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The contribution of seasonal climate forecasts to the management of agricultural disaster-risk in South Africa

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ABSTRACT

This study examined the use of Seasonal Climate Forecast (SCF) information in the agricultural sector in South Africa following the compilation and dissemination of early warning information aiming to reduce risks faced by farming communities. SCF information received from the scientific community is disseminated to the agricultural sector through intermediaries. The study assessed the channels through which SCF information is disseminated to end users by intermediaries. To achieve this, ethnographic interviews took place with 110 intermediaries covering national, provincial, agricultural union's structures. In these interviews the status of the preparation of early warning information, the effectiveness of the dissemination of information and the success in capacitating end users to understand the SCF information, were assessed in order to create a more functional system. The findings highlighted that improved channels and structures, through which reliable and timely SCF information that could serve as early warning should be developed. In addition, it was found that end user SCF information feedback programmes should improve, which will assist intermediaries to improve the dissemination of information. Governing bodies, intermediaries and end-users should collectively identify institutional, social and infrastructural barriers in the channels of early warning information dissemination, and should jointly devise action plans to overcome these.

1. Introduction

1.1. Background

It is estimated that over 70% of natural hazards worldwide are caused by weather and climate or water-related hazards [1]. It is also a known fact that advanced warning of natural hazards, like droughts, plays an important role in reducing morbidity and mortality, and therefore contributes to the protection of livelihoods and the improvement of agricultural production [2]. It has also been demonstrated that by establishing effective early warning systems in place, the damaging impact of natural hazards that pose a risk to agricultural production and food security could be reduced significantly [3]. Early warning is defined as the set of capabilities needed to generate and disseminate timely and meaningful information to enable individuals, communities and organisations threatened by a hazard to prepare and act appropriately and timely to reduce the possibility of harm or loss [4]. This definition does not include reference to the time scale on which a warning is given. Seasonal Climate Forecasts (SCFs) have recently been introduced as an addition of early warning information to early warning systems [5]. The seasonal time scale associated with SCF could contribute to early warning systems, although many stakeholders regard early warning as a short-term process [4]. In this study, SCFs are seen as an integral part of early

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warning systems, since SCF information could contribute significantly to the management of disaster risk within the agricultural sector where seasonal time scales are directly linked to production time scales.

In general, early warning systems consist of four interrelated elements [2,6], namely: (1) *Risk knowledge*, which is defined as the overall knowledge of a community on the risks that might arise from hazards. The impact of such a risk will depend on the vulnerability of the community. Risk assessments and mapping of the affected areas are used to motivate people to prioritise early warning needs, and guide preparations for disaster prevention and responses; (2) *Prediction, monitoring and warning services*, which refer to a technical monitoring and warning services that are based on a well-documented scientific procedures, as well as the further constant monitoring of possible disasters. There must be a scientific basis for the forecasting of hazards. Warning services for different hazards should be coordinated where possible to gain the benefit of shared institutional, procedural and communication networks; (3) *Dissemination and communication* of meaningful and understandable warnings that contain useful information to those at risk. Useful information are critical to enable proper responses that will help safeguard lives and livelihoods; and lastly; (4) *Response capacity*, which is the preparedness to act on hazards and vulnerabilities, and the capacity of all stakeholders and governing bodies to respond [2,6,7]. Effective early warning systems are maintained when all these four elements are effectively implemented [2]. In addition, for an early warning system to be effective, it must be understandable, trusted and relevant to the communities that it serves.

Early warning systems offer advance warning and information services that could be used to warn communities, such as farmers, in advance of impending threads so that the necessary preventative actions could be taken. Furthermore, in order to sustain the four elements over a longer period, strong political support and durable institutions are required [8].

Since extremes in climate variability pose a high risk for disasters in the agricultural sector, effective climate forecasting information communication, dissemination, interpretation and usage may be strengthened by collaboration amongst climate information producers and users (e.g intermediaries) in order to assist farmers, during preparatory planning and decision-making processes [9–11].

Many African farmers, especially smallholder farmers, are already confronted by challenging technological and environmental constraints, including the effects of global warming that are likely to result in climate change with a possible negative impact on food production [12–14]. In South Africa, smallholder farmers are to a large extent poor, and therefore vulnerable to the risks posed by natural hazards [15]. Currently, planning and decision making abilities of smallholder farmers appear to be hampered by a highly variable climate [16,17]. SCFs could be of great value in disaster risk management within the agricultural sector [18].

1.2. Seasonal Climate Forecast

The Southern African Regional Climate Outlook Forum (SARCOF), as mandated by the World Meteorological Organisation (WMO), produces different types of SCFs prepared by meteorological services and universities [19]. SCFs are forecasts of at least one month in advance of meteorological variables such as rainfall and temperature. In South Africa, SCFs are issued by the South African Weather Service (SAWS), which is mandated by the South African Government to provide weather and climate forecasts [20].

SCFs generally generated successfully using ocean-atmosphere Coupled General Circulation Models (CGCM), in contrast to the use of Atmospheric General Circulation Models (AGCMs) forced by prescribed Sea Surface Temperatures (SSTs) [21]. However, the CLImate VARiability and predictability meeting (CLIVAR) that took place in 2007 concluded that there is still scope for substantial improvements in SCFs in the future by developing improved numerical modelling simulations and facilities. For example, research on the performance of numerical prediction models showed an improvement in short range forecast skill, while SCF skill still lags behind [22]. Despite this, information generated from SCFs are regarded as very useful for early warning systems and as well be applicable for disaster risk management.

1.3. Application of seasonal climate forecast information

SCFs have been considered an important means of decreasing vulnerability to climate and increasing production, as well as food security [23]. The applications of SCF information by users implies that the information is considered during planning and decision making by farming communities. It is important to provide scientific information in order to improve societal response, even if challenges still exist on how vulnerable groups use the SCFs [24]. However, subsistence farmers who depend on rain for their livestock and crops in fragile environments are geographically and economically marginalised and remain poor [25]. Agricultural productivity, and in particular crop growth, highly dependent on climatic conditions, which makes agricultural activities vulnerable to climate variability and change, and therefore the correct use of reliable SCF information may enhance a farmers' productivity [26–29,17]. Some studies [30–33,19,34,35] have demonstrated the potential benefits of SCFs. However, benefits will not be fully realised unless the potential end users in the agricultural sector understand and use SCFs. It is important for the accurate forecasts to be reliable. The reliability is the average or disagreement between stated forecast value and the observed value [19].

The onset of rainfall relative to water deficit during critical periods for yield determination and conditions during ripening, harvesting and drying, are often of particular importance to farming community. For this reason, agricultural decision makers need SCF information at the spatial and temporal scale [32,19]. A sustained assessment on SCF information uptake would certainly improve communication of any uncertainties with respect to agro-meteorological forecast information.

1.4. Uncertainty in SCFs

Most SCFs are intrinsically uncertain, and effective communication of uncertainties in seasonal agro meteorological