ABOUT THE PRESENTER & MUST

- Godliving Y. S. Mtui, PhD (Biotech)
- Prof. of Biotechnology
- Fmr Deputy Vice Chancellor AC, MUST

ABOUT MBEYA UNIVERSITY OF SCIENCE & TECHNOLOGY (MUST)

- A Public University
- Established in 2012
- Acad programmes: Engineering, Technology, Sciences, Technical Edu, & Business
- Current enrolment: 13,000
- Staffing Level: 750
- Number of Campuses: 03

Tanzania's Agricultural Landscape

❖DOMINANCE OF SMALLHOLDER FARMING

- Over 70% of Tanzanians engage in agriculture, primarily small-scale, subsistence farming

❖DIVERSE AGRO-ECOLOGICAL ZONES

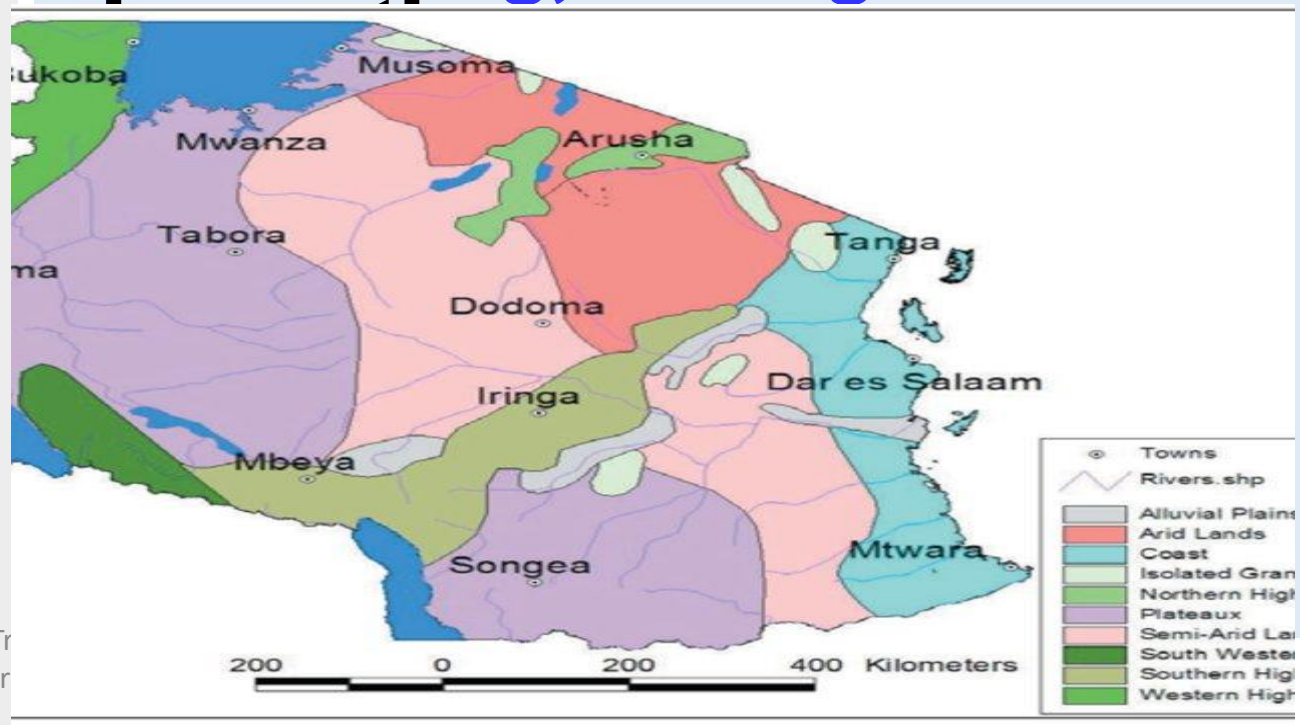
- The country spans coastal, highland, semi-arid, and lake regions, enabling cultivation of a wide range of crops

❖KEY ECONOMIC CONTRIBUTOR

- Agriculture contributes about 25–30% to GDP and employs the majority of the rural population, supporting food security and exports.

CHALLENGES & OPPORTUNITIES

- Tanzania is faced with climate change, low productivity, and poor infrastructure - but holds potential in irrigation, agro-processing, and agritech.



AgriBiotech Trends in Tanzania

➢STRATEGIC ROLE IN MODERN FARMING

- **Biotechnology is increasingly vital for boosting agricultural productivity and food security in Tanzania amid climate change and population growth.**

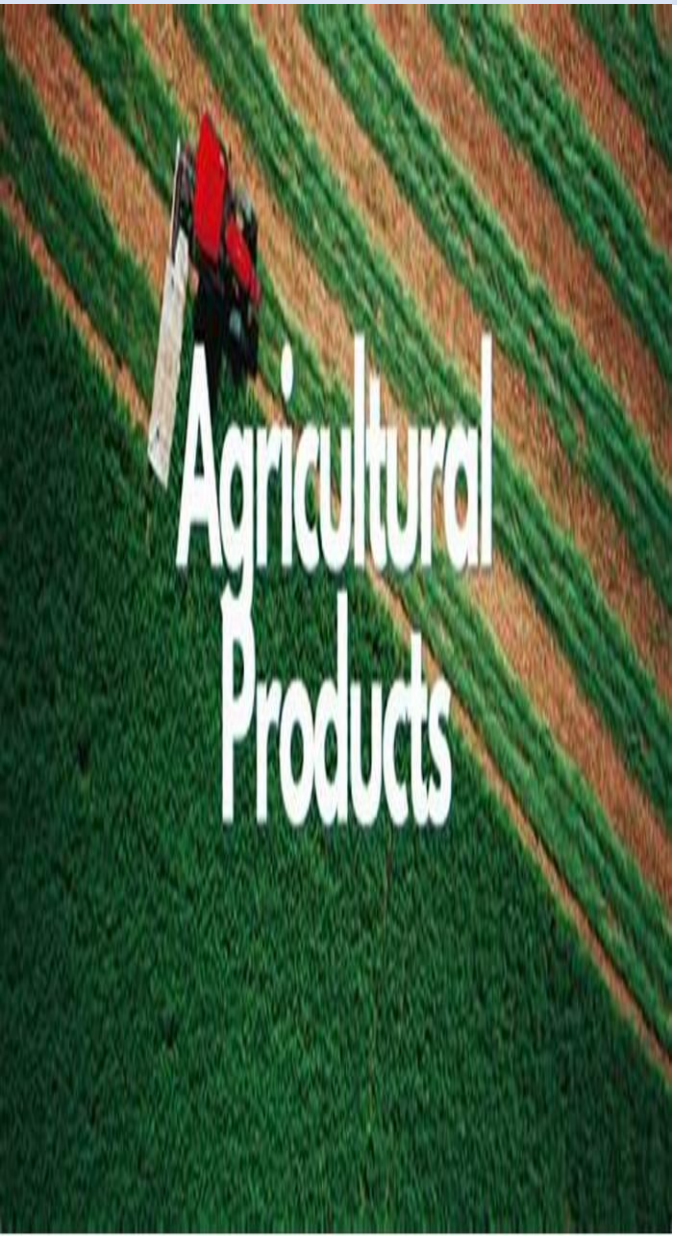
➢KEY INNOVATIONS AND APPLICATIONS

- **Includes genetic modification, tissue culture, molecular breeding, and biofertilizers - addressing pests, low yields, and climate stress.**

➢PROGRESS, CHALLENGES, AND PROSPECTS

- **While adoption is growing, challenges remain in policy, infrastructure, and awareness; however, the potential for sustainable transformation is high.**

Trends in Agricultural Biotechnology in TZ



✓EMERGING TECHNOLOGIES IN USE

Growing adoption of tissue culture, biofertilizers, and biopesticides for healthier crops and sustainable soil management.

✓RESEARCH AND INNOVATION EFFORTS

Active research on genetically modified (GM) crops e.g. maize and cassava, with confined field trials underway.

✓CAPACITY BUILDING AND PARTNERSHIPS

Expansion of biotechnology education and strengthened public-private collaborations to boost innovation and local expertise.

Advances in Agricultural Biotechnology in Tanzania

❑ DISEASE-RESISTANT CROP VARIETIES

- **Development of cassava varieties resistant to Cassava Mosaic Disease (CMD) through biotech and conventional breeding.**

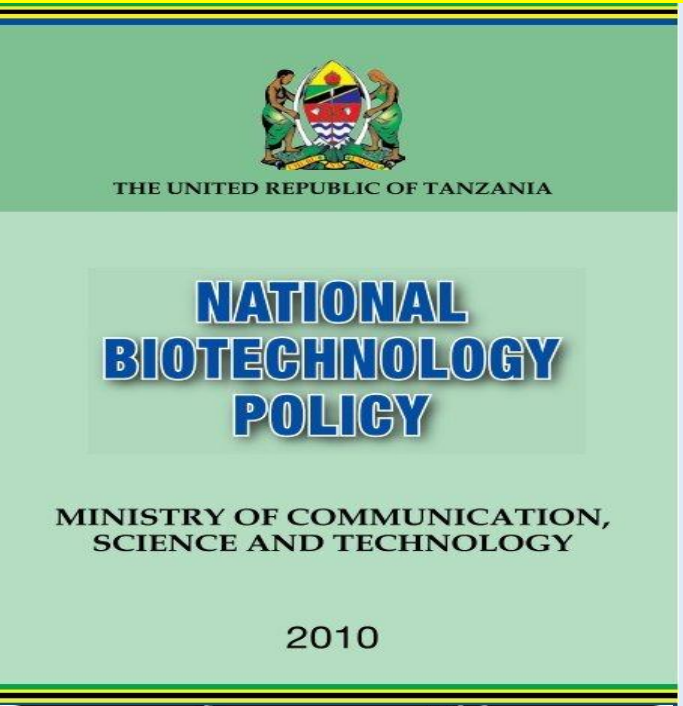
❑EXPANSION OF TISSUE CULTURE FACILITIES

- **Institutions like MARI and NM-AIST are enhancing production of clean planting materials via advanced lab infrastructure.**

❑ INTEGRATION OF GENOMIC TOOLS

- **Use of molecular markers and genomics in crop improvement is growing within research and collaborative programs.**

Institutional Support & Policy Development



✓STRONG INSTITUTIONAL SUPPORT

- Key institutions like COSTECH, the Ministry of Agriculture, and TARI actively promote biotechnology development in Tanzania.

✓POLICY AND REGULATORY FRAMEWORKS

- National policies and guidelines have been established to guide and support biotechnology initiatives.

✓BIOSAFETY COMPLIANCE

- Tanzania has adopted biosafety frameworks aligned with international standards to ensure safe application of modern biotechnology

Lab & Field Trials of GM Crops in Tanzania

- **TZ has approved confined field trials (CFTs) of several GMO crops:**

✓ **BT MAIZE**

- **Developed to resist stem borers.**
- **Conducted at TARI's Makutupora and Ifakara stations.**
- **Trials implemented under WEMA project, led by AATF and supported by CIMMYT.**

✓**CASSAVA**

- **Genetic modification aimed at resistance to Cassava Brown Streak Disease (CBSD).**
- **Trials conducted in Makutupora (Dodoma) and Naliendele (Mtwara).**
- **In partnership with institutions like Donald Danforth Plant Science Center (USA) and IITA.**

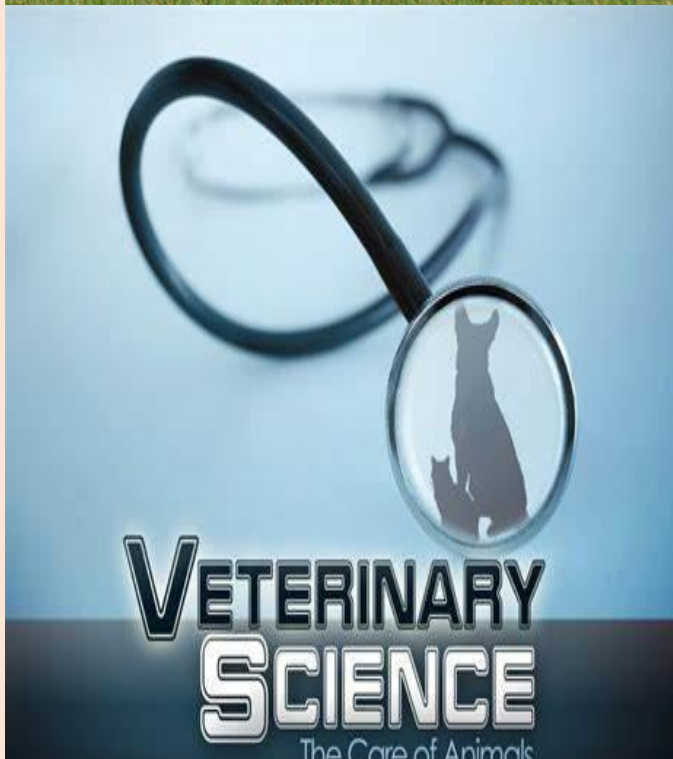
✓**DROUGHT-TOLERANT MAIZE (DT MAIZE)**

- **Developed for water efficiency and climate resilience.**

Biotechnological Advances in Animal Husbandry and Veterinary Science

- **Biotechnology is transforming animal husbandry and veterinary practices in Tanzania.**
- **Responds to rising demand for animal products, animal welfare, and sustainable practices.**
- **Provides tools for improved disease control, productivity, and ethical animal care.**

- ✓ **Major achievements in vaccine development and disease diagnostics.**
- ✓ **Institutions like SUA and TALIRI leading vaccine research and testing.**
- ✓ **Advanced diagnostic tools using real-time PCR and next-generation sequencing.**



Tanzania R&D Biotech Institutions

✓**TANZANIA COMMISSION FOR SCIENCE AND TECHNOLOGY (COSTECH)**

- **Coordinates national biotech policies, funding, and regulatory frameworks.**

✓**TANZANIA AGRICULTURAL RESEARCH INSTITUTE (TARI)**

- **Leads crop improvement, genetic engineering, and pest/disease control research.**

✓**MIKOCHENI AGRICULTURAL RESEARCH INSTITUTE (MARI)**

- **Specializes in tissue culture, molecular diagnostics, and marker-assisted breeding.**

✓**SOKOINE UNIVERSITY OF AGRICULTURE (SUA)**

- **Provides training and research in genetic engineering an vaccine development.**

Tanzania R&D Biotech Institutions....

✓**NELSON MANDELA AFRICAN INSTITUTION OF SCIENCE AND TECHNOLOGY (NM-AIST)**

- **Focuses on postgraduate biotech education, bioinformatics, and genomic research.**

✓**UNIVERSITY OF DAR ES SALAAM (UDSM)**

- **Engages in environmental biotechnology, genetics, and informatics innovation.**

✓**TANZANIA LIVESTOCK RESEARCH INSTITUTE (TALIRI)**

- **Leads research in livestock breeding, nutrition, and vaccine technologies.**

✓**AFRICAN AGRICULTURAL TECHNOLOGY FOUNDATION (AATF – TANZANIA OFFICE)**

- **Facilitates biotech access and GMO technology transfer in agriculture.**

Tanzania R&D Biotech Institutions....

✓**TANZANIA VETERINARY LABORATORY AGENCY (TVLA)**

- **Offers molecular diagnostics and livestock disease surveillance.**

✓**IFAKARA HEALTH INSTITUTE (IHI)**

- **Researches zoonotic diseases and animal–human disease transmission.**

✓**ZANZIBAR AGRICULTURE AND LIVESTOCK RESEARCH INSTITUTE (ZALIRI)**

- **Conducts research in crops, livestock, fisheries, and environmental health.**

✓**ZANZIBAR ANIMAL HEALTH RESEARCH CENTER (ZAHRC)**

- **Partners with ZALIRI in livestock and fisheries health research.**

Agribiotech at Mbeya University of Science and Technology (MUST)

- ✓**TRAINING: Food Sci & Tech, molecular biology, Bioinformatics, etc.**
- ✓**RESEARCH:**
- **Optimized processing of avocado seeds to improve nutrients and functional values.**
- **Effect of lactic acid fermentation on health promoting components of mango seed kernels**

Agricultural Biotechnology Research outputs in Tanzania

- **Status and prospects of agricultural biotechnology show growing innovations and institutional support.**
- **Biotech is enhancing food security, with positive trends and policy implications emerging.**
- **Genomic technologies are gaining momentum, though challenges in adoption persist.**
- **Tissue culture techniques are improving banana and cassava propagation efficiency.**

Tanzania Agric Biotech Research outputs...

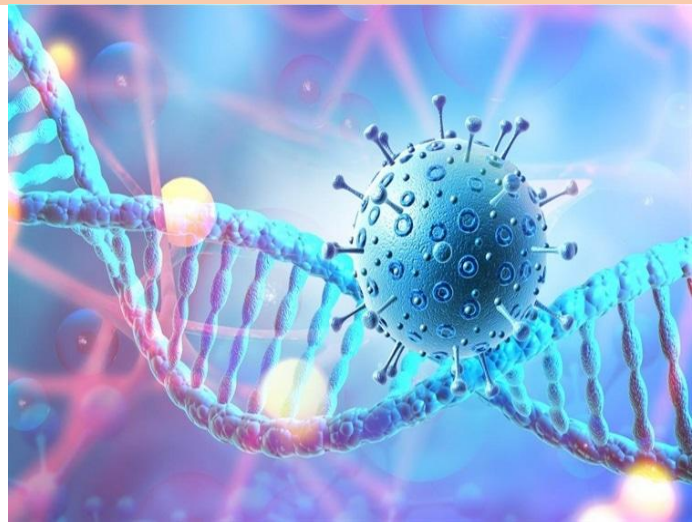
✓MICROBIAL AND GENOMIC APPLICATIONS

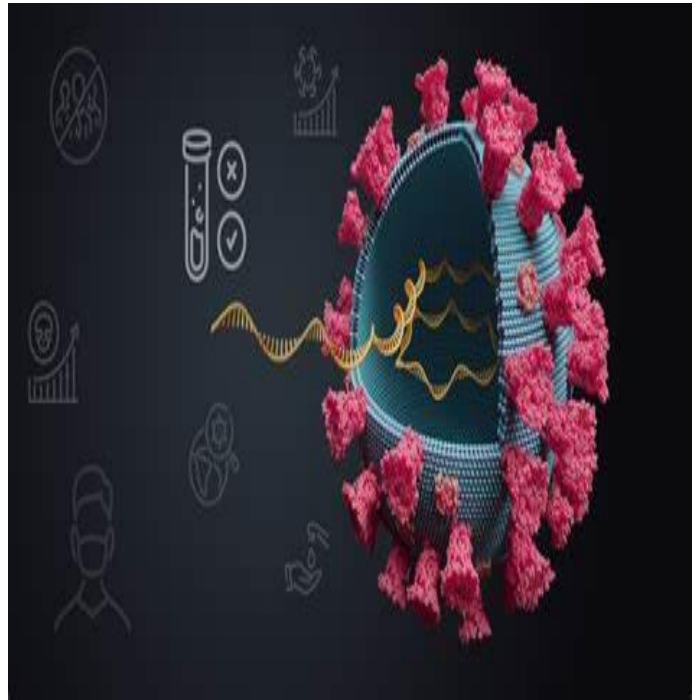
- Microbial **biofertilizers** are being applied in maize production for sustainable yield gains.
- **Genomic tools** are being used to improve chevon (goat meat) production.
- **Marker-assisted selection (MAS)** is increasing breeding efficiency for disease-resistant beans.
- Leptospira antigen panel developed to scale up **diagnosis** and improve livestock productivity.

Tanzania Agric Biotech Research outputs...

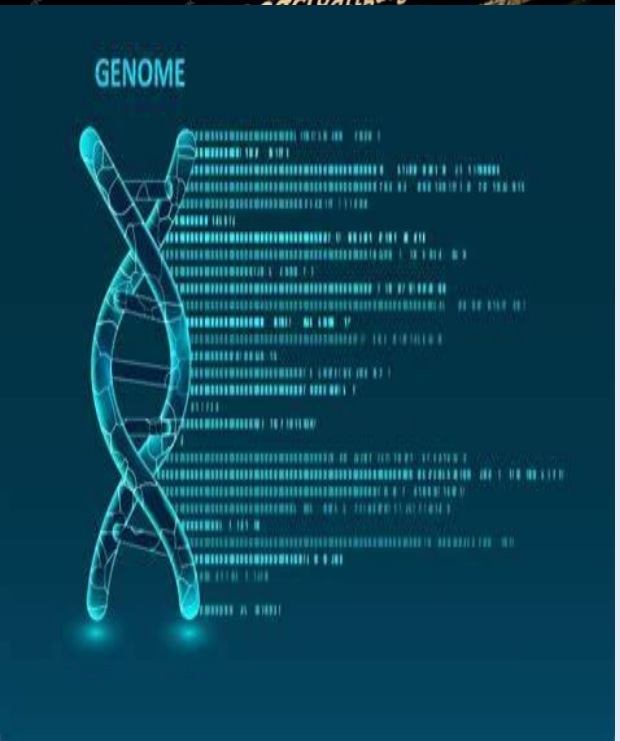
✓PATHOGEN GENOMICS AND SURVEILLANCE

- **Genomic surveillance has been used to characterize African swine fever virus genotypes.**
- **Pathogen genomics is being leveraged to map swine fever transmission in domestic pigs.**
- **Phage technology offers alternatives to antibiotics in controlling *E. coli* in poultry.**
- **Microparticle-based assays are in development for non-invasive viral RNA detection.**





Tanzania Agric Biotech Research outputs…



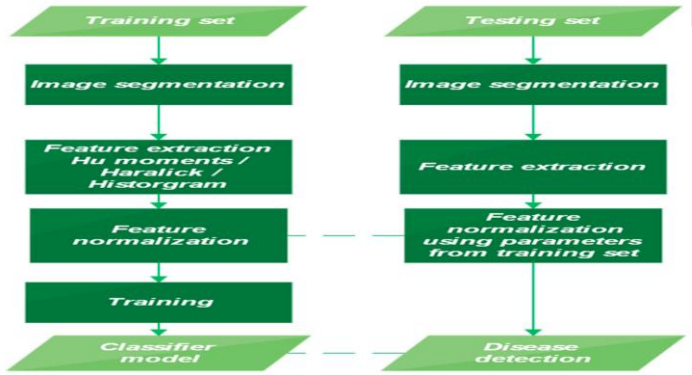
✓DISEASE MONITORING RESEARCH

- Foot-and-mouth disease research includes **genome sequencing** to understand virus spread.
- Marek's disease virus strains are under **molecular characterization**
- Queen mackerel (fish) genetic stock structure is being delineated to support **fisheries management**.
- Interventions are being studied to **reduce human exposure to *Mycobacterium bovis*** via milk.

Future trends in agric biotechnology

- AI in agricultural biotechnology enhances crop yield, detects plant diseases, and optimizes resource use through data integration from satellites, sensors, and genetic analysis.
- Future AI applications will guide genetic modification for climate resilience, improved nutrition, and reduced pesticide use, supporting global food security.
- AI-powered genomic analysis helps manage complex sequencing data by enabling accurate gene annotation, mutation detection, and prediction of gene-disease links.
- Emerging applications include real-time genome analysis, early disease prediction, and genomic therapies guided by AI.

Future Trends in AgricBiotech....



✓**SMART FORECASTING & AUTOMATION: Machine learning models predict crop diseases and automate breeding programs.**

✓**AI + DRONE IMAGING: Integration of drone images with AI helps monitor soil and plant health.**

✓**BOOSTING YIELDS & FOOD SECURITY: AI-driven tools contribute to improved crop productivity and national food security.**

Cutting-edge Biotechnologies in Agriculture

- ✓**ADVANCED TECHNIQUES: Molecular breeding, nanobiotechnology, and microbiome engineering are reshaping crop development.**
- ✓**RESILIENT & SMART FARMING: These tools enhance crop resilience and support precision agriculture.**
- ✓**AI-OPTIMIZED SYSTEMS: Vertical farms benefit from AI and bioinformatics for efficient food production.**

Challenges and Opportunities in Biotech Implementation in Tanzania

- ✓**KEY CHALLENGES: Limited infrastructure, research funding, regulatory hurdles, public mistrust of GMOs, and low smallholder farmer adoption due to limited awareness.**
- ✓**OPPORTUNITIES: Expand biotechnology education, foster public-private partnerships, and strengthen regulatory frameworks for safe and effective use**
- ✓**CONCLUSION: Biotechnology is transforming agriculture and animal health; addressing existing gaps is essential to enhance productivity, resilience, and food security in Tanzania.**

END OF THE PRESENTATION

Thank you very much

Ahsanteni sana

Haikenyi mnu nawi

Arigatou gozaimasu

Tack sa mycket

For your attention !

INTERACTIVE SESSION

Any:

QUESTIONS?

COMMENTS?

SUGGESTIONS?

session interactive