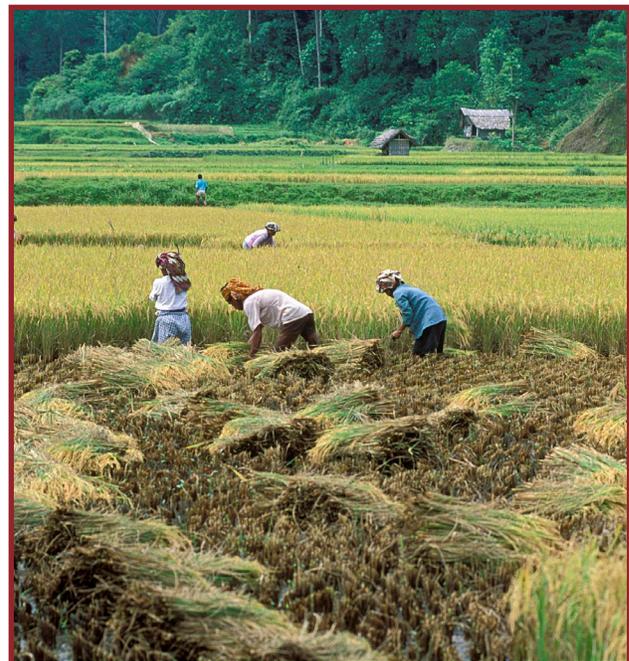


# Increasing Agricultural Production and Resilience Through Climate Information Services

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More than any other sector of the economy, agriculture relies directly on the natural resource base—that is the land and water resources that are essential elements of crop and livestock production. Agriculture takes up 40 percent of global land area and uses 70 percent of global freshwater resources. Nor is any other sector as vulnerable to the effects of climate change. The challenge facing farmers today and in coming decades is not just to maintain current production levels, but to increase them dramatically—enough to feed some nine billion people by the year 2050.

A fundamental way to enable farmers to meet this challenge in the face of climate-related stresses is to provide them with timely and highly practical information. Climate information services (CIS) include immediate and short term weather forecasts and advisories as well as longer term info about new seeds and technologies and market information. CIS is especially useful in helping farmers to manage risks in what is already an exceptionally risky sector in which to operate, and in reducing uncertainty that so often constrains decision making. CIS is designed to inform their decisions about what to grow, when to plant and harvest, how to allocate their labor, and where to sell their produce. Much of this information is specifically adapted for use in local conditions and quickly becomes recognized as being highly relevant to the needs of producers operating in local contexts. This note examines how CIS was applied in Ethiopia and Kenya, which like many African countries have limited irrigation



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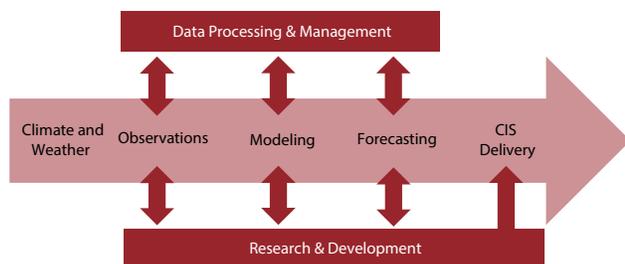
\* Note: North West University Mafikeng Campus, Mmabatho, South Africa.

infrastructure and are therefore highly dependent on rain-fed agriculture. Improving the generation of agro-meteorological and hydro-meteorological information, and promoting the active use of this information on the part of end users in these settings is an urgent necessity.

The capacity of both the providers and the users of these services is out of necessity a major focus, given that a) national agro- and hydro-meteorological services in African countries are typically chronically underfunded, and b) the primary intended beneficiaries of these services are smallholder farmers, much of whose production is geared to subsistence, and few if any of whom have much familiarity with non-traditional varieties and methods which are likely to prove instrumental to both their continued subsistence and to any prospective transition towards producing for markets. Developing their practical understanding of what the information means and how to use it entails an important element of education and training.

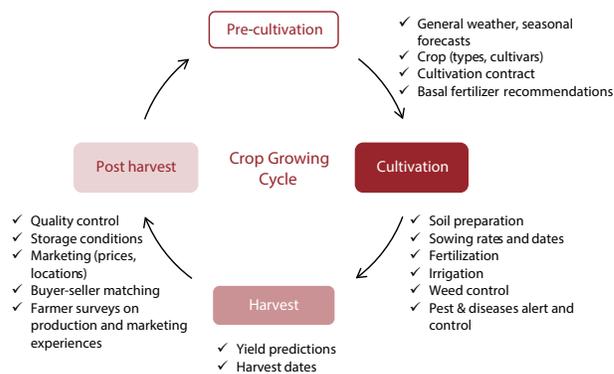
The CIS concept itself refers to an integrated system or process of which the end user is an integral part (Figure 1), and in this way is a kind of expansion of the closely related notion of agro-weather services and observation systems. While agro-weather services are quite central to CIS, the notion of climate related services connotes a kind of permanent relationship between observers, modelers, forecasters, and farmers which leaves producers in particular in a state of preparedness, of *knowing what to do* in order to adapt not only to seasonal variability in weather, but to longer term trends in climate change itself. This can lead not only to better informed decision making on the part of producers (Figure 2), but to the creation of climate-smart agricultural value chains, in which agricultural investment up and down entire supply chains are

**FIGURE 1: Components of climate information services**



Source: World Bank 2014.

**FIGURE 2: Typical advisory services for crop production and marketing**



Source: Authors.

guided by principals that enable actors manage risk over a period of several years.

The modern information and communication technologies that CIS relies on does not necessarily replace the traditional knowledge that farmers have inherited from their ancestors. In fact, CIS needs to rely on their intimate understanding of local conditions and how they have adapted to variability over time. As this variability increases however as the result of climate change, augmenting that understanding with climate related information about trends that are emerging further into the future becomes more necessary. In this sense, the education and training of farmers; a two-way exchange between them and the extension agents and input suppliers they interact with. Indeed, some traditional strategies and management responses for coping with drought and other adverse developments may very well become even more valuable in the future, although the increasing level of variability will require most to undergo some degree of adaptation.

The World Bank and its partners launched a pilot project in September of 2012, in Ethiopia and Kenya named *Agro-Weather Tools for Adapting to Climate Change* to determine how climate information services can be used to improve the adaptation response of farmers. While the national agricultural meteorology programs in both countries are limited, a number of international development agencies and NGOs are operating in both countries and have been implementing various climate information services as components of more general initiatives to increase the resilience and adaptive capacity of smallholder producers in particular.

## EMBU EAST, EMBU COUNTY, KENYA

The pilot project enlisted the participation of 4,500 farmers who were stratified into four categories as per the crop of interest—tea, coffee, sorghum, and maize and beans (maize usually intercropped with beans). 14 sources of agro-weather information that was available to the beneficiaries were identified (Table 1). The farmers surveyed identified extension agents, radio broadcasts, and mobile phones as the most prominent. The multiple sources of information used by farmers suggested the need for a strategy that employs a combination of modern and traditional ICTs. The information is likely to have more value if it was communicated through extension agents or contacts that farmers already know and trust. The beneficiaries of CIS 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. The project results in general saw significant differences emerge between beneficiaries and a non-beneficiary control group, with the mean score

**TABLE 1: Sources of Agroweather Information (percentage of respondents)**

<i>Source of Agroweather Information</i>	<i>Embu East, Embu District, Kenya</i>	<i>Gende Gurba Village, Ada'a District, Ethiopia</i>
Extension Officers	66	66
Input Dealers	20	12
University	6	9
NGO	9	8
National Agricultural Research Organizations*	11	60
TV	27	N/A
Radio	71	89
Faith Based Organizations	21	18
Internet	8	17
Cell phone/SMS	53	75
Interactive Voice Response	30	63
Newsletter/Bulletin	63	70
Newspapers	12	50
Other Farmers	44	N/A

Note: \*This refers to the Kenya Agricultural and Livestock Research Organization (KALRO) and the Ethiopian Institute of Agricultural Research (EIAR).

of the beneficiary group higher than the non-beneficiary group. In comparison to the non-beneficiary group, the beneficiary group were older, spent less money on seeds, fertilizers, and labor, and spent more money on fungicides. The project beneficiaries also used less money from their personal savings, obtained more credit from family and relatives, and had higher yields per hectare. These results were highly favorable in terms of the efficiency of operations and in how inputs were used, reducing the cost of production, raising productivity, and increasing incomes. In the longer term, these results are very likely to improve farmers' resilience to climate variability.

## GENDE GURBA VILLAGE, ADA'A DISTRICT, ETHIOPIA

In Ethiopia, where agriculture accounts for about 40 percent of the GDP, and where some 75 percent of the population is dependent on rain fed, small scale subsistence agriculture, an improved agro-meteorology program could increase the agricultural contribution to GDP by as much as 6.1 percent. A total of 1,700 farmers participated in the pilot project, and were stratified into four categories as per the crop of interest—chick pea, lentil, teff, and wheat. The survey identified 12 agro-weather information sources (Table 1). Here too, farmers relied on a variety of information sources, with radio, cellphone, and bulletins being the most prominent. Low literacy rates makes printed dissemination pathways problematic, especially for early warning systems. Radio is principally used for accessing information on rainfall and diseases. Beneficiaries indicated that the agro-weather information had a wide range of positive impacts.

Overall, the project found that in comparison to non-beneficiaries, beneficiaries of agro-weather information obtained more credit from family and relatives, achieved higher yields per hectare, spent more money on seeds, fertilizers, and used from money from their personal savings. Similar to the Kenyan case study, the timely access to agro-weather information allowed the beneficiary group to make better decisions that increased efficiency of the operations and inputs. This resulted in a reduction in production cost and an increase in productivity and incomes—and with similar positive implications for their resilience to weather variability.

## IMPACT OF CIS ON CROP PRODUCTION AND RESILIENCE

The contrast between project participants and non-participants in both project locations serves to validate the proof of concept the pilot employed—that smallholder farmers make more informed decisions when they have access to agro-weather tools, both timely weather forecasts and seasonal advisories. This advantage held consistently across the commodities, with dramatic differences in the timing of planting, fertilizer applications, and harvesting. CIS effectively enabled farmers to make appropriate decisions in their choice of varieties. It was highly useful in making and complementing recommendations as to which farm inputs to use. It was used to good advantage by extension services and farmer organizations, resulting in higher rates of adoption of new varieties and practices. And despite the marked difference between participants and non-participants, the interest that CIS stimulated among other producers generated benefits that spilled over into the entire local farming community.

Another major benefit of CIS is the remarkable impact on crop yields and income. In Kenya, farmers with access

to agro-weather information (beneficiaries) recorded an average maize yield of 970 kg per hectare compared to 210 per hectare for non-beneficiaries. The average income from maize for the beneficiaries was 9,402 shillings (KSh) compared to 3,918 for non-beneficiaries. The pattern of teff yields and incomes are similar in Ethiopia, where beneficiaries recorded average yield of 1,656 kg per hectare compared to 771 for non-beneficiaries. The average income obtained from teff for beneficiaries was 19,760 birr compared to 17,878 for non-beneficiaries.

Access to agro-weather information markedly improved the resilience of project beneficiaries (Table 2). Data on “experience of crop failure” suggest a failed season situation in which there is insufficient water to meet crop requirements, leading to lower yields despite increased labor inputs. Climate change and weather variability have increased the frequency of failed seasons in East Africa. The impacts of these were more pronounced on non-beneficiaries, who were markedly less prepared to adapt to weather variability. Better farming decisions resulting from access to agro-weather information led to lower variability in yield and income and less crop failure among the beneficiaries.

**TABLE 2: Impact of agro-weather information on farmers’ resilience (percentage of respondents\*)**

Resilience indicators	Embu East, Embu District, Kenya		Gende Gurba Village, Ada’a District, Ethiopia	
	Non-beneficiary	Beneficiary	Non-beneficiary	Beneficiary
Coefficient of variation of annual crop yields	119	67	46	7
Coefficient of variation of annual incomes from crops	13	3	53	49
Experience of crop failure	97	3	83	27
Use of appropriate crop varieties	70	100	67	89
Correct timing of planting	8	98	26	72
Correct timing of fertilizer application	14	82	28	100
Correct dosage of fertilizer	20	70	100	100
Correct timing of harvesting	35	100	17	74

\* Coefficient of variation (CV) is the ratio of the standard deviation to the mean, multiplied by 100. The CV was calculated for Maize yields in Kenya and Teff yields in Ethiopia, and respectively for the incomes derived from the crops.

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