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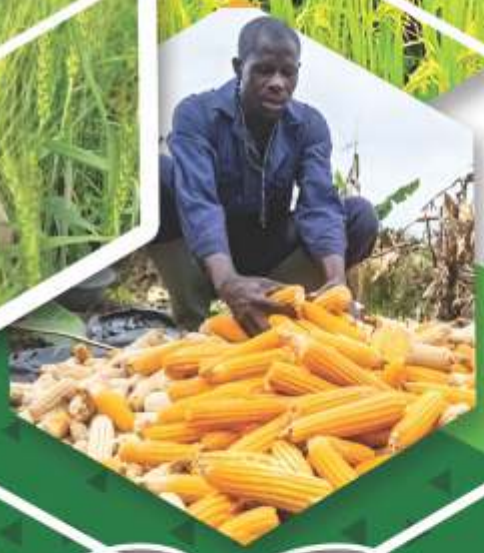

2023

ANNUAL REPORT

CSIR-CROPS RESEARCH INSTITUTE

2023 ANNUAL REPORT

ISSN: 2590-9606

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ACRONYMS

IGF	Internally Generated Funds
KOPIA	Korea Program for International Cooperation in Agricultural Technology
AICCRA	Accelerating the Impact of CGIAR Climate Research for Africa
EiB	Excellence in Breeding
ICRAF	International Centre for Research in Agroforestry
UKRI	United Kingdom Research and Innovation
CORAF	West and Central African Council for Agricultural Research and Development
IITA	International Institute of Tropical Agriculture
CIAT	International Center for Tropical Agriculture
AATF	African Agricultural Technology Foundation
MAG	Modernizing Agriculture in Ghana
CSIR	Council for Scientific and Industrial Research
NGOs	Non-Governmental Organisations
CRI	Crops Research Institute
RDA	Rural Development Administration
KAFACI	Korea-Africa Food and Agricultural Cooperation Initiative
KOPIA	Korea Partnership for Innovation of Agriculture
AGRA	Alliance for Green Revolution for Africa
INERA	National Agricultural Study and Research Institute
AGG	Accelerating Genetic Gains
WAVE	Central and West African Virus Epidemiology
AEAs	Agricultural Extension Agents
AWD	Alternate Wetting and Drying
GCRF	Global Challenges Research Fund
UK	United Kingdom
OFAB	Open Forum on Agricultural Biotechnology
COP	Community of Practice
IAR4D	Integrated Agricultural Research for Development
TCDA	The Tree Crops Development Authority
ABI	Accelerated Breeding Initiative

ACRONYMS

CGIAR	Consultative Group on International Agricultural Research
NARES	National Agricultural Research and Extension Systems
F-RGA	Field Rapid Generation Advance
SNP	Single Nucleotide Polymorphisms
IGKV	Indira Gandhi Agricultural University
FOFIFA	The Centre National de Recherche Appliquée au Développement Rural
IIAM	Agricultural Research Institute of Mozambique
CBI	Crop Breeding Institute
TARI	Tanzania Agricultural Research Institute
ISRA	Institut Sénégalais de Recherche Agricole
CNRA	Centre National de Recherche Agronomique
NCRI	National Cereals Research Institute
SARI	Savanna Agricultural Research Institute
CIMMYT	International Maize and Wheat Improvement Center
WECAWHEAT	West and Central Africa Wheat Collaborative Network
IDA	International Development Association
CSA	Climate-Smart Agricultural
FFS	Farmer Field Schools
BMGF	Bill and Melinda Gates Foundation
FCDO	Foreign Commonwealth and Development Office
CMD	Cassava Mosaic Disease
CBSD	Cassava Brown Streak Disease
EOC	Emergency Operation Centre
ILV	Indigenous Leafy Vegetables
SFR	Seeds for Resilience
PVS	Participatory Varietal Selection
MSPs	Mechanization service providers
KGGTF	Korea Green Growth Trust Fund
SAM	Sustainable Agricultural Mechanization
MOFA	Ministry of Food and Agriculture

ACRONYMS

ACT	**African Conservation Tillage Network**
F-SAMA	**Framework for Sustainable Agricultural Mechanization in Africa**
KRPD	**Kopia Rice Pests and Diseases**
IPM	**Integrated Pest Management**
AAC	**Asian African Consortium**
RYMV	**Rice Yellow Mottle Virus**
DNA	**Deoxyribonucleic Acid**
IITA	**International Institute of Tropical Agriculture**

FOREWORD

It is with great pleasure that we share a summary of our activities for the year 2023. Our research efforts during 2023 focused primarily on our mandate crops—cereals, legumes, horticultural crops, tropical fruits and vegetables, roots and tubers, and industrial crops.

We are pleased to report that these activities had a significant positive impact on our stakeholders and the public, resulting in numerous success stories and contributing to increased agricultural productivity across various sectors.

Despite the longstanding challenge of limited research funding—particularly the minimal financial support from the Government of Ghana—we have been fortunate to receive substantial backing from donor agencies. These partnerships have become the primary source of funding for our operations, and we are truly grateful to all our partners for their continuous support in helping us achieve our goals.

Our staff members continue to enhance their skills and expertise through various technical training programmes, as well as through graduate and postgraduate studies. This ongoing capacity building ensures that our human resource base remains highly competent and competitive. At the same time, we are making strides in upgrading our infrastructure and expanding commercialization efforts to increase our internally generated funds (IGF), which are vital to sustaining our operations amid declining government and donor contributions.

We extend our heartfelt appreciation to our dedicated and hardworking staff, whose commitment—both in the office and in the field—has led to the development and release of demand-driven technologies aimed at improving rural livelihoods and supporting national economic growth. Together, we are making meaningful progress toward realizing our vision, and we remain committed to embracing every opportunity that lies ahead.

Thank you.

ACKNOWLEDGEMENTS

Our continued success in agricultural research is the result of the collective efforts and unwavering support from our cherished stakeholders. We extend our heartfelt gratitude to each and every one of you for walking this journey with us over the years. Thank you sincerely—it is our hope that we will continue to collaborate and achieve even greater milestones together in the years ahead.

We are especially thankful to our partners and collaborators who generously sponsored many of our project activities in 2023. These include the Korea Program for International Cooperation in Agricultural Technology (KOPIA), the Korea Africa Food and Agriculture Cooperation Initiative (KAFACI), Accelerating the Impact of CGIAR Climate Research for Africa (AICCRA), the Excellence in Breeding (EiB) Project, CORNELL GREAT, the International Centre for Research in Agroforestry (ICRAF), United Kingdom Research and Innovation (UKRI), Crop Trust, CORAF, the International Institute of Tropical Agriculture (IITA), the International Center for Tropical Agriculture (CIAT), and the African Agricultural Technology Foundation (AATF), among many others. We also acknowledge the invaluable support of the Canadian Government through the Modernizing Agriculture in Ghana (MAG) programme.

We continued to foster strong collaborations with sister institutes under the Council for Scientific and Industrial Research (CSIR), public and private universities, farmer groups, civil society organizations, ministries, departments, NGOs, and various research institutions. We deeply appreciate the dedication and cooperation of all these institutions. Finally, our deepest appreciation goes to our committed scientists, technical teams, and support staff. Your hard work, long hours, and tireless dedication have made these achievements possible. We say a big *"ayekoo"* to you all—you are the backbone of our success.

May we continue to grow together.
God richly bless us all

OUR PROFILE

The Council for Scientific and Industrial Research (CSIR) is the foremost national science and technology organization in Ghana. Established in 1964, the CSIR-Crops Research Institute (CSIR-CRI) is the largest of the thirteen (13) institutes of the CSIR. The Institute provides innovative research and research-related services to the general public as well as other institutions.

The CSIR-CRI's mission is to develop and disseminate demand-driven technologies and build capacity for sustainable food and industrial crop productivity, with the vision to become a Centre of Excellence for agricultural research, innovation and capacity building for development.

The Institute's core mandate is to conduct research and develop improved food and industrial crop varieties and their production technologies to enhance food security and poverty reduction. The mandate crops include: legumes (cowpea, soybean, groundnut, canning beans and bambara groundnut), cereals (maize and rice), roots and tubers (yam, cocoyam, cassava, taro and sweet potatoes), vegetables (pepper, garden eggs, tomato, onion, okra and leafy vegetables), tropical fruits (citrus, mango, avocado, cashew, pineapple, and pawpaw), and industrial crops (rubber and sugarcane).

With Excellence, Fairness, Commitment, Transparency, Accountability and Teamwork as our core values, , the Institute aims to

- develop and disseminate appropriate technologies that are demand-driven and acceptable to end-users.
- promote and strengthen strategic partnerships with relevant stakeholders to enhance the generation of solutions to challenges in agricultural research, technology development and transfer.
- improve institutional capability to undertake effective research and service delivery to enhance agricultural productivity.
- enhance research and technology delivery through efficient mobilization and management of funds

- improve the management and operating procedures and systems as a means of ensuring efficiency in research delivery.

In addition to our core mandate, the Institute also offers several services to various stakeholders. These include but are not limited to the production of foundation seeds for the National Seed Industry, the supply of healthy planting materials of citrus, avocado, mango, plantain and banana cassava, cocoyam, sweetpotato, taro and yam, the establishment of farms (tree crop plantations), , the production of extension materials and advise on the use of appropriate experimental designs for field studies.

EXECUTIVE SUMMARY

The 2023 Annual Report highlights the Institute's key achievements over the past year, reaffirming our commitment to embracing every challenge and driving impactful agricultural research for national development.

A major milestone was the launch of a new 5-Year Strategic Plan (2023–2027) under the leadership of Prof. Moses Brandford Mochiah. This plan repositions the Institute's focus on the commercialization of agricultural research to enhance industrialization, promote economic growth, and improve the livelihoods of farmers and rural communities. It succeeds the previous plan, which concluded in 2019.

In support of national rice self-sufficiency efforts, the Institute organized a capacity-building workshop for plant breeders from Ghana, Zimbabwe, Madagascar, Ivory Coast, India, and Nigeria. The program introduced participants to advanced tools such as Rapid Generation Advance (F-RGA), Speed and Smart Breeding technologies, barcoding, electronic data capture, and SNP genotyping.

Through the Central and West African Virus Epidemiology (WAVE) project for root and tuber crops, funded by the Bill & Melinda Gates Foundation, the Institute coordinated a review of the national response strategy for Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD). This review produced a comprehensive plan, including the establishment of an Emergency Operation Centre (EOC), to address these serious threats to cassava production.

In a move to bolster food security, nutrition, and biodiversity, the CSIR-Crops Research Institute (CSIR-CRI) launched a project to revive Indigenous Leafy Vegetables (ILVs) through the Seeds for Resilience (SFR) initiative. The project engaged farmers and scientists through workshops, field trials, and focus groups, promoting sustainable agricultural practices while preserving underutilized crops crucial to food security and climate resilience.

The Institute sustained strong stakeholder engagement through conventional and digital media platforms including Facebook, Instagram, Twitter, CRI's official website, and CRI-TV, an online television platform established in 2020. These channels significantly enhanced the Institute's visibility and public awareness of its research and innovations.

A notable individual achievement came when Ing. Dr. Shadrack Kwadwo Amponsah, Senior Research Scientist, was honored as "Aquaculture Researcher of the Year – 2022" at the 2023

Chamber of Aquaculture Ghana Awards for his pioneering work in improving aquaculture production systems and sustainability.

Despite these successes, the Institute continued to grapple with significant challenges, particularly high staff attrition, which has affected staff strength and operational capacity.

To boost internal revenue generation, the Institute maintained active commercialization initiatives, primarily through the production and sale of planting materials.

Additionally, CSIR-CRI staff remained active contributors to the scientific community, achieving a notable milestone in 2023 with over 100 publications, including refereed journal papers, conference presentations, production guides, manuals, books, book chapters, posters, and technical reports.

2023 RESEARCH OUTPUTS

01

CSIR-CROPS RESEARCH INSTITUTE UNVEILS 5-YEAR STRATEGIC PLAN TO PROPEL AGRICULTURAL RESEARCH AND INNOVATION

SPONSORS: CSIR-Crops Research Institute

Plate 1:Launching of the CSIR-CRI 5-year Strategic Plan

The CSIR-Crops Research Institute (CSIR-CRI) launched an ambitious five-year strategic plan aimed at revolutionizing agricultural research and driving innovation to support Ghana's agricultural sector. The launch event, held on June 27, 2023, gathered stakeholders from across the agricultural sector, policy-makers, and distinguished guests, marking the beginning of a new era in the Institute's operations.

Plate 2:Prof. Moses Brandford Mochiah, Director, CSIR-CRI

The newly unveiled strategic plan, spanning 2023 to 2027, intends to refocus the Institute's efforts on commercializing agricultural research to stimulate growth, foster industrialization, and improve the livelihoods of farmers and communities. The launch follows the expiration of CSIR-CRI's previous strategic plan (2015–2019), making it imperative to develop a contemporary, forward-looking framework to align the Institute with evolving national and global priorities in agriculture.

A Vision for Excellence and Innovation

Plate 3:A section of staff at the launch

Prof. Moses Brandford Mochiah, the Director of CSIR-CRI, underscored the strategic plan's significance in guiding the Institute's work in the years to come. "This plan will serve as our Bible, directing all research activities and ensuring that we remain focused on our mission to become a Center of Excellence in agricultural research and innovation," he stated. Prof. Mochiah emphasized that the new plan aims to enhance the Institute's impact on Ghana's agricultural sector by fostering a stronger connection between research and practical outcomes that benefit farmers and industry stakeholders alike.

He explained that the plan was meticulously crafted to consider various factors, including local and international market demands, CSIR-CRI's strengths and challenges, resource allocation, and staffing needs. The comprehensive document reflects a commitment to implementing transformative research initiatives while addressing critical challenges facing the agricultural sector.

STRATEGIC FOCUS AREAS TO DRIVE TRANSFORMATION

Plate 4:Dr. Foster Boateng, Board Chair, CSIR-CRI

The strategic plan outlines five main priority areas intended to serve as pillars for the Institute's mission:

- **Integrated Agricultural Research for Development (IAR4D)** – A holistic approach that integrates agricultural research and development efforts to meet real-world challenges. This priority area emphasizes collaboration with local and international partners to address food security, sustainability, and climate resilience.
- **Communication** – A focus on strengthening the Institute's communication channels to disseminate research findings effectively to farmers, industry stakeholders, and policymakers. Improved communication will ensure that research results translate into tangible benefits across the agricultural value chain.
- **Financial Sustainability** – Building a resilient financial model to sustain the Institute's operations and research projects. This priority aims to explore diverse funding sources, including grants, partnerships, and commercialization of research outputs, to ensure long-term financial health.
- **Human and Infrastructure Capacity Development** – Investing in staff training, research infrastructure, and resources to build a skilled and capable workforce that can drive innovation. This includes the development of advanced laboratories, acquisition of modern equipment, and training programs to equip researchers with cutting-edge skills.
- **Systems and Management Procedures** – Strengthening the Institute's internal systems and management practices to improve efficiency and accountability. This includes enhancing organizational structures and adopting modern management tools for better oversight and project execution.

LEADERSHIP'S COMMITMENT TO STRATEGIC IMPLEMENTATION

Dr. Foster Boateng, the Chairman of CSIR-CRI's Board and Deputy Chief Executive Officer of the Tree Crops Development Authority (TCDA), praised the Institute's commitment to driving change through a structured strategic approach, stressing that "strategy brings discipline, focus, and structure." "By following a structured approach, success will naturally follow," Dr. Boateng remarked. He also commended the Institute's leadership for its dedication to putting together a forward-thinking plan and encouraged management to ensure its implementation for maximum impact. To oversee its execution, a six-member Implementation Committee was inaugurated, led by the Deputy Director of the Institute.

A NEW ERA FOR GHANA'S AGRICULTURAL FUTURE

The unveiling of CSIR-CRI's strategic plan signals a bold step forward in aligning agricultural research with Ghana's development goals. By focusing on practical, impact-driven research and fostering partnerships across sectors, the Institute aims to address pressing challenges in agriculture, including food security, climate resilience, and economic growth.

The strategic plan's launch reinforces CSIR-CRI's commitment to playing a pivotal role in shaping Ghana's agricultural landscape and advancing research that benefits both local and global communities. With its five priority pillars, the Institute is well-positioned to transform research into real-world solutions that will enhance productivity, sustainability, and the overall resilience of Ghana's agricultural sector.

EMPOWERING NARES FOR HIGH-IMPACT RICE BREEDING IN SUB-SAHARAN AFRICA

SPONSORS: Excellence In Breeding (EiB)

Rice consumption in Sub-Saharan Africa is rising faster than ever due to factors like population growth, urbanization, and changing diets. However, traditional rice varieties, widely relied upon by farmers, lack the resilience needed to meet this growing demand, especially under climate stress. To address this, advancements in rice breeding and the development of climate-resilient varieties are urgently needed.

Existing rice breeding systems in Sub-Saharan Africa largely follow traditional, pedigree-based approaches, which are time-consuming, costly, and labour-intensive. To accelerate progress, the CGIAR Accelerated Breeding Initiative (ABI) recently organized a transformative workshop at the CSIR-Crops Research Institute in Kumasi, Ghana. Led by Sanjay Katiyar, the workshop titled "Accelerated Breeding Modernization for Hi-Impact Rice Breeding" gathered over thirty breeders from nine West African countries to modernize breeding practices across the region.

A WORKSHOP TO SIGNIFICANTLY TRANSFORM NARES' BREEDING PROGRAMMES IN WEST AFRICA

Plate 5:A section of staff at the EIB Workshop

This workshop introduced participants to advanced tools and methods, such as field Rapid Generation Advance (F-RGA), Speed and Smart breeding technologies, barcoding, electronic data capture, and SNP genotyping.

Plate 6:Dr. Maxwell Darko Asante, Rice Breeding Lead at CSIR-CRI addressing the workshop

Emphasis was also placed on integrating the best global Communities of Practice (CoPs) into breeding programs. Girish Chandel from IGKV, India, highlighted the successful adoption of these technologies in South Asia, where customized breeding methods have led to high-yielding, te-resilient varieties.

Plate 7:A participant receiving her certificate at the end of the workshop

As part of a larger project aimed at boosting genetic gains and developing rice varieties suited for African conditions, the workshop supports the transformation of NARES (National Agricultural Research and Extension Systems) breeding programs to enhance food security locally and globally. Sanjay Katiyar stressed the importance of NARES empowerment to align with CGIAR's global breeding programs and meet One CGIAR's food security goals by 2030.

Plate 8:A section of participants at the workshop

Participants represented a diverse set of organizations, including the Centre National de Recherche Appliquée au Développement Rural (FOFIFA), Madagascar; Agricultural Research Institute of Mozambique (IIAM); Crop Breeding Institute (CBI), Zimbabwe; Tanzania Agricultural Research Institute (TARI); Institut Sénégalais de Recherche Agricole (ISRA), Senegal; Centre National de Recherche Agronomique (CNRA), Ivory Coast; National Cereals Research Institute (NCRI), Nigeria; Indira Gandhi Agricultural University (IGKV), India; and CSIR's Crops Research Institute (CRI) and Savanna Agricultural Research Institute (SARI), Ghana.

This collaboration underscores the widespread commitment to accelerating rice breeding progress across Sub-Saharan Africa.

Team: *Maxwell Darko Asante, Priscilla Francisco Ribeiro, Bernard Sakyiamah, Kirpal Agyeman Ofosu, Charles Afriyie-Debrah, Felix Frimpong, Jonas Osei-Adu*

03 DEMYSTIFYING THE MYTH OF GROWING WHEAT IN GHANA: INTRODUCTION OF HEAT-TOLERANT WHEAT CULTIVARS IN GHANA.

SPONSORS: ARIMA Farms, CYMMIT

Bread wheat (*Triticum aestetivum*) is one of the world's most important cereals with an estimated economic value of $40 billion per annum in trade. Ghana's estimated wheat consumption per capita is 27kg per annum, largely used for bread, animal/poultry feed and food. However, Ghana imports wheat primarily from Canada, Russia, Lithuania, France and Ukraine every year. Unfortunately, the war in Russia and Ukraine, the cessation of the black sea grain deal as well as fluctuating weather patterns have negatively hindered wheat grain exports from these parts of the world.

The CSIR-CRI has, therefore, commenced wheat adaptive research studies in the Forest, Transition and Guinea Savannah agro-ecological zones of Ghana with funding from India partners, ARIMA-FARMS, CYMMIT, and the WECAWheat Network. Researchers at the Institute have pioneered an innovative project to tackle this urgent matter and introduce the cultivation of wheat into the country. They have introduced heat-tolerant wheat genotypes adaptable in Ghana's varied climatic scenarios and an all-encompassing research initiative aimed at creating robust wheat germplasm suited to the local habitat.

Plate 9:Dr. Felix Frimpong, Research Scientist, CSIR-CRI

Through stringent field tests and careful selection procedures, the team has identified promising heat-tolerant wheat cultivars that showed exceptional adaptability and yield potential in Ghana. These cultivars not only proved resilient to high temperatures but also exhibited superior farming traits and grain quality attributes, making them perfect contenders for commercial farming. A major milestone of the project has been the successful testing of heat-tolerant wheat cultivars across various agroecological zones in Ghana.

CYMMIT's proficiency in germplasm development and genetic enhancement played a pivotal role in boosting the resilience and productivity of the chosen wheat lines. Capitalizing on the collective efforts of all partners, the team is set to begin processes towards the commercial release of these wheat cultivars for production in Ghana.

This success journey not only emphasizes the transformative potential of agricultural research but also underscores the strength of partnerships in propelling innovation and sustainable growth in the agricultural space.

Team: *Felix Frimpong, Kennedy Agyeman, Maxwell Darko Asante, Theophilus Frimpong Kwame Obeng Dankwa, Francis Amoako-Andoh, Aisha Karim, Elvis Agyei Obeng Benedicta Nsiah-Frimpong, Daniel D. Gamenyah, Mavis Badu Brempong*

AICCRA FACILITATING GENDER SMART TECHNOLOGIES USING COMMUNITY TECHNOLOGY PARKS

SPONSORS: International Development Association (IDA) of the World Bank.

Climate variability and change have a profound negative impact on global agriculture, food security, nutrition, and the livelihoods of millions of people worldwide. Extreme climate events such as droughts, changes in rainfall intensity and patterns, significantly contribute to the emergence, spread, and outbreaks of pests and diseases, which in turn affect the productivity of key staple crops like maize, cowpea, yam, and sweet potato. In Ghana, climate change has widened the yield gap and led to higher post-harvest losses of essential food crops, disproportionately impacting farmers, with women and vulnerable groups being especially affected.

To address these challenges, the Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) project is working to scale up gender-responsive, climate-smart agricultural (CSA) technologies, practices, and services. These interventions aim to boost productivity, build resilience, and reduce greenhouse gas emissions at the community and farm levels.

An effective and efficient means of scaling up CSA technologies is through the use of community technology parks. Such parks not only demonstrate workable technologies but also bring all stakeholders together to interact to ensure speedy adoption.

AICCRA established 31 technology parks across 22 communities in five intervention regions to promote gender-responsive climate-smart agricultural (CSA) technologies for the sustainable cultivation of yam, sweet potato, maize, and cowpea. The initiative piloted these

technologies with a focus on value chains: 13 parks for maize, 3 for yam, 13 for cowpea, and 2 for sweet potato. In each community, CSA practices were tested against traditional methods, allowing farmers to evaluate their effectiveness.

A total of 2,341 farmers, extension officers, and stakeholders participated in farmer field schools (FFS) across these communities, with 49% of participants being women. Among them, 988 (42%) were under the age of 35. Improved maize seeds, land preparation techniques, agronomic practices, harvesting, and marketing technologies were introduced, achieving 60% ratings for low labor intensity and 90% ratings for maintaining women's roles in crop management for maize, cowpea, and sweet potato.

Plate 10:Beneficiary farmers planting maize in lines on their field

AICCRA intervention fields demonstrated substantial yield improvements, with maize and cowpea yields increasing by 64% and 128% over national averages, respectively. Additionally, income from these fields was 65% and 118% higher than income from traditional farming practices. AICCRA-supported yam fields achieved a 40% higher average tuber yield, and sweet potato fields showed over 200% fewer weevil-damaged tubers compared to conventional fields.

Farmers in all participating communities ranked bundled CSA technologies as their top choice for managing climate-related risks. Currently, 274 farmers, including 42% women, are actively using AICCRA technologies. The success of AICCRA interventions demonstrates promising potential for yield and income gains, with significant implications for climate policy in sub-Saharan Africa, particularly Ghana.

Gender-responsive climate-smart agricultural (CSA) technologies offer significant potential to boost crop productivity amid climate challenges. Demonstration parks have proven effective in encouraging adoption by showcasing these innovations directly to farmers.

The impact of AICCRA's field activities is promising, particularly in terms of primary adopters recorded over the year. To further increase adoption, it is recommended that participating farmers train others on these technologies. To sustain the progress, it is essential to expand access to promoted CSA technologies. Future efforts should prioritize the most impactful interventions, as identified by each district, to maximize ongoing benefits.

Plate 11:Harvested maize from AICCRA demo fields

Gender-smart CSA technologies have the potential to increase crop productivity in the midst of climate change. A sure way to facilitate adoption is through demonstration parks.

The impact of AICCRA activities on the field is highly encouraging especially in the number of primary adopters recorded in the year. To increase the numbers, it is recommended that the farmers (adopters) use the technologies to train other farmers. To sustain the gains made, there should be increased access to CSA technologies promoted and the most impactful interventions ranked by each district should be given priority in future implementation/promotions.

Team: *Stephen Yeboah, Moses B. Mochiah, Joseph Adomako, Kofi Frimpong Anin, Ernestina A. Narveh, Patricia Amankwaa-Yeboah, Joyce Haleegoah, Bernard Sakyiamah*

05

GHANA INTENSIFIES EFFORTS TO COMBAT CASSAVA VIRAL DISEASES

SPONSORS: BMGF/UK-FCDO

In a significant move to safeguard the nation's food security, Ghanaian authorities have undertaken a comprehensive review of the country's response plan to mitigate the devastating impact of cassava viral diseases. The initiative, led by the Central and West African Virus Epidemiology (WAVE) for root and tuber crops project of the CSIR-Crops Research Institute, in collaboration with key stakeholders, aims to strengthen preventive measures and enhance the resilience of the cassava sector.

Cassava, a staple crop in many Ghanaian households, serves as a major source of sustenance and income for countless farmers and stakeholders across the nation. Its starchy roots provide the foundation for numerous Ghanaian dishes. Despite its importance to the nation's food security status, a shadow has been cast over this staple as viral diseases such as Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD) threaten to decimate the crop. However, a beacon of hope has emerged as Ghana's response plan for mitigating cassava viral diseases has been reviewed and revitalized by stakeholders within the cassava value chain.

Plate 12:Participants at the workshop

Recognizing the urgency of the situation, the Ghanaian government, in collaboration with agricultural experts and international partners, initiated a comprehensive response plan to address the incidence of viral diseases in 2019. The plan aimed not only to curb the spread of the viral diseases already endemic in the country but to prevent the potential invasion of the more damaging Cassava Brown Streak Disease (CBSD) into the country. The recent spread of the CBSD from East Africa into Central Africa, poses a threat to West Africa and more specifically to Ghana

Plate 13:Participants at the workshop

The reviewed response plan outlines a multi-faceted approach to combat these threats such as

- **Early Detection and Surveillance:** Implementing robust surveillance systems to monitor disease outbreaks and track their spread.
- **Disease-Resistant Varieties:** Promoting the adoption of improved cassava varieties that exhibit resistance to viral diseases.
- **Integrated Pest Management:** Employing sustainable pest management practices to minimize the use of harmful chemicals and protect beneficial insects.
- **Farmer Education and Training:** Empowering farmers with knowledge and skills to identify and manage disease symptoms.
- **Research and Development:** Investing in research to develop innovative solutions, such as disease-resistant cultivars and advanced control methods.
- **International Cooperation:** Collaborating with regional and international partners to share knowledge and resources.

Additionally, the plan suggested the setting up of an Emergency Operation Centre (EOC) under the Ministry of Food and Agriculture to combat the threat and contain the spread of cassava viral diseases.

Plate 14:Participants at the workshop

The EOC will coordinate all detection and response activities. The review process involved extensive consultations with experts and other stakeholders. The feedback gathered from these discussions has been incorporated into the revised plan, ensuring its effectiveness and adaptability to evolving challenges. Prior to the review process, the WAVE project also organized simulation exercises in three cassava growing regions of the country to test the nation's preparedness and response to a potential cassava brown streak virus invasion and also help address any weaknesses. The reviewed response plan will become a blueprint for action, a rallying point for stakeholders united in their determination to safeguard Ghana's cassava.

By strengthening its response to cassava viral diseases, Ghana aims to protect its food security, support rural livelihoods, and contribute to the overall economic development of the country. The Government remains committed to working closely with farmers, researchers, and international partners to secure a sustainable future for the cassava sector. The reviewed plan will be approved, published, and will serve as a reference document for managing cassava viral diseases in the country.

Plate 15:A group photograph of participants

The WAVE project is funded by the Bill and Melinda Gates Foundation (BMGF), the United Kingdom Foreign Commonwealth and Development Office (FCDO), with support from the European Union through CORAF. Its aim is to understand and predict the emergence and evolution of root crop viruses in West and Central Africa through a coordinated management of viral disease threats to ensure food security.

Team: *Allen Oppong, Joseph Lamptey, Moses Brandford Mochiah, Ruth Prempeh, Linda Abrokwah, Esther A. Marfo, Esther Afoley Annang, Benedicta Nsiah Frimpong, Zipporah Appiah-Kubi, Bernard Sakyiamah, Peter Amoah, Augustine Agyekum, Rose Osei Kofi*

06

PROMOTING INDIGENOUS LEAFY VEGETABLES: SCIENTISTS ENGAGE FARMERS THROUGH PARTICIPATORY VARIETAL SELECTION

SPONSORS: Crop Trust

In a bold effort to boost food security, biodiversity, and nutrition, the CSIR-Crops Research Institute (CSIR-CRI) has launched an initiative to revive and promote indigenous leafy vegetables (ILVs) through the Seeds for Resilience (SFR) project. The project brings together farmers, scientists, and local agricultural agencies in a collaborative effort to identify, cultivate, and improve varieties of indigenous leafy vegetables that hold both nutritional value and cultural significance.

Additionally, the project aims to encourage farmers to actively participate in the selection process of traditional leafy vegetable varieties that are well-suited to their specific environments and preferences. Through a series of workshops, field trials, and focus groups, farmers are trained on sustainable practices while providing scientists with insights into varietal performance and preferences. This project not only seeks to preserve these often-overlooked crops but also addresses critical issues such as food insecurity, malnutrition, and climate resilience.

The Importance of Indigenous Leafy Vegetables

Indigenous leafy vegetables like Amaranth, Hibiscus (rosselle) and Corchorus leaves are deeply rooted in the cultural diets of many communities in Ghana. Known for their adaptability to local climates and soil conditions, these crops are hardy and often drought-resistant, making them ideal for regions prone to erratic rainfall and changing weather patterns.

Many of these leafy greens are rich in essential nutrients such as vitamins A, C, and E, iron, calcium, and dietary fibre. They have been shown to support immune function, improve eye health, and help in managing diseases such as anaemia and diabetes. Despite their benefits, however, the cultivation and consumption of these crops have been in decline due to factors like urbanization, changing dietary habits, and the rise of commercial vegetable varieties.

The Role of Participatory Varietal Selection

Plate 16:Stakeholders observing some leafy vegetables

Participatory varietal selection is an approach that places farmers at the center of crop research and improvement, ensuring that the varieties selected are not only high-yielding and nutritious but also align with local tastes, cultural preferences, and farming conditions. This model of community-based agricultural research involves hands-on training and trials, where farmers are directly involved in testing various plant varieties, assessing traits such as taste, yield, pest resistance, and ease of cultivation.

Dr. Patricia Pinamang Acheampong, a Principal Research Scientist of the CSIR-CRI and the project lead, explained the benefits of this approach: "When farmers are included in the decision-making process, they're more likely to adopt and champion the cultivation of these crops. They know their land, their community, and what works best for them."

The program, which spans multiple regions, begins with researchers introducing a set of indigenous vegetable varieties in a series of experimental plots. Farmers then evaluate these plants based on specific criteria, ranging from adaptability to growth rate, flavour, and nutritional content. By the end of the growing season, the farmers select the varieties they feel are most promising, and these selections are shared with local communities.

Initial Successes and Farmer Feedback

Plate 17:Farmer engagements

Early results from trials conducted in the Ashanti region have been encouraging. In Barekese, for instance, farmers have seen promising yields from certain varieties of amaranth and hibiscus "We used to grow these vegetables in small quantities, but now we see their true potential," said Esther Oppong, a smallholder farmer participating in the project. "With the new techniques we've learned, we are able to produce enough not just for our family, but also to sell at the local market."

Farmers like Esther note that training on sustainable practices, such as organic pest control and water-saving techniques, has been transformative.

ADDRESSING FOOD SECURITY AND CLIMATE RESILIENCE

Beyond nutrition, promoting indigenous leafy vegetables is also about increasing resilience in the face of climate change. Unlike many modern crops, ILVs are well-suited to extreme conditions, requiring less water and fertilizer and exhibiting natural resistance to pests.

Mr. Isaac Newton Boakye Mensah, an agronomist working with the project noted, "By cultivating crops that thrive under difficult conditions, we're creating a buffer against food insecurity."

FUTURE PLANS AND CHALLENGES

Plate 18:Stakeholders during the participatory varietal selection

Despite promising results, the project faces some hurdles, including limited resources, market access, and the perception of ILVs as "poor people's food." To overcome these challenges, the project leaders have started awareness campaigns aimed at increasing consumer interest and acceptance of these crops. Additionally, efforts are being made to create formal supply chains that connect farmers with urban markets, where demand for nutrient-rich and sustainably grown vegetables is steadily rising.

Plate 19:A section of participants during the participatory varietal selection exercise

Moving forward, scientists plan to expand the PVS program to more regions, ensuring a broader genetic diversity of crops that can adapt to different ecological zones. This expansion will help build a resilient agricultural system that honours traditional knowledge and prioritizes community-led solutions to modern agricultural problems.

***Team**: Patricia Pinamang Acheampong, Augustine Boakye Boateng, Isaac Newton Boakye Mensah, Francis Safo, Mary Dua*

07

UNVEILING SAM: THE MOVEMENT REVOLUTIONIZING AGRICULTURE THROUGH SMART AGRICULTURE MECHANIZATION

SPONSORS: Korea Green Growth Trust Fund

Farmers in Ghana's Northern Region faced significant setbacks this year due to a lack of mechanized agricultural equipment. This challenge left many unable to plant or harvest what little they managed to plant. Despite some progress, mechanization adoption in Ghana remains low, with 77.6% of farm operations performed manually. Mechanization service providers (MSPs) struggle to meet demand due to logistical challenges, including poor connectivity between equipment operators and farmers and underutilized machinery. Moreover, existing MSPs and operators often fail to promote sustainable mechanization practices.

To address these issues, the Korea Green Growth Trust Fund (KGGTF), in collaboration with the AICCRA Ghana Cluster, has introduced the **Go Smart Mechanization!** project. This initiative seeks to promote sustainable agricultural mechanization (SAM) and conservation agriculture, targeting smallholder farmers across West Africa. The project brought together a wide range of stakeholders during a two-day workshop to strategize and share best practices for advancing SAM technologies in Ghana.

Participants included representatives from the Ministry of Food and Agriculture (MOFA), farmers, agribusiness owners, agricultural extension officers, and local artisans involved in equipment fabrication. The workshop emphasized collaboration across the agricultural value chain to create sustainable solutions.

Plate 20:Stakeholders brainstorming during the workshop

Dr. Stephen Yeboah, a Senior Research Scientist and AICCRA project lead at the CSIR-Crops Research commended the project and the African Conservation Tillage Network (ACT) for their efforts. He encouraged participants to brainstorm ways to support SAM adoption. Participants then shared diverse expectations, such as integrating SAM into agricultural training curricula, promoting local artisan involvement, and ensuring gender equity in mechanization practices.

SAM's Potential Impact

Plate 21:Stakeholders brainstorming during the workshop

Dr. Patricia Amankwah-Yeboah, the convenor of the workshop, highlighted how traditional mechanization methods contribute to soil degradation and low productivity. SAM technologies, such as rippers, crimpers, and jab planters, alongside climate-smart agricultural practices like using drought-tolerant seeds, offer a sustainable alternative. She emphasized the importance of leveraging frameworks like the Framework for Sustainable Agricultural Mechanization in Africa (F-SAMA) to scale up these practices.

KEY OUTCOMES AND FUTURE DIRECTIONS

The workshop included subgroup discussions on innovative business models, policy support, and technology development. A panel tackled critical issues such as government support, digitalization, and financial models for SAM. The event concluded with actionable recommendations such as expanding SAM to include irrigation and livestock farming, strengthening communication and engagement among stakeholders and incorporating SAM principles into Ghana's Agricultural Engineering Policy.

Farmers are already sending waves of testimonies due to the benefits they are gaining from the SAM. A participant testified to the benefits he and the farmers of the region are enjoying from the SAM pilot. He stated, "*We have been exposed to good land preparation methods using simple SAM equipment like rippers to prepare our fields. Now we know it's not just about using tractors and plough for land preparation; there are other efficient and sustainable technologies we have been exposed to, and it's yielding amazing results on our fields.*"

A VISION FOR THE FUTURE

The SAM workshop laid the groundwork for transforming agriculture in Ghana. By prioritizing sustainable mechanization, stakeholders aim to empower smallholder farmers with cost-effective, environmentally friendly technologies. As SAM progresses, it holds the promise of revolutionizing farming practices and enhancing food security across the country.

Team: *Stephen Yeboah, Moses B. Mochiah, Joseph Adomako, Kofi Frimpong Anin, Ernestina A. Narveh, Patricia Amankwaa-Yeboah, Joyce Haleegoah, Bernard Sakyiamah*

08

TACKLING PESTS AND DISEASES: A BREAKTHROUGH FOR FARMERS IN BAYEREBON No. 5

SPONSORS: KOPIA

Farmers in Bayerebon No. 5, a community heavily reliant on rice cultivation, have long struggled with the challenges posed by pests and diseases, which disrupt crop growth and reduce yields. For these farmers, rice farming is more than just an occupation—it's a lifeline. Addressing these challenges has become critical to safeguarding their livelihoods. Recognizing the urgent need for effective pest management solutions, the Council for Scientific and Industrial Research - Crops Research Institute (CSIR-CRI) partnered with the KOPIA Ghana Center to launch the Rice Pests and Disease (KRPD) project. Led by Dr. Kofi Frimpong Anin, a Senior Research Scientist at CSIR-CRI, the initiative aims to fill gaps in pest and disease management in rice farming communities across Ghana. The project's mission is to empower farmers with integrated pest management (IPM) techniques, ensuring sustainable and productive rice cultivation.

Plate 22:Dr. Kofi Frimpong-Anin, Project Lead, CSIR-CRI

As part of the KRPD project, field demonstrations were conducted in Offinso Sakamu, Nobwamu, and Bayerebon No. 5. In Bayerebon No. 5, where rice crops were ready for harvest. A farmer's field day was held on September 20, 2023 to showcase three experimental treatments; traditional pest and disease control methods, minimal fertilizer application without pest treatment as well as integrated pest management systems.The results were striking. The IPM-treated plots showed minimal pest and disease presence, demonstrating the effectiveness of the new methods.

EMPOWERING FARMERS WITH KNOWLEDGE AND TOOLS

Plate 23: Dr. Stephen Arthur, Weed Scientist, CSIR-CRI

Farmers were introduced to advanced rice farming techniques, including bunding, alternate wetting and drying, and transplanting, which enhance water and nutrient management. They also learned about the precise application of herbicides, insecticides, fungicides, and fertilizers. Weed management, a significant challenge, was addressed with strategies such as pre-emergence herbicides and improved land-clearing methods.

Mohammed Abubarik, a local farmer, shared how the training shifted their approach from inefficient broadcasting of seeds to more resource-saving techniques like transplanting. This not only reduces seed wastage but also optimizes field management. Akua Serwaa, a prominent farmer, highlighted the transformative impact of the project, particularly for women. Limited resources had previously confined them to cultivating small plots, but with the new knowledge and resources, they are now planning to expand their cultivation areas.

COMMUNITY AND LEADERSHIP SUPPORT

Honorable Kwesi Danso, Assemblyman for Bayerebon No. 5, acknowledged the vital role of women in the community's rice farming efforts. He praised the KRPD project for addressing the longstanding pest and disease challenges and called for its expansion to other districts. He also urged farmers to share their newly acquired knowledge to create a ripple effect of improved practices across the region.

Plate 24:Mohammed Abubarik, a participant

Dr. Frimpong Anin emphasized the project's ongoing efforts to identify pests, diseases, and weeds affecting rice at various growth stages. He assured farmers of continued support and the development of tailored IPM packages to combat these issues effectively.

A Sustainable Future for Rice Farming

The collaboration between CSIR-CRI and the KOPIA Ghana Center marks a significant step toward sustainable rice farming in Ghana. By equipping farmers with innovative pest management strategies, the initiative is not only improving crop yields but also enhancing food security and community resilience. For farmers in Bayerebon No. 5, this project signals a brighter, more sustainable future.

Team: *Dr. Blankson W. Amoabeng, Dr Atta Aidoo Snr, Dr. Grace Bolfrey-Arky, Jerry Fenteng Asamoah, Ernestina N. Awarikabey, Kofi Lelabi Kota and Prof M.B. Mochiah*

09 FARMERS IN GHANA'S IRRIGATION SCHEMES PREFER NEW AROMATIC RICE DEVELOPED BY CSIR-CROPS RESEARCH INSTITUTE

SPONSORS: KOPIA Ghana Center

On Thursday, 6th July, 2023, the CSIR-Crops Research Institute organized a field day at Dawhenya in the Ningo-Prampram district of Ghana for farmers, millers, and scheme managers from Dawhenya, Ashiaman, Aveyime, and Kpong Irrigation schemes to assess the field performance and milled grain of twelve (12) rice varieties. The varieties comprised newly released ones such as *CRI-Enapa, CRI-Dartey, CRI-Kantinka, Legon 1 (Ex baika), CRI-Onuapa, CRI-KoreaMo, CRI-Agyapa, ISRIZ-6* and *ISRIZ-7* as well as existing (relatively older) varieties like *CRI-Amankwatia, CRI-AgraRice and Jasmine 85*. All the varieties were developed and released in Ghana, with the exception of *ISRIZ-6* and *ISRIZ-7* which were released in Senegal.

Plate 25:Scientists from CSIR-CRI engage farmers during the field day

The field day was part of activities under the KOPIA-Ghana Center funded project which aims at providing superior rice varieites and certfied seeds to farmers.

After touring the field, community-based focus group discussions led by Dr. Maxwell Darko Asante, Principal Investigator for the project and Deputy Director of the CSIR-Crops Research Institute were conducted. Different varieties were preferred by the different communities. However, *CRI Agyapa,* was overwhemingly selected by all the different communities as one of their most preferred varieties. The participants indicated that their choice of "*CRI-Agyapa"* was due to its attributes such as—high yield, good number of productive tillers, dense and good-looking panicles, early maturity, good taste, high level aroma, translucent grains as well as high head rice recovery.

CRI-Agyapa was also selected by farmers in the Anum Valley Irrigation Scheme, Nobewan during a field demonstration earlier in the year.

Other varieties selected by the stakeholders included *CRI-Kantinka, CRI-Amankwatia, CRI-AgraRice, Jasmine 85, CRI-Enapa, CRI-Dartey, CRI-KoreaMo* and *Legon 1*. The participants attributed their selection of these varieties to their good grain milling properties, aroma, dense and long panicles, high yield, and long grain.

Plate 26:Varietal selection during the field day

FEEDBACK FROM PARTICIPANTS

At the end of the field day, participants were very appreciative of the whole exercise. Representatives of the various stakeholder groups gave their feedback on the exercise.

Madam Margaret Yevu, a farmer from Aveyime, said the program had been very educative for them. She expressed her heartfelt gratitude to the organizers and requested that the field days be organized regularly.

Mr. Richard Martey Afleh, the leader of the farmers' group at the Dawhenya Irrigation Scheme, added that the programme was a very good one and that it would help farmers choose varieties to plant for the next planting season. He further stated that the new varieties were very good for them because they have long grains-a preferred trait by the Ghanaian market. He said, "CRI-Agyapa is a very promising variety because it has all the good traits farmers and consumers want, which are aroma, long grain, early maturing, good milling quality, high yielding and good panicles".

Plate 27:Representatives from KOPIA in a group photo

Madam Catherine Norvi Sogbadzi, a miller and aggregator from Asutuare stated how impressed she was with the excellent quality of the milled grains as well as the appearance of the improved varieties and indicated how easy it would be to sell them. "The varieties here today, possess all the attributes preferred by the Ghanaian rice market so selling them will not be difficult at all. They will be better options in place of some of the previous varieties that get broken when milled", she stated. She then pleaded with the private sector to invest in rice production by providing state-of-the-art rice mills so that farmers can meet the demand of consumers.

Plate 28:Participants observing the rice fields during the field day

Mr. Emmanuel Volsuuri from the Asian African Consortium (AAC), a subsidary of the Jospong Group of Companies, a new private sector player in the Ghanain rice industry, stressed the significance of the programme to the rice value chain and revealed the AAC's intention of setting up mechanization centers in every district. He further indicated that tractors, power tillers, transplanters, combine harvesters and ultra-modern rice milling machines would be available for hiring at these centers. "I believe strongly that the mechanization centers will go a long way to mitigate some of the challenges faced by most actors in the rice value chain in the country. We also plan on setting up seed production units that will supply farmers with good quality seeds", he stressed.

Plate 29:Research scientists from CSIR-CRI engage farmers during the field day

The Rice Desk Officer of the Ministry of Food and Agriculture (MOFA), Mr. Alhassan Imoro, encouraged farmers to adopt the improved varieties and use good quality seeds for planting. He also emphasized the necessity of such field days in contributing to Ghana's efforts at attaining rice self-sufficiency.

Team: *Maxwell Darko Asante, Elizabeth Norkor Nartey, Daniel Gamenyah, Charles Afriyie-Debrah, Kirpal Agyeman Ofosu, Sober Ernest Boadu, Phyllis Aculey*

DRIVING RICE SELF-SUFFICIENCY IN GHANA THROUGH IMPROVED SEED SYSTEMS AND DISEASE-RESISTANT VARIETIES

SPONSORS: KOPIA Ghana Center

Rice has become the fastest-growing staple food in Ghana, with per capita consumption rising sharply from 15 kg in 2010 to about 48 kg in 2023. Currently, the nation's rice demand is estimated at 1.5 million metric tons of milled rice annually. However, only half of this demand is met through local production, leaving the country to import the remaining 50% at a cost of nearly US$500 million—a significant amount that could otherwise be invested in strengthening the local economy.

Despite its growing importance, rice production in Ghana faces major challenges. Among these are an inefficient seed system characterized by low availability and poor quality of certified seeds, as well as the widespread occurrence of serious diseases. In particular, Rice Yellow Mottle Virus (RYMV) and rice blast disease are responsible for substantial yield losses, sometimes up to 100%, especially among Ghana's most popular aromatic rice varieties such as CRI-Amankwatia, CRI-AgraRice, Jasmine 85, Togo Marshall, and Legon 1.

To tackle these constraints, the CSIR-Crops Research Institute, in partnership with the KOPIA Ghana Center, has produced approximately 10 metric tons of foundation seeds for three popular rice varieties—CRI-Amankwatia, CRI-AgraRice, and Legon 1—at the Dawhenya Irrigation Scheme. These foundation seeds were distributed to 65 farmers who, in turn, produced around 300 metric tons of certified seeds, contributing to improved seed availability for rice producers.

In addition to enhancing seed supply, the Institute has made significant strides in combating rice diseases. Through DNA marker-assisted backcrossing, disease-resistant versions of the popular aromatic varieties have been successfully developed. This breeding program involved crossing the preferred local varieties (recurrent parents) with Gigante, a donor variety containing key resistance genes—RYMV1 (rymv1-2) for resistance to RYMV, and Pi54 for rice blast resistance. The process also retained the BADH2 gene, which controls the desirable aroma trait in rice.

Following three generations of backcrossing, 71 aromatic lines with more than 75% of the genetic background of the original varieties and carrying the resistance genes were selected. These lines were rigorously tested under high disease pressure in RYMV and blast hotspots across the country, where they consistently demonstrated high levels of resistance. Importantly, preliminary yield trials showed that many of the new lines produced yields equal to or higher than the recurrent parents, without compromising the preferred aroma.

The development of disease-resistant versions of CRI-AgraRice, CRI-Amankwatia, Jasmine 85, and Togo Marshall marks a major breakthrough for Ghana's rice industry. The adoption and dissemination of these improved varieties are expected to substantially reduce yield losses, boost local production, and reduce Ghana's dependence on costly rice imports. Ultimately, this innovation will enhance the livelihoods of rice farmers and create positive ripple effects along the entire rice value chain.

Looking ahead, the Institute plans to scale up foundation seed production to support the generation of 5,400 metric tons of certified seeds by 2027. This will be enough to cover nearly one-third of Ghana's total rice production area. Combined with other interventions in seed production and varietal improvement, this initiative is set to make a significant contribution toward achieving rice self-sufficiency in Ghana.

Team: *Kirpal Agyemang Ofosu, Maxwell Darko Asante , Elizabeth Norkor Nartey , Sober Ernest Boadu , Daniel Gamenyah , Yameen Huss Cole , Phyllis Aculey , , Richard Peprah , Felix Frimpong , Charles Afriyie-Debrah , Emmanuel Asamoah , Ralph Bam, Manila William, Allen Oppong*

DONORS AND PARTNERS

Research DONORS

Securing funding for agricultural research is crucial for fostering innovation, ensuring food security, and developing sustainable, resilient agricultural systems to support a growing global population. A significant portion of the Institute's research funding comes from donor agencies. In 2023, various local and international organizations played a key role in supporting the Institute's research efforts. These included the Korea Program for International Cooperation in Agricultural Technology (KOPIA),), the Accelerating the Impact of CGIAR Climate Research for Africa (AICCRA), the Korea Africa Food and Agriculture Cooperation Initiative (KAFACI), the Excellence in Breeding (EiB) project, CORNELL GREAT, the United Kingdom Research and Innovation (UKRI), Crop Trust, CORAF, the International Institute of Tropical Agriculture (IITA), the International Center for Tropical Agriculture (CIAT), and the African Agricultural Technology Foundation (AATF), among others.

MEDIA PUBLICATIONS OF RESEARCH OUTPUTS

Effective communication of research findings is vital to driving impact and ensuring the successful adoption of agricultural innovations. A robust exchange of knowledge among stakeholders strengthens the transfer of improved technologies to farmers. To achieve this, the Institute actively partners with the media across all its programs—including farmer field days, demonstrations, training sessions, varietal releases, and innovation platform activities.

In 2023, the Institute engaged extensively with print and electronic media to share research breakthroughs and technologies with key stakeholders. Highlights of these efforts are featured below. Beyond traditional media, the Institute maintains a dynamic digital presence—showcasing its work through its website, Facebook, Twitter (X), Instagram, and YouTube—ensuring wider reach and engagement.

Team: *Bernard Sakyiamah, Linda Agyeman, Lynda G.S. Nsafoah, William Aidoo, Peter Amankwah, David Kow* Amo, *Augustine Ofosu, Samuel Boateng, Dennis Gyasi Boakye, Enoch Bobie Agyemang, Enoch Osei Tutu, Patricia Konadu Mensah.*

COMMERCIALIZATION ACTIVITIES

The Commercialization Division of CSIR-CRI spearheads the Institute's income-generating initiatives, ensuring the effective dissemination and transfer of technologies to farmers and the public. Revenue streams are derived from products, services, and administrative overheads applied to research, development, and commercial projects.

Key offerings include:

- **Improved planting materials** (seeds & seedlings) and farm produce, including fruits from the Institute's orchards and plantations. In 2023, CSIR-CRI produced and sold mango, citrus, and avocado seedlings.
- Training programs, consultancies, and hiring services.
- **Facility rentals**, including a biotechnology laboratory, conference halls, guest houses, and seed processing/storage centers—available to the public for a fee.

By leveraging these resources, CSIR-CRI enhances its financial sustainability while accelerating agricultural innovation and adoption.

Team: *Mark Anti, Samuel Azuug Ndebilla, Briamah Abdul-Manaf, Richard Peprah, Ivy Osei-Adu, Bismark Ababio, Nana Kamkam Boadu, Theresa Boakye, Augustine A Boakye, Isaac Mensah, Eric Donkor, Thomas Acheampong*

AWARDS

RECOGNITION OF EXCELLENCE IN AQUACULTURE RESEARCH AND INNOVATION: **ING. DR. SHADRACK KWADWO AMPONSAH**

In recognition of outstanding contributions to aquaculture research and sustainable development in Ghana, Ing. Dr. Shadrack Kwadwo Amponsah, Senior Research Scientist at the Council for Scientific and Industrial Research – Crops Research Institute (CSIR-CRI), was the recipient of multiple prestigious awards at the 2023 Chamber of Aquaculture Ghana Awards and Dinner event, held on April 27, 2023.

Under the theme *"Fostering Stakeholder Collaborations for a Sustainable Aquaculture Industry"*, the ceremony acknowledged key players advancing the national aquaculture agenda through research, innovation, and strategic industry engagement.

Dr. Amponsah received the coveted "Aquaculture Researcher of the Year – 2022" award for his groundbreaking scientific research in aquaculture, particularly through experimental studies aimed at improving production systems and sustainability in the industry.

In addition to this recognition, he was also awarded:

- Aquaculture Sustainability Award
- Aquaculture Innovation Technology Award

These awards underscore Dr. Amponsah's role in advancing aquaculture science and practice in Ghana, particularly through research initiatives that bridge innovation and practical application.

OUR PEOPLE

Prof. Moses B. Mochiah,
Director

Dr. Maxwell Darko Asante,
Deputy Director

Mr. Francis O. Amofah,
Head, Administration

Dr. (Mrs.) Priscilla F. Ribeiro,
Head, Cereals

Mr. Paul Berko,
Head, Finance

Dr. Patricia P. Acheampong,
Head, Socioeconomics/Biometrics

Dr. Kennedy Agyeman,
Head, Legumes/Oil Seeds

Dr. Allen Oppong,
Head, Plant Health

OUR PEOPLE

Dr. Shadrack K. Amponsah,
Head, Agric Engineering/Transport

Dr. Michael Kwabena Osei
Head, Finance

Mr. Mark Anti,
Head, Commercialization

Dr. Ernest Baafi,
Head, Roots and Tubers

Dr. Hillary Mireku Botey,
Head, Biotech, Seed and
Postharvest

Mrs. Lawrencia D. Acheampong,
Head, Scientific Support Services

OUR PEOPLE (SENIOR MEMBERS)

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Cynthia Darko
Emmanuel Otoo
Eric Owusu Danquah
Ernest Baafi
Habbibah Aggrey
Kwadwo Adofo
Kwaku Onwona-Hwesofour Asante
Kwame Obeng Dankwa
Mary Otiwaa Osei Asante
Mavis Akom
Peter Appiah-Danquah
Richard Dormatey

BIOTECH, SEED & POSTHARVEST

Abigail Amoa Owusu
Agnes Achiaa Aboagye
Agnes Nimo Bosompem
Belinda Akomeah
David Appiah-Kubi
Emmanuel Adjei-Asamoah
Faustina Okyere
Francis Osei Amoako-Andoh
Gertrude Osei-Diko
Harry Okyere
Hillary Mireku Botey
Isaac Osei Tutu
John Vinoagbe
Lily Naa Adoley Batsa
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Kirpal Agyemang Ofosu
Maxwell Darko Asante
Philip Ghanney
Phyllis Aculey
Priscilla Francisco Ribeiro
Stephen Yeboah
William Lelabi Kota
Elizabeth Norkor Nartey

LEGUMES & OIL SEEDS

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Agbesi Kwadzo Keteku
Kennedy Agyeman
Mavis Badu Brempong
Maxwell Lamptey
Paul Marno
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Clement Oppong Peprah
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Isaac Osei-Bonsu
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Esther Afoley-Annan
Esther Agyemang Marfo
Esther Nana Animah
Godfried Ohene-Mensah
Jerry Asamoah Fenteng
Joseph Adomako
Kofi Frimpong - Anin
Moses Brandford Mochiah
Stephen Arthur
Yaw Danso
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Alexander Adu-Appiah
Benedicta Nsiah Frimpong
Elvis Agyei Obeng
Harriet Achiaa Dwamena
Jonas Osei-Adu
Joyce Efia-Sarpong Haleegoah
Lydia Brobbey
Monica Opoku
Natson Eyram Amengor
Patricia Pinamang Acheampong
Richard Adabah

AGRIC ENGINEERING/TRANSPORT

Michael Tetteh Odamtten
Patricia Amankwaa - Yeboah
Shadrack Kwadwo Amponsah

2023 SCIENTIFIC PUBLICATIONS

Refereed Journal Papers

1. **Acheampong, P. P. Asante, B. O., Annan-Afful, E., Yeboah, S., Amankwah-Yeboah, P., Darkey, S. K., Aidoo, A. K., Asante, M. O. O., Akom, M., Yeboah, E., Ofori, P., Ennin, S. A. & Nsafoah, G. S. L.** (2023).Struggles over staples production? Constraints and food crops technologies adoptions of smallholder cocoa farmers in Ghana's Bono, Ahafo and Western North regions. *Journal of Agriculture and Food Research* 13 (2023) 100630. https://doi.org/10.1016/j.jafr.2023.100630

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Introgression of blast and Rice yellow mottle virus (RYMV) resistances into popular aromatic rice varieties in Ghana through marker-assisted backcrossing

Authors: **Ofosu, K.A., William, M., Oppong, A., Gamenyah, D., Aculey, P., Nartey, N.E., Peprah, R., Asante, M.D.**

Rice yellow mottle virus disease and rice blast are the two most important rice diseases in sub Sahara Africa. RYMV causes 25 to 100% yield losses in rice, depending on the variety and period of infection. Six serotypes of the virus are found in Africa, with the S2 serotype being predominant in Ghana. Rice blast is a fungal disease caused by Magnaporthe oryza. Yield losses due to blast can reach up to 100% if the disease is not properly controlled. The most popular aromatic rice varieties in Ghana are either susceptible or moderately susceptible to rice blast and RYMV. In this study, we employed marker-assisted backcrossing using KASP SNP markers, to introgress the RYMV-resistant gene, RYMV1 (rymv1-2), and blast-resistant gene, Pi_54 from the donor Gigante into four popular aromatic rice varieties (CRI-AgraRice, Jasmine 85, Togo Marshall and CRI Amankwatia). At B3F2, 86 out of 1,489 plants genotyped had both the rymv1-2 and Pi_54 resistant genes. These resistant lines were screened for RYMV using isolates from hotspots of these diseases in Ghana. All introgressed lines showed high resistance to RYMV based on disease severity scores and DAS-ELISA test results. Mid-density genotyping was performed for 71 selected lines from these four crosses using a panel of approximately 1100 DArT markers to identify lines with high recurrent parent genome. A total of 18 out of the 71 lines had 85% or above in terms of percent recurrent parent genome. Results of a preliminary yield trial (PYT) showed some of these introgressed lines had slightly higher yields ($P<0.05$) as compared to their recurrent parents. These lines will be inoculated with blast isolates from Ghana. It is expected that high yielding RYMV and blast-resistant versions of the four popular rice varieties would be released to replace the existing susceptible varieties.

Exploring Gender Differences in the Role of Trait Preferences among Stakeholders in the Rice Value Chain in Ghana

Authors: **Asante, B. O., Frimpong, B. N., Asante, M. D., Prah, S., Ayeh, S. J., Sakyiamah, B., and Tufan, H. A.**

This paper examines the gendered trait preferences for rice and their role in the adoption of improved rice varieties among men and women rice farmers in Ghana. Four hundred rice farm households and 261 consumers were surveyed across 20 communities using a simple random sampling technique. Kendall's coefficient of concordance, Tobit, and the multivariate probit regressions were used in the analyses. The results show differences in preferences for cooking quality traits and postharvest traits among men and women farmers. There was also a gender differential in the intensity of purchasing rice among men and women consumers. The results show that rice farmers' decisions to adopt any of the four varieties AGRA rice, Jasmine, Togo Marshall, or Amankwatia—are influenced by age, being married or indigenous, years of schooling, off-farm activities, farming experience, household size, farm size, FBO membership, extension contact, market proximity, and access to credit. To improve the rice value chain in Ghana, rice breeding efforts should consider varieties with trait preferences such as being tolerant of pest and diseases, aromatic, early maturing, and tolerance to shattering. However, to enhance the consumption of improved rice varieties, breeding efforts should target varieties that are aromatic, good textured, and have medium-sized grains for female consumers, while for male consumers preferred varieties would be less easily broken, white grain color, translucent, and with short cooking time.

Comparison of the effectiveness of heterotic grouping methods in classifying intermediate maturing maize (Zea mays L.) inbred lines under stressful and non-stressful environments.

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The effectiveness of a hybrid breeding program depends on the heterotic patterns that can be used to utilize grain-yield heterosis. This study was carried out to (a) categorize inbred lines into heterotic groups using three different methods and (b) determine the most effective heterotic grouping method for categorizing set of inbred lines. A total of 96 hybrids generated from thirty-two set of inbred lines crossed to three elite testers (87036, 1368 and 9071) using the line × tester design were evaluated together with three checks under low N (30 kg ha-1) and high N (90 kg ha-1 N) environments at three locations in Ghana. Classification of inbred lines were based on three different methods: Heterotic group's specific and general combining ability (HSGCA), specific combining ability (SCA), and general combining ability effects of multiple traits (HGCAMT). The SCA approach, which had the highest breeding efficiency across all test environments, was ultimately determined to be the most effective way for classification. The inbred in each heterotic group may be recombined to form populations which could be improved through recurrent selection. The various heterotic groups can be useful in designing hybridization strategies to create maize hybrids that are both high-yielding and tolerant to low levels of nitrogen in stressful environments.

Maize-groundnut intercropping to manage fall armyworm and improved crop productivity in smallholder farming systems.

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Fall armyworm (*Spodoptera frugiperda*) could cause significant losses in maize production in sub-Saharan Africa, thereby threatening the livelihoods of smallholder farmers. Farming systems such as maize-legume intercropping could reduce fall armyworm (FAW) infestations. However, the impact of maize-groundnut intercropping on fall armyworm infestation and its severity is unknown. We, therefore, assessed the impact of intercropping maize with groundnut planted at different times on fall armyworm infestation while exploring the benefits of groundnut to soil fertility improvement. The study was conducted during the minor 2018 and major cropping season in 2018 and 2019, respectively. Maize-groundnut intercropped treated soils increased the concentrations of Nitrate-N, ammonium, and microbial biomass carbon by 31%, 42%, and 45% respectively, compared with non-groundnut treated soils (control). The treatments had no significant effect on FAW infestation and severity. The number of infected maize plants in Ejura was 68% more than in Fumesua and 88% higher in the minor season than in the major season, irrespective of location. The results also indicated that the severity of FAW infestation determined 30% of the maize grain yield. Major seasons and locations interactively influenced maize grain yield, with the major rainy seasons recording 43% more grain yield than the minor seasons. The study provides further understanding of the mechanisms involved in controlling FAW infestation under maize-groundnut intercropping.

Productivity of onion (Allium cepa L.) as influenced by composted poultry manure and fishpond waste in an aquaponics-based food system.

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Sustainable intensification of food production with aquaponics-based food systems requires conscious efforts of soil amelioration with the rich organic outflows to realize the closed nature of such integrated systems. This study assessed the effects of composted poultry manure and fishpond waste on the growth and yield of onion (*Allium cepa* L.) for sustainable production by smallholder farmers. A randomized complete block design on-station study was conducted in an aquaponics-based system at the CSIR-Crops Research Institute, Kumasi, in the 2016 minor season. The onion cultivar "Boko red" was grown under three treatments; 0 application (absolute control), 12 t/ha composted poultry manure, and 6 t/ha composted poultry manure plus 25 l/hill of pond water derived based on the crop nutrient requirements. Growth parameters (plant height and the number of leaves) were taken weekly from four weeks after transplanting, as well as yield parameters (total dry matter and total bulb weight). Among the treatments, the highest mean yield (25381 kg/ha) was attained with composted poultry manure and pond water combined. This shows the potential usage of organic waste as alternate sources of fertilizers for vegetable production, in integrated aquaculture systems. Organic waste such as poultry manure, droppings of small ruminants, fishpond waste, crop residues etc., are freely and abundantly available in integrated aquaculture systems, and can substitute inorganic fertilizers with considerably benefit to farmers by increasing yield.

Critical attributes and considerations for selecting irrigation systems for wastewater

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With increasing global population, the gap between the supply and demand for water is widening and poses a threat to human existence. In the face of water scarcity, urban wastewater is increasing in its attention as an alternate water source for crop production. However, several challenges such as toxicity hazards, salinity build-up and health concerns have been identified with the use of wastewater in agriculture. There are several technological solutions that can help ameliorate or lower the level of contamination associated with using wastewater for irrigation. This paper explores the use of some irrigation technologies to abate the toxicity and health concerns associated with wastewater irrigation. The paper identifies some decision parameters for the selection of identified irrigation technologies and subjects them to multi-criteria decision analysis (MCDA) to rank them based on the level of exposure of the crop and irrigator/field worker to contamination among other relevant criteria. This paper validates that limiting the contact of the wastewater with the edible parts of the crop, especially for leafy vegetables, can minimize contamination to the crop and field workers. Though not totally without constraints, the identified irrigation methods present prospects for a cleaner and more sustainable production with regard to wastewater usage in agriculture. Sub-surface drip irrigation systems were identified as the best irrigation system for filtered and treated wastewater followed by surface drip and pitcher irrigation. Irrigators can fall back on some of these identified methods for wastewater application for sustainable crop production and maximized food safety.

Physiological resilience of bambara groundnut (Vigna subterranea L. Verdc) genotypes to intermittent periods of drought stress at different growth stages

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Different genotypes of Bambara groundnut (Vigna subterranea L. Verdc) grow well under conducive environmental conditions, provided that adequate soil moisture is available during vegetative and reproductive phases. However, drought stress is the major limiting factor to bambara production, which accounts for up to 40% of yield losses. This situation could worsen due to drastic and rapid changes in the global climate. Landraces grown by farmers are low-yielding. Understanding the physiological response of different genotypes to drought stress is key to achieving food security through crop improvement and diversification. This study focused on variations in the response of Bam-bara groundnut genotypes to intermittent drought stress during the crop's critical growth (vegetative and reproductive) stages. The experiment was undertaken at CSIR-Crops Research Institute Screen-house. The treatments were used in a factorial experiment with three replications in a randomized complete block design. The Bambara genotypes showed considerable variability in tolerance to drought stress. Drought stress during vegetative and reproductive stages significantly reduced crop growth indices, the leaf relative water content, chlorophyll content and leaf area. Drought stress during vegetative and reproductive stages had a more severe impact on the seed yield of genotype Nav Red, reducing it by 69% and 13%, respectively. Farmers should pay more attention to adopting drought-tolerant and high-yielding varieties for improved Bambara groundnut productivity and livelihoods.

ISSN 2590-9606

Design & Print : 2P Koncept - 0246774334