

technologies of monitoring crop farms in large-scale agricultural operations, SSD-Sat 1 presents an important solution with timely, data-driven decisions for improved crop management and yields.

### ***References***

1. Bol Thon M.N. Разработка Проектного Облика Наноспутника для Мониторинга Сельскохозяйственного Культура В Южном Судане, 2024 – 55 pages.
2. Zhang Q. Precision Agriculture Technology for Crop Farming, 2021, 382 pages. <https://www.routledge.com/Precision-Agriculture-Technology-for-Crop-Farming/Zhang/p/book/9781032098272>
3. Saalami E., Mustapja A. Advances in Agriculture UAV Technologies, 2021, 280 pages.

## **ADOPTION OF GENETICALLY IMPROVED SEEDS AND BIOTECHNOLOGY IN UGANDA: BENEFITS, CHALLENGES AND FARMER EXPERIENCES**

**Laker Finella Daphine**

Supervisor E.A. Efimova

Самарский национальный исследовательский университет им. ак. С.П. Королева

Agriculture is central to Uganda's economy, with smallholder farmers producing most of the country's food and cash crops. However, crop yields remain low due to pests, diseases, climate stress, and degraded soils. Genetically improved seeds and modern biotechnology provide opportunities to improve productivity, resilience, and food security. In Uganda, research institutions such as the National Agricultural Research Organization (NARO) have developed improved crop varieties using both conventional breeding and biotechnology.

Genetically improved seeds include hybrid seeds, disease-resistant varieties, drought-tolerant varieties, and bio-fortified crops. Biotechnology refers to scientific methods such as tissue culture, genetic engineering, and molecular marker-assisted breeding used to improve crop traits. Unlike traditional seeds, improved varieties are developed to address specific challenges that Ugandan farmers face—such as pests, drought, and low soil fertility.

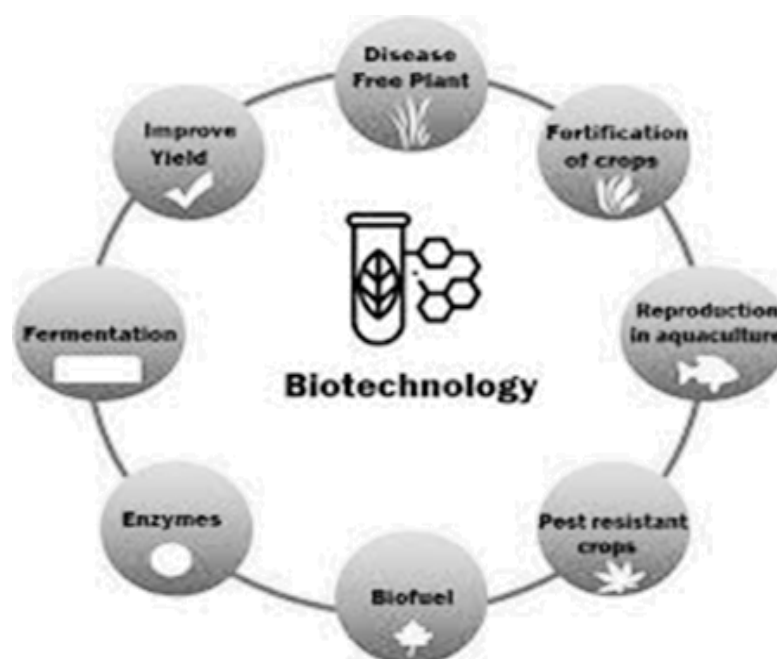


Figure 1 – Biotechnology [7]

- NARO Hybrid Maize Varieties— varieties such as Longe 10H and Bazooka provide higher yields and resistance to common maize diseases. These hybrids are widely used in central and eastern Uganda [1].

- Improved Cassava Varieties (NAROCASS series) — resistant to Cassava Brown Streak Disease and Cassava Mosaic Disease; released by NARO to help farmers overcome devastating cassava epidemics [5].

- Tissue-cultured Banana Plantlets — biotechnology laboratories in Uganda produce clean, disease-free banana plantlets, used by farmers especially in western and central regions to combat Banana Bacterial Wilt [1].

- Bio-fortified Orange-Fleshed Sweet Potatoes (OFSP) — promoted by HarvestPlus and partners to address vitamin A deficiency while providing higher yields [2].

- Genetically Modified (GM) Research Trials - Uganda has conducted research on GM bananas resistant to wilt and GM cassava varieties. While commercial release awaits full regulatory approval, these technologies show potential for long-term food security [4].

Farmers have benefited a great deal from this.

Higher yields - Hybrid maize and improved beans provide significantly better harvests than traditional varieties. Disease and pest resistance -Reduces dependence on expensive pesticides. Shorter maturity periods-allows multiple seasons of production and reduces climate risks. Higher income -Farmers using improved seeds often report better market prices and surplus production. Nutritional improvements -Bio-fortified crops improve household nutrition, especially for children [2].

The following are some of the challenges affecting most farmers, these include; High cost of improved seeds - Hybrid seeds are more expensive than

local varieties .Limited access in rural areas -many farmers still rely on informal seed markets. Low awareness and mistrust -some farmers are hesitant due to misinformation, Seed recycling limitations-Hybrid seeds cannot be effectively reused, increasing annual costs. Regulatory hurdles - Biotechnology approvals require strong policy support and scientific oversight.

Farmers in eastern Uganda adopting hybrid maize varieties have reported doubling their yields, enabling them to sell surplus grain and improve household incomes.

Cassava growers in northern Uganda using NAROCASS varieties have rebuilt their production after years of crop failure due to viral diseases [5].

Banana growers using tissue-cultured plantlets have reduced losses from Banana Bacterial Wilt and achieved uniform crop establishment.

These examples illustrate how improved seeds can transform livelihoods when combined with extension support and quality seed distribution.

The following are some of the recommendations for Increasing Adoption;

Expand seed distribution networks to rural communities. Strengthen farmer education through extension services. Increase investment in biotechnology research at NARO. Support seed subsidies for vulnerable smallholder farmers. Clarify national biotechnology regulations to support safe innovation.

In conclusion genetically improved seeds and biotechnology present powerful tools for improving agricultural productivity in Uganda. While challenges exist, strategic investment, farmer awareness, and strong regulatory frameworks can accelerate adoption. With continued support from government, research institutions, and development partners, improved seeds can play a key role in ensuring food security, boosting farmer income, and building climate resilience.

### ***References***

1. NARO Improved Crop Varieties [Electronic Resource]. URL: <https://www.naro.go.ug/> (accessed 08.12.2025)
2. Harvest Plus Uganda (Bio-fortified Crops) [Electronic Resource]. URL: <https://www.harvestplus.org/where-we-work/uganda/> (accessed 08.12.2025)
- 3.AGRA Seed Systems [Electronic Resource]. URL: <https://agra.org/> (accessed 08.12.2025)
- 4.Uganda Biosciences Information Center (UBIC) [Electronic Resource]. URL: <https://ubic.ug/> (accessed 08.12.2025)
- 5.IITA Cassava Research [Electronic Resource]. URL: <https://www.iita.org/crop/cassava/> (accessed 08.12.2025)
6. World Bank (2024). Uganda Agricultural Economic Update.
7. Ranjha MMAN, Irfan S, Nadeem M, Mahmood S (2020) A comprehensive review on nutritional value, medicinal uses, and processing of banana. Food Rev Int. <https://doi.org/10.1080/87559129.2020.1725890> (accessed 08.12.2025)