The Means of Achieving Better Recognition of the Value And Benefits of Climate Forecasts and Agrometeorological Information Disseminated to Users

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Abstract

Climate forecasts and agrometeorological information disseminated to users have the potential of influencing decision-making in many sectors such as agriculture and food security, energy and water resources, health and disaster management. The weather and climate forecast information include short-range, medium-range, long-range and seasonal weather forecasts. The agrometeorological information comprises agrometeorological observations, analysis of present and past weather, biological data and agrometeorological products or derived data. The climate forecasts and agrometeorological information is disseminated to users in the following ways: meetings, workshops, telephone/fax, radio, print and electronic media, electronic mail, internet/Websites, bulletins, agricultural extension officers, disaster managers and personal contact. In order to illustrate the value of information received by the users, the applications or uses of the information is briefly presented. Possible ways and means of achieving better recognition of the value and cost benefit of the climate forecasts and agrometeorological information by the users are extensively discussed.

Introduction

Climate forecasts and agrometeorological information are key factors in many weather related sectors. Food security in Africa has been hampered by the lack of, or inadequate use of climate forecasts and agrometeorological information by agricultural practitioners.

The National Meteorological and Hydrological Services (NMHS) produce and disseminate climate forecasts and many forms of agrometeorological information on a regular basis. The potential contribution of the information to agricultural production and food security is immense.

The potential users of the information are a broad range of public and private enterprises. These include farmers, agricultural advisers, chemical and fertilizer producers, seed companies, the media, hydropower producers, hydrologists, health practitioners, disaster management agencies, national governments, commercial organizations, research institutes and universities.

The challenge for climate scientists and agrometeorologists is to educate users on ways to derive maximum benefit from the use of the climate forecasts and agrometeological information they receive. The farmers must first be convinced about the benefits of incorporating agrometeorological information before they move from the traditional farming systems.

Climate Forecasts and Agrometeorological Information

Weather and Climate Forecasts

The weather forecasts are classified according to the period of time for which they are valid (WMO, 1980). Short-range forecasts are valid for a period of a few hours up to 48 hours. Outlooks are usually for the day following a short-range forecast and attempt to indicate the general weather trend to be expected. Medium-range forecasts are valid from 3 days up to 2 weeks ahead. They attempt to indicate the general trend of weather and the approximate time of the expected changes. Long-range forecasts are valid for a month ahead and indicate only the average conditions over a large area.

Climate forecasts attempt to predict the average weather from a month to a year in advance. There has been a marked improvement in the accuracy of climate forecasts in recent years. The last century witnessed the development of statistical forecasting techniques, both univariate (e.g. predicting rainfall in terms of its past history) and multivariate (predicting the rainfall in terms of other quantities that seem to correlate with rainfall such as temperature and pressure)(Stern and Easterling, 1999). These methods are still in widespread use, but, when directly compared with numerical model predictions, they generally have lower skill at shorter prediction lead times.

Numerical climatic prediction involves predicting the evolution of the surface boundary conditions and the atmospheric properties with which they interact (Stern and Easterling, 1999). In general, some aspects of the surface change slowly (e.g., sea surface temperature (SST), because of the immense heat capacity of the ocean) and some change rapidly (e.g., surface moisture). Sea surface temperature provides a convenient example of how climate forecasts are made, and the basic idea applies to other boundary conditions as well (sea ice, land ice, soil moisture, vegetation cover, etc.). The numerical methods are limited by the availability of ocean data so that prediction by statistical methods is sometimes the best available prediction for the region.

In the last five years, climate scientists in different regions of Africa have been trained to produce climate forecasts. They combine outputs from global and statistical models to produce climate forecasts in the form of probabilities of rainfall falling in any of the following three categories: above-normal, near–normal and below-normal.

Agrometeorological Information

Agrometeorological information may be composed of the following:

- Basic agrometeorological observations;
- An analysis and interpretation of the records of the weather and the climate that has existed in the past, including the recent past;
- Biological observations; and
- Agrometeorological products.

Observed Data

The data observed at synoptic or agrometeorological stations which are distributed at representative sites over the country includes air temperature, precipitation, humidity, cloud, sunshine hours, radiation, wind, evaporation, soil temperature at various depths, and soil moisture. The data is quality controlled and dispatched regularly, once or more times daily, every seven or ten days and sometimes monthly to collecting centres which are usually national or regional climatological centres.

Past weather, climatic data

An analysis of the past weather and climate is useful for assisting in planning the location and design of many types of facilities such as irrigation schemes, water storage systems and agribusiness enterprises (Maunder,1990). Climatic data is expressed in terms of averages, totals and frequencies for specific time units. A certain degree of detail is required regarding the time variability and trend of climatic factors in order that the users make reliable and realistic decisions (WMO, 1980). Crude climatic data such as annual averages may result in incorrect decisions and the use of monthly averages gives a much better indication of the true agroclimate of the area. In order to obtain greater detail of seasonal trend and short period anomalies, it is necessary to determine ten-day or weekly averages of basic agrometeorological data.

Biological information

Biological observations are important for relating weather events to crop growth and production (WMO, 1980). Phenological observations, with records of pest and disease events, can be made over wide areas on crops grown commercially. The information is collected, analysed and disseminated to the users.

Agrometeorological products

The influence of weather on agriculture is due to a combination of two or more variables, or the mean value of a particular variable or variables (Callander, 1990). For example, potential evapotranspiration is derived from values of other elements such as water vapour deficit, temperature, solar radiation, wind speed, length of day and latitude; successful crop spraying may require certain values of temperature, wind speed and the absence of rainfall (Callander, 1990). An agriculturally useful number or index which is derived from a single or a combination of the basic weather observations is called an agrometeorological product. The users of agrometeorological information usually require it in the form of products rather than single variables. Some of the agrometeorological products are listed in Table 2.1.

The Value of Climate Forecasts and Agrometerological Information

In most countries, the changing socio-economic patterns, trends in population growth from rural to predominantly urban areas, the increased incidence of climatic disasters such as drought or floods, increased demand for energy and water, high incidences of diseases, the accelerating demand for agricultural products, and the emergence of more sophisticated agricultural production systems have created a need for more rational and effective use of climate forecasts and agrometeorological information.

Recent research has shown that climate forecasts and agrometeorological products are useful only to the extent that they provide information that people can use to improve their outcomes beyond what they would otherwise have been.

In order to illustrate the value of climate forecasts and agrometeorological information it is necessary to highlight the sections of agriculture that use the information in their operations.

Observed Variable	Agrometeorological Products
Temperature	Temperature probabilities, chilling hours, degree days, hours or days below selected temperatures, diurnal variability, maximum and minimum temperature statistics, growing season statistics, frost risk.
Precipitation	Probability of specified amount during a period, number of days with specified amounts of precipitation, probabilities of thundershowers or hail, duration and amount of snow cover, date of beginning and ending of snow cover, probability of extreme precipitation amounts.

Wind	Wind rose, maximum wind, average wind speed, diurnal variation, hours of wind less than selected speed.
Cloud cover, sunshine, radiation	Per cent possible sunshine, number of clear, partly cloudy and cloudy days, amounts of global and net radiation.
Humidity	Probability of specified relative humidity, duration of specified threshold of humidity with time.
Free water evaporation	Total amount, diurnal variation of evaporation, relative dryness of air, evapotranspiration.
Dew	Duration and amount of dew, diurnal variation of dew, association of dew with vegetative wetting, probability of dew formation with season.
Soil temperature	Mean and standard deviation at standard depth, depth of frost penetration, probability of occurrence of specified temperatures at standard depths, dates when threshold values of temperature (germination, vegetation) are reached.

Table 2.1. Agrometeorological products from Callander, 1990

(i) Owners of large farms of one square kilometre or more often make large investments in mechanization and labour. They grow a variety of crops. In order to run the farms professionally, they may require extensive weather and climate information for making operational decisions such as scheduling of irrigation, estimating fertilizer demand, or forecasting of agricultural production and possible future prices of agricultural products (Maunder, 1990);

(ii) Horticulturists deal with high-value crops grown over a very small area. They usually control the climatic conditions as much as possible in a greenhouse or in plastic tunnels. In order to make the necessary adjustments to regulate the radiation passing through the roof of the greenhouse and the ventilation of the air inside the greenhouse, the horticulturist needs quantitative information on cloudiness and local humidity routinely;

(iii) Family farms whose main products are animals or regional staple foods such as cereal, grain, grasses, beans, fruits, vegetables and some minor crops usually require agro-weather broadcasts which guide their short-term operational decisions;

(iv) Cattle farmers require agrometeorological information to provide forage for their herds. In countries without winter, farmers are interested in early warning about impending disasters such as drought, floods or severe storms;

(v) Government planners require yield forecasts of staple crops or an early warning of impending crop failures so that they can take measures to combat food shortages. Agricultural planners need information on agroclimatic zones of each country so as to advise farmers on the choice of crop varieties;

(vi) Agro-based industries and other related businesses involved in processing or transporting food to markets use climate forecasts and agricultural information for planning purposes;

(vii) Hydrologists use agrometeorological information for planning the locations and designs of water storage systems and irrigations schemes. They use the information in projecting the amount of water expected in the dams or reservoirs.

Methods of Dissemination

The climate forecasts and agrometeorological information is disseminated to users in the following ways: meetings, workshops, telephone/fax, radio, print and electronic media, electronic mail, Internet/Websites, bulletins, agricultural extension officers, disaster managers, farmers' clubs, schools, chiefs, churches, personal contact (farmer to farmer, farmers to agrometeorologists, farmers to agricultural advisers) and non-governmental organizations.

Ways of Achieving Better Use of Climate Forecasts and Agrometeorological Information by Users

The following are possible ways of assisting users to derive maximum benefit from the climate forecasts and agrometeorogical information:

Match the information package to the characteristics and situation of the target group.

To influence a user's behaviour, it is important to see the decision situation from that user's perspective (Stern and Easterling, 1999). Users vary in their capacities to understand information that is potentially useful to them. They differ in the levels of basic literacy and information is most effective if it meets the users at their own level. They also differ in the kinds of information that is most useful given their particular situations, and in some situations, the effectiveness of the information depends greatly on other conditions. For example, a forecast of the precipitation for the next growing season may be more useful to dry land farmers than to irrigators in the same region. Some users are more interested in the forecast of the onset and cessation of the rainy season rather than the estimate of the average monthly or seasonal precipitation.

Provide the information timeously and make regular updates.

When information reaches the users, it is of great importance for decision-making. For example, crop yield forecasts are much more useful to farmers if they are made before planting; storm or flood forecasts are much more valuable if they are made before insurance policy renewal dates. Lead time is a very important factor. It usually takes a long time to get drought relief systems functioning and so forecasts will be more valuable to users if they are provided with enough lead time. The usefulness of a climate forecast may also depend on how frequently it is updated and how well users understand the implications of updating, because forecasts often improve in accuracy as time passes and their implications for action may change.

In designing information to be disseminated to users, consider the entire information delivery system, not just the message and the users.

Users differ in the sources of information they use, consider and trust and in their levels of concern with particular hazards or risks. It is generally helpful to get information to users from sources they trust and to make sure the information addresses their most relevant concerns. Any effort to inform a diverse spectrum of users must consider the roles and interactions of a variety of information sources. It may be necessary for the climate scientists or agrometeorologists to inform the agricultural extension officers, who will downscale and interpret the information and then pass it on to farmers. Sometimes it is advisable to use redundant sources of information, with the same message sent through multiple channels so that the users will receive the information from a trusted source.

Use participation to enhance information delivery.

Participatory approaches to delivering climate forecasts might include structured dialogues between climate scientists and forecast users to identify climate parameters of particular importance to users and the organizations that the users might rely on for climate forecast information. Such dialogues might assist in establishing communication channels among scientists, information disseminating organizations and users. These approaches will make climate forecasts and agrometeorological information more decision relevant, and improve mutual understanding between climate scientists, agrometeorologists and users.

Combine information with mitigation or preventive strategies.

Information on the behaviour of the weather or weather related parameters is more acceptable when combined with mitigation or preventive strategies. For example a frost forecast can be combined with frost prevention mechanism and a forecast of drought with ways of conserving soil moisture.

Use principles of persuasive communication.

The principles likely to make an important difference in this field include presenting short and simple information packages and giving guidance to users on what to do to take advantage of the climate forecasts and agrometeorological information available.

Educate and train the climate scientists, agrometeorologists and users.

It is very important to educate the climate scientists and the agrometeorologists on how to package, disseminate and market the information to the users. The users must be educated on the value and cost benefits of applying the information disseminated to them in their operations. The users must also be trained on how to analyse, summarize and interpret the information they receive so that they can derive maximum benefit.

Carry out research into users' needs.

Agrometeorologists and climate scientists should carry out research into the information required by each target sector. The research will enable documentation of the scope (scale, timeliness, detail and importance) and dimensions (spatial and temporal domain, lead time, nature of variable or event, form of information, content and format of the information package) of the user's needs (Aber, 1990).

Design an information dissemination system for all users.

The typical information disseminating systems such as the distribution of written material, television broadcasts, Internet and so on, are oriented primarily for the educated and the rich farmers. The information distributed through these channels does not normally reach the less-educated, elderly, people with low incomes and those without power. These constraints can be overcome by disseminating the climate forecasts and agrometeorological information through the people who are known and trusted by the marginalized groups, including their social networks.

Conclusion

Climate forecasts and agrometeorological information are only useful if the recipients of the information use it to improve their production and operations. To achieve better recognition of the value and benefits of climate forecasts and agrometeorological information it is important to identify the decision attributes of the information for particular activities and to encourage climate scientists and agrometeorologists to package the information with those attributes when possible. The information should be disseminated using all means possible so that it reaches all the users and with enough lead time to influence decision-making. Research should be carried out to try and close the gap between the potential value and actual value of the information.

The scientists should be educated on how to formulate and disseminate the information. Climate scientists and agrometeorologists should make an effort to convince the potential decision-makers of weather and climate sensitive operations, about the value and benefits of climate forecasts and agrometeorological information disseminated to them.

The potential value of climate forecasts and agrometeorological information to an economic activity (including farming and related agro-business activities) and to a particular operation will be realized only when the qualified climate scientist or agrometeorologist working with the cooperation and backing of management, develops the information most suited to the specific needs of the activity.

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