OACPS R&I | OACPS RESEARCH AND INNOVATION PROGRAMME

INNOVATION FUND

Unlocking productivity within smallholder farming systems through use of digital and green technology in the face of climate change

Parent project: Strengthening agricultural knowledge and the innovation ecosystem for inclusive rural transformation and livelihoods in Eastern Africa (AIRTEA)

PROJECT COORDINATOR
Koppert Biological Systems, Kenya

PARTENAIRES
Kenyatta University, Kenya Agricultural and Livestock Organization (KALRO), Geo Spatial Research International

LOCATION
Kenya

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SECTOR
Agriculture

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CHALLENGE

At global scale, agriculture is shown to directly contribute 10-12% of global greenhouse gas (GHG) emissions. This situation requires a new paradigm shift for global agriculture where efficient use of nitrogen (N) fertilizer produce higher yields with concomitant reduction in both reactive N losses and GHG emissions. In Kenya, agriculture contributes about 27% to the Gross Domestic Product (GDP), but yields of major crops remain below the global average. Biotic and abiotic factors are the main challenges affecting smallholder farmers and this has been exacerbated by climate change, which is largely attributed to GHG emissions, putting the livelihoods of smallholder farmers at stake.

Umoja farmers and Homabay county extension officers during a training workshop on green and digital technologies.

PERSPECTIVES

The agricultural sector is the mainstay of the rural Kenyan economy around which socio-economic privileges and deprivations revolve, and any change in its structure is likely to have a corresponding impact on the existing pattern of social equality. No strategy for economic reform can succeed without sustained and broad-based agricultural development, which is critical for raising living standards, alleviating poverty, assuring food security, generating a buoyant market for expansion of industry and services, and making a substantial contribution to national economic growth.

JUSTIFICATION

Future growth in agriculture must come from new technologies which are not only cost-effective, in conformity with natural climatic conditions of the country and relevant to rain-fed areas, but also address: continued genetic improvements for better seeds and yields; data improvements for better research, better results, and sustainable planning; bridging the gap between knowledge and practice; and judicious land use resource surveys, efficient management practices and sustainable use of natural resources. The project will introduce climate change adaptation strategies, such as the use of biological (green) technologies, Geospatial Technology (in particular Geographic Information Systems, GIS) and Artificial Intelligence (AI) that will ensure Nutrient Use Efficiency (NUE), Water Use Efficiency (WUE), Integrated Pest Management (IPM) and sustainability in smallholder farming systems.

METHOD

Monitoring crop health through farm parcel data and Normalized Difference Vegetation Index (NDVI) through a Geoportal will provide information to farmers through a mobile app (CropDig) that the project will develop. GIS field data and open-source data will be used to assess crop health, pest and disease infestation, and information on control measures provided to farmers.

The GIS system will provide a platform for crop health and crop yield monitoring. The AI identification model will use the Convolutional Neural Network (CNN) algorithms that are trained to identify symptoms, morphological characteristics, soil moisture data, plant nutrient deficiency, beneficial insects, as well as plant damage caused by arthropod pests and diseases.

AI tools will be used to examine plant arthropod pests and diseases on selected farms by performing real-time analysis of the images displayed on a smartphone screen when using CropDig Maize farmers and agricultural extension agents will be trained on-farm on GIS, AI and improved application of biological inputs.

Knowledge sharing and linkages will be achieved through; formation of networks consisting of youths to assist farmers to read and understand training materials tailored to farmers and youths. These networks will further support engagement (interaction) between agricultural extension agents and farmers in promoting new technologies during field days, workshops and agricultural forums.

INNOVATIVENESS

The technological innovations and geospatial technology developed through this project will contribute to creating dynamic and competitive agriculture practices that are protective to the environment as well as providing excellent nutrition to people. GIS tools and online web resources help farmers conduct crop forecasting and manage their agricultural production by utilising multispectral imagery collected by satellites.

The ability of GIS to analyse and visualise agricultural environments has proven to be very beneficial to the farming industry, because GIS has the capability to analyse various soil data and determine which crops should be planted where and how to maintain soil fertility. ers, agronomists and extensionists.

GIS will be used for monitoring crop health and yields (by using the NDVI). AI-based equipment and machines have taken today's agricultural system to a different level and have enhanced crop production and improved real-time monitoring, harvesting, processing and marketing. AI-based technological solutions such as precision farming can vastly improve outputs with less inputs.

The use of AI technologies has become commercially feasible through advances in big-data analytics, increased computing power and cloud-based storage, as well as cost reductions in satellite imagery, remote sensors and other hardware (including smart phones), and the increased affordability and availability of mobile connectivity.

AI technologies will inform the precision application of biological-based interventions within smallholder farms for pest management, soil amendment and plant growth. AI will also be linked to market systems by looping in all the main actors within agricultural value chains. The information obtained from both the GIS system and AI will be integrated in a farmer-friendly mobile application for farmers, agronomists and extensionists.

A farmer field school in Machakos discussing Good Agricultural Practices in Maize production.

Members of the Youngstar Youth farmer group and Machakos county extension officer during field training on CropDig

EXPECTED RESULTS

Impact

- Improved livelihoods in the smallholder farming households in Machakos, Kitui, Migori and Homabay counties in Kenya

Outcome

- Increased use of digital and green farming solutions in maize productio by women and youth.

- Improved E-extension services of public and private extension agencies.

- Improved access to the maize market by smallholder farmers.

Outputs

- Smallholder farmers capacitated and mentored on green and digital technologies.

- Green and digital farming technology apps developed for maize production.

- Innovation Platforms for green and digital technologies for maize production strengthened or established.

- Youth and women capacitated on starting new businesses offering green and digital technologies.

- Market linkages created for smallholder farmers applying green and digital technologies.