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Integrating indigenous knowledge with conventional science: Enhancing localised climate and weather forecasts in Nessa, Mulanje, Malawi

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ABSTRACT

Subsistence rain fed agriculture underpins rural livelihoods in the Sub Saharan Africa. The overdependence on rainfall suggests the need for more reliable climate and weather forecasts to guide farm level decision making. Traditionally, African farmers have used indigenous knowledge (IK) to understand weather and climate patterns and make decisions about crops and farming practices. However, increased rainfall variability in recent years associated with climate change has reduced their confidence in indigenous knowledge, hence reducing their adaptive capacity and increasing their vulnerability to climate change. To address this problem, researchers are advocating the integration of indigenous knowledge into scientific climate forecasts at the local level, where it can be used to enhance the resilience of communities vulnerable to climate change. A study was therefore conducted to establish commonly used IK indicators in weather and climate forecasting and people's perceptions of climate change and variability in Nessa Village, Southern Malawi. We further compared the people's perceptions on climate change and variability with empirical evidence from a nearby weather station during 1971–2003 and the major constraints that the people face to fully utilise conventional weather and climate forecasts. Our results show various forms of traditional indicators that have been used to predict weather and climate for generations. These include certain patterns and behaviour of flora and fauna as well as environmental conditions. We further established that the peoples documentation of major climatic events over the years in the area agreed with the empirical evidence from the temperature and rainfall data. Overall, rainfall in the area has reduced since 1971 with increasing temperatures. The people were however of the view that current scientific weather and climate predictions in Malawi were not that useful at village level because they do not incorporate IK.

1. Introduction

Smallholder agriculture underpins most rural livelihoods and the national economy in Malawi. More than 90% of the people, mainly comprising resource-poor rural communities, are predominantly engaged in subsistence rainfed agriculture (Action Aid, 2006). In many rainfed agriculture areas, worsening poverty and increasing food insecurity is closely linked to low and/or declining levels of agricultural productivity (Katz and Brown, 1992; Bazzaz and Sombroek, 1996; Hulme, 1996; Hulme et al., 2001; WRI, 1996; Klein, 2001; Wamukonya and Rukato, 2001; Thirtle et al., 2001; Irz et al., 2001; Adger et al., 2003; Boko et al., 2007). The high dependence of rainfed agriculture in Malawi therefore renders the country highly vulnerable to effects climate change and variability such as seasonal shifts, rainfall onset and the seasonal rainfall distribution pattern (Environmental Affairs Department (EAD), 2002a,b, 2006). Such overdependence on rainfed agriculture and the high rainfall seasonal variability suggest a need for reliable climate and weather forecasts. Climate and weather forecasts, if properly utilised, are known to guide farm level decisions including selection of appropriate tillage systems, crop varieties, planting dates and gauging potential markets and trends (Ziervogel, 2001).

However, there are many constraints impeding the full utilisation of the seasonal climate and weather forecast to guide farm level decisions among the rural farmers. Adejuwon et al. (2007) established some of these constraints among rural farmers in West Africa. These include the forecasts course spatial and temporal resolutions which were found to be not deal for farm level decisions in the short term, like a day, and at lower spatial scales like a village. The forecasts normally use climate regions as the lowest spatial scale, with different predictions for each region but without concise information on local climatic variation. Moreover, the large temporal scales also proves problematic because it gives the prediction for the total rainfall over months and does not usually state when during that time the rainfall is likely to occur or when the rains might

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start (Ziervogel, 2001). There is also an apparent lack of a credible communication procedure of the forecasts to peasant farmers. The scientific and technical nature of such forecasts further complicates their utility among peasant farmers. Adejuwon et al. (2007) also highlighted on the low correlation between the predictands used in the forecast and key factors for crop performance and yield. The accuracy of the forecasts has also been found insufficient, which is presently at 75% according to Chang'a et al. (2010).

In view of these constraints in scientific weather and climate forecasting, indigenous knowledge (IK) is recently being advocated to complement modern scientific knowledge. Collectively, this knowledge represents a dynamic information base that has supported most rural communities by adapting to constantly changing and varying climates (Nyong et al., 2007). Traditionally, African farmers have used indigenous knowledge to understand weather and climate patterns and make decisions about crop and irrigation cycles. Chang'a et al. (2010) detailed on the application of IK in rainfall prediction in the south western highlands of Tanzania. That study also highlighted on the beneficial utilisation of IK within southern and eastern Africa. Much as there is no standard definition of IK, IPCC (2007) and Ajibade (2003) used the term to describe the knowledge systems developed by a community as opposed to the scientific knowledge that is generally referred to as 'modern' knowledge. Johnson (1992) defines IK as a body of knowledge built up by a group of people through generations of living in close contact with nature. According to Johnson (1992), this knowledge includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use. This involves an ability to analyse situations and interpret the results; practical experience of tackling problems and perspective of having an overview of a subject or issue. In climate and weather prediction, IK has proved to be more accurate and reliable at local level (Ziervogel, 2001; Nyong et al., 2007). IK has therefore provided the basis for local-level decision making in many rural communities (IPCC, 2007).

However, increased rainfall variability associated with climate change in recent years has resulted in farmers reduced confidence in IK, hence reducing their adaptive capacity and increasing their vulnerability to effects of climate change and variability. This has created a dilemma for those who recognise the limitations of traditional climate forecasts but are unable to use scientific ones. To address this problem, the integration of IK into scientific climate forecasts at the local level has been noted to have the potential to enhance the resilience of communities vulnerable to climate change (IGAD Climate Prediction and Applications Centre (ICPAC)). The integration of these knowledge sets can perhaps work more effectively if the capacities of the knowledge holders and agencies responsible for weather predictions are assessed and developed. Support to this process requires identifying what key capacities already exist and what additional capacities may be needed to reach these objectives. It can also set the baseline for continuous monitoring and evaluation of progress against relevant indicators and help create a solid foundation for long-term planning, implementation and sustainable results (UNDP, 2008, 2010).

The Natural Resources Environment Centre (NAREC) of the University of Malawi, in collaboration with the Institute of Resource Assessment (IRA) at the University of Dar es Salaam and the Natural Resources Institute (NRI) of Greenwich University are implementing a four year action research to cover this gap. The general objective of the project is to strengthen the capacity of individuals, organisations and systems within the agricultural innovation systems in less favoured areas and more favoured areas (agro ecologically and socio economically) of Tanzania and Malawi to adapt to the challenges and opportunities arising from Climate Change and Variability. The project started in April 2007 and is funded by the International Development Research Centre (IDRC) of Canada under the Climate Change Adaptation in Africa (CCAA) programme which was initiated in a bid to champion behavioural change in vulnerable communities as a way of adapting to effects of climate change and variability in Africa. During the situation analysis phase of the study which applied a participatory approach, local communities highlighted that timely access to the seasonal weather forecast and related climate change information to inform their agricultural activities was a major challenge. This has often resulted in the selection of unsuitable crop varieties for a particular season. The study compared how local communities perceive the role of IK in adapting to climate change and variability. Scientific seasonal forecasts from the Malawi Meteorological Services were delivered at village based seminars to guide the selection of crops and varieties for three consecutive years. During these interactions with the villagers, an apparent gap arose between the application of IK in weather forecasting and the conventional weather forecast which if fully utilised can improve adaptation to climate change.

This study was therefore aimed at establishing how IK is used in weather and climate forecasting and how this can be integrated with conventional forecasts under changing climate conditions to improve agricultural production. Specifically, the study sought people's perceptions of climate change and variability and linked this perception with empirical evidence, documented IK indicators that are used to predict weather and climate, and explored how knowledge is shared among users and analysed constraints and opportunities that affect reliability of the weather information.

Understanding people's perceptions and knowledge of weather and climate is critical for effective communication of scientific forecasts with the local people. The knowledge is learned and identified by farmers within a cultural context and their knowledge base follows a specific process. Local knowledge provides a framework to explain the relationships between particular climatic events and farming activities (Rengalakshmi, 2007).

2. Materials and methods

The area under study is Nessa Village in Mulanje District in Southern Malawi. The village is located on the outer slopes of Mulanje Mountain at approximately 15°60′S and 35°40′E (Fig. 1). Nessa Village lies in a typically high rainfall area in Malawi. Annual rainfall in the area exceeds 1800 mm annually, approximately 16% of which is experienced in dry season, with occasional occurrence of mist and fog. Temperature ranges from a minimum average of 21 °C during winter (May to August) to a maximum average of 32 °C just before the onset of the main rain season in October.

Qualitative data was collected using key informant interviews and focus group discussions of eight men and women held separately. The qualitative information collected was mainly on people's perceptions on IK weather and climate indicators, climate change and variability, and their constraints in accessing weather and climate information. Purposively sampled key informants comprised the Head of Monitoring and Prediction Division at the Malawi Climate Change and Meteorological Services Department and two other officers within the Division, Nessa Village headman, six elders aged 50 years and above (four women and two men). Additionally, 196 household heads were systematically selected from a sampling frame of 586 generated at village level with the aid of the village headman and interviewed using a semi structured questionnaire. This sample reflected the proportion of the total population in the village (National Statisfical Office, 2005). The sample was selected at an interval based on the following formula:

$$K = N/n$$

where *k* is the sampling frame, *N* is the total number of households in Nessa Village and n is the sample size (Burns, 1994). In this study,