A QUESTION OF DEVELOPMENT

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SYNTHESES OF AFD STUDIES AND RESEARCH

Impacts of weather and climate information services on African agriculture

CLIMATE CHANGE ADAPTATION TOOLS

Weather and seasonal forecasts give African farmers the information they need to prepare for climate shocks and change their practices. These changes are generally economically beneficial. Yet consideration of the business model, forecast dissemination institutions and target users is key to service longevity and to prevent creating new inequalities.

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Weather and climate information services (WCIS) are defined as all types of services (smartphone apps, radio broadcasts and text messages) that provide short-term weather forecasts (1 to 15 days), seasonal forecasts (trends for the next three months) and climate projections (over the 21st century), that are easy to use for all users (farmers, business heads and mayors in flood-risk areas), and are designed to help them make decisions (choose sowing dates, trigger a flood alert plan, etc.). These WCISs find a wide range of uses in weather-sensitive sectors such as agriculture, water resource management, health and energy (see Diagram 1). They are firm items on the international development agenda (Paris Climate Agreement – Article 7(7C), SDG – Target 13.7, etc.). The Global Framework for Climate Services (GFCS) was established in 2012 to steer their development. It has since been replicated in national frameworks in many countries and often implemented by operational projects such as the Hydromet programme launched by a consortium of donors and UN agencies. Most of the projects in Southern countries concentrate on short- and medium-term information (1 to 15 days and 1 to 3 months) rather than on long-term climate projections. The more common short-term deterministic forecasts are generally produced daily by the National Meteorological and Hydrological Services (NMHSs). To quantify their greater uncertainty, seasonal forecasts for the coming three months are presented in the form of the probability of occurrence of a given period (dry, normal or wet).

This article looks into these two types of forecasts, focusing on their utility, uses and impacts for African farming (in the broad sense of the term, including livestock farming). It then examines some of the challenges raised by the entire agricultural sector's use of these WCISs.

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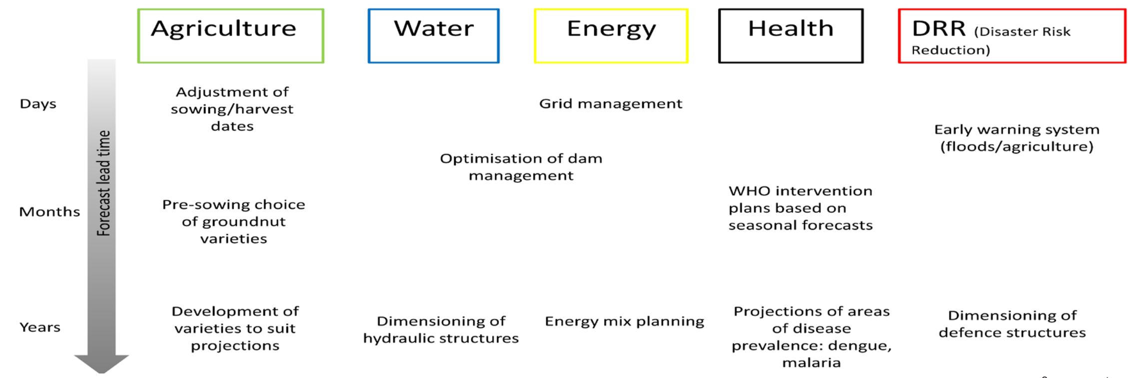
DIAGRAM 1: EXAMPLES OF USE OF CLIMATE SERVICES BY FORECASTING PERIOD (VERTICAL) AND THE FIVE MAIN SECTORS



Note: The dotted-line box represents the types of services studied in this article.

Source: author

USE OF WEATHER AND CLIMATE INFORMATION SERVICES

Useful information, but little knowledge of it

In many Southern countries, what is lacking in particular is the actual dissemination of the forecasts to the users. Most surveys show that producers are extremely interested in this type of forecast, such as in Zimbabwe where 98% of crop farmers interviewed said it was important for them to have rainfall forecasts for the coming season. Pastoralists and agropastoralists have more specific needs regarding the variable considered. In Burkina Faso, for example, none of the herders interviewed wanted seasonal forecasts, but rather forecasts of the date of the onset of the season and the quality of rainfall in the first two weeks of the season (Rasmussen *et al*., 2014).

These surveys also point up that the majority of farmers do not always have access to the forecasts. For example, 70% of survey respondents have access to forecasts in North Burkina Faso compared with just 2% in the Central African Republic. There is some indication that access to forecasts is more marked in West Africa than in East Africa (Vaughan et al., 2019) and lower for forecasts of more than one day. In Ethiopia, for example, 50% of the farmers interviewed have access to daily forecasts, whereas just 10% have access to ten-day forecasts and 1% to seasonal forecasts.

However, where crop farmers have access to forecasts, the rate of use is fairly high. A total of 74% of crop farmers averaged across six studies use seasonal forecasts when they have access to them (Vaughan et al., 2019). Pastoralists and agropastoralists make more marginal use of the existing services, which are not well suited to their needs. Herders in Ethiopia base their decisions mainly on their own traditional forecasting methods.

Forecast-driven changes in practices

When information is adequately disseminated, changes in cropping practices can be observed (see Table 1). For example, short-term forecasts are generally used to adjust the cropping calendar and seasonal forecasts to plan for the coming season: choice of variety/type of crop to be sown, quantity of inputs to buy, etc. Examples of pastoralism are less frequent, but there are cases of buying fodder in advance and migrating to new pastures when the date of the onset of the season can be predicted.

TABLE 1. EXAMPLES OF POTENTIAL ADJUSTMENTS IN RESPONSE TO THE DIFFERENT TYPES OF INFORMATION

Types of forecasts	Types of potential responses	Concrete example (Senegal)
Daily (rainfall, 1 to 10 days)	Timeframe for sowing, harvesting and weeding (depending on the crop) Irrigation management	A farmer in the Sudano-Sahelian zone might sow maize in June following substantial rainfall. However, if a spell of drought is forecast for the next ten days, he might postpone sowing so as not to lose his seeds, which would not germinate.
Seasonal (rain-fall, 3 months)	Volume of fertiliser bought Choice of varieties Choice of crops Choice of soil type Adjustment of seed density Renegotiation of loans	If the season is forecast as dry, a producer will tend to choose drought-resistant varieties of groundnut and maize and will provide to buy less fertiliser (less of an effect in dry periods)

Source: author

Impacts of the use of weather and climate information services

The different evaluations of these changes in practices find generally positive impacts on both the return on investment and, on average, farmers' income and/or productivity. For example, several evaluations find a high cost-benefit ratio for an early warning system in Ethiopia ranging from 1:3 to 1:6 (Usher *et al.*, 2018). Also of note is a potential increase in millet farmers' earnings in Niger of up to +15% on average for the most well-off farmers (see Table 2). These gains are due to more productive cropping choices (better sowing date) and better input management.

However, these averages can conceal disparities, especially losses when forecasts are proved wrong – as inevitably happens. For example, in the above case of Niger, the same study estimates that heeding the forecast incurs losses of earnings in approximately 20% of cases. Similarly, gains differ by category of producer. The forecasts benefit primarily those with more means (land, access to inputs, etc.). In Mali, for example, it was found that the forecasts benefited the 15% most well-off male producers.

TABLE 2. EXAMPLES OF EVALUATIONS OF THE USE OF WEATHER AND CLIMATE INFORMATION SERVICES FOR FARMERS IN AFRICA

Type of agriculture and zone	Type of forecasts	Evaluated impacts	Comments
Millet farmers in Niger	Seasonal and ten-day	Up to +15% income on average over 5 years	Fewer failed sowings and better use of suitable varieties
Cow pea farmers in Burkina	Seasonal and daily	+66% on gross margin	Better yield and less use of inputs
General impacts on the economy in Kenya, Malawi, Mozambique, Tanzania and Zambia	Seasonal	Impact on GDP: +$113 million/ year for the zone	
Subsistence farming in Zimbabwe	Seasonal	+9.2% harvest yield on average over two years	Year, larger increase in the second year

Source : Vaughan *et al.* (2019)

WCIS DEVELOPMENT PROSPECTS

An estimated $1.5 to $2 billion needs to be invested to modernise the existing services in Africa, where current per capita spending is approximately 12 times lower than WCIS expenditure in Europe (Usher *et al.*, 2018). Yet over and above the pure financial and technical challenge involved (supply of data collection equipment), at least three important questions need to be addressed as a matter of priority before high-quality WCISs can be rolled out to virtually all African users.

Finding a sustainable commercial and financial model

First of all, a viable financial model needs to be defined for each country's NMHS, generally the responsibility of the bodies with the climate information services mandate, since maintenance costs are high for forecasting infrastructures (weather stations, radars and servers) and are often not covered by the operating budgets. It is therefore vital to guarantee additional financial resources for WCISs, especially when new equipment is supplied, to prevent the infrastructures from falling into disuse. The origin of these resources is highly dependent on the country and status of the NMHSs (authorised or not to sell their products). Usher *et al.* (2018) report that a number of African countries charge private businesses in certain sectors for their products and services. In South Africa, the sale of services to the aviation sector generated approximately 35% of all national weather service revenues in 2016-2017. Aviation revenues in the country post a high growth rate and are used to balance the weather service's budget. Malawi, by contrast, does not charge the private sector for any of its products. In all cases, a nationally contextualised strategy needs to be put in place to guarantee stable funding, whether through private sector engagement or public policy dialogue to increase public subsidies.

Information dissemination

Secondly, there is the need to efficiently disseminate the information, which calls for: (i) sound knowledge of users and their needs; and (ii) a well-trained information broker. In many cases, information on end users' needs is extremely patchy and does not identify important segments such as women, herders and private sector players. Detailed knowledge of their needs and regular feedback on the services on offer are therefore key to understand the variables of interest (e.g. season start dates and wind speeds), the required spatial and temporal resolution (daily, ten-day and seasonal forecasts), the dissemination channel (voice server, text message or radio), etc. In addition, NMHSs rarely have the means and capabilities they need to properly disseminate the information. The role of an intermediary is to simplify and interpret the information and train users to use and properly understand it (how to understand the probabilities, where the information comes from, and whether it is inconsistent with traditional know-how). This role of brokers can be played by various players, depending on the country, but is generally taken on by public extension services, NGOs, telecommunications operators, religious authorities, radio stations or other specialised structures. The broker's role is vital, and yet often minimised, in both operational projects and forecast-value quantification studies.

Targeting beneficiaries

Thirdly, there is the issue of the players targeted by these services. The need to consider the diversity of producers' situations to avoid creating inequalities (gender and income inequalities) has already been discussed. If these services are to reach their full potential for a country's economy, the focus needs to extend beyond solely the use made of WCISs by producers. There is currently very little information available on other uses in the value chain such as storage, processing, pricing and stock forecasts made by other players than small producers. The potential uses and needs of agribusiness, the private sector in general and NGOs are still understudied and they are not frequent targets in operational projects to develop WCISs.

Conclusion

Weather and climate information services are much-needed climate risk management tools for the agricultural sector and generally have a positive impact on earnings and productivity. Many development projects often address the issue of the angle of improving the quality of the forecasts produced by the national meteorological and hydrological services. Yet to develop effective WCISs in Africa, the different players also need to consider and define a roadmap for a suitable financial model, the information dissemination strategy and how to counter the inequalities potentially associated with these services. Research players should continue to document the relatively unexplored needs and expectations of stakeholders (NGOs, agribusiness and the private sector) while working on improving the forecasting capacity of the variables required.

REFERENCES

Dinku T., Madajewicz M., Curtis A., Connor S., O'Sullivan R., Phiri P., Steynor A., Tadross M., Traore S., Hauswirth D., Kloppers K., Lennard C. et E. Allis (2018), *Development of Metrics to Assess National Meteorological Services in Africa,* USAID-supported Assessing Sustainability and Effectiveness of Climate Information Services in Africa project, Washington, DC

Rasmussen L. V., Mertz O., Rasmussen K., Nieto Solana H., Ali A. et I. Maiga (2014), "Weather, Climate, and Resource Information should Meet the Needs of Sahelian Pastoralists", *Weather, Climate, and Society,* 6, 482-494.

Roudier P., Muller B., d'Aquino P., Roncoli C., Soumaré M.A., Batté L. et B. Sultan (2014), "The Role of Climate Forecasts in Smallholder Agriculture: Lessons from Participatory Research in two Communities in Senegal", *Clim. Risk Manag, 2, 42-55.*

Usher J., Phiri C., Linacre N., O'Sullivan R. et U. Qadir (2018), *Climate Information Services Market Assessment and Business Model Review,* USAID-supported Assessing Sustainability and Effectiveness of Climate Information Services in Africa project, Washington, DC

Vaughan C., Hansen J., Roudier P., Watkiss P. et E. Carr (2019), "Evaluating Agricultural Weather and Climate Services in Africa: Evidence, Methods and a Learning Agenda", *WIREs Clim Change.*.

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