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Ethno-meteorology and scientific weather forecasting: Small farmers and scientists' perspectives on climate variability in the Okavango Delta, Botswana

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ABSTRACT

Recent trends in abrupt weather changes continue to pose a challenge to agricultural production most especially in sub-Saharan Africa. The paper specifically addresses the questions on how local farmers read and predict the weather; and how they can collaborate with weather scientists in devising adaptation strategies for climate variability (CV) in the Okavango Delta of Botswana. Recent trends in agriculture-related weather variables available from country's climate services, as well as in freely available satellite rainfall products were analysed. The utility of a seasonal hydrological forecasting system for the study area in the context of supporting farmer's information needs were assessed. Through a multi-stage sampling procedure, a total of 592 households heads in 8 rural communities in the Okavango Delta were selected and interviewed using open and close-ended interview schedules. Also, 19 scientists were purposively selected and interviewed using questionnaires. Key informant interviews, focus group and knowledge validation workshops were used to generate qualitative information from both farmers and scientists. Descriptive and inferential statistics were used in summarising the data. Analysis of satellite rainfall products indicated that there was a consistent increase in total annual rainfall throughout the region in the last 10 years, accompanied by an increase in number of rain days, and reduction of duration of dry spells. However, there is a progressive increase in the region's temperatures leading to increase in potential evaporation. Findings from social surveys show that farmers' age, education level, number of years engaged in farming, sources of weather information, knowledge of weather forecasting and decision on farming practices either had a significant relationship or correlation with their perceptions about the nature of both local [ethno-meteorological] and scientific weather knowledge. Nonetheless, there was a significant difference in the mean scores of farmers in relation to their perceptions and those of the climate scientists about the nature of both local and Western knowledge. As farmers are adept at judging seasonal patterns through long-standing ethno-meteorology, one major CV adaptation measure is their ability to anticipate changes in future weather conditions, which enables them to adjust their farming calendars and make decisions on crop type selection in any given season.

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Introduction

Traditional African cultures comprise an institution of "rainmakers" – people who would not as much invoke the rains, but anticipate them based on ethno-meteorology (see for instance, Gewald, 2002; Huffman, 2009). The forecasting was based on skillful art of observing the natural environment as expressed in the timing or flowering of plants, hatching of insects, arrival of migratory birds, etc., which enables farmers to make adjustments in farming calendar and crop selection types in any given season. This indigenous knowledge[1] was often passed down from one generation to the other. Thus smallholder farmers value their ability to accurately observe and anticipate local conditions in various ways that serve their needs better than outside forecasts (see Onyango, 2009; Ouma, 2009). Elsewhere, it is acknowledged that local knowledge, at the least, plays a complementary role in generating climate information and understanding climate variability (see Ifejika Speranza et al., 2010; Orlove et al., 2010). The ability to anticipate changes at seasonal and shorter time scales and to adjust the farming practice accordingly, is a key element in creating resilience of indigenous farmers to the vagaries of weather conditions, thus serving as the basis for improving food security. This is particularly important in the context of climate variability (CV) and change which now constitute a serious threat to agricultural productivity and food security in sub-Saharan Africa. It is increasingly recognised that the adoption of seasonal forecast is an important element of climate change adaptation strategy, particularly in arid and semi-arid southern African countries (Hansen et al., 2011).

Scholars have documented different ways in which local communities historically adapted to CV in Botswana (Prah, 1978; Hitchcock, 1978; Cooke, 1978; Dube and Sekhwela, 2008; Landau, 1993). However, modernisation has eroded the knowledge system of community people to the extent that these local custodians are stigmatised as '. . . backward charlatans' (Onyango, 2009). Apart from the labeling and stigmatisation experienced by small farmers, abrupt changes in weather patterns, which also interrupt natural indicators used in ethno-meteorology,[2] continue to overwhelm the smallholders in their present circumstance. For instance, the Nganyi clan in western Kenya, which is noted for its expertise in weather reading and rain-making, has admitted that the present global warming associated with climate change has become a daunting challenge facing them in their agricultural activities (Ouma, 2009). More than ever before, smallholders are now consistently vulnerable, making them more socio-economically miserable. Regardless of the present influx of scientific weather forecast, it appears smallholder farmers are already enmeshed in the complexities of CV and climate change.

Contemporary, periodic seasonal forecasts are issued by government departments dealing with meteorology. Unlike short term forecasts (5–10 days ahead), seasonal forecasts (3–6 months ahead) based on ensemble runs of global and regional climate models as well as analyses of synoptic conditions performed by skilled meteorologists in most cases do not provide handy and timely information relevant to farmers' needs. For example, the forecast released regularly by Southern African Regional Climate Outlook Forum, provides information in the form of probabilities of terciles with often minimal differences between them (e.g. 35% chance of below normal, 35% chance of normal and 30% chance of above normal rains). Such forecast language and concepts involved may not be understood by smallholder farmers. Also, there is little understanding about the extent to which these forecasts actually reach smallholder farmers, and to what extent these are appropriated and used by them to prepare for the expected inclement weather conditions. Additionally, the magnitude of the upcoming change in weather conditions is not usually communicated to farmers.

Consequently, failure of farm harvests with its associated poor returns on investment has led farmers to continue to diversify their means of livelihoods by appropriating (whether rightly or wrongly) other ecosystems services. Although a few long-term data exists, there is evidence that temperatures have been increasing in the past thirty years in Botswana in line with global and regional trends. As far as rainfall is concerned, the changing pattern is less obvious. There was a considerable reduction of rainfall observed between the 1970s and 1990s throughout the country, with a considerable drought during 1984–1986 (Bhalotra, 1987). There is also an understanding that droughts in Botswana are associated with *El Nino* episodes, but the relationship is not straight forward (Nicholson et al., 2001). However, the rains have been progressively improving since around year 2000, leading to the occurrence of floods that might have been considered disastrous in 2010. Such a precipitation history implies that rainfall is not only inherently variable (and thus from agricultural point of view, unreliable) on a year-to-year basis, but also that there is a strong variability at multi-decadal time scales. This multi-decadal variability has been detected in statistical analyses of rainfall and river flow time series (McCarthy et al., 2000; Mazvimavi and Wolski, 2006) and corroborated by 60–120 year cycles found through stalagmite and tree ring paleoclimatic analyses by Tyson and his colleagues (Tyson et al., 2002). More recently, Jury (2010) analysed the relationship between Okavango River discharges and sea surface temperature variability, and found a weak, but statistically significant relationship between North Atlantic Oscillation (NAO) index and summer (January–April) Okavango discharges manifesting itself at time-scales longer than 30 years. The modes of climate variability such as NAO, manifested at decadal and longer time scales, have a strong potential to modify influence of the well known sea-surface temperature anomalies (like *El Nino* or *La Nina*) on rainfall (see, for instance, Power et al., 1999). The multi-decadal variability in rainfall, due to its characteristic time scale longer than 20–30 years, is firstly often confused with effects of climate change, but more importantly it is

[1] In this context, indigenous or local knowledge, weather forecasting knowledge and ethno-meteorology are, on the one hand, used interchangeably in this paper. On the other hand, meteorology and scientific weather forecasting connote the same thing. Weather scientists and meteorologists also mean the same thing.

[2] Ethno-meteorology is an indigenous way of forecasting and interpreting local weather conditions in a given locality or remote community.