Can GM crops help African farmers? Insights from Uganda

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Can genetically modified (GM) crops help African farmers improve yields and livelihoods? This project aimed to answer this question by bringing to the fore the perspectives of more than 250 smallholder farmers in Uganda, a country with one of the largest experimental programmes dedicated to agricultural biotechnology on the continent.

Much of the enthusiasm around the potential for GM crops to alleviate poverty and hunger in Uganda revolves around the country's primary carbohydrate staple, the East African highland banana. Known locally as *matooke*, this banana is not eaten raw but rather peeled, boiled, mashed and then wrapped in banana leaves and stewed in a pot set over a fire, creating a soft mash with a vibrant yellow colour. *Matooke* is by far the most important crop in Uganda, accounting for more than a third of the country's daily caloric intake.

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Current experimental trials are developing a strain of *matooke* that is genetically modified to resist the crop's most pernicious pests, such as nematodes and weevils, and diseases including banana bacterial wilt (BBW), black Sigatoka and

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Fusarium wilt. There is also a separate experimental line using genetic modification to biofortify the crop, increasing its Vitamin A content in order to reduce maternal and infant mortality. It is difficult to overestimate the degree to which environmental scourges impede the nation's *matooke* production: the most pressing of these, BBW, is projected to cause losses of US$ 4–8 billion over the coming decade.[1]

Previous efforts at enhancing resistance through conventional breeding yielded few results, hindered both by crop characteristics – banana is predominantly sterile, with a long generation time – and cultural preferences: progress with interbreeding wild races that demonstrate resistance to pests and diseases has largely been rejected by consumers due to dissatisfaction with taste and texture. These constraints have convinced breeders in Uganda's National Agricultural Research Organization (NARO) that genetic modification presents the most promising means of ensuring *matooke*'s long-term sustainable production. Many observers expect the first GM version of *matooke* to be ready as early as 2017, though it is important to note that no GM varieties can be released until the Ugandan parliament has passed legislation allowing for commercialisation.

This project investigated farmer attitudes and intentions to adopt GM versions of *matooke* banana. There is a great need for diagnostic research that analyses attitudes towards GM crops before they are commercially released, as these are the major predictors for both adoption rates and use intensities. Probing attitudes is crucial to predicting how farmers will react to these technologies

once they are released and the extent to which they will transform agricultural production.[2] Thus these research findings make an important contribution to the scholarly debate over whether GM versions of African carbohydrate staple crops can improve agricultural production among the continent's smallholder farmers.

The research objectives of this project were threefold:

1. Evaluate farmer attitudes to GM varieties of *matooke* banana currently under experimentation.
2. Assess whether this technology can help farmers to improve yields and livelihoods.
3. Bring to light farmers' perspectives on these soon-to-be-released technologies.

We sought to realise these objectives by using both random and purposive techniques to create a sample that could accurately reflect farmer perspectives on these emerging technologies. Our starting point was the country's most recent Census of Agriculture, which revealed that the vast majority of *matooke* banana growers were unevenly spread across three major growing regions, with 15 per cent in the eastern region, 35 per cent in the central region, and 50 per cent in the southwestern region. We set out to generate a data set that reflected this geographical distribution. Districts were randomly selected based on an updated list provided by the more recent national census. A random number generator was then used to select sub-counties, parishes,

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villages and individual households. Certain districts and sub-counties had to be excluded for reasons of health and safety as well as inaccessibility during the rainy season.

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More than 170 farmers from across the three major growing regions participated in a progression of quantitative exercises, which relied heavily on visual aids and side-by-side comparisons, designed to bridge the gap between hypothetical exercises and farm-level realities. These exercises aim to depict the implications of BBW-resistant and biofortified GM banana in order to capture farmer responses and reactions to these soon-to-be-released varieties. A further 100 farmers participated in qualitative methods including focus groups and video diaries designed to probe why farmers feel the way they do about these emerging technologies. Sampling for these qualitative methods was designed to maximise heterogeneous characteristics including age, education, gender and farm size.

We produced research results that speak directly to the project's three research objectives. With respect to the first objective, we used non-parametric statistical tests to determine which socio-economic factors influenced farmer attitudes towards GM *matooke* varieties. Five were statistically significant in shaping farmers' intentions to adopt: region, farm size, membership of a farmers' association, previous experience with improved varieties, and visits from agricultural extension workers. Our results indicate that the more market- and commercially oriented farmers in the southwest region, with larger farms, better information and larger networks, are most likely to hold positive attitudes to GM *matooke*.

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With respect to the second research objective, our findings cast doubt on whether GM *matooke* will benefit the country's poorest and most vulnerable farmers. Three results are relevant here. First, there is a disconnect between the first GM variety scheduled to be released (the biofortified version with increased Vitamin A content) and the agronomic characteristics that farmers would prefer to see prioritised, which revolve primarily around pest and disease resistance. This suggests that the traits given precedence in the experimental programmes do not accurately reflect farmers' needs. Second, data reveal that the increased cost of GM *matooke* could prove to be a barrier to adoption, particularly among the poor, with research scientists estimating that GM planting materials could cost four times as much as non-GM versions. Third, our findings reveal that a major obstacle to uptake might have nothing to do with the GM technology itself but relate to the variety into which it is inserted, one which is considered unpopular among growers because of its unappealing texture and small fruit.

With respect to the third research objective, this project allowed for the development of methods for talking *with* rather than talking *to* farmers about the prospects of GM *matooke*. Community meetings and policy workshops brought together major stakeholders and offered a forum for farmers to voice their perspectives on the potential advantages and disadvantages of GM technology, though these outreach activities also underlined the crucial power relations that preclude farmers from playing a meaningful role in shaping agricultural development decisions.

Two policy recommendations emerge from these results. First, identifying the key variables that shape attitudes and intentions to adopt – including region, farm size, farmers' association membership, experience with improved varieties and agricultural extension workers' visits – offers a promising means for policy makers to target demographic pockets of early adopters. Our results suggest that the roll-out should start with the larger, more market-oriented farmers in the southwest region, who appear most enthusiastic about these new varieties. Also, policy makers should aim to capitalise on existing farmers' associations, adopters of improved varieties and relationships with extension agents, as farmers who already have experience of and exposure to new knowledge and technologies through these networks seem more willing to embrace GM versions of *matooke*.

The second policy insight is more cautionary. The five variables that significantly impact attitudes and intentions to adopt are all associated with affluence and influence. These results thus raise important questions about the potential for GM *matooke* to help the poorest and most vulnerable in the country; that is, those who are disproportionately located in the eastern and central region, with smaller farms, who tend to be excluded from formalised social networks and lack critical access to information. The current prioritisation of biofortified varieties, high costs associated with initial release and choice of a host variety lacking in popularity raise concerns about whether these varieties will be able to help the segments of the population that need it most.

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More generally, our conversations with farmers reinforce the message that new

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breeding technologies alone are insufficient to alter the continent's future agricultural production.

Appropriate technology is sorely needed in Africa, but this has to be understood as one critical element of a broader package of agricultural development. Farmers were consistent in describing their agricultural requirements holistically, vocalising the need for improved varieties alongside access to markets, the availability of credit, better information, enhanced extension services and adequate storage. Any investment in new GM varieties without concomitant investment in addressing these structural dynamics is destined to fail.

In conclusion, this research is a reminder that any analysis of whether a GM version of an African carbohydrate staple crop can achieve its stated goal of alleviating poverty and hunger for poor farmers depends on the specific circumstances faced by farmers on the ground. Many of the arguments in favour of GM crops hinge upon a separation of technology and context, which assumes that a single technology can succeed in effecting change within vastly different settings across the continent. But assessing the potential impact of these technologies requires situating them within the particular ecological, political and social contexts in which they are expected to succeed. To move beyond the polarized pro- versus anti- debate, we need more grounded, empirical studies of whether a particular GM trait and crop makes sense in a particular place. After all, it is the continent's farmers who will decide whether GM crops will emerge as a fixture of African agricultural production.

References

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