Info Note

Enhancing National Climate Services (ENACTS) approach to support climate resilience in agriculture

Improving availability, access, and use of historical climate information

Tufa Dinku, James Hansen, Alison Rose, Beau Damen, and Michael Sheinkman

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Key messages

- Many opportunities to improve agricultural resilience to a variable and changing climate depend on access to high-quality local climate records and are constrained by data gaps. Addressing data quality of meteorological station observations
- The ENACTS approach builds capacity of a National Meteorological Service (NMS) to produce higher quality historical climate data in gridded format, ready for use by the agriculture sector for modeling and/or mapping.
- The ENACTS approach involves collaboration with NMS to apply quality-control methods to available station data and to blend that station data with satellite measurements and reanalysis products using the IRI Climate Data Tools (CDT). The resulting gridded data products combine the benefits of high quality station data with the spatial and temporal coverage of satellite and reanalysis data products. The quality of ENACTS data products is higher than global gridded datasets because additional station data has been incorporated.
- Online "Map-rooms" support access to a range of derived climate information products and tools.
- ENACTS has already enabled 11 African countries and 2 regional centers to improve their climate services. The IRI Climate Data Tool and the ENACTS approach also offer a proven solution to needs identified in Asia and the Pacific

FAO Regional Office for Asia and the Pacific (FAORAP) climate change initiative

The FAO Strategy on Climate Change (FAO, 2017a) aligns their program of work with recent global agreements, including: the Paris Agreement on Climate Change; and the Sendai Framework for Disaster Risk Reduction, and the 2030 Agenda on Sustainable Development. The Strategy outlines a Plan of Action which includes enhancing the capacities of FAO member countries to plan, implement, monitor, and report on climate change adaptation and mitigation. The results framework for this Plan of Action (FAO, 2017b) describes the specific outputs and indicators, which include support for:

- Technical and policy exchanges involving multiple countries;
- Integration of agriculture and food security considerations into national and regional policies and strategies;
- Strengthened capacity to collect, generate, and analyze data and information to support decision making about climate change adaptation and mitigation, early warning systems, and/or value chain management;
- Application of tools for analysis of and planning for the impacts of climate change;
- Adoption of Disaster Risk Reduction plans, practices, guidelines, and standards;
- Pilot testing, validation and adoption of Climate-Smart Agriculture approaches, practices, and technologies;
- Implementation of Nationally Determined Contributions; and
- Leveraging national and international climate finance for the food and agriculture sectors.

International Research Institute for Climate and Society
Earth Institute | Columbia University
Food and Agriculture Organization of the United Nations
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The FAO Regional Office for Asia and the Pacific (FAORAP) is implementing a Regional Initiative on Climate Change (RI-CC) to support the Strategy and its Action Plan at regional and national levels (FAORAP, 2018). To deliver technical knowledge and expertise, FAO is leveraging its strategic partnerships with research and implementation actors, including CGIAR centers and their partners in the national agricultural research and extension services. CCAFS Info Notes are one of the mechanisms FAORAP is using to disseminate information to member states in Asia and the Pacific. This Info Note describes application of the Enhancing National Climate Services (ENACTS), a set of tools that build the capacity of national meteorological agencies to improve the quality and availability of historical climate data and to generate climate information products and services useful to the agriculture sector.

Climate-resilient agriculture depends on local historical climate data

Many opportunities to make agriculture more resilient to a variable and changing climate depend on local historical climate data and have not been fully exploited in part because of gaps in climate data. For example:

Improving food security early warning and response. In many countries, effective food security management depends on timely estimates of agricultural production at national and sub-national levels. Systems for monitoring and estimating impacts of climate on staple crop production are an important component of climate resilience. High-quality historical climate records in gridded format can contribute to more accurate estimates of agricultural production, when used as inputs to crop yield simulation models. When seasonal forecasts are incorporated into these simulations, the estimates can provide early warning of decreases in crop production far in advance of the harvest, allowing additional time to design and implement appropriate responses.

Adapting crops, farming systems and agricultural support to local climatic risks. Analysis of the seasonality, trends and variability that characterize local climate provides insights into the risks that farmers and value chain actors face. High quality historical climate data used as inputs to crop simulation models, can help to identify those crop varieties and agricultural extension packages appropriate for local conditions, by characterizing their climate suitability and riskiness in a manner that would require many years of conventional agronomic experiments.

Using seasonal climate forecasts for agricultural planning. There is a major gap between what is known about farmers' needs, and the format and scale of widely available seasonal forecasts. Experience shows that farmers can use seasonal forecasts effectively if they are downscaled and accompanied by local historic climate data, presented graphically in probabilistic terms, and supported through a structured participatory process. High quality historical climate data are needed as inputs to produce and evaluate downscaled seasonal forecasts.

Supporting cost-effective index insurance. Index-based agricultural insurance, which bases payouts on an objectively measured index that is correlated to loss rather than farmers' actual losses, overcomes long-standing obstacles to insuring smallholder farmers in developing countries. Reliable local near-real-time data are a prerequisite for supporting weather index insurance contracts. Accurate analysis of the insured risk, based on long-term historical climate data, is a prerequisite to offering those contracts at a fair price.

Understanding drivers of change. Analysis of local historical climate records provides a way to assess whether perceived changes in agricultural performance are driven by climate, or by other environmental changes such as soil degradation. Long-term records can indicate whether climate variations are more consistent with anthropogenic change or shorter-term natural variability.

Interventions that are effective at a pilot scale are impossible to scale out to locations that lack long-term climate records. Where they involve manual processing and analysis of daily station records, it can also be prohibitively costly to scale up services across a country.

ENACTS builds National Meteorological Service capacity to provide locally relevant services at scale

Enhancing National Climate Services (ENACTS) is an ambitious effort, developed by the IRI, to simultaneously improve the availability, access and use of climate information. This is accomplished by working with a National Meteorological Service (NMS) to (1) develop high-resolution spatially and temporally complete gridded historical meteorological data sets; (2) generate suites of derived climate information products; and (3) disseminate them through online "Map-rooms." ENACTS enables the NMS to provide enhanced climate services by overcoming the challenges of data quality, availability and access – while facilitating stakeholder engagement and use.

High-quality gridded climate data improves quality data availability

The IRI's Climate Data Tool (CDT), which does the quality control and merging in the ENACTS approach, seems to have just about reached the point where it can be shared broadly, and used independently by NMS staff with a strong background in satellite remote sensing and spatial data issues.

Merging techniques produce gridded data that combine the quality of station observations with the spatial and temporal coverage of satellite and reanalysis data. Satellite remote sensing (for precipitation) and reanalysis

(for temperature) offer spatially complete data, are freely available, and have relatively long time series (>30 years for satellite rainfall, >50 years for reanalysis). However, satellite data products generally have poor accuracy. Merging the two types of data corrects the errors in the spatially complete products, which in turn fill spatial and temporal gaps in station records (Fig. 1). The Climate Data Tools (CDT) software, developed by the IRI, enables quality control and merging process. The result is a daily or 10-daily time series dataset with over 30 years of rainfall and over 50 years of temperature, at a nominal 4 km grid, across the country.

The quality of gridded data depends on the amount of station observations they incorporate. Because developing country NMS are stewards of much more data than are available to external organizations, they can therefore produce national ENACTS data that are of higher quality than the best global data sets.

Online Map Rooms improve access to climate information and services.

Access is enhanced by making information products available online. The IRI Data Library, which is installed at the NMS, provides a powerful and highly customizable platform for deriving historical, monitored and seasonal forecast tools and products based on the gridded data; and to make these products available online in the form of an interactive "Map-room." The Map-rooms, which support analyses, visualization and download of data, open with a map view of statistics (mean, standard deviation or probability-of-exceedance) of the variable and time of year of interest. Users can access additional location-specific products for any selected grid cell or administrative polygon.

ENACTS was initially developed with gridded data on a 10-daily time step, and a basic set of Map-rooms. The Climate Analysis Map-room provides information about year-to-year variability and trends (Fig 2). The Climate Monitoring Map-room supports monitoring of the current season. The Climate Forecasting Map-room provides analysis of relationships between historic variability and predictors such as the El Niño/Southern Oscillation.

Agriculture is expanding and exploiting the ENACTS approach in Africa

Many applications of meteorological data for agriculture work require daily data. In response to demand from agricultural partners, through CCAFS engagement, the quality control and merging tools in CDT were expanded to be able to work on a daily time step. This supported the development of a flexible set of Map-room tools to support analysis of historical rain day frequency, mean rainfall intensity, wet and dry spell frequency (based on user-selected duration and wet/dry threshold), and rain-fed growing season onset dates—for user-selected periods within the year. With added requirements for soil and temperature data, soil water balance Map-room tools translate daily rainfall data into soil water content and water balance-based agricultural drought indicators such as the Water Requirements Satisfaction Index (WRSI).

New seasonal forecast Map-rooms incorporate enhancements designed to improve their usefulness for local agricultural decision-making. Major enhancements over typical forecast products include: (a) statistical downscaling onto the historical rainfall grid; (b) map views that includes probability of exceeding a user-selected rainfall amount or climatological percentile; and (c) provision of full climatological (based on historical gridded data) and forecast distributions for any user-selected grid cell (Fig 3).

The expanded Map-room product suite fits well with the requirements of well-developed and tested participatory methods for providing climate information to farming communities and supporting its use for agricultural decision-making. One such workshop-based approach, Participatory Integrated Climate Services for Agriculture (PICSA), is being integrated with NMS Map-rooms in Rwanda (Fig. 4). ENACTS enables Meteo-Rwanda to provide agricultural extension and other intermediaries with ready online access to the set of graphical historical and forecast information products that they are trained to bring to groups of farmers through the PICSA process.

ENACTS is proven and available for scaling out to Asia and the Pacific

Historical time series data are the foundation for climate services. Many options for improving the resilience of agriculture are not feasible beyond pilot scales, if climate data are not available due to gaps in time or space, limited technical capacity, and/or policy constraints.

The IRI and CCAFS have demonstrated that ENACTS is a feasible and cost-effective approach to building the capacity of national meteorological services (NMS) to expand the range of gridded climate services and products, including providing tailored climate services to farming communities in partnership with their agricultural extension services. Countries in Asia face similar data challenges in their efforts to build the resilience of their farming populations and agricultural sectors. In Asia and the Pacific, there is growing interest in using the ENACTS approach to support climate resilience in agriculture. http://iri.columbia.edu/resources/enacts/

FAO Strengthening Agro-climatic Monitoring and Information System (SAMIS)

"Strengthening Agro-climatic Monitoring and Information Systems (SAMIS) to Improve Adaptation to Climate Change and Food Security in Lao PDR" is an FAO implemented project supporting the Department of Meteorology and Hydrology (DMH) of the Ministry of

Natural Resources and Environment (MONRE) and the Ministry of Agriculture and Forestry (MAF) to meet two objectives:

- To enhance national and provincial levels monitoring, analysis, communication and use of agro-meteorological data and information for decision-making in relation to agriculture and food security.
- To improve monitoring and analysis of agricultural production systems by strengthening Land Resources Information Management Systems (LRIMS) and Agro-Ecological Zoning (AEZ) to support agricultural policies and climate-change adaptation.

The SAMIS project in Lao PDR is an example of a capacity building project, whose climate services and products would benefit from the high-quality gridded climate data produced using the ENACTS approach.

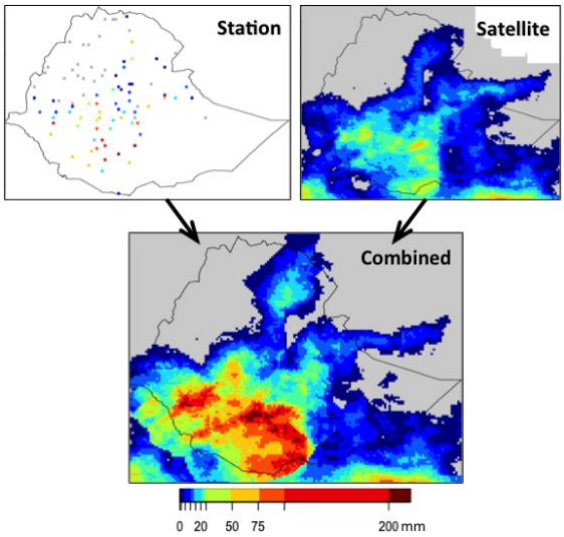

Figure 1. Comparison of station rainfall observations, satellite data and merged data for a single dekad across Ethiopia.

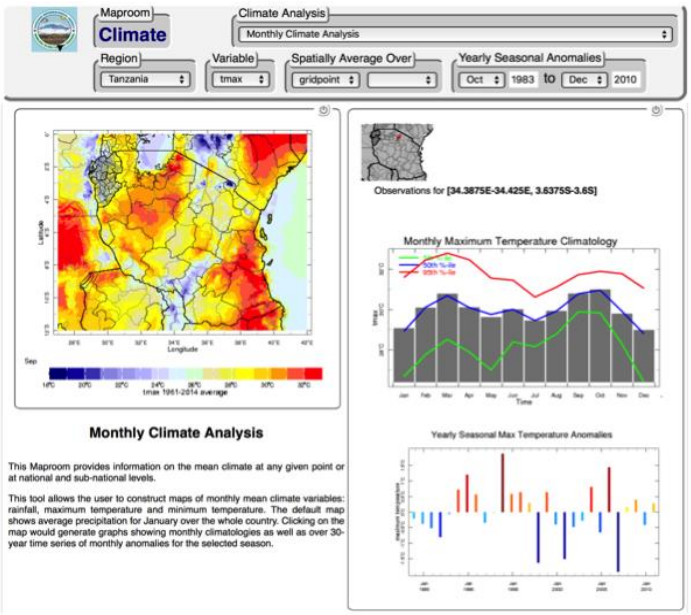

Figure 2. Tanzania's Monthly Climate Analysis Maproom analyses for a selected grid cell (http://maproom.meteo.go.tz/maproom/Climatology/Climate_Analysis).

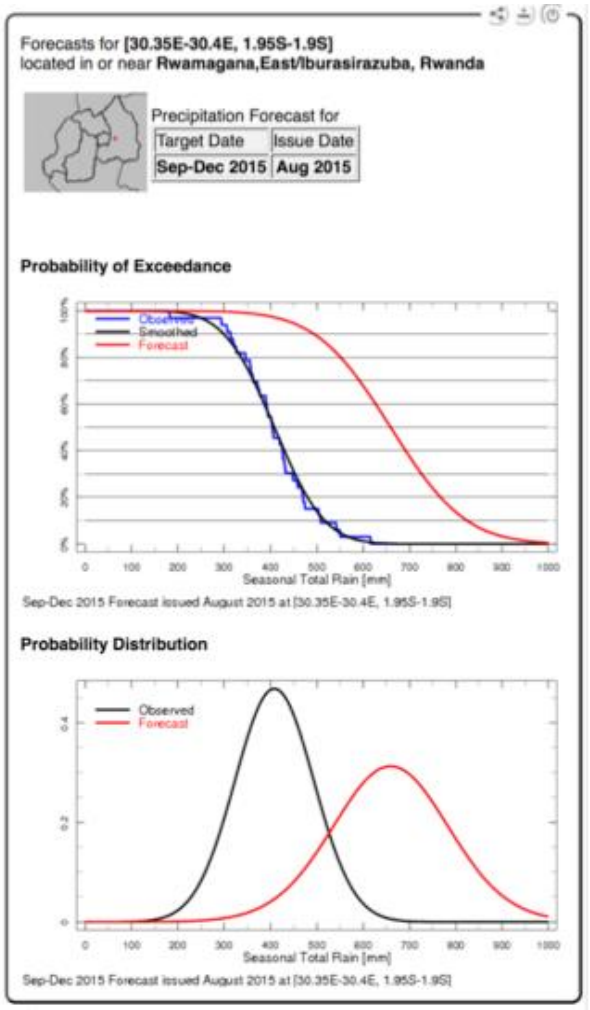

Figure 3. September-December 2015 seasonal total forecast for a selected grid cell, from Rwanda's Seasonal Precipitation Forecast Map-room (http://maproom.meteorwanda.gov.rw/maproom/Climatology/Climate_Forecast).

Further Reading

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Strengthening Agro-climate Monitoring and Information Systems (SAMIS) to improve adaptation to climate change and food security in Lao PDR (2016-2020) *[GCP/LAO/021/LDF and GCP/LAO/024/LDF] (www.thegef.org/project/strengthening-agro-climatic-monitoring-and-information-systems-improve-adaptation-climate)*

SAMIS is a Global Environment Facility (GEF) funded project that highlights FAO's role in supporting development, dissemination and use of climate services for users in the agriculture sector at multiple levels. It aims to enhance monitoring, analysis, communication and use of agro-meteorological data and information for decision-making in relation to agriculture and food security at national, provincial, and community levels. At national and provincial levels SAMIS will improve monitoring and analysis of agricultural production systems by strengthening Land Resources Information Management Systems (LRIMS) and produce Agro-Ecological Zoning (AEZ) maps to support agricultural policies and climate-change adaptation measures. Climate services tailored for community and farm-levels will be developed and pilot tested at several Farmer Field Schools.

For more information about the climate change activities of the FAO Regional Office for Asia and the Pacific (FAORAP) contact Beau Damen (Beau.Damen@FAO.org).

This brief summarizes the role of the ENACTS initiative in efforts to support climate-smart agriculture and climate-resilient farmer livelihoods in Africa, Asia and Latin America.

This series of briefs has been developed in collaboration with the FAO to inform member states about research which supports FAO initiatives, programs, or projects in Asia and the Pacific. The International Center for Tropical Agriculture (CIAT) coordinated the preparation of these briefs with CGIAR centers and partners; edited the document; and liaised with the FAO Regional Office for Asia and the Pacific.

Tufa Dinku *is a Research Scientist and leader of the ENACTS initiative, at the International Research Institute for Climate and Society (IRI), USA. (TDinku@iri.columbia.edu).*

James Hansen *is Leader of CCAFS Flagship 4 on Climate Services and Safety Nets; and a Senior Research Scientist at the International Research Institute for Climate and Society (IRI), Columbia University, Palisades, NY USA. (JHansen@iri.columbia.edu)*

Alison Rose *is Science Officer of CCAFS Flagship 4, at the International Research Institute for Climate and Society (IRI), Columbia University, Palisades, New York, USA. (ARose@iri.columbia.edu)*

Peter Läderach *is a Senior Climate Change Specialist at CIAT. (P.Laderach@cgiar.org).*

Michael Sheinkman *is a Regional Affiliate Expert on Climate / Disaster Risks at CIAT (mas25@columbia.edu)*

Beau Damen *is a Natural Resources Officer at the FAO Regional Office for Asia and the Pacific (FAORAP) (Beau.Damen@FAO.org)*

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The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) brings together some of the world's best researchers in agricultural science, development research, climate science and Earth System science, to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security. Visit us online at **https://ccafs.cgiar.org**.

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