Improving user perception of the value of agrometeorological services provided

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Introduction

Agrometeorological services are commonly defined as meteorological and climatological information tailored to agriculture activities ranging from simple ten days rainfall data to more elaborated services such as the advice on daily irrigation information, short- to medium-range weather forecasts and climate prediction at a longer range. In Africa and recently in the late 1990s, seasonal forecasts became one of the major new kinds of services. In fact regional climate outlook forums have been widespread under the sponsorship of many international organizations: WMO, NOAA/OGP, World Bank. The main objective of these forums is to alleviate and mitigate climate variability impacts on agriculture, food security and water resources. In these forums, scientists and experts from various fields met together to establish the best estimate of the state of the coming rainfall season using categorical description in three categories: below, near, and above normal categories, each category assigned with probability of likelihood of occurrence. (ACMAD/WMO, 1998, ACMAD/WMO, 1999)

The present paper is organized in three parts:

1. General structure of agrometeorological services;
2. User perception;
3. Estimate of potential predictability of seasonal forecast in West Africa.

General structure of agrometeorological services

Agrometeorlogical services constitute links between meteorological information and agriculture activities, so that one can structure the services according to type and scale of these activities as follow:

Historical climatolgical information

From this information users try to identify the structure of the climate at a given site; such information is needed before establishing the activity for which the climatological investigation is seeking, such as site identification, investment prospect, agro-studies, forestry, etc. Frequencies, averages, extremes, variances of various weather parameters and phenomena are among this information.

Operation oriented information

This information is used on daily and weekly time scales in the field operations such as planting, irrigation, pesticide treatment, storage, harvest etc. Daily, weekly, 10 days basic meteorological information and short- to medium-range weather forecasts are among the information provided for this type of activity.

Climate prediction information

Seasonal, intra-seasonal and inter-annual climate variability and prediction information and services are provided for an early planing of agricultural activities such as anticipation of the outcome of crop yield according to expected trend in the climate system and its impact on

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various weather risks and hazards: flooding, droughts, forest fires, sea high tides, etc. The recent development of climate outlook systems and regional outlook forums has triggered the need for such information especially for decision making at policy level: government, food, security units, early warning agencies and aid agencies.

In Africa, such services have been put in place at the regional level through several regional centres: ACMAD, AGRHYMET, DMCs. Most emphasis has been made on the delivery of probabilistic predictions of the likelihood occurrence of one of three categories of rainy season: Below, Near and Above normal. Each of these categories is assigned a probability figure so that the highest probability indicates the most likely category to happen. A tentative of delivering rain onset prediction was made within the ACMAD demonstration programme from 1997 to 1999 based on wind shear methodology (Omotosho, Second climate Outlook Forum PRESAO-2); unfortunately the lack of continuity in this is tentative due to lack of data input at appropriate periods of the year which has not permitted the verification of this prediction. Nevertheless, this service, including rain onset and dry spell prediction, remains highly demanded.

Service channels

Various schemes can be established for communication channels of the agrometeorological information and services. Basic and simple schemes put channels according to type and scale of this information. Figure 1 illustrates information channels through various users layers which could be classified in three main sets of layers. The top layer consists of government agencies and administration where appropriate contingency planning for action exists; downward we find intermediary layers which we call end users service providers such as multidisciplinary groups such as ‘’Group des Travaux Pluri-disciplinaires (GTP) “in many of the west African countries, semi public offices such as ‘’Office de mise en valeur agricole’’ in Morocco and private bureau of consultation in other continents and nations. These intermediaries act for shorter term action planning than the upper layer for advisories and monitoring. End-users layers consist of farmers, traders, agro-industrials, irrigation services and many others acting on the ground in agriculture for output production and field actions.

Figure 1 shows agrometeorological service channels from the meteorological office to users: thicker arrows indicate privileged channels. Red is for an extended early warning type of information: drought, general flooding, etc. Black arrows are for basic agrometeorological services on daily and weekly time scale. According to type of information, privileges of information are often given to one more than to the others, for example early warning information at extended time and scale (Red arrows in figure 1) are given specifically (thicker arrows) to the top layers (government agencies and administration). Day to day type of information (black arrows) is directed generally toward intermediaries and end users more frequently than on top layers (thicker arrows downward).

User perception improvement of agrometeorological services

Weather and climate information are generally demanded at a high degree of need especially for agriculture and water resources. Governments and intermediaries in Africa are those that most request this information. In order to improve users perception regarding agrometeorological information we need first to assess the present state of this perception. Information collected within several reports and proceedings across various ad-hoc meetings and workshops (REPORTS from PRE-PRESAO1, PRESAO1, POST-PRESAO1, PRE-PRESAO2, PRESAO2, POST-PRESAO2, GHARCOF and SARCOF, 1998,1999, 2000, 2001) permits roughly to summarize this perception that in general climate and weather information are well perceived and appreciated by users, whereas improvements are mostly needed for climate prediction at seasonal to inter-annual time scales. Table 1 summarizes the perception of users for usefulness, clarity, precision and availability of meteorological and climatological information including basic one and prediction.

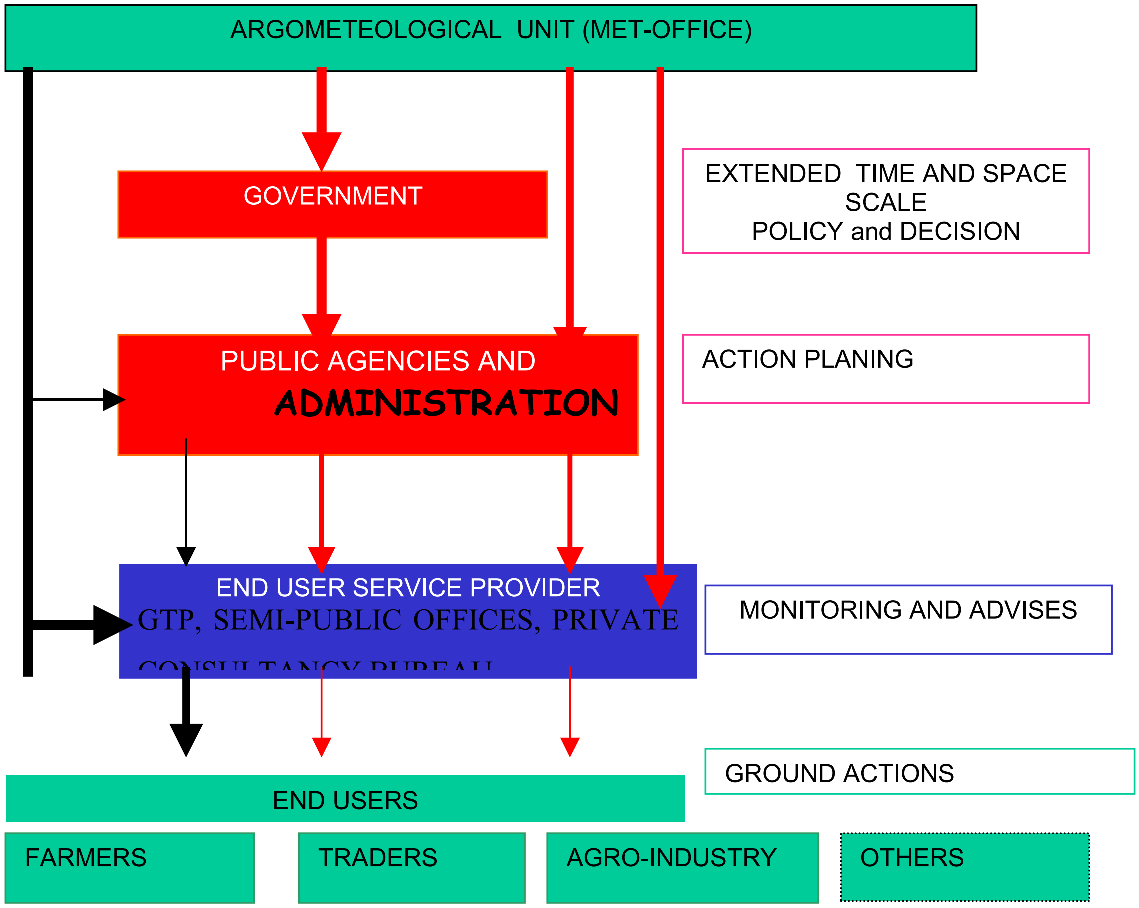

Figure 1. Service channels

	USEFULNESS	CLARITY	PRECISION	AVAILABILITY
BASIC CLIMATOLO-GICAL INFORMATION	VERY USEFUL MOST DEMANDED	GOOD	GOOD	MUCH NEED IN DATA AVAILABILITY
WEATHER FORECAST	USEFUL BUT NEED EDUCATION ON HOW TO USE	NEED OF MORE DIRECTED INFORMATION	NEED SPACE AND TIME RESOLUTION	NEED TO BE ACCESSED IN TIMELY MANNER
SEASONAL FORECAST	NEED TO BE MORE EXPLAINED	MUCH NEED IN REDEFINITION IN THE CONTENT	MUCH NEED : QUANTITATIVE AND LESS PROBABILITY	NEED APPROPRIATE DISSEMINATION AND COMMUNICATION

Table 1. Perception of Users

From this synthesis one can conclude that seasonal forecasts need much improvement to meet user requirements for all characteristics of the services: usefulness, clarity, precision and availability. Since the mid-1990s WMO has established the CLIPS project mainly to address user aspects of climate prediction and information services. as preliminary applied research we should beforehand assess the afforded possibility driven from the climate system in terms of skill and range of the forecast. Having identified this possibility, refinement, packaging and delivery of seasonal forecast products becomes a matter of application domain. As an example we present a general assessment of predictability potential for seasonal forecasts in West Africa in the following section.

Estimate of potential predictability for seasonal forecast in West Africa

Statistical models based on sea surface temperature anomalies have been constructed on grid boxes for the whole domain of West Africa (figure 2). Multiple linear regression methods applied during the past 40 years and then cross-validated using one year removal has led to a compilation of year to year comparisons between hind-cast obtained from the cross-validation and observation. The potential of predictability is therefore assessed using contingency tables for the three-category forecast: below, near and above normal. This statistical analysis allows computation of two measures of predictability potential: the probability of detection and the false alarm rates referred herein as POD and FAR respectively (Baddour, WMO/ACMAD ,1998).

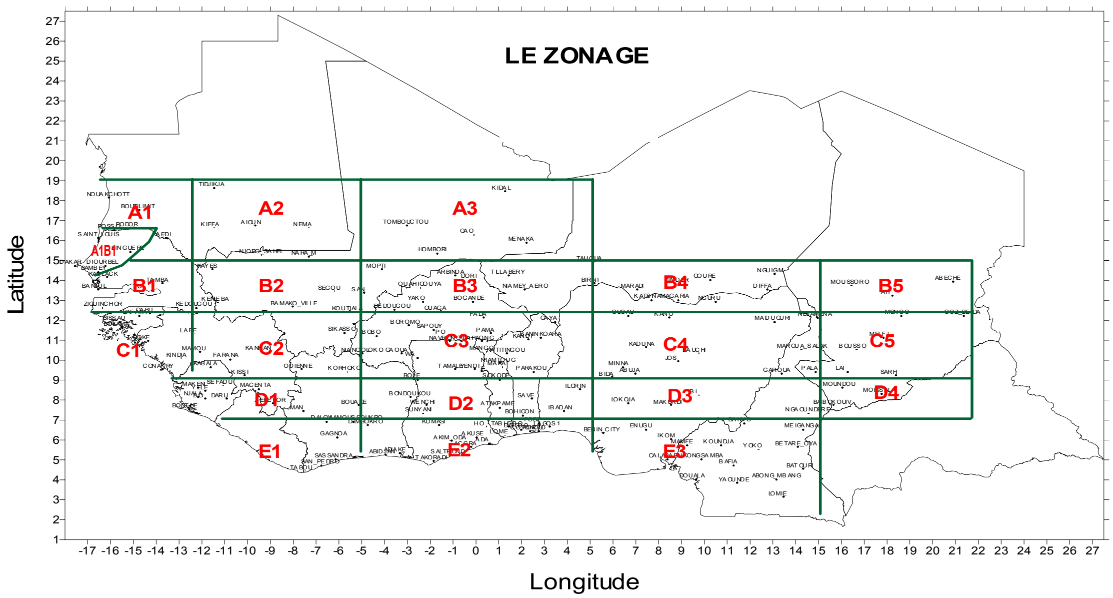

Fig 2: Domain of West Africa and grid boxes for which statistical method for seasonal forecast was performed and predictability potential assessed.

POD and FAR are classified therefore according to their values into four classes as given in table 2. Limits between classes have been selected subjectively, nevertheless they indicate reasonable limits considering that a chance forecast outcome has 33% of POD and FAR values.

Level of goodness	Colour scale	Value of POD	Value of FAR
Good	blue	> 70 %	< 10 %
Fair	green	50 % to 70%	10% to 20%
Moderate	orange	40% to 50 %	20% to 30 %
bad	red	< 40%	> 30 %

Table 2: Scale of degree of goodness of predictability potential given by the probability of detection (POD) and False Alarm Rate (FAR)

Table 3 gives for each box and each extreme category (below or above normal) value in percent and scale of POD and FAR for the rainy season July-August-September. Boxes are labelled from top to bottom: A1.A2,..E3. Below the table are given total number of boxes for a given colour. One can see that among 21 grid boxes we get 18 (85% of total boxes) of fair to good POD and 15 (71 of total boxes %) of fair to good FAR when predicting either below or above normal categories. One can notice that near normal category is not treated here because the assessment targets extremes early warning potential.

Table 4 is as table 3 except for September-October-November rainy season recalling that the first season is a major one for the Sahelo-Soudanaise region (north of 7 degree north) whereas the second is the short rainy season in the Guinea coast. Although the good potential is less than for July-August-September, there is acceptable potential for seasonal forecast, in fact most of boxes shows moderate to good POD falling mainly in fair class. FAR is as good as in July-August-September:15 out of 21 boxes shows fair to good class.

POD		FAR
>=70	good	<=10
50..70	fair	10..20
40..50	moderate	20..30
< 40	bad	>=30

grid box	SKILL	Probability of detection Dry	Wet	False alarm rate Dry	Wet
A1	0.44	50	70	17	23
A2	0.42	30	50	29	0
A3	0.64	70	70	9	0
A1B1	0.5	70	50	15	25
B1	0.49	50	50	13	14
B2	0.56	70	30	0	17
B3	0.55	60	55	20	9
B4	0.49	70	50	25	30
B5	0.57	50	60	13	21
C1	0.47	50	50	13	13
C2	0.47	70	70	11	15
C3	0.5	50	67	18	11
C4	0.52	60	40	9	0
C5	0.37	40	70	20	30
D1	0.36	70	60	25	0
D2	0.63	90	70	8	0
D3	0.57	67	50	25	8
D4	0.21	33	50	22	11
E1	0.71	70	70	0	0
E2	0.51	70	70	0	8
E3	0.2	50	10	38	21
N = 21	Total	9	7	6	9
	Total	9	11	9	6
	Total	1	1	5	4
	Total	2	2	1	2

Table 3: Potential of predictability for July-August-September Rainy season

Conclusion

Agrometeorological services have been described according to the agriculture sector, the services are channelled to end users through various layers of users: Government agencies and administration layers, intermediaries and end users. This stratification comes along with the scope of the use of the services from top to bottom, at strategic long term planning for the first layer, medium planning and advisories for the intermediaries and day to day actions for the end users layers. Perception of agrometeorological services driven from African ad-hoc meetings and workshops shows increasing needs in new services such as climate prediction, including seasonal forecast, rain onset and dry spell prediction. Much need of improvement for seasonal climate prediction services is dominant from reports of these meetings and workshops.

POD		FAR
>=70	good	<=10
50..70	fair	10..20
40..50	moderate	20..30
< 40	bad	>=30

grid box	SKILL	Probability of detection dry	Probability of detection wet	False alarm rate dry	False alarm rate wet
A 1	0.54	30	60	25	0
A 2	0.22	56	75	0	10
A 3	0.14	30	44	11	30
A 1 B 1	0.38	67	50	30	0
B 1	0.37	55	50	15	10
B 2	0.26	36	50	18	11
B 3	0.54	60	70	0	10
B 4	0.25	40	50	9	25
B 5	0.36	60	40	15	22
C 1	0.58	40	60	14	0
C 2	0.52	60	80	17	11
C 3	0.3	50	45	10	22
C 4	0.31	60	60	13	10
C 5	0.24	80	55	27	0
D 1	0.43	70	60	8	10
D 2	0.24	30	40	13	33
D 3	0.38	50	40	20	44
D 4	0.19	45	55	17	27
E 1	0.53	50	50	13	0
E 2	0.51	55	60	25	18
E 3	0.43	30	60	30	10
N = 21	Total	2	3	5	11
	Total	11	13	11	3
	Total	3	5	3	4
	Total	5	0	2	3

Table 4: Potential of predictability for September-October-November

An assessment of predictability potential of seasonal forecast was given and summarized in this paper, statistical methods for modelling using multiple linear regression regressed on seasonal rainfall and sea surface temperature with 1 to 3 months lag time. Predictability assessment is based on probability of detection and false alarm rate driven from cross validation of the regression methods (Baddour et al, 1998) over at least 30 years of data. Results show good potential for both rainy season July-August-September and September-October-November at range. In fact 70 to 85 % of West Africa domain (percent of total boxes used) falls in fair to good predictability. Results are better for July-August-September than for the September-October-November rainy season although for the latter fair predictability is dominant.

These encouraging results should be attributed to the strong impact of sea surface temperature anomalies signals coming from the Atlantic ocean and ENSO as well. Economic assessment of the value of these forecasts on agriculture is therefore a strong step needed toward improving perception of the users to the value of climate prediction in the agriculture sector. A basic methodology for economic assessment has been presented during the meeting and still needs refinement for publication, nevertheless other existing such as crop yield modelling could serve as sensitivity studies for economic impacts.

References:

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3. Climate Outlook Forums Reports Available at ACMAD and DMC of Nairobi Contribute as a leader team to the development of African capacity in climate research and applications see below list of working services.