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"Reconcile land system changes
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Modernizing cassava breeding: iita's interdisciplinary approach to genetic innovation and sustainable impact

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Abstract

Cassava sustains the livelihoods and food security of over 800 million people globally. Global cassava production has surged from 203 million tones in 2004 to an estimated 330 million tones in 2023, a 62 % increase, with Africa contributing over 60 % of the total. Nigeria, the world's largest producer, increased output from 43.4 million tones in 2007 to 63.0 million tones in 2021, yet yields remain low at 10.8 $^{\text{tones}}/_{\text{ha}}$, underscoring the need for accelerated genetic innovation to close yield gaps. Over the last decade, the International Institute of Tropical Agriculture (IITA), working with the Next Generation Cassava Breeding project (nextgencassava.org), has transformed cassava breeding into an integrated, interdisciplinary process, connecting genetics, genomics, social science, and seed systems to establish a foundation for accelerated genetic gain and variety adoption. Through genomic selection (GS), improved trial designs and networks, and participatory evaluation, IITA's breeding programme has achieved annual genetic gain exceeding 2 % for key traits such as fresh root yield, dry matter content, and disease resistance. Significant advances have been made in unraveling the genetic architecture of complex traits including provitamin A content, dry matter, cyanogenic potential, and resistance to cassava mosaic disease (CMD) and cassava brown streak disease (CBSD). These discoveries have led to the development and deployment of trait-linked molecular markers, enabling breeders to accelerate introgression of valuable traits through marker-assisted selection (MAS). In GS, the programme has implemented Genomic Pedigree Cross Prediction (GPCP) to optimise crossing designs by accounting for both additive and non-additive variance, enhancing long-term selection response. Beyond technical advances, the breeding programme underwent structural modernisation, aligning pipelines with defined market segments, adopting a stage-gate product advancement process, and integrating key performance metrics. Operational improvements include flowering induction treatments to boost crossing efficiency and digitisation of breeding data management through platforms such as Cassavabase. This case study illustrates how interdisciplinary integration of modern breeding tools with participatory research, social science, and seed systems strengthens the pathway from

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genetic discovery to equitable, sustainable impact. Lessons from IITA's experience offer insights for advancing breeding programmes addressing complex food, nutrition, and livelihood challenges in tropical agriculture.

Keywords: Cassava, food security, genetic innovation, genomic selection, IITA, sustainable impact