizations in controlling and regulating production and release of GM food and crops. Three main categories of consumer perceptions were identified: a) benefit; b) food and environmental concern; and c) future health concern. A comparison of consumer characteristics, perceptions and attitudes showed significant differences between rural and urban consumers. Consumers in rural areas are more likely to accept the introduction of a GM banana regardless of whether they grow or buy bananas. Urban consumers are more concerned about long-term health effects. Finally, we discuss the implications of the results for biotechnology and biosafety regulations for GM bananas in Uganda.

## INTRODUCTION

In the mid 1990s, Uganda launched its long-term approach of breeding for resistance to banana (*Musa* spp.) productivity constraints using conventional breeding and genetic engineering methods. Through genetic engineering, the strategy is to develop genetically modified (GM) cultivars that are resistant to local pests and diseases, have improved agronomic attributes, and are acceptable to consumers (Kikulwe et al., 2007). The genetic engineering projects in Uganda have targeted the most popular and infertile cultivars that cannot be improved through conventional breeding.

Currently, about 200 GM bananas with resistance against black leaf streak were planted in confined field trials undergoing biosafety field assessments. There are also a number of other GM bananas awaiting regulatory approval of the country's National Biosafety Committee for confined field trials. After a thorough confined field testing, GM bananas are expected to be released into the environment for commercialization.

However, the introduction of GM banana in Uganda is likely to generate a wide portfolio of concerns, as it has in other African countries. It is well known that concerns about compliance with biosafety regulations, environmental standards and food safety of

GM organisms can be an important obstacle to public acceptance of biotechnology products (Paarlberg, 2008). A number of studies have shown that acceptance of GM foods differs among consumers (e.g., Colson et al., 2008; Dannenberg et al., 2009). Although, the population could benefit substantially from GM crops in Africa (Wesseler, 2009), limited research is available on how consumers perceive introduction of GM crops (see Kimenju and De Groote (2008) study in Kenya).

To understand consumer acceptance of GM banana in Uganda, a study was conducted in 2007 among banana-consuming households in both rural and urban areas. This paper reports results of consumer perception.

## **METHODS AND MATERIALS**

A cross-sectional study was conducted in three regions in Uganda where cooking bananas ('matooke', AAA-EA genome) are produced and consumed, including urban areas that are mostly sole consumers of bananas. Implementation of this procedure allowed us to capture the heterogeneity in preferences across different population segments. The sample was drawn using a multistage sampling procedure, and stratified into rural and urban consumers. The primary sampling unit (PSU) was the sub-county for rural areas and the division for urban areas. Eleven PSUs were selected: seven in rural areas and four in urban areas. This selection was based on the distribution of the Ugandan population (UBOS, 2006). The secondary sampling unit was the community. At the sub-county/division level, two parishes were randomly selected from each PSU. In each parish, one community was drawn using a systematic random sampling criterion with a random start. Urban communities were sampled from the three main cities (Kampala, Mbarara and Jinja); within each community, households were randomly selected from a current community listing resulting in a total number of 440 households.

Survey data was collected in July and August of 2007 using standardized questionnaires through face-to-face interviews. Prior to the interviews, respondents were informed about the various aspects of biotechnology development and associated biosafety regulations, with particular emphasis on GM banana. Data on socioeconomic characteristics of households, household awareness, perceptions and attitudes toward GM crops, as well as the level of consumer trust in various organizations were collected. The list of organizations included: (a) private ones (Uganda National Farmers Federation (UNFFE), Uganda Traders Association (UTA), Consumer Education Trust (CONSENT), food processors, cooperatives, NGOs and Agro-genetic Technologies (AGT)); and (b) public ones (National Agricultural Research Organization (NARO), National Agricultural Advisory Services (NAADS), Uganda National Bureau of Standards (UNBS), Uganda Revenue Authority (URA), Ministry of Agricultural Animal Industries and Fisheries (MAAIF), National Environment Management Authority (NEMA), Uganda National Council of Science and Technology (UNCST), public extension workers, politicians and local leaders).

Consumer attitudes on genetic modification was measured using a Likert five point scale from 1 = strongly disagree to 5 = strongly agree. For our analysis, agree and strongly agree responses were aggregated to one group ('agree'), disagree and strongly disagree were aggregated to 'disagree', and neither agree nor disagree were renamed 'uncertain'.

## **RESULTS**

### **Socioeconomic Characteristics**

Nearly half of the households were located in the central region, while eastern and southwestern regions shared the rest equally (Table 1). Forty-four % were women, with more than half in urban areas compared to about a third in rural areas. On average, most respondents had attained primary education, followed by secondary. A small proportion had university education, while the rest had never been to school. In urban areas, a higher proportion of consumers had at least attained secondary education, while in rural areas

more than a half had primary education. About a third of households surveyed had an annual income (i.e., the total income for the household as a whole) of not more than Ugandan Shillings (UGSH) 0.5 million (\$1 = UGSH 1,750), with slightly less than a half in rural areas and only 12% in urban areas. The majority of households had annual incomes of between UGSH 0.5 million and UGSH 5.0 million, with more than a half in rural and about two-thirds in urban areas. Households earning over UGSH 5.0 million were about only 13%, with a larger proportion in urban areas compared to rural areas. Ninety-six percent of the consumers in rural areas were banana producers compared to less than a half in urban areas. More than three-quarters of the urban households buy banana compared to less than half in rural areas. A third of all households surveyed sell banana, with a much larger share among rural households.

### **Consumer Awareness and Trust**

All respondents knew their area local leaders and politicians (e.g., members of the Parliament, district representatives) and MAAIF (Fig. 1b). UNCST (Fig. 1b) was the least known public institution, while CONSENT and AGT were the least known private institutions (Fig. 1a). UNCST and CONSENT were more known among urban respondents (i.e., 32 and 19%, respectively) compared to rural ones (22 and 16%, respectively), while AGT was slightly more known in rural areas (12%) compared to urban ones (10%). In spite of being less known, these institutions are expected to play a vital role in awareness and implementation of biotechnology and biosafety in the country. MAAIF, local leaders, and extension workers (both at district and sub-county levels) were the most trusted public institutions in relation to not allowing production (i.e., not to produce) of crops that could be harmful to the people. Additionally, information on level of trust indicate that CONSENT (private) and UNBS (public) were the most trusted institutions in ensuring that harmful products are not sold in shops, supermarkets or restaurants. With regard to control the release of harmful crops to the environment, respondents had much more confidence mostly in public institutions, including NEMA, MAAIF, NAADS and the local authorities.

### **Consumer Perceptions**

Consumers' attitudes toward GM banana were grouped in three types of perceptions: a) benefit; b) food and environmental risks; and c) health risks. The majority of the respondents would buy GM banana at the same price as the non-GM banana if GM banana is more nutritious, tastes better, or requires fewer pesticides for its production (Fig. 2a). However, a substantial number of consumers also expressed concerns about the technology in relation to food safety, global disasters and health risks (Figs. 2b, c).

A comparison between different consumers and their perceptions show that rural consumers were more likely to buy GM banana compared to urban consumers if the quality of the banana improves (Table 2). Urban consumers showed slightly more concern about the likely negative effects (both food and environmental, and health) associated to GM technology than rural consumers. Gender does not seem to influence benefit perception. College and university graduates were found to be less likely to buy GM banana compared to others, while respondents with university and secondary education showed more concern about food/environment and health safety of GM foods than the rest. Additionally, consumers with low income were slightly more likely to buy GM food and also showed less concern about the negative effects of the technology compared to the high income earners. If the nutritious quality of the banana improves, at least 88% of respondents were likely to consume GM banana regardless of whether they produce, sell or buy banana.

## **DISCUSSION AND CONCLUSION**

The results of our study show that public institutions were more known to consumers than private institutions. Consumers also exhibited higher confidence in public than private institutions. The results suggest that public institutions, both at local and

national levels, could play a fundamental role in the awareness creation and communication of biotechnology and biosafety regulation development. In cases where private institutions are involved such institutions need to be become better known to the people when embarking on the activities.

The majority of the consumers would buy a genetically modified banana if there are potential benefits, with rural consumers viewing GM banana slightly more positive than urban. The results are similar to those observed in other developing countries such as Kenya (Kimenju and De Groote, 2008) and China (Li et al., 2002; Huang et al., 2006). However, consumers, particularly in urban areas, expressed concerns about the food/environmental and health safety of the technology. In addition, consumers with higher education and income levels showed a relatively higher negative attitude towards GM banana, suggesting that education and income are the likely socioeconomic factors to influence GM food acceptability in Uganda. The government needs to communicate to the general public the scientific facts regarding the technology in order to provide neutral information about GM crops. Urban consumers, who in general have a higher level of formal education and have higher incomes, should be targeted first since they were found to be more concerned about GM food safety and yet play a crucial role for the acceptability of the technology. Further research is required to understand in more detail the significant differences between rural and urban consumers, including their willingness to pay (e.g., Wesseler et al., 2007) towards the introduction of GM banana. In addition, incomes per household as whole were estimated for this paper. Future analysis is required to express income as per capita income, and find out how it differs between rural and urban households.

#### **ACKNOWLEDGEMENTS**

We are grateful for the financial support provided by Wageningen University, Wageningen, The Netherlands and the International Food Policy Research Institute, Washington, USA.

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## **Tables**

Table 1. Socioeconomic characteristics (expressed as percentages).

Characteristics	Rural	Urban	All
Gender of respondent:			
Female	36.6***	55.6***	43.5
Male	63.4***	44.4***	56.5
Education of respondent:			
No education	13.5***	8.8***	11.8
Primary	58.7***	31.8***	49.0
Secondary	22.4***	38.8***	28.3
University/college	5.3***	20.6***	10.9
Annual household income (UGSH)			
≤0.5 million (low)	41.3***	11.9***	30.6
>0.5 million to <5 million (medium)	54.8***	60.6***	56.9
≥5 million (high)	3.9***	27.5***	12.5
Banana engagement status:			
Grow banana	95.7***	45.6***	77.6
Buy banana	45.2***	78.7***	57.4
Sell banana	44.8***	13.8***	33.6

\*\*\* indicates significant differences between distributions at 1% using a t-test.

Table 2. Perception by consumer characteristics (% for agree and strongly agree responses).

	Type of perception								
	Benefit			Food/environment			Health		
	I would buy genetically modified (GM) banana bunch if it was sold at the same price as a non-GM banana bunch, but was much more nutritious	I would buy a GM banana bunch if it was sold at the same price as a non-GM banana bunch, but was produced with fewer pesticides	I would buy a GM banana bunch if it was sold at the same price as a non-GM banana bunch, but tasted better	Among the risks we presently face, those impacting food safety are very important	Even though GM food may have advantages, it is basically against nature	If something went wrong with GM food, it would be a global disaster	Eating GM food would harm me and my family	Harmful environmental effects of GM crops are likely to appear in the distant future	Harmful human health effects of GM foods are likely to appear in the distant future
Consumer type									
Rural	94	81	94	62	34	62	24	31	33
Urban	84	68	82	65	41	70	33	44	43
Gender									
Male	89	76	90	60	41	64	31	37	38
Female	93	78	89	67	31	67	21	33	27
Education level									
Never	96	77	94	59	38	58	31	23	27
Primary	93	82	93	65	29	62	20	28	31
Second.	89	78	90	61	36	68	28	50	47
Univ.	79	50	70	62	64	81	52	40	44
Income level									
low	93	79	94	58	33	59	28	33	39
Med.	89	77	88	67	35	67	22	34	34
High	89	69	85	58	51	73	45	45	40
Involvement status									
Grow	92	79	92	62	36	64	26	33	34
Sell	88	70	88	65	41	74	32	34	34
Buy	90	77	60	63	36	65	27	38	37

## Figures

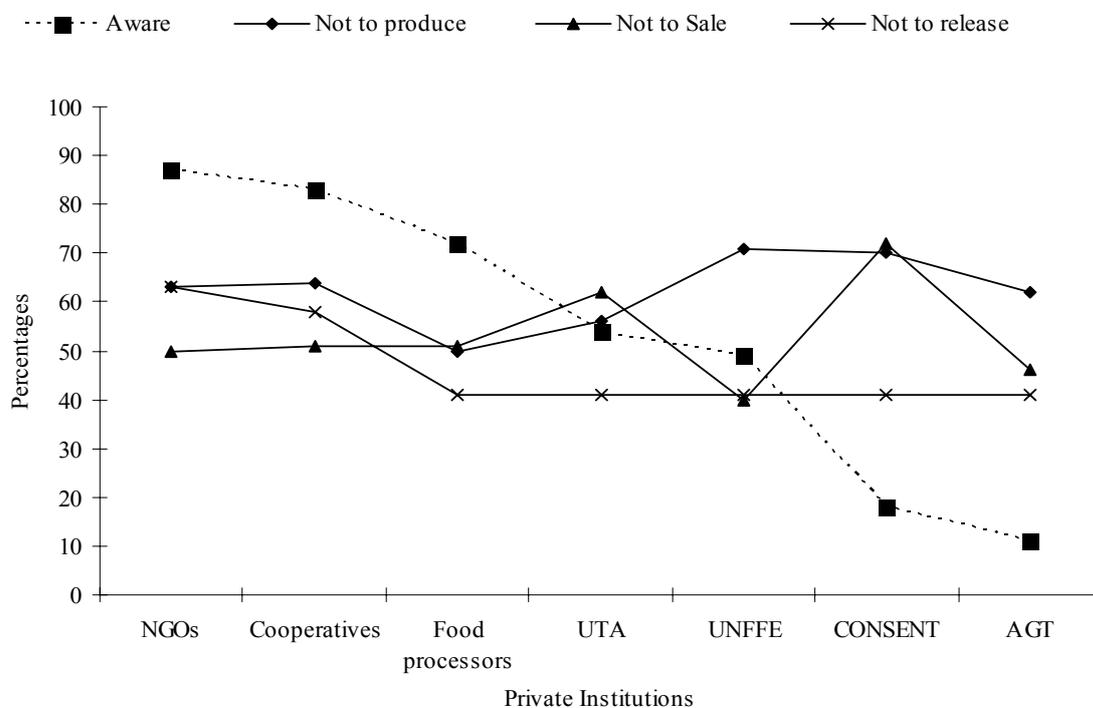


Fig. 1a. Awareness of and confidence in private institutions. Aware: if the named institution is known to the respondent; not to produce: if respondent has confidence that the named institution can control production of food or crops that could be harmful to people; not to sale: if respondent has confidence that the named institution can prevent harmful products to be sold in shops, supermarkets and restaurants; and not to release: if respondent has confidence that the named institution can control release of crops that could be harmful to the environment. Acronyms: NGOs (non-governmental organizations), UTA (Uganda Traders Association), UNFFE (Uganda National Farmers Federation), CONSENT (Consumer Education Trust), AGT (Agro-genetic Technologies).

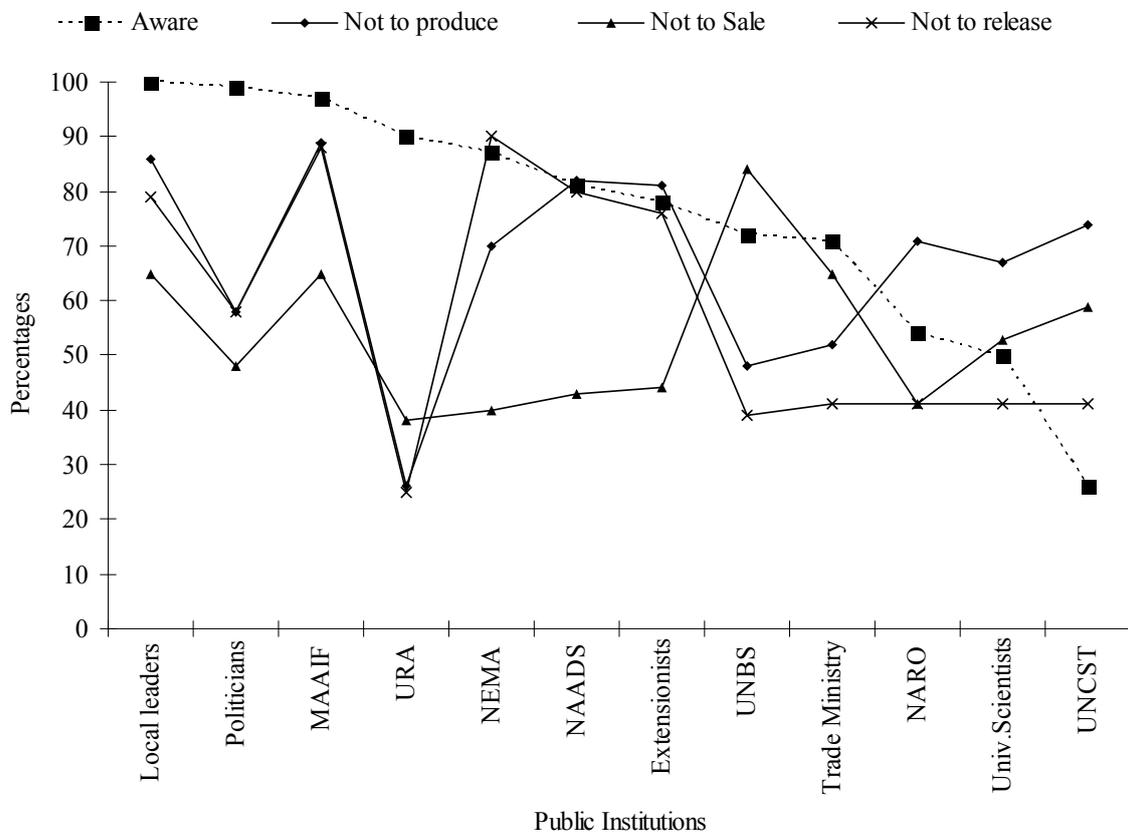


Fig. 1b. Awareness of and confidence in public institutions. Aware: if the named institution is known to the respondent; not to produce: if respondent has confidence that the named institution can control production of food or crops that could be harmful to people; not to sale: if respondent has confidence that the named institution can prevent harmful products to be sold in shops, supermarkets and restaurants; and not to release: if respondent has confidence that the named institution can control release of crops that could be harmful to the environment. Acronyms: MAAIF (Ministry of Agricultural Animal Industries and Fisheries), URA (Uganda Revenue Authority), NEMA (National Environment Management Authority), NAADS (National Agricultural Advisory Services), UNBS (Uganda National Bureau of Standards), NARO (National Agricultural Research Organization), UNCST (Uganda National Council of Science and Technology).

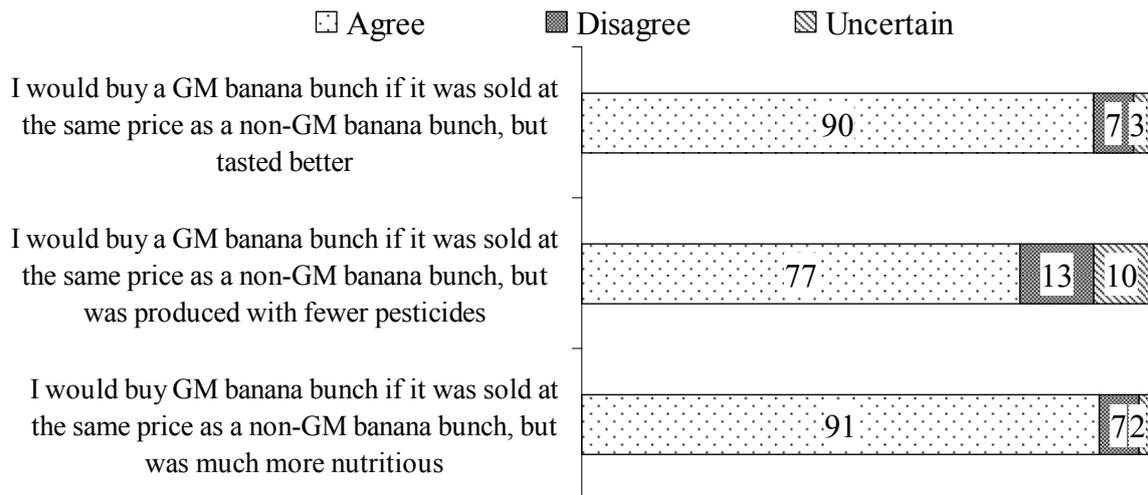


Fig. 2a. Benefits perceptions (expressed as percentage). GM = genetically modified.

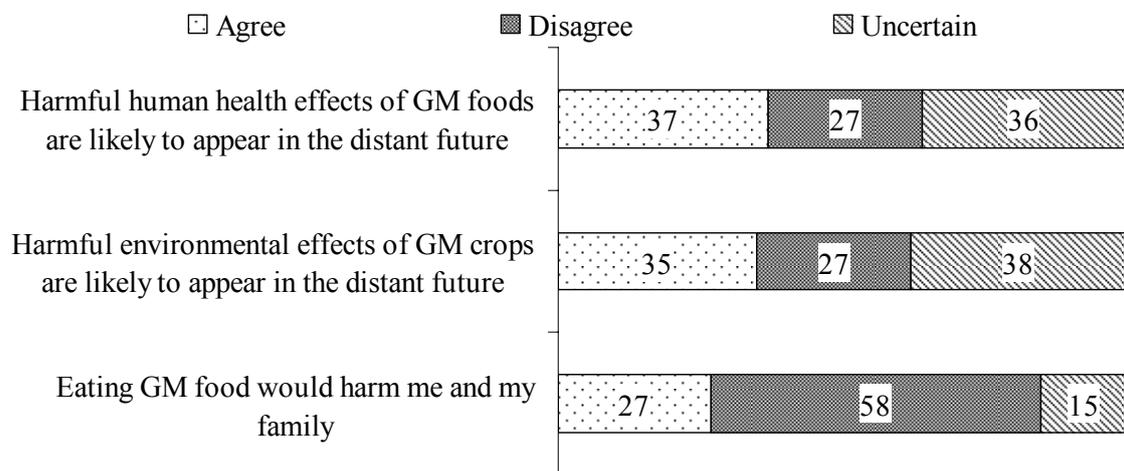


Fig. 2b. Health perceptions (expressed as percentage).

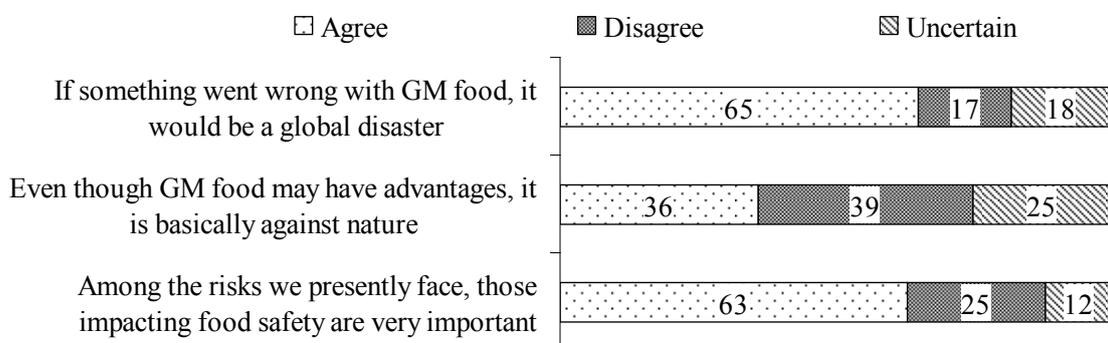


Fig. 2c. Food/environmental perceptions (expressed as percentages).

