Food and Agriculture Organization of the United Nations

e-Agriculture Promising Practice Agro-weather Tool for climate smart agriculture

Harnessing climate data from research to help smallholder farmers in Kenya

Key facts

- **Location:** Arid and semi-arid regions of Kenya
- **ICT used:** Mobile and web based information services
- **Area of work:** Climate and weather
- **Target group**: smallholder farmers
- **Stakeholders:** researchers, students, policy makers and Kenya Agricultural and Livestock Research Organization (KALRO)
- **Timeframe:** Since 2014

In order to support Kenyan farmers, the Kenyan Agricultural and Livestock Research Organization (KALRO) developed the Agro-Weather Tool. The farmers still rely heavily on traditional methods to understand weather predictions and those do not allow them to mitigate the risks brought about by climate change

The Agro-Weather Tool is a web and mobile-based information system that incorporates climate information and good agricultural practices for farmers. The tool has been developed to help farmers better manage weather risks, maximize productivity and minimize the environmental impact of farming practices.

In further support of the farmers in the arid and semi-arid regions of Kenya, KALRO also developed KALRO Knowledge Hub and mobile applications.

Context and problem addressed

Climate change is a challenge to development in general, but specifically challenging for smallholder farmers producing food in Kenya. Kenyan farmers rely heavily on traditional methods to understand weather predictions but these do not allow them to mitigate risks brought about by climate change.

Systems that integrate weather data with findings from agricultural research are often weak in Kenya. As a result, farmers still have to rely on their own observations of the weather, as they are not able to make sense from weather data sets made available by meteorological stations or researchers. Farmers adapt their agricultural practices based on their own previous experiences but it is hard to keep up with new tendencies in the climate or extreme weather events. Furthermore the lack of information systems makes it also hard to keep up with the growing complexity of the markets, the new production techniques and different other important aspects of the agricultural value chains.

To improve the access of smallholder farmers to accurate, timely and useful information on weather and climate change, it is important to increase the impact of knowledge and information generated by researchers. Only when weather and climate information is translated into valuable advice on how to adapt agricultural practices accordingly, it is of true value for farmers.

In addition, growing demand for centralized but standardized knowledge and information to support agricultural research and development in Kenya. Farmers, scientists, policy and decision makers, extension service providers and all kinds of organizations increasingly need specialized information and knowledge to perform their respective roles as actors in the agricultural transformation process. The KALRO Knowledge Hub platform and mobile applications have been central in facilitating access to and flow of agricultural research information and knowledge in the project areas and beyond.

Role of the stakeholders

Kenya Agricultural and Livestock Research Organization (KALRO) has developed the Agro-Weather Tool and related applications and the systems are hosted within the organization. From 2014 to date the Kenya Agricultural and Livestock Research Organization has been involved in the provision of processed climate information through technological developments and dissemination of information and agricultural advisories using ICTs. As a result KALRO has been able to tackle issues of access, sharing, analyses, utilization and management of agricultural research data, information and knowledge, including providing location specific usable information on climate change to smallholder farmers. These efforts have translated scientific research into usable information and improved equitable access and utilization of research outputs. The practice of data, information and knowledge sharing using ICTs has been implemented in different locations in Kenya and the systems and tools are hosted at Kenya Agricultural and Livestock Research Organization (KALRO). Other stakeholders in the process include:

- Meteorological professionals provide weather and climate data
- Agricultural research scientists provide research data, agronomic information and agricultural research knowledge
- Data scientists and managers provide analysis, management and interpretation of analyzed information
- ICT professionals provide expertise in systems development, database architecture design, systems integration, communication, data mining and modeling.

The KALRO Knowledge Hub brings together knowledge, data and information on agriculture and livestock. https://asalkhub.kalro.org

Development

Datasets

Over the years, agricultural research in Kenya has generated important datasets through various programs and research activities. These datasets include information on rural farming such as crop varieties, acreage cultivated, faced challenges, number and types of livestock; farmer household data; productivity levels; agricultural technologies adopted and adapted; farming systems among others.

Agro-Weather Tool

Those data sets, together with the data and information received from meteorological systems feed into the Agro-weather Tool and are processed through a built-in algorithm. The Agro-Weather Tool generates location specific information based on the forecast information and data provided. Researchers use this processed information to generate advisories that are disseminated to the farmers through short messaging system (SMS) technology, web-based portals and interactive voice response system.

Identification of stakeholders' needs and expectations is undertaken during registration as they specify their value chains. This helps in understanding the different types of knowledge, information and services required. For instance, using GIS tools allow the integration of multiple datasets with ecological requirements of crops thus generating crop suitability maps at national and regional scales for specific crop suitability assessments. Further, the integration of biophysical data to assess land capabilities for evidence based decision support in planning has informed the decision and design of national and regional development projects.

The practice in anchored on a virtual platform. An integrated Agro-Weather Tool and knowledge management system is developed using artificial intelligence (i.e. agent based) technology. It has an interface that uses SMS and Unstructured Supplementary Service Data (USSD) technology generating and provision of timely agronomic advisories. It also utilizes an online gateway that includes a webportal, knowledge management systems and Interactive Voice Response services (IVR's). In addition it employs Geographical Information Systems (GIS) properties in mapping and processing geospatial data and information.

Knowledge Hub and Applications

KALRO, through the Arid and Semi-Arid Lands Agricultural Productivity Research Project (ASAL-APRP), a European Union (EU) funded initiative, has also established a Knowledge and Information Hub (K-Hub) including mobile applications. The aim of the K-hub is to improve delivery and impact of scientific knowledge, policy options and technologies. ASAL-APRP has improved delivery and impact of scientific knowledge, policy options and technologies as a powerful instrument to drive increased adoption of KALRO's agricultural technologies among the pastoralists/farmers in ASAL areas. The KALRO ASAL K-Hub is envisioned to provide equitable access and utilization of agricultural knowledge and information within and beyond project areas. The K-Hub is a focal point for the generation, exchange of knowledge, create network of community of practice and visualize analyzed available agricultural datasets for decision-making. Among other things, the K-hub mainstreams new scientific concepts in technology

KALRO has developed 3 applications (dryland crops, chicken and pasture seed) to provide guidelines in acquisition of technologies, production and management, disease and pest control, record keeping, market information and economic analysis. They can be downloaded for free from Google Play and Safcom Store.

innovation, management practices and policies in the Kenya. It serves to facilitate learning and increase the capabilities of ASAL-APRPs stakeholders, which include farmers, policy makers, national agricultural extension, research and academic institutions, relevant government institutions, development partners, private sector and NGOs amongst others. The mobile applications support increased access to KALRO research technologies and management practices.

Impact

Farmers with access to agro-weather information (beneficiaries) recorded an average maize yield of 970 kilograms (kg) per hectare (ha) compared with 210 kg per ha for non-beneficiaries. The average income from maize for the beneficiaries was 9 402 Kenya shillings (KSh) compared with 3 918 KSh for non-beneficiaries.

A study conducted by the World Bank in 2016 (WB Group report number 103186-KE) showed the impacts of a failed season in which there was insufficient water to meet crop requirements, leading to lower yields despite increased labor inputs, were more pronounced on non-beneficiaries, who were markedly less prepared to adapt to weather variability. The practice has a remarkable impact on crop yields and income as reported by farmers in Embu County in Kenya

Through generation of weather patterns for specific locations with enough accuracy, farmers were able to plan better and take timely decisions at different levels of the agricultural production system. Thanks to improved access to this information, farmers now know better when to plant and what to plant. The Agro-Weather Tool has improved the way farmers manage weather risks through maximizing their productivity and minimize the environmental impacts. The Agro-Weather Tool has effectively enabled farmers to make appropriate decisions in their choice of value chains. It is highly useful in making and complementing recommendations about which agricultural innovations and management practice to use for example which farm inputs they should use. It has been used to good advantage by extension services and farmer organizations, resulting in higher rates of adoption of new agricultural Technologies and Innovation and Management Practices (TIMPs) such as varieties and agronomic practices.

Innovation and success factors

The system and tools combine climate and weather information, agronomic research knowledge and ICTs, in particular web 2.0; mobile devices; virtualization; consolidation; converged communication; open standards and Geographical Information System (GIS) through automation to generate customized and personally relevant advisories to small holder farmers using simple, affordable and available technologies such as mobile phones. They offer a necessary complement to the traditional knowledge of the farmers on weather forecasts that now are altered due to climate change.

Constraints and challenges

Various challenges affect effective use of climate-related information to improve the lives of smallholder farmers. Critical gaps exist regarding the design, delivery, and relevance of climate-related information as provided by the weather observation network. This makes it difficult to use the information for risk management, application of appropriate agricultural practices and selection of the right agricultural technology among smallholder farmers.

More specifically there are also difficulties in tailoring content, downscaling the information to location specific information, as well as providing real-time information that reaches the farms timely for decision-making. Other challenges include providing timely access to remote rural communities with marginal infrastructure and ensuring farmers own the climate information services to be able to contribute to the design and delivery of the information.

Furthermore it is also challenging to link the information on climate to a larger package of agricultural advisory services that will enable farmers to take appropriate action with a more global vision.

During the initial stages of developing the Agro-Weather Tool and systems, it was necessary to

undertake a mapping of the priorities of the stakeholders in the value chain. This process was lengthy and laborious as it involved meeting physically with the stakeholders involved that lived in remote rural areas. Nevertheless, these meetings were important to identify the needs and also to ensure the registration of farmers to the service. Some of the beneficiaries had literacy challenges and this was addressed through the development of interactive voice recording system and translation of advisories into local languages.

Additionally, the cost of undertaking voice recording and sending information to the farmers remains a constraint to date. However, by charging a small fee to those who receive the messages it is expected to help meet the costs of the translation and telecommunications levied by the service providers for offering the services.

Lessons learned

Access to climate information can empower farmers to undertake proper planning and make effective decision towards adopting climate smart agricultural practices. Adopting and adapting these practices leads to reduction in losses related to climate change impacts. Provision of timely information to farmers with accompanied information on step-by-step agronomic guides and training has shown results as a good intervention and innovation in addressing information gaps that moves research findings from theory to practical application. This has enable farmers to make the right decisions and strengthening of their adaptive capacity and resilience. The development of the Agro-Weather Tool and ensuring it responded well to the needs of the smallholder farmers was a lengthy process, that also came with a certain cost. It is difficult to calculate the amount that needs to be invested in such a tool ahead of the development and implementation.

Sustainability

The practice could be financially sustainable and affordable, if farmers start paying small amounts of money for the information they receive.

98% of farmers in Kenya own and have access to mobile phones and many of them are smallholder farmers that would benefit from using the Agro-Weather Tool. Climate change and food insecurity are a real threat and access to the right information at the right time offers more opportunities and outweighs the minimal costs of messages that might be charged. The idea for sustainability is anchored on the social enterprise model. In this case farmers will be required to pay for cost of sending the information. The cost of infrastructure is undertaken with funds from international development partners and is premised on the foundation of public good. Generation of climate and research information is a critical component of agriculture, which is supported by several initiatives, programs and governments. Arrangements and agreements have been made and signed between relevant parties who are responsible for information generation to ensure its sustainability and continuous updates of the system. The processing of both climate and agronomics data and information has been automated into the Agro-Weather Tool and knowledge management systems.

Replicability and upscaling

The pilot project enlisted the participation of 4,500 farmers, who were stratified into four categories according to their crop of interest: tea, coffee, sorghum, and maize and beans (maize is usually intercropped with beans). The beneficiaries indicated that the information provided improved use of farm resources, changed planting and harvesting practices, and was effectively used to prevent pest and disease attacks. During the implementation of the project, significant differences emerged between beneficiaries and a non-beneficiary control group, with the mean score of the beneficiary group higher than the non-beneficiary group. It would be possible to upscale the use of the Agro-Weather tool to larger groups of farmers. The systems combines several ICT tools and technologies capable of providing downscaled, location specific, timely, relevant and cost-effective agro-weather information including livestock and agronomic advisories modeled in line with the projected weather/climate to enable farmers adopt climate smart agriculture and farm management practices. It is robust and applicable in any setting.

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Resources

- http://agroweather.kalro.org;
- https://asalkhub.kalro.org

E-AGRICULTURE CALL FOR GOOD AND PROMISING PRACTICES

This document was developed in the framework of the 2017 e-Agriculture Call for Good and Promising Practices on the use of ICTs for Agriculture and Rural Development in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the Technical Centre for Agricultural and Rural Cooperation (CTA).

e-Agriculture is always happy to review your good or promising practices! You can submit a proposal, following the sections in this document to e-agriculture@fao.org
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Good and Promising Practices on the use ICT for agriculture in collaboration with CTA